

The Cables.gl Book

A Comprehensive Guide to Visual Programming

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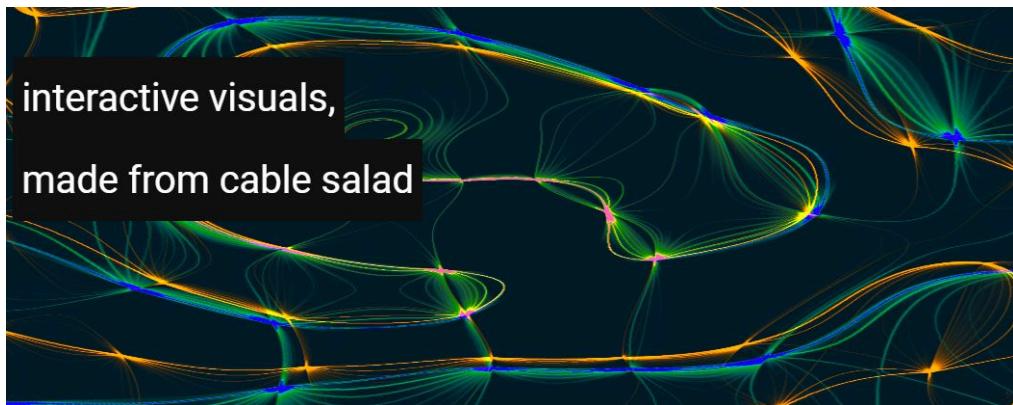
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1 Introduction to Cables.gl

1.1 What is Cables.gl?



Cables.gl is a powerful, browser-based visual programming environment for creating interactive 2D and 3D graphics using WebGL. It was created by **undev** in Berlin and has become a popular tool for creative coding, interactive installations, data visualization, and web-based visual experiences.

Unlike traditional coding environments, cables.gl uses a **node-based** (or “patch-based”) approach where you connect visual operators (ops) together to create your projects. This makes it accessible to artists and designers while still being powerful enough for developers.

1.2 A (Brief) History of cables.gl

cables.gl was created by **undev** (Berlin) with the goal of making **real-time WebGL** creation approachable through a node-based workflow—similar in spirit to visual programming environments used in motion design and interactive installations, but built for the browser.

Over time, cables.gl grew from a tool for quick experiments into a full ecosystem:

- **Early days:** a strong focus on rapid prototyping and sharing patches online.
- **Maturing platform:** a steadily growing op library for 2D, 3D, textures, audio, and interaction, plus better tooling (timeline, profiling/debugging utilities, export options).

- **Community-driven growth:** more public patches, tutorials, Discord knowledge-sharing, and reusable patterns (e.g., render-to-texture workflows, post-processing chains, audio-reactive setups).
- **Production use:** cables.gl exports make it viable for deployment in websites, installations, and client work—where performance, asset management, and reliable runtime behavior matter.

If you're coming from traditional code, it helps to think of cables.gl as a **visual runtime graph**: triggers define *when* things run; value connections define *what data* flows; and the patch as a whole becomes a web-ready app.

1.3 Why Use Cables.gl?

1.3.1 Visual Programming

- No coding required to get started
- Drag-and-drop interface
- See results in real-time as you build

1.3.2 Browser-Based

- No installation needed
- Works on any modern browser
- Collaborate and share easily

1.3.3 High Performance

- Built on WebGL for GPU-accelerated graphics
- Optimized for real-time rendering
- Handles complex 3D scenes smoothly

1.3.4 Export Options

- Standalone HTML/JS builds
- Embed in websites
- Create offline applications

1.3.5 Extensible

- Write custom operators (ops) in JavaScript
- GLSL shader support
- Import external libraries

1.4 Key Concepts

1.4.1 Operators (Ops)

The building blocks of cables.gl. Each op performs a specific function - from drawing shapes to processing audio to handling user input.

1.4.2 Patches

A patch is your complete project - a collection of ops connected together to create your visual experience.

1.4.3 Ports

Ops have input and output ports. You connect ports together with "cables" (hence the name!) to pass data between ops.

1.4.4 Types of Ports

- **Trigger** (grey) - Execution flow, like "when to do something"
- **Number** (green) - Numerical values
- **String** (yellow) - Text values
- **Object** (blue) - Complex data like meshes, textures, arrays
- **Array** (cyan) - Collections of data

1.5 Featured Videos

1.5.1 Overview and Getting Started

1.5.2 More Resources



<https://youtu.be/hVxrxXhH7vQ>

Cables.gl Standalone (Offline) Build: Create Without Limits!
by Decode GL

Note: There are limited intro-specific YouTube videos for cables.gl, but the platform has excellent resources:

- Browse the cables.gl Public Patches to see examples
- Check the official cables.gl YouTube channel for official tutorials
- The Decode GL channel has multiple cables.gl tutorials
- Search for "cables.gl" on YouTube for the latest community content
- Many cables.gl creators share their work on social media and personal channels



<https://youtu.be/goO3PhuenBI>

First Steps in Cables.gl - Tutorial
by The Interactive & Immersive HQ



<https://youtu.be/xnObNRv8n9I>

Introduction to cables.gl - Data-Driven Gradient from Geo-Located Weather - Part 0
by Kirell Benzi

1.6 Getting Help

- **Official Documentation:** cables.gl/docs
- **Example Patches:** Browse public patches for inspiration

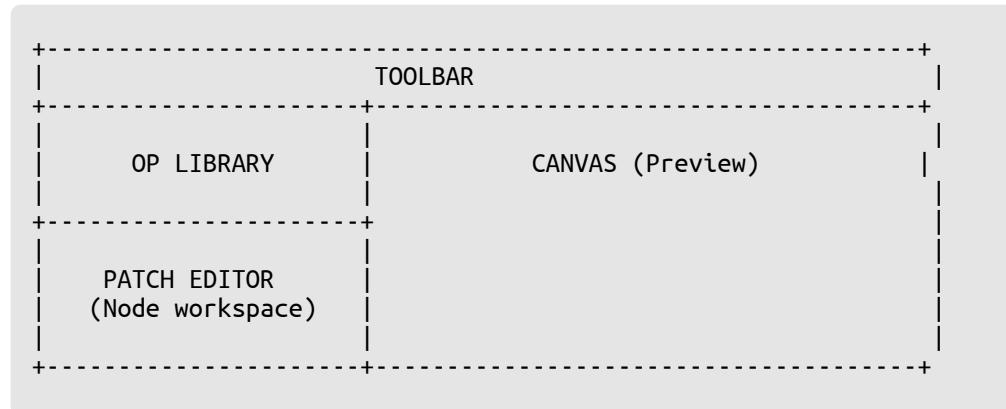
2 Getting Started with Cables.gl

2.1 Creating Your Account

1. Go to cables.gl
2. Click "Sign Up" to create a free account
3. Verify your email
4. You're ready to start creating!

2.2 The Interface

2.2.1 Main Areas



2.2.2 Key Interface Elements

1. **Canvas** - Live preview of your creation
2. **Patch Editor** - Where you place and connect ops
3. **Op Library** - Browse and search for operators
4. **Parameters Panel** - Adjust settings for selected ops
5. **Timeline** - For animation keyframes

2.3 Navigation Controls

- **Pan the view:** Middle mouse drag or Space + drag
- **Zoom in/out:** Mouse scroll wheel
- **Select op:** Left click
- **Multi-select:** Shift + click or drag box
- **Delete selected:** Delete or Backspace

- **Add new op:** Double-click or Tab
- **Connect ports:** Drag from output to input

2.4 Keyboard Shortcuts

Mastering keyboard shortcuts will significantly speed up your workflow in cables.gl.

2.4.1 Essential Shortcuts

- **Tab or Double-click:** Add new op (opens search)
- **Delete or Backspace:** Delete selected op(s)
- **Ctrl + C / Cmd + C:** Copy selected op(s)
- **Ctrl + V / Cmd + V:** Paste selected op(s)
- **Ctrl + X / Cmd + X:** Cut selected op(s)
- **Ctrl + D / Cmd + D:** Duplicate selected op(s)
- **Ctrl + Z / Cmd + Z:** Undo
- **Ctrl + Shift + Z / Cmd + Shift + Z:** Redo

2.4.2 Selection & Navigation

- **Ctrl + A / Cmd + A:** Select all ops
- **Shift + Click:** Add to selection
- **Ctrl + Click / Cmd + Click:** Toggle selection
- **Escape:** Deselect all
- **Space + Drag:** Pan the patch view
- **Mouse Wheel:** Zoom in/out
- **Ctrl + 0 / Cmd + 0:** Zoom to fit all ops
- **F:** Focus/frame selected op(s)

2.4.3 Organizing & Aligning

- **Ctrl + Shift + A / Cmd + Shift + A:** Align selected ops horizontally
- **Ctrl + Shift + D / Cmd + Shift + D:** Distribute selected ops evenly
- **Ctrl + G / Cmd + G:** Group selected ops
- **Arrow Keys:** Nudge selected op(s) by small amount
- **Shift + Arrow Keys:** Nudge selected op(s) by larger amount

2.4.4 Working with Ops

- **Enter:** Open/edit selected op's parameters
- **Ctrl + E / Cmd + E:** Enable/disable selected op
- **Ctrl + M / Cmd + M:** Mute selected op
- **R:** Rename selected op
- **C:** Add comment node
- **Ctrl + F / Cmd + F:** Find/search ops in patch

2.4.5 Cables & Connections

- **Drag from port:** Create connection
- **Click connection:** Select cable
- **Alt + Click connection:** Delete cable
- **Shift + Drag port:** Create cable with search

2.4.6 View & Interface

- **T:** Toggle timeline
- **Ctrl + / / Cmd + /:** Toggle op library
- **H:** Toggle patch editor visibility
- **P:** Toggle parameters panel
- **Ctrl + S / Cmd + S:** Save patch
- **Ctrl + Shift + S / Cmd + Shift + S:** Save as...

2.4.7 Performance & Debugging

- **Ctrl + Shift + P / Cmd + Shift + P:** Performance monitor
- **Ctrl + Shift + L / Cmd + Shift + L:** Show patch loading info
- **Alt + Click op:** View op documentation

2.4.8 Pro Tips

- **Hold Shift while connecting:** Automatically opens op search to insert an op in the connection
- **Hold Alt while dragging:** Duplicate op while moving
- **Double-click a connection:** Insert a new op in that cable
- **Right-click an op:** Quick access to op menu (rename, mute, group, etc.)
- **Click and drag in empty space:** Selection box for multiple ops

2.5 Your First Patch

Let's create a simple animated shape!

2.5.1 Step 1: Create the Render Pipeline

1. Double-click in the patch editor to open the op search
2. Search for MainLoop and add it
3. The MainLoop is the heartbeat of your patch - it triggers every frame

2.5.2 Step 2: Add a BasicMaterial

1. Add a BasicMaterial op
2. Connect MainLoop's trigger output to BasicMaterial's trigger input
3. You should see a black canvas appear

2.5.3 Step 3: Draw a Circle

1. Add a Circle op
2. Connect BasicMaterial -> Circle
3. A white circle appears!

Here's what your patch should look like:

Visualization Options

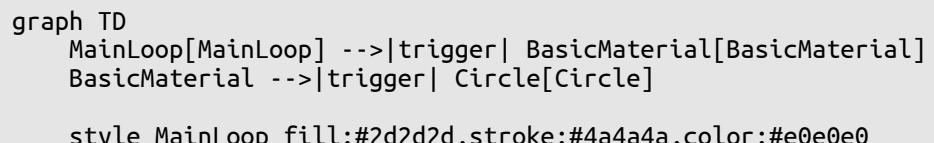
Option 1: Screenshot from Real Cables.gl (Most Authentic)

See Screenshot Guide for instructions on capturing real cables.gl patches.

Option 3: HTML/CSS Interactive

Open HTML Version in your browser for an interactive view.

Option 4: Mermaid Diagram (Simple Flow)



```
style BasicMaterial fill:#2d2d2d,stroke:#4a4a4a,color:#e0e0e0
style Circle fill:#2d2d2d,stroke:#4a4a4a,color:#e0e0e0
```

The basic render chain: MainLoop triggers the BasicMaterial, which then draws the Circle

2.5.4 Step 4: Add Color

1. Select the BasicMaterial op
2. Adjust the color values (r, g, b) in the parameters panel
3. Or connect a SetColor op's output to BasicMaterial's color input ports
4. The circle will display with your chosen color

2.5.5 Step 5: Animate It

1. Add a Time op (outputs current time)
2. Add a Math op (for calculations)
3. Add a Sin op (sine wave)
4. Connect: Time -> Sin -> Circle's Scale input
5. Watch your circle pulse!

2.6 Understanding the Flow

Data flows from **top to bottom** and **left to right**:

```
MainLoop (starts the frame)
  |
BasicMaterial (defines appearance and color)
  |
Circle (draws the shape)
```

The **trigger** connection (grey) determines WHEN things happen. The **value** connections (colored) determine WHAT values are used.

2.7 Saving Your Work

- Patches auto-save regularly
- Click the save icon to force a save
- Use “Save As” to create copies
- Export for standalone deployment

2.8 Tips for Beginners

1. **Start Simple** - Begin with basic shapes before complex 3D
2. **Explore Examples** - Study public patches to learn patterns
3. **Use Comments** - Add comment ops to document your work
4. **Name Your Ops** - Rename ops for clarity in complex patches
5. **Save Often** - And use versioning for major changes

2.9 Featured Videos

2.10 Common First-Patch Issues

2.10.1 “I don’t see anything!”

- Make sure MainLoop is connected to BasicMaterial
- Check that your shape ops are connected in the chain
- Verify the canvas is visible (not minimized)

2.10.2 “Colors aren’t changing!”

- Check BasicMaterial’s color values (r, g, b) in the parameters panel
- Make sure RGB values aren’t all 0 (black)
- If using SetColor, connect it to BasicMaterial’s color input ports

2.10.3 “Animation isn’t working!”

- Ensure Time op is connected
- Check that the animated value is actually changing (view the port value)

3 2D Graphics in Cables.gl

3.1 Introduction to 2D Drawing

Cables.gl excels at creating stunning 2D graphics and animations, from simple shapes to complex generative art. This comprehensive chapter covers fundamental 2D drawing operations, advanced transformations, interactive elements, feedback loops, post-processing effects, and professional techniques for creating production-ready 2D visuals.

Whether you're creating data visualizations, interactive installations, or generative art, this chapter will give you the tools and knowledge to master 2D graphics in cables.gl.

3.2 Basic Shapes

3.2.1 Circle

The Circle op is one of the most common 2D primitives.

Key Parameters: - Radius - Size of the circle - Segments - Smoothness (more segments = smoother circle) - Inner Radius - Creates a ring when > 0

3.2.2 Rectangle

The Rectangle op draws rectangular shapes.

Key Parameters: - Width - Horizontal size - Height - Vertical size - Pivot - Origin point for positioning

3.2.3 RoundedRectangle

A rectangle with smooth corners.

Key Parameters: - Width / Height - Dimensions - Corner Radius - How rounded the corners are

3.2.4 Polygon

Create regular polygons (triangles, pentagons, etc.)

Key Parameters: - Sides - Number of sides (3 = triangle, 5 = pentagon, etc.) - Radius - Size of the polygon

3.2.5 Line / Lines

Draw single or multiple lines.

Key Parameters: - Start and End coordinates - Line width - Line style (solid, dashed)

3.3 Color and Appearance

3.3.1 SetColor

Changes the drawing color for subsequent shapes.

MainLoop -> BasicMaterial -> Circle

Connect SetColor output to BasicMaterial's color input ports (r, g, b, a) to set the color.

Color Modes: - RGB (Red, Green, Blue) - HSB (Hue, Saturation, Brightness) - Hex values

3.3.2 SetAlpha

Controls transparency.

MainLoop -> BasicMaterial -> Shape

Connect SetAlpha output to BasicMaterial's alpha (a) input port to control transparency.

Values range from 0 (invisible) to 1 (fully opaque).

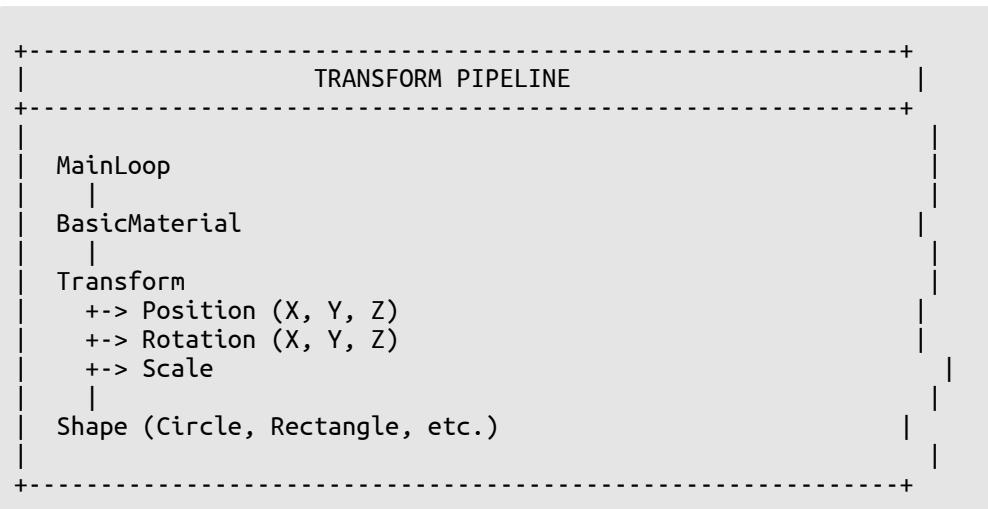
3.3.3 Gradients

Use texture-based gradients or shader-generated gradients for smooth color transitions.

3.4 Transformations

3.4.1 Transform

The `TransformOp` modifies position, rotation, and scale of all following shapes.

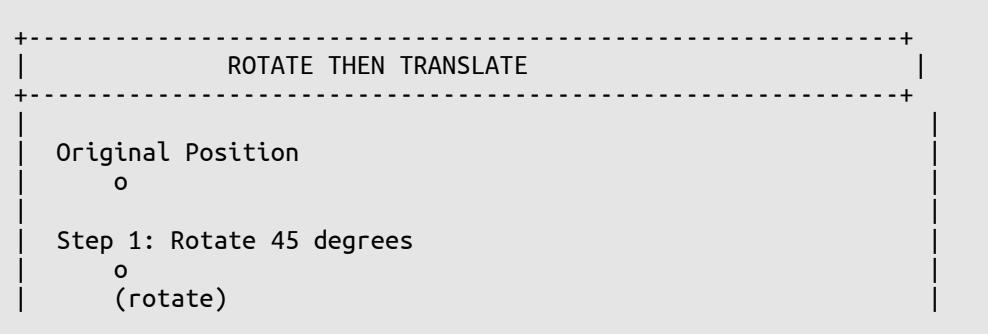


Parameters: - `TranslateX`, `TranslateY`, `TranslateZ` - Position - `RotateX`, `RotateY`, `RotateZ` - Rotation (degrees) - `Scale` - Uniform scaling

3.4.2 Transformation Order Matters!

Transformations are applied in order. These produce different results:

Rotate then Translate:



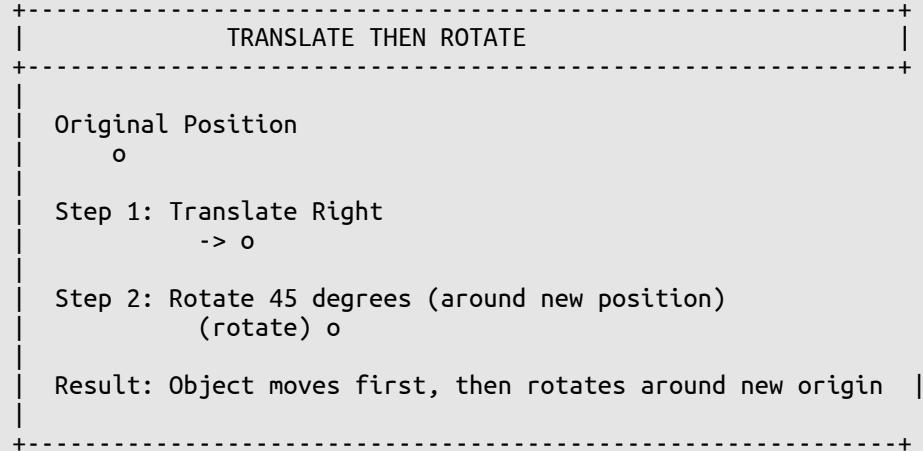
Step 2: Translate Right

-> o

Result: Object rotates around origin, then moves

`Transform (rotate) -> Transform (translate) -> Shape`

Translate then Rotate:



`Transform (translate) -> Transform (rotate) -> Shape`

3.4.3 Nested Transforms

Create hierarchies by chaining transforms:

```
Transform (parent)
  |
  Transform (child)
  |
  Shape
```

The child inherits and adds to the parent's transformations.

3.5 Blending Modes

3.5.1 SetBlending

Controls how colors combine when shapes overlap.

Common Modes: - Normal - Standard opacity blending - Add - Colors add together (great for glow effects) - Multiply - Colors multiply (darkening effect)

3.5.2 Depth Testing

For 2D, you often want to disable depth testing:

```
MainLoop -> BasicMaterial -> DepthTest (disabled) -> Your 2D Content
```

This ensures draw order matches your connection order.

3.6 Patterns and Repetition

3.6.1 IteratorLoop

Create patterns by repeating shapes:

```
MainLoop -> IteratorLoop -> [Your Shape Setup]
```

Use the iterator index to offset position, color, or other properties.

3.6.2 ArrayIterator

Iterate over data arrays to position multiple shapes.

3.7 Text Rendering

3.7.1 DrawText

Display text in your patches.

Key Parameters: - Text - The string to display - Font - Font family - Size - Text size - Alignment - Left, center, right

3.7.2 TextTexture

Create textures from text for more advanced effects.

3.8 Advanced Transformation Techniques

3.8.1 Matrix Transformations

For precise control, work directly with transformation matrices:

```
MatrixMultiply -> Combine multiple transformations
MatrixInvert -> Reverse a transformation
```

3.8.2 Pivot Points

Control the center of rotation and scaling:

```
Transform (set pivot) -> Transform (rotate) -> Shape
```

Common Pivot Values: - 0, 0 - Bottom left corner - 0.5, 0.5 - Center (default) - 1, 1 - Top right corner

3.8.3 Compound Transformations

Build complex motion by layering transforms:

Example: Orbital Motion

```
Transform (parent orbit)
  |
  Transform (child rotation)
  |
  Transform (child offset)
  |
  Shape
```

This creates a shape that orbits while rotating on its own axis.

3.9 Interactive 2D Elements

3.9.1 InteractiveRectangle

Create draggable, clickable UI elements:

```
InteractiveRectangle
  | (outputs X, Y, Width, Height on interaction)
  Control other ops with mouse input
```

Use Cases: - On-screen sliders - Draggable controllers - Interactive buttons - Touch-enabled interfaces

3.9.2 Mouse Input

Capture and use mouse position:

```
Mouse -> Map (screen to world coords) -> Visual property
```

Mouse Ops: - MouseX / MouseY - Cursor position - MouseButton - Click detection - MouseWheel - Scroll input

3.9.3 Example: Interactive Color Picker

```
MainLoop
  |
  MouseX -> Map (0 to 1) -> Hue
  MouseY -> Map (0 to 1) -> Brightness
  |
  HSBtoRGB -> BasicMaterial (color input)
  |
  FullscreenRectangle
```

3.10 Generative Art Techniques

3.10.1 Feedback Loops

Create evolving, self-referential visuals by feeding output back as input:

Basic Feedback Setup:

```
MainLoop
  |
  RenderToTexture (previous frame)
  |
  ImageCompose (blend with new content)
  |
  Transform (slight scale/rotate)
  |
  TextureEffects (blur, fade)
  |
  Draw new shapes
  |
  Output (becomes next frame's input)
```

Parameters to Experiment With: - Feedback decay (fade amount) - Transformation amount (scale, rotation) - Blend mode (add, multiply, screen) - Blur intensity

Result: Trails, echoes, and organic growth patterns

3.10.2 Op Art and Moiré Patterns

Create optical illusions with overlapping patterns:

```
IteratorLoop (creates grid)
  |
  Time -> Sin -> Rotation angle
  |
  IteratorLoop (nested for lines)
  |
  Rectangle (thin line)
```

Vary parameters like: - Line spacing - Rotation speed - Line thickness - Pattern density

3.10.3 Procedural Pattern Generation

Use noise and math to create endless variations:

Perlin Noise-Based Patterns:

```
IteratorLoop
  |
  Position -> NoiseTexture sample
  |
  Noise value -> Circle size
  |
  Noise value -> Color
```

Grid Distortion:

```
IteratorLoop (grid)
  |
  Position + (Noise * distortion amount)
  |
  Shape
```

3.11 Post-Processing Effects

3.11.1 Image Composition

Layer multiple render passes for rich effects:

```
RenderToTexture (Pass 1: Shapes)
  |
  RenderToTexture (Pass 2: Glow)
  |
  RenderToTexture (Pass 3: Noise)
  |
  ImageCompose (blend all layers)
  |
  Final Output
```

3.11.2 TextureEffects for 2D

Apply effects to your rendered 2D scene:

Blur:

```
RenderToTexture -> TextureEffects (Blur) -> Output
```

Color Grading:

```
RenderToTexture -> ColorCorrection
  | (adjust hue, saturation, brightness, contrast)
  Output
```

Glow Effect:

```
Original scene
  |
  RenderToTexture (bright pass)
  |
```

```
Blur (large radius)
|  
ImageCompose (add to original)
```

3.11.3 Displacement Mapping

Distort shapes using textures:

```
NoiseTexture -> DisplacementMap -> Shape rendering
```

Creates wavy, distorted effects on 2D graphics.

3.12 Advanced Pattern Techniques

3.12.1 Recursive Subdivision

Create fractal-like patterns:

```
// Custom op: Recursive shape division
for (depth = 0; depth < maxDepth; depth++) {
    // Draw shape
    // Divide into smaller shapes
    // Recursively apply
}
```

3.12.2 Particle Systems in 2D

Simple particle engine structure:

```
ArrayLoop (particle count)
|  
Particle data (position, velocity, life)
|  
Physics update (gravity, friction)
```

```
|  
Transform -> Circle (particle visual)
```

3.12.3 Grid-Based Automata

Cellular automata and Game of Life patterns:

```
ArrayIterator (grid cells)
|  
Cell state + neighbor count
|  
Update rules (Conway's rules, etc.)
|  
Visual representation
```

3.13 Data Visualization

3.13.1 Chart Generation

Create custom charts and graphs:

Bar Chart:

```
ArrayIterator (data values)
|  
Index -> X position
Value -> Rectangle height
|  
Rectangle (bar)
```

Line Chart:

```
ArrayIterator (data points)
|  
Connect points with Lines op
|  
Add circles for data points
```

3.13.2 Integration with ECharts

Apache ECharts is a powerful open-source charting library that integrates seamlessly with cables.gl. This combination lets you create professional-grade data visualizations with interactive 3D effects and real-time updates.

Why ECharts + cables.gl?

- **Rich Chart Types:** Bar, line, pie, scatter, radar, candlestick, heatmap, treemap, sunburst, and more
- **Interactive Features:** Tooltips, zooming, panning, data selection
- **Real-Time Updates:** Stream live data into animated charts
- **3D Enhancement:** Apply cables.gl effects to chart outputs

Setup and Integration:

1. Load the **ECharts Extension** in cables.gl using the `Ops.Extension.ECharts.ECharts` op
2. **Configure Chart Options** using JSON format (same as standard ECharts)
3. **Connect Data Sources** from other cables.gl ops (JSON fetch, WebSocket, etc.)
4. **Apply Visual Effects** using cables.gl post-processing

Basic ECharts Patch Structure:

```
MainLoop
  |
ECharts Op
  +-> Option (JSON configuration)
  +-> Width / Height
  +-> Data inputs
  |
ECharts Instance -> Use in other ops
```

Example: Simple Bar Chart Configuration:

```
{
  "xAxis": {
    "type": "category",
    "data": ["Mon", "Tue", "Wed", "Thu", "Fri"]
  },
  "yAxis": {
    "type": "value"
```

```
},
"series": [
  "data": [120, 200, 150, 80, 70],
  "type": "bar",
  "color": "#5470c6"
]
}
```

Example: Real-Time Line Chart:

```
WebSocket (data stream)
  |
ParseJSON -> Extract values
  |
Array (rolling buffer of last N values)
  |
ECharts Op (line chart config)
  |
Render to texture
  |
Apply glow effect
```

Example: Interactive Pie Chart with Events:

```
ECharts Op (pie chart)
  |
EChartsEvent Op
  +-> Click event -> Trigger actions
  +-> Hover event -> Show details
  |
Update other visuals based on selection
```

Combining Charts with 3D:

```
ECharts Op -> Render to texture
  |
Plane3D (apply texture)
  |
Transform (rotate in 3D space)
  |
```

Post-processing (glow, bloom)

Advanced Techniques:

- **Multi-Chart Dashboards:** Use multiple ECharts ops with different configurations
- **Animated Transitions:** ECharts handles smooth data transitions automatically
- **Custom Themes:** Define color palettes that match your cables.gl aesthetic
- **Responsive Charts:** Connect viewport size to chart dimensions

Performance Tips:

- Limit data points for smooth animation (< 1000 for real-time)
- Use `notMerge: true` for complete data replacement
- Disable animations for very high-frequency updates
- Cache chart instances when possible

Resources:

- Apache ECharts Documentation
- ECharts Examples Gallery
- cables.gl ECharts Integration Tutorial

3.13.3 Real-Time Data

Visualize live data streams:

```
WebSocket/API -> Parse data  
|  
ArrayIterator -> Visualize each value  
|  
Smooth/Interpolate for fluid animation
```

3.14 Complex Example Projects

3.14.1 Example 4: Kaleidoscope Effect

```
MainLoop  
|  
BasicMaterial  
|  
IteratorLoop (6 segments)  
|  
Transform (rotate by index * 60°)  
|  
Transform (mirror flip alternating)  
|  
Your content (shapes, webcam, etc.)
```

3.14.2 Example 5: Audio-Reactive Loading Animation

```
AudioAnalyzer (beat detection)  
|  
IteratorLoop (circle of dots)  
|  
Index + Time -> Rotation  
Beat amplitude -> Scale pulse  
|  
SetColor (beat changes color)  
|  
Circle (dot)
```

3.14.3 Example 6: Data-Driven Weather Visualization

```
API -> Fetch weather data  
|  
Parse JSON -> Extract values  
|  
Temperature -> Background color  
Humidity -> Particle density  
Wind -> Animation speed  
|  
Animated scene reflecting weather
```

3.14.4 Example 7: Feedback Tunnel Effect

```
RenderTarget (previous frame)
|
Transform (scale 1.05, center pivot)
|
SetAlpha (0.98 for fade)
|
Draw to screen
|
Add new circles at edges
|
Feed back into texture
```

Creates an infinite tunnel effect.

3.14.5 Example 8: Mouse Trail with Fade

```
MousePosition
|
RenderTarget (with feedback)
|
ColorCorrection (reduce brightness)
|
Draw circle at mouse position
|
Blend with previous frame
```

Creates smooth, fading trails following the cursor.

3.15 Performance Optimization

3.15.1 Culling and Clipping

Only draw what's visible:

```
If (shape position in viewport bounds)
    -> Draw shape
Else
    -> Skip
```

3.15.2 Object Pooling

Reuse shape instances instead of creating new ones:

```
// Maintain pool of inactive shapes
// Activate/deactivate as needed
// Prevents GC thrashing
```

3.15.3 Level of Detail (LOD)

Simplify distant or small shapes:

```
If (shape size < threshold)
    -> Use simple circle
Else
    -> Use detailed polygon
```

3.15.4 Batching Draw Calls

Group similar operations:

```
SetColor once
|
Draw all shapes of same color
|
SetColor again
|
Draw next batch
```

Reduces state changes and improves performance.

3.16 Masking and Clipping

3.16.1 Stencil Buffer Masking

Use shapes as masks for other shapes:

```
EnableStencil  
|  
Draw mask shape (Circle)  
|  
SetStencilMode (draw only inside)  
|  
Draw content (Rectangle)  
|  
DisableStencil
```

3.16.2 Alpha Mask Technique

Use texture alpha for complex masks:

```
MaskTexture -> AlphaMask  
|  
Your content (masked by texture)
```

```
BaseHue -> Color 1  
BaseHue + 120° -> Color 2  
BaseHue + 240° -> Color 3
```

Analogous:

```
BaseHue -> Color 1  
BaseHue + 30° -> Color 2  
BaseHue - 30° -> Color 3
```

3.17 Color Theory in Practice

3.17.1 Color Harmonies

Generate pleasing color palettes:

Complementary:

```
BaseHue -> SetColor (shape 1)  
BaseHue + 180° -> SetColor (shape 2)
```

Triadic:

3.17.2 Gradient Creation

Smooth color transitions:

Linear Gradient:

```
IteratorLoop (steps)  
|  
Index / TotalSteps -> Mix (Color1, Color2, t)  
|  
SetColor -> Rectangle strip
```

Radial Gradient:

```
Distance from center -> Mix (Inner, Outer, t)
```

3.18 Typography and Text Effects

3.18.1 Dynamic Text

Animate text properties:

```
Time -> Character spacing  
MouseX -> Font size
```

AudioLevel -> Text opacity

3.18.2 Text as Texture

Use text rendering for effects:

```
TextTexture (render text to texture)
  |
  Apply shader effects
  |
  Use as sprite or background
```

3.18.3 Kinetic Typography

Animate individual letters:

```
TextArray (split into chars)
  |
  ArrayIterator
  |
  Transform (unique per character)
  |
  DrawText (single char)
```

3.19 Practical Examples

3.19.1 Example 1: Pulsing Circle

```
MainLoop
  |
  BasicMaterial (set your color)
  |
  Time -> Sin -> Scale input
  |
  Circle
```

3.19.2 Example 2: Rotating Grid

```
MainLoop
  |
  BasicMaterial
  |
  IteratorLoop (10x10)
  |
  Transform (position from iterator)
  |
  Transform (rotation from Time)
  |
  Rectangle
```

3.19.3 Example 3: Color Gradient Circle

```
MainLoop
  |
  IteratorLoop (for each ring)
  |
  IteratorIndex -> Map to Hue -> HSBtoRGB -> BasicMaterial (color
  input)
  |
  BasicMaterial
  |
  Circle (radius from iterator index)
```

3.20 Debugging and Workflow Tips

3.20.1 Visualizing Values

See what your ops are outputting:

```
Value -> NumberDisplay
Value -> DrawNumber (on screen)
```

3.20.2 Color Coding

Use consistent colors to identify different element types:
- Structural elements: Blue
- Interactive elements: Green
- Data elements: Yellow
- Background: Dark grey

3.20.3 Naming Convention

Name ops descriptively:
- TransformRotation_MainShape - Color_Background -
Iterator_ParticleGrid

3.20.4 Comment Ops

Document complex sections:

```
Comment ("This section creates the feedback loop")
|
Your complex patch area
```

```
IteratorLoop (rows)
|
IteratorLoop (columns)
|
(X + Time) -> Sin -> Y offset
|
Transform -> Shape
```

3.21 Common Patterns and Recipes

3.21.1 Pattern: Circular Array

Arrange shapes in a circle:

```
IteratorLoop (count)
|
Index * (360 / count) -> Angle
Angle -> Cos -> X position
Angle -> Sin -> Y position
|
Transform -> Shape
```

3.21.2 Pattern: Wave Grid

Create wave motion across a grid:

3.21.3 Pattern: Spiral

Generate spiral patterns:

```
IteratorLoop
|
Index -> Angle (index * goldenAngle)
Index -> Radius (sqrt(index) * spacing)
|
Polar to Cartesian
|
Transform -> Shape
```

3.21.4 Pattern: Responsive Grid

Grid that adapts to screen size:

```
ViewportWidth / CellSize -> Columns
ViewportHeight / CellSize -> Rows
|
IteratorLoop (columns * rows)
|
Grid positioning logic
```

3.22 Troubleshooting Common Issues

3.22.1 “Shapes not appearing”

- Check trigger connections (grey ports)
- Verify MainLoop is connected to BasicMaterial
- Check BasicMaterial alpha isn't 0
- Verify camera/viewport settings

3.22.2 “Performance is slow”

- Reduce segment count on circles
- Lower particle/iterator counts
- Disable antialiasing if not needed
- Use simpler blend modes
- Check for unnecessary texture reads

3.22.3 “Colors look wrong”

- Verify color space (RGB vs HSB)
- Check SetColor is before shapes
- Verify alpha values
- Check blend modes

3.22.4 “Animation is jerky”

- Use Smooth op for value transitions
- Check frame rate in performance monitor
- Reduce complexity during motion
- Pre-calculate expensive operations

3.23 Performance Tips

1. **Reduce Segments** - Circles don't need 100 segments if they're small
2. **Batch Similar Shapes** - Group similar operations together
3. **Use Instancing** - For many identical shapes, use instanced drawing
4. **Limit Transparency** - Overlapping transparent shapes are expensive
5. **Cache Calculations** - Don't recalculate same values each frame
6. **Cull Off-Screen** - Don't draw what's not visible
7. **Simplify Blending** - Complex blend modes are expensive
8. **Optimize Textures** - Use appropriate texture sizes

9. **Limit Feedback Depth** - Don't keep too many feedback history frames
10. **Profile Regularly** - Use performance monitor to identify bottlenecks

3.24 Featured Videos

3.24.1 Official Tutorials



<https://youtu.be/goO3PhuenBI>
First Steps in Cables.gl - Kaleidoscope Webcam Effect
by The Interactive & Immersive HQ



<https://youtu.be/xnObNRv8n9I>
Introduction to cables.gl - Data-Driven Gradient from Geo-Located Weather
by Kirell Benzi

3.24.2 Additional Resources

- **Generative Op Art Tutorial:** Class Central Course - Learn feedback loops and Op Art
- **Interactive Rectangle Tutorial:** Blog Post - Create on-screen sliders
- **Post-Processing Guide:** Official Docs - Apply effects to scenes

- **Data Visualization:** Apache ECharts Integration - Combine with charting libraries
 - **Cables.gl Examples:** Official Examples - Browse community creations
 - **Coding with Cables:** GitHub Repo - Code examples and custom ops
-

3.25 Exercises

3.25.1 Beginner

1. Create a colorful loading spinner using rotating circles
2. Build a grid of squares that change color based on mouse position
3. Make a simple particle system with random positions and sizes

3.25.2 Intermediate

4. Create a kaleidoscope effect with 8 mirrored segments
5. Build an interactive color picker using mouse position
6. Implement a feedback tunnel with infinite zoom effect
7. Create a data visualization showing time-series data as animated bars

3.25.3 Advanced

8. Build a generative Op Art piece using feedback loops
9. Create a particle system with physics (gravity, collision)
10. Implement a cellular automaton (Game of Life or similar)
11. Create an audio-reactive geometric pattern generator
12. Build a real-time weather visualization using API data

3.26 Project Ideas

1. **Abstract Clock** - Time visualization with geometric shapes
2. **Music Visualizer** - Frequency bands displayed as 2D patterns
3. **Generative Logo** - Company logo with parametric variations
4. **Loading Animations** - Collection of animated loaders
5. **Data Dashboard** - Real-time data display with charts
6. **Interactive Art Installation** - Touch/camera-driven visuals
7. **Typography Animation** - Kinetic text effects
8. **Pattern Generator** - Infinite procedural pattern variations
9. **Mouse-Driven Drawing Tool** - Paint with code
10. **Meditation Visual** - Calming, slowly evolving patterns

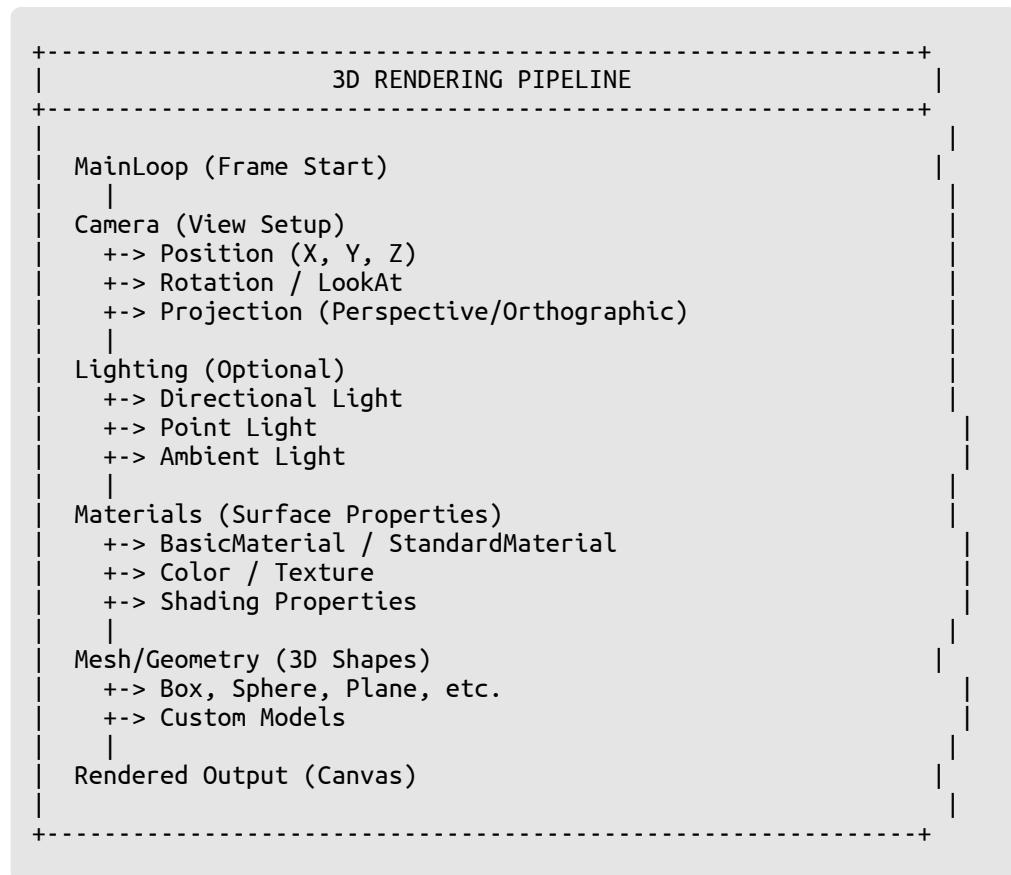
4 3D Graphics in Cables.gl

4.1 Introduction to 3D

Cables.gl provides powerful tools for creating real-time 3D graphics using WebGL. This chapter covers everything from basic 3D concepts to advanced rendering techniques, scene management, and performance optimization. Whether you're creating simple 3D visualizations or complex interactive experiences, this guide will give you the knowledge to master 3D graphics in cables.gl.

4.2 The 3D Pipeline

A basic 3D setup requires:



4.3 Cameras

Cameras define how we view the 3D scene.

4.3.1 PerspectiveCamera

The most common camera type - mimics human vision with perspective distortion.

Key Parameters: - FOV (Field of View) - How wide the view is (typically 45-90 degrees) - Near / Far - Clipping planes (objects outside this range aren't rendered) - Position X/Y/Z - Camera location

4.3.2 OrthographicCamera

No perspective distortion - useful for UI, 2D-style 3D, or technical views.

Key Parameters: - Zoom - Scale of the view - Near / Far - Clipping planes

4.3.3 Orbit Controls

Add interactive camera controls:

Camera -> OrbitControls

Allows users to rotate, zoom, and pan the view.

4.3.4 LookAt

Point the camera at a specific location or object.

Camera -> LookAt (target position)

Use Cases: - Follow a moving object - Create cinematic camera movements - Focus on specific scene elements

4.3.5 Camera Animation

Animate camera movement for cinematic effects:

```
Time -> Sin -> Camera Position X  
Time -> Cos -> Camera Position Z  
Time -> Camera Rotation Y (orbit)
```

4.3.6 Camera Shake Effect

Add dynamic camera shake:

```
Random -> Multiply (shake intensity) -> Add to Camera Position
```

4.3.7 First-Person Camera

Create FPS-style camera controls:

```
MouseX -> Camera Rotation Y  
MouseY -> Camera Rotation X  
WASD Keys -> Camera Position
```

4.3.8 Camera Path Following

Follow a predefined path:

```
ArrayIterator (path points)  
|  
Smooth interpolation between points  
|  
Camera Position
```

4.3.9 Camera Constraints

Limit camera movement:

```
Camera Position -> Clamp (min, max) -> Constrained Position
```

4.4 Lighting

Lighting brings depth and realism to 3D scenes.

4.4.1 AmbientLight

Uniform light that illuminates everything equally.

```
MainLoop -> Camera -> AmbientLight -> [Rest of scene]
```

Tip: Use subtle ambient light to prevent completely black shadows.

4.4.2 DirectionalLight

Light from a specific direction (like the sun).

Key Parameters: - Direction (X, Y, Z) - Color - Intensity

4.4.3 PointLight

Light emanating from a point in space (like a light bulb).

Key Parameters: - Position (X, Y, Z) - Color - Intensity - Falloff radius

4.4.4 SpotLight

Focused beam of light (like a flashlight or stage light).

Key Parameters: - Position and direction - Cone angle - Falloff

4.4.5 Shadow Mapping

Enable shadows for more realism:

```
DirectionalLight (shadows enabled) -> ShadowMap -> Scene
```

Shadow Parameters:
- Shadow Map Size - Resolution (higher = sharper, slower)
- Shadow Bias - Prevents shadow acne - Shadow Radius - Softness of shadow edges

Tip: Use lower shadow map sizes for better performance. 1024x1024 is usually sufficient.

4.4.6 Three-Point Lighting Setup

Professional lighting arrangement:

```
MainLoop -> Camera  
|  
AmbientLight (subtle, 0.2 intensity) - Fill light  
|  
DirectionalLight (main, from top-left) - Key light  
|  
PointLight (weaker, opposite side) - Rim light  
|  
[Your scene]
```

Key Light: Main illumination (brightest) **Fill Light:** Reduces harsh shadows (ambient or weak directional) **Rim Light:** Creates edge highlights (back/side lighting)

4.4.7 Image-Based Lighting (IBL)

Use environment maps for realistic lighting:

```
HDRITexture -> Environment Map -> PBRMaterial
```

Creates reflections and lighting based on real-world environments.

4.4.8 Light Probes

Place light probes in your scene for accurate local lighting:

```
LightProbe -> Sample nearby lights -> Apply to objects
```

4.4.9 Volumetric Lighting

Create god rays and atmospheric lighting:

```
DirectionalLight -> VolumetricScattering -> [Scene]
```

4.4.10 Light Animation

Animate lights for dynamic scenes:

```
Time -> Sin -> Light Intensity (pulsing)  
Time -> Rotate -> Light Direction (rotating sun)  
AudioAnalyzer -> Light Color (audio-reactive)
```

4.5 Geometry and Meshes

4.5.1 Primitive Shapes

Cube - Basic box shape

```
Parameters: Width, Height, Depth
```

Sphere - Perfect sphere

Parameters: Radius, Segments (horizontal/vertical)

Cylinder - Tube shape

Parameters: Radius Top/Bottom, Height, Segments

Plane - Flat surface

Parameters: Width, Height

Torus - Donut shape

Parameters: Radius, Tube Radius, Segments

4.5.2 Loading 3D Models

OBJLoader - Load .obj format models

OBJLoader -> Mesh

GLTFLoader - Load .gltf/.glb models (recommended)

GLTFLoader -> Scene/Mesh

FBXLoader - Load .fbx models

4.5.3 Creating Custom Geometry

Use **PointCloud** or **CustomGeometry** ops to build meshes from data.

PointCloud:

ArrayIterator (positions) -> PointCloud

CustomGeometry:

Vertices Array -> Normals Array -> UVs Array -> CustomGeometry

4.5.4 Procedural Geometry Generation

Create geometry programmatically:

Example: Procedural Terrain

```
IteratorLoop (grid)
  |
  NoiseTexture (sample at position) -> Height
  |
  Calculate vertex positions
  |
  Generate normals
  |
  CustomGeometry
```

Example: Parametric Surfaces

```
U/V parameters -> Math functions -> Vertex positions
  |
  CustomGeometry
```

4.5.5 Geometry Instancing

Render many copies efficiently:

```
Mesh -> InstanceTransform (array of transforms) -> InstancedMesh
```

Use Cases: - Forests of trees - Crowds of characters - Particle systems - Repeating architectural elements

4.5.6 Geometry Modifiers

Modify existing geometry:

Subdivision:

```
Mesh -> Subdivide -> Smoother surface
```

Displacement:

```
Mesh -> DisplacementMap -> Deformed geometry
```

Morphing:

```
Mesh1 -> Morph -> Mesh2 (blend between shapes)
```

4.5.7 Boolean Operations

Combine geometries:

```
Mesh1 -> BooleanUnion -> Mesh2  
Mesh1 -> BooleanSubtract -> Mesh2  
Mesh1 -> BooleanIntersect -> Mesh2
```

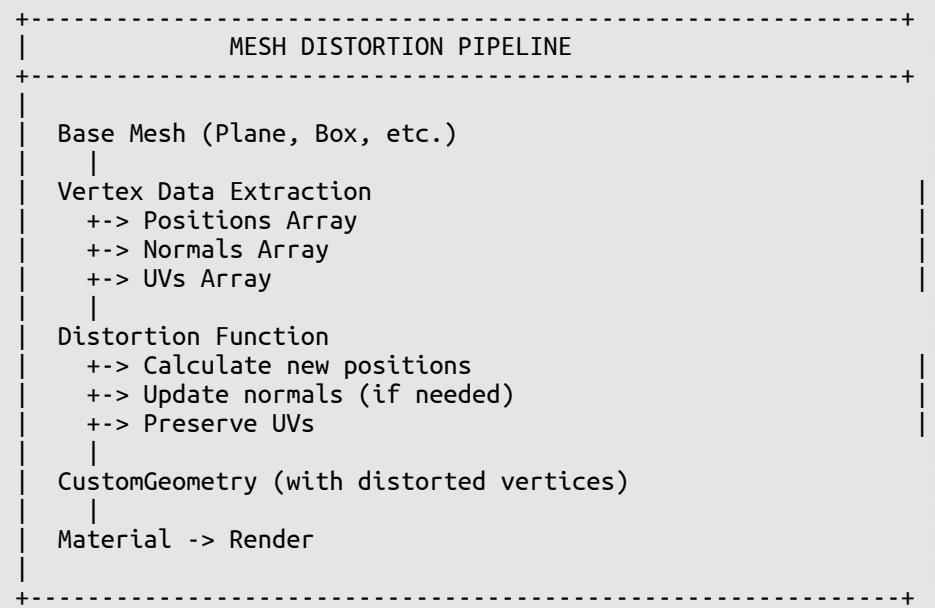
4.6 Real-Time Mesh Distortion

Real-time mesh distortion allows you to dynamically modify geometry vertices during rendering, creating effects like bending walls, scaling surfaces, and warping shapes. This is essential for architectural visualization, interactive installations, and dynamic 3D effects.

4.6.1 Understanding Vertex Manipulation

Mesh distortion works by modifying vertex positions in real-time. Each vertex has:

- **Position** (X, Y, Z) - Where the vertex is located
- **Normal** (NX, NY, NZ) - Which direction the surface faces
- **UV Coordinates** (U, V) - Texture mapping coordinates

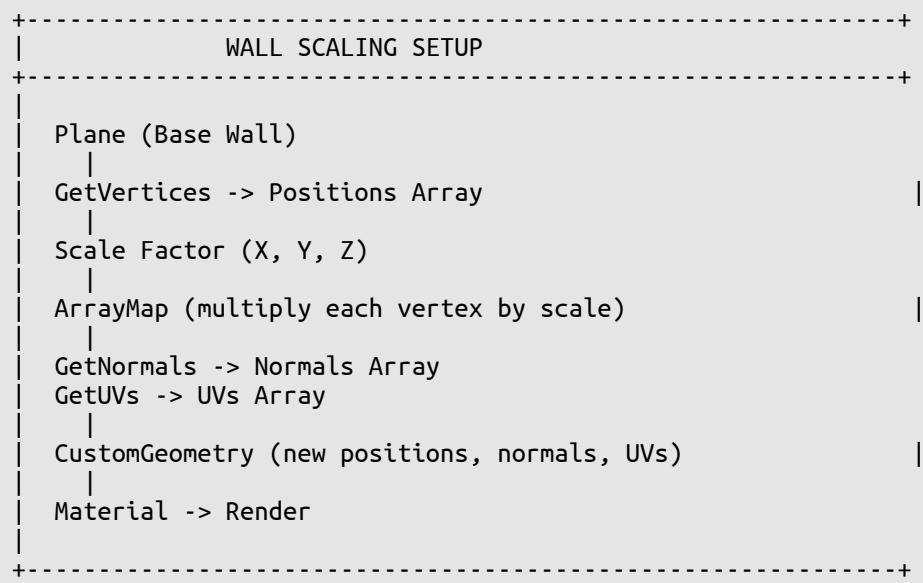


4.6.2 Method 1: Node-Based Distortion

Using built-in cables.gl ops to distort meshes.

Example 1: Scaling a Wall (Size Transformation)

Transform a plain wall into different sizes using procedural scaling:



Step-by-Step Node Setup:

1. Create Base Plane:

- Add Plane op
- Set Width: 10, Height: 5
- Set Segments Width: 20, Segments Height: 10 (for smooth distortion)

2. Extract Vertex Data:

- Add GetVertices op
- Connect Plane -> GetVertices
- Output: Array of vertex positions

3. Create Scale Controls:

- Add Slider ops for X, Y, Z scale
- Or use Number ops with values

4. Apply Scaling:

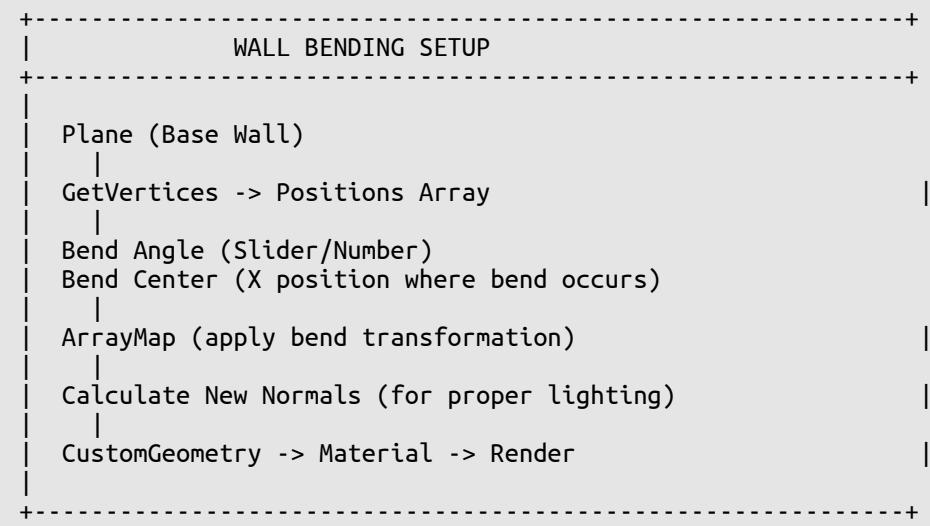
- Use ArrayMap or ArrayIterator to multiply each vertex
- For each vertex: $[x, y, z] * [scaleX, scaleY, scaleZ]$

5. Rebuild Geometry:

- Get original normals and UVs from Plane
- Add CustomGeometry op
- Connect: Scaled Positions -> CustomGeometry
- Connect: Original Normals -> CustomGeometry
- Connect: Original UVs -> CustomGeometry

Example 2: Bending a Wall (Curved Distortion)

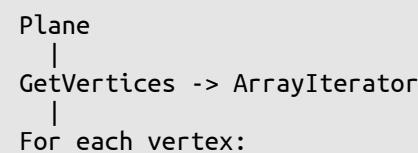
Bend a plain wall into a curved wall with controllable angle:



Bending Algorithm (Node-Based):

For each vertex: 1. Calculate distance from bend center 2. Calculate angle based on distance and bend amount 3. Rotate vertex around bend axis 4. Update position

Node Setup for Bending:



```

| Vertex X -> Subtract (Bend Center) -> Distance from center
| Distance -> Multiply (Bend Angle) -> Rotation angle
|
Vertex Y -> Sin(Rotation) -> New Y position
Vertex Z -> Cos(Rotation) -> New Z position
Vertex X -> Keep original
|
Combine -> New Vertex Position
|
ArrayCollect -> All Distorted Vertices
|
CustomGeometry

```

4.6.3 Method 2: JavaScript Custom Op for Mesh Distortion

For more control and performance, use a JavaScript custom op to handle distortion.

Custom Op: Wall Distorter

Create a custom op that handles both scaling and bending:

```

// Custom Op: WallDistorter
// Distorts a plane mesh with scaling and bending

const inVertices = op.inArray("Input Vertices");
const inNormals = op.inArray("Input Normals");
const inUVs = op.inArray("Input UVs");

// Scale parameters
const inScaleX = op.inFloat("Scale X", 1.0);
const inScaleY = op.inFloat("Scale Y", 1.0);
const inScaleZ = op.inFloat("Scale Z", 1.0);

// Bend parameters
const inBendAngle = op.inFloat("Bend Angle", 0.0); // in radians
const inBendCenter = op.inFloat("Bend Center X", 0.0); // X position of bend
const inBendAxis = op.inSwitch("Bend Axis", ["X", "Y", "Z"], "X");

```

```

// Outputs
const outVertices = op.outArray("Distorted Vertices");
const outNormals = op.outArray("Distorted Normals");
const outUVs = op.outArray("Output UVs");

function distortVertices() {
    const vertices = inVertices.get();
    const normals = inNormals.get();
    const uvs = inUVs.get();

    if (!vertices || vertices.length === 0) {
        outVertices.set([]);
        outNormals.set([]);
        outUVs.set([]);
        return;
    }

    const scaleX = inScaleX.get();
    const scaleY = inScaleY.get();
    const scaleZ = inScaleZ.get();
    const bendAngle = inBendAngle.get();
    const bendCenter = inBendCenter.get();
    const bendAxis = inBendAxis.get();

    const distortedVertices = [];
    const distortedNormals = [];

    for (let i = 0; i < vertices.length; i += 3) {
        let x = vertices[i];
        let y = vertices[i + 1];
        let z = vertices[i + 2];

        // Apply scaling first
        x *= scaleX;
        y *= scaleY;
        z *= scaleZ;

        // Apply bending
        if (Math.abs(bendAngle) > 0.001) {
            if (bendAxis === "X") {
                // Bend along X axis (curves in Y-Z plane)
                const distanceFromCenter = x - bendCenter;
                const angle = distanceFromCenter * bendAngle;

                // Rotate around X axis
                const cosa = Math.cos(angle);
                const sinA = Math.sin(angle);
                const newY = y * cosa - z * sinA;

```

```

const newZ = y * sinA + z * cosA;
y = newY;
z = newZ;

// Update normals
if (normals && normals.length > i + 2) {
    const nx = normals[i];
    const ny = normals[i + 1];
    const nz = normals[i + 2];
    distortedNormals.push(
        nx,
        ny * cosA - nz * sinA,
        ny * sinA + nz * cosA
    );
} else if (bendAxis === "Y") {
    // Bend along Y axis (curves in X-Z plane)
    const distanceFromCenter = y - bendCenter;
    const angle = distanceFromCenter * bendAngle;

    const cosA = Math.cos(angle);
    const sinA = Math.sin(angle);
    const newX = x * cosA - z * sinA;
    const newZ = x * sinA + z * cosA;
    x = newX;
    z = newZ;

    if (normals && normals.length > i + 2) {
        const nx = normals[i];
        const ny = normals[i + 1];
        const nz = normals[i + 2];
        distortedNormals.push(
            nx * cosA - nz * sinA,
            ny,
            nx * sinA + nz * cosA
        );
    }
} else if (bendAxis === "Z") {
    // Bend along Z axis (curves in X-Y plane)
    const distanceFromCenter = z - bendCenter;
    const angle = distanceFromCenter * bendAngle;

    const cosA = Math.cos(angle);
    const sinA = Math.sin(angle);
    const newX = x * cosA - y * sinA;
    const newY = x * sinA + y * cosA;
    x = newX;
    y = newY;
}

```

```

if (normals && normals.length > i + 2) {
    const nx = normals[i];
    const ny = normals[i + 1];
    const nz = normals[i + 2];
    distortedNormals.push(
        nx * cosA - ny * sinA,
        nx * sinA + ny * cosA,
        nz
    );
}
} else {
    // No bending, just copy normals
    if (normals && normals.length > i + 2) {
        distortedNormals.push(
            normals[i],
            normals[i + 1],
            normals[i + 2]
        );
    }
}

distortedVertices.push(x, y, z);
}

outVertices.set(distortedVertices);
if (distortedNormals.length > 0) {
    outNormals.set(distortedNormals);
} else if (normals) {
    outNormals.set(normals);
}
if (uvs) {
    outUVs.set(uvs);
}

// Update when inputs change
inVertices.onChange = distortVertices;
inNormals.onChange = distortVertices;
inUVs.onChange = distortVertices;
inScaleX.onChange = distortVertices;
inScaleY.onChange = distortVertices;
inScaleZ.onChange = distortVertices;
inBendAngle.onChange = distortVertices;
inBendCenter.onChange = distortVertices;
inBendAxis.onChange = distortVertices;

```

Using the Wall Distorter Op

Setup:

```
Plane (Base Wall)
|
GetVertices -> WallDistorter (Input Vertices)
GetNormals -> WallDistorter (Input Normals)
GetUVs -> WallDistorter (Input UVs)
|
WallDistorter (Distorted Vertices) -> CustomGeometry
WallDistorter (Distorted Normals) -> CustomGeometry
WallDistorter (Output UVs) -> CustomGeometry
|
Material -> Render
```

Controls: - **Scale X/Y/Z:** Resize the wall - **Bend Angle:** Curvature amount (in radians, use `Math.PI/4` for 45°) - **Bend Center X:** Where the bend occurs along the wall - **Bend Axis:** Which axis to bend around

4.6.4 Advanced: Animated Wall Distortion

Combine distortion with animation for dynamic effects:

```
// Custom Op: AnimatedWallDistorter
// Adds time-based animation to distortion

const inVertices = op.inArray("Input Vertices");
const inNormals = op.inArray("Input Normals");
const inUVs = op.inArray("Input UVs");

// Animation parameters
const inTime = op.inFloat("Time", 0.0);
const inAnimationSpeed = op.inFloat("Animation Speed", 1.0);
const inAnimationType = op.inSwitch("Animation Type",
    ["None", "Pulse", "Wave", "Oscillate"], "None");

// Distortion parameters (same as before)
const inScaleX = op.inFloat("Scale X", 1.0);
const inScaleY = op.inFloat("Scale Y", 1.0);
const inScaleZ = op.inFloat("Scale Z", 1.0);
const inBendAngle = op.inFloat("Bend Angle", 0.0);
```

```
const inBendCenter = op.inFloat("Bend Center X", 0.0);

// Outputs
const outVertices = op.outArray("Distorted Vertices");
const outNormals = op.outArray("Distorted Normals");
const outUVs = op.outArray("Output UVs");

function getAnimatedBendAngle() {
    const baseAngle = inBendAngle.get();
    const time = inTime.get();
    const speed = inAnimationSpeed.get();
    const type = inAnimationType.get();

    if (type === "None") {
        return baseAngle;
    } else if (type === "Pulse") {
        // Pulse between 0 and baseAngle
        const pulse = (Math.sin(time * speed) + 1) / 2; // 0 to 1
        return baseAngle * pulse;
    } else if (type === "Wave") {
        // Wave effect
        return baseAngle * Math.sin(time * speed);
    } else if (type === "Oscillate") {
        // Oscillate around baseAngle
        return baseAngle + Math.sin(time * speed) * (baseAngle * 0.5);
    }

    return baseAngle;
}

function distortVertices() {
    const vertices = inVertices.get();
    const normals = inNormals.get();
    const uvs = inUVs.get();

    if (!vertices || vertices.length === 0) {
        outVertices.set([]);
        outNormals.set([]);
        outUVs.set([]);
        return;
    }

    const scaleX = inScaleX.get();
    const scaleY = inScaleY.get();
    const scaleZ = inScaleZ.get();
    const bendAngle = getAnimatedBendAngle();
    const bendCenter = inBendCenter.get();
```

```

const distortedVertices = [];
const distortedNormals = [];

for (let i = 0; i < vertices.length; i += 3) {
    let x = vertices[i];
    let y = vertices[i + 1];
    let z = vertices[i + 2];

    // Apply scaling
    x *= scaleX;
    y *= scaleY;
    z *= scaleZ;

    // Apply animated bending
    if (Math.abs(bendAngle) > 0.001) {
        const distanceFromCenter = x - bendCenter;
        const angle = distanceFromCenter * bendAngle;

        const cosA = Math.cos(angle);
        const sinA = Math.sin(angle);
        const newY = y * cosA - z * sinA;
        const newZ = y * sinA + z * cosA;
        y = newY;
        z = newZ;

        // Update normals
        if (normals && normals.length > i + 2) {
            const nx = normals[i];
            const ny = normals[i + 1];
            const nz = normals[i + 2];
            distortedNormals.push(
                nx,
                ny * cosA - nz * sinA,
                ny * sinA + z * cosA
            );
        }
    } else {
        if (normals && normals.length > i + 2) {
            distortedNormals.push(
                normals[i],
                normals[i + 1],
                normals[i + 2]
            );
        }
    }
}

distortedVertices.push(x, y, z);

```

```

}
outVertices.set(distortedVertices);
if (distortedNormals.length > 0) {
    outNormals.set(distortedNormals);
} else if (normals) {
    outNormals.set(normals);
}
if (uvs) {
    outUVs.set(uvs);
}
}

// Update on input changes
inVertices.onChange = distortVertices;
inNormals.onChange = distortVertices;
inUVs.onChange = distortVertices;
inTime.onChange = distortVertices;
inAnimationSpeed.onChange = distortVertices;
inAnimationType.onChange = distortVertices;
inScaleX.onChange = distortVertices;
inScaleY.onChange = distortVertices;
inScaleZ.onChange = distortVertices;
inBendAngle.onChange = distortVertices;
inBendCenter.onChange = distortVertices;

```

4.6.5 Practical Example: Interactive Curved Wall

Complete setup for an interactive curved wall with real-time controls:

```

+-----+
|           INTERACTIVE CURVED WALL SETUP
+-----+
|
MainLoop
|
Plane (Base Wall)
Width: 10, Height: 5
Segments: 30x15 (for smooth curves)
|
GetVertices -> WallDistorter
GetNormals -> WallDistorter
GetUVs -> WallDistorter
|

```

```

Slider (Bend Angle: 0 to PI/2) -> WallDistorter
Slider (Bend Center: -5 to 5) -> WallDistorter
Slider (Scale X: 0.5 to 2.0) -> WallDistorter
Slider (Scale Y: 0.5 to 2.0) -> WallDistorter
|
WallDistorter -> CustomGeometry
|
StandardMaterial -> Render
|
Camera -> OrbitControls
+
-----+

```

4.6.6 Performance Optimization

For real-time distortion, optimize your setup:

1. Reduce Vertex Count When Possible:

- Use fewer segments for static walls
- Increase segments only where distortion is visible

2. Cache Calculations:

```

let cachedVertices = null;
let cachedBendAngle = null;
let cachedScale = null;

function distortVertices() {
    const bendAngle = inBendAngle.get();
    const scale = inScaleX.get();

    // Only recalculate if inputs changed
    if (cachedVertices &&
        cachedBendAngle === bendAngle &&
        cachedScale === scale) {
        return; // Use cached result
    }

    // Recalculate...
    cachedVertices = distortedVertices;
    cachedBendAngle = bendAngle;
    cachedScale = scale;
}

```

3. Use Instancing for Multiple Walls:

- Create one distorted wall
- Use InstancedMesh to duplicate it
- Much faster than distorting each wall separately

4. Update Only When Needed:

```

// Only update on frame if animation is active
const inRender = op.inTrigger("Render");
inRender.onTriggered = function() {
    if (inAnimationType.get() !== "None") {
        distortVertices();
    }
};

```

4.6.7 Advanced Techniques

Multi-Axis Bending

Bend along multiple axes simultaneously:

```

// Bend along both X and Y axes
const bendX = distanceFromCenterX * bendAngleX;
const bendY = distanceFromCenterY * bendAngleY;

// Apply rotations in sequence
// First rotate around X, then around Y

```

Non-Linear Distortion

Use easing functions for smooth transitions:

```

function easeInOutCubic(t) {
    return t < 0.5
        ? 4 * t * t * t
        : 1 - Math.pow(-2 * t + 2, 3) / 2;
}

```

```
const easedAngle = baseAngle * easeInOutCubic(progress);
```

Texture Coordinate Preservation

When distorting, UVs should remain unchanged for proper texturing:

```
// Always preserve original UVs  
outUVs.set(inUVs.get()); // Don't modify UVs during distortion
```

4.6.8 Common Use Cases

1. Architectural Visualization:

- Bend walls to show different room layouts
- Scale walls to demonstrate space variations

2. Interactive Installations:

- User-controlled wall distortion
- Audio-reactive bending

3. Animation:

- Morphing between straight and curved walls
- Dynamic space transformations

4. Game Mechanics:

- Procedural level generation
- Dynamic environment changes

4.6.9 Troubleshooting

Problem: Normals look wrong after distortion - Solution: Recalculate normals after distortion - Use CalculateNormals op or compute in JavaScript

Problem: Texture stretches or distorts - Solution: Don't modify UV coordinates - Keep original UVs from the base mesh

Problem: Performance is slow - Solution: Reduce vertex count - Cache calculations - Only update when parameters change

Problem: Bending looks jagged - Solution: Increase mesh segments - Use smoother interpolation

4.7 Materials

Materials define how surfaces appear when lit.

4.7.1 BasicMaterial

Simple colored material, not affected by lighting.

4.7.2 LambertMaterial

Matte material with diffuse lighting.

4.7.3 PhongMaterial

Shiny material with specular highlights.

Key Parameters: - Diffuse Color - Base color - Specular Color - Highlight color - Shininess - How sharp the highlights are

4.7.4 PBRMaterial (Physically Based Rendering)

Most realistic material option.

Key Parameters: - Albedo - Base color - Metalness - How metallic (0 = plastic, 1 = metal) - Roughness - Surface smoothness (0 = mirror, 1 = rough) - Normal Map - Surface detail - Ambient Occlusion - Crevice shadows - Emissive - Self-illumination - Clearcoat - Additional glossy layer (for car paint, etc.)

PBR Workflow Tips: - Use real-world material values for best results - Metalness and Roughness are inverse - metals are usually smooth (low roughness) - Combine texture maps for realistic surfaces - Use HDR environment maps for accurate reflections

4.7.5 Material Blending

Blend between materials:

```
Material1 -> Mix -> Material2 (blend factor) -> BlendedMaterial
```

4.7.6 Animated Materials

Animate material properties:

```
Time -> Sin -> Material Color (pulsing)
Time -> Material Roughness (shimmer effect)
MouseX -> Material Metalness (interactive)
```

4.7.7 Material Variants

Create material variations:

```
BaseMaterial -> Multiply Color -> Variant1
BaseMaterial -> Multiply Color -> Variant2
```

4.7.8 Custom Shader Materials

Use custom GLSL shaders (see Shaders chapter):

```
ShaderMaterial (custom GLSL) -> Mesh
```

4.7.9 Material Instancing

Apply same material to multiple objects efficiently:

```
Material -> Apply to multiple meshes
```

4.8 Transformations in 3D

4.8.1 Transform

Same as 2D but with full 3D control:

```
Transform
++ TranslateX, TranslateY, TranslateZ
++ RotateX, RotateY, RotateZ
++ ScaleX, ScaleY, ScaleZ (or uniform Scale)
```

4.8.2 Matrix Operations

For advanced control, use matrix ops: - MatrixMultiply - Combine transformations - LookAt - Point object at target - Billboard - Always face camera - MatrixInvert - Reverse transformation - MatrixDecompose - Extract position/rotation/scale

4.8.3 Hierarchical Transforms

Create parent-child relationships:

```
Transform (parent)
|
Transform (child) - inherits parent's transform
|
Mesh
```

Use Cases: - Character rigging (body -> arm -> hand) - Vehicle systems (car -> wheel -> tire) - Solar systems (sun -> planet -> moon)

4.8.4 Constraint Systems

Constrain object movement:

Distance Constraint:

Object1 Position -> Distance -> Object2 Position (maintain distance)

Look-At Constraint:

Object -> LookAt -> Target (always face target)

Path Constraint:

Object -> Follow Path -> Constrained movement

4.8.5 IK (Inverse Kinematics)

Control chains of objects:

End Effector Position -> IK Solver -> Joint Angles
|
Transform chain

4.8.6 Physics-Based Transforms

Use physics for natural movement:

PhysicsBody -> Transform (position/rotation from physics)

4.8.7 Transform Caching

Cache expensive transformations:

Transform -> Cache -> Reuse for multiple objects

4.9 Rendering Techniques

4.9.1 Rendering Order

Opaque objects should render before transparent ones:

```
MainLoop -> Camera
|
[Opaque objects]
|
EnableBlending
|
[Transparent objects]
```

4.9.2 Multiple Render Passes

Create effects like glow, depth of field, or reflections:

```
MainLoop -> Camera -> RenderToTexture -> [Scene]
|
TextureEffect
|
RenderToScreen
```

4.9.3 Fog

Add atmospheric depth:

```
MainLoop -> Camera -> Fog -> [Scene]
```

Types: - Linear fog - Constant density - Exponential fog - Density increases with distance - Height fog - Fog based on Y position

4.9.4 Screen-Space Ambient Occlusion (SSAO)

Add depth and realism:

```
MainLoop -> Camera -> RenderToTexture (depth)
|  
SSAO Effect  
|  
Apply to scene
```

4.9.5 Screen-Space Reflections (SSR)

Realistic reflections without reflection probes:

```
Scene -> RenderToTexture -> SSR Effect -> Reflections
```

4.9.6 Depth of Field

Focus blur effect:

```
Camera -> DepthOfField -> Focus distance -> Blur amount
```

4.9.7 Bloom

Glowing highlights:

```
Scene -> Brightness threshold -> Blur -> Add back -> Bloom
```

4.9.8 Motion Blur

Blur moving objects:

```
Previous frame -> Current frame -> Blend -> Motion blur
```

4.9.9 Color Grading

Post-process color adjustments:

```
Scene -> ColorCorrection
++ Exposure
++ Contrast
++ Saturation
++ Color temperature
++ Tint
```

4.9.10 Chromatic Aberration

Color separation effect:

```
Scene -> ChromaticAberration -> Distorted colors
```

4.9.11 Vignette

Darken edges:

```
Scene -> Vignette -> Darkened corners
```

4.9.12 Post-Processing Chain

Combine multiple effects:

```
Scene
|
```

```
RenderToTexture
  |
  SSAO
  |
  Bloom
  |
  ColorGrading
  |
  ChromaticAberration
  |
  Vignette
  |
  Final Output
```

4.10 Scene Management

4.10.1 Scene Hierarchy

Organize complex scenes:

```
MainLoop -> Camera
  |
  Scene (root)
    +- Environment
      +- Skybox
      +- Fog
    +- Lighting
      +- AmbientLight
      +- DirectionalLight
      +- PointLights (array)
    +- Static Objects
      +- [Buildings, terrain, etc.]
    +- Dynamic Objects
      +- [Characters, vehicles, etc.]
    +- Effects
      +- Particles
      +- Post-processing
```

4.10.2 Object Grouping

Group related objects:

```
Group (name: "Characters")
  +- Character1
  +- Character2
  +- Character3
```

4.10.3 Layer System

Use layers for organization:

```
Layer 0: Background
Layer 1: Environment
Layer 2: Characters
Layer 3: Effects
Layer 4: UI
```

4.10.4 Culling and Optimization

Hide objects outside view:

```
Object Position -> FrustumCull -> Only render if visible
```

4.10.5 LOD (Level of Detail) System

Use simpler models at distance:

```
Distance from camera -> If > threshold -> Use LOD model
```

4.11 Practical Examples

4.11.1 Example 1: Rotating Cube

```
MainLoop  
|  
PerspectiveCamera  
|  
DirectionalLight  
|  
Time -> RotateY input  
|  
PhongMaterial  
|  
Cube
```

4.11.2 Example 2: Lit Sphere with Orbit Controls

```
MainLoop  
|  
PerspectiveCamera -> OrbitControls  
|  
AmbientLight (subtle)  
|  
PointLight  
|  
PBRMaterial (metalness: 1, roughness: 0.2)  
|  
Sphere
```

4.11.3 Example 3: Loading a 3D Model

```
MainLoop  
|  
PerspectiveCamera  
|  
DirectionalLight  
|  
GLTFLoader (your model.glb)  
|  
Transform (scale/position)
```

4.11.4 Example 4: Solar System

```
MainLoop  
|  
PerspectiveCamera -> OrbitControls  
|  
AmbientLight (space ambient)  
|  
DirectionalLight (sun)  
|  
[Sun] - Static sphere with emissive material  
|  
[Planet1] - Transform (orbit around sun)  
|    +-- Time -> RotateY (orbit)  
|    +-- Time -> RotateY (self-rotation)  
|       +-- Sphere  
|  
[Planet2] - Different orbit speed  
|    +-- [Moon] - Orbits planet
```

4.11.5 Example 5: Procedural Terrain

```
MainLoop  
|  
PerspectiveCamera -> OrbitControls  
|  
DirectionalLight  
|  
IteratorLoop (grid: 100x100)  
|  
Position -> NoiseTexture (3D noise) -> Height  
|  
Calculate vertex (X, height, Z)  
|  
Calculate normal from neighbors  
|  
CustomGeometry  
|  
PBRMaterial (terrain textures)
```

4.11.6 Example 6: Instanced Forest

```
MainLoop
  |
  PerspectiveCamera
  |
  DirectionalLight
  |
  TreeModel (loaded GLTF)
  |
  ArrayIterator (1000 positions)
  |
  Random -> Scale variation
  Random -> Rotation variation
  |
  InstanceTransform
  |
  InstancedMesh
```

4.11.7 Example 7: Interactive 3D Scene

```
MainLoop
  |
  PerspectiveCamera -> OrbitControls
  |
  MouseX -> Map -> Light Direction X
  MouseY -> Map -> Light Direction Y
  |
  DirectionalLight
  |
  MouseClick -> Toggle -> Object visibility
  |
  [Scene objects]
```

4.11.8 Example 8: Animated Character

```
MainLoop
  |
  PerspectiveCamera
  |
  DirectionalLight
  |
  CharacterModel
```

```
|
Timeline
  +-- Frame 0: Idle pose
  +-- Frame 30: Walk cycle start
  +-- Frame 60: Walk cycle end
  +-- [Loop]
  |
  Apply to skeleton
  |
  AnimatedMesh
```

4.11.9 Example 9: Particle System

```
MainLoop
  |
  PerspectiveCamera
  |
  ArrayIterator (particles)
  |
  Particle Data
    +-- Position (update with velocity)
    +-- Velocity (update with forces)
    +-- Life (decrease over time)
    +-- Size (scale with life)
    |
    Transform (position, scale)
    |
    BasicMaterial (color from life)
    |
    Sphere (small)
```

4.11.10 Example 10: Reflective Surface

```
MainLoop
  |
  PerspectiveCamera
  |
  [Scene to reflect]
  |
  RenderToTexture (reflection view)
  |
  CubemapTexture
  |
```

```
PBRMaterial (reflection map)
  |
  Plane (mirror surface)
```

4.11.11 Example 11: Volumetric Fog

```
MainLoop
  |
  PerspectiveCamera
  |
  Scene
  |
  RenderToTexture (depth)
  |
  VolumetricFog
    +-- Depth texture
    +-- Noise texture (for variation)
    +-- Light direction
    |
    Blend with scene
```

4.11.12 Example 12: Dynamic Lighting Setup

```
MainLoop
  |
  PerspectiveCamera
  |
  Time -> Sin -> Sun angle
  |
  Sun angle -> Calculate direction
  |
  DirectionalLight (sun)
    +-- Color (warm -> cool based on angle)
    +-- Intensity (day -> night)
  |
  AmbientLight
    +-- Intensity (complement sun)
  |
  [Scene]
```

4.11.13 Example 13: Morphing Objects

```
MainLoop
  |
  PerspectiveCamera
  |
  Time -> Sin -> Morph factor (0 to 1)
  |
  Mesh1 -> Morph -> Mesh2
  |
  Material
```

4.11.14 Example 14: Physics Simulation

```
MainLoop
  |
  PerspectiveCamera
  |
  PhysicsWorld
    +-- Gravity
    +-- Colliders
  |
  PhysicsBody (rigid body)
    +-- Mass
    +-- Forces
    +-- Collisions
  |
  Transform (from physics)
  |
  Mesh
```

4.11.15 Example 15: Post-Processing Pipeline

```
MainLoop
  |
  PerspectiveCamera
  |
  [Render scene]
  |
  RenderToTexture
  |
  SSAO
```

```
Bloom (extract bright areas)
  |
  Blur (bloom)
  |
  Add bloom back
  |
  ColorGrading
    +-+ Exposure
    +-+ Contrast
    +-+ Saturation
  |
  ChromaticAberration
  |
  Vignette
  |
  Final output
```

4.11.16 Example 16: Audio-Reactive 3D

```
MainLoop
  |
  PerspectiveCamera
  |
  AudioAnalyzer -> FFTArray
  |
  ArrayIterator (frequency bands)
  |
  FFT Value -> Scale Y
  |
  Transform (position from index, scale from FFT)
  |
  Cube (bar visualization)
```

4.11.17 Example 17: Procedural City

```
MainLoop
  |
  PerspectiveCamera -> OrbitControls
  |
  DirectionalLight
  |
  IteratorLoop (grid: city blocks)
```

```
NoiseTexture -> Building height
Random -> Building type
  |
  Transform (position, height)
  |
  Cube (building)
  |
  PBRMaterial (building texture)
```

4.11.18 Example 18: Water Surface

```
MainLoop
  |
  PerspectiveCamera
  |
  Time -> Sin -> Wave offset
  |
  Plane (subdivided)
  |
  Vertex shader (displace vertices)
  |
  WaterMaterial
    +-+ Normal map (animated)
    +-+ Reflection (scene)
    +-+ Refraction
    +-+ Foam (at edges)
```

4.11.19 Example 19: Portal Effect

```
MainLoop
  |
  PerspectiveCamera
  |
  [Main scene]
  |
  PortalCamera (different view)
  |
  RenderToTexture (portal view)
  |
  Plane (portal frame)
  |
  Material (portal texture)
```

Stencil buffer (mask to portal shape)

4.11.20 Example 20: Multi-Pass Rendering

```
MainLoop  
|  
PerspectiveCamera  
|  
[Pass 1: Opaque objects]  
|  
RenderToTexture  
|  
[Pass 2: Transparent objects]  
|  
Blend with Pass 1  
|  
[Pass 3: Effects]  
|  
Blend all passes  
|  
Post-processing
```

4.12 Advanced Animation Techniques

4.12.1 Skeletal Animation

Animate characters with bones:

```
Skeleton (bone hierarchy)  
|  
Animation data (keyframes)  
|  
Skin weights (vertex -> bone influence)  
|  
AnimatedMesh
```

4.12.2 Morph Targets

Blend between shape variations:

```
BaseMesh -> MorphTarget1 (blend factor) -> MorphTarget2
```

Use Cases: - Facial expressions - Shape variations - Smooth transitions

4.12.3 Procedural Animation

Generate animation with code:

```
Time -> Math functions -> Transform values  
|  
Apply to objects
```

4.12.4 Physics Animation

Use physics for natural movement:

```
PhysicsBody -> Forces -> Motion -> Transform
```

4.12.5 Animation Blending

Smoothly transition between animations:

```
Animation1 -> Blend -> Animation2 (blend factor)
```

4.13 Performance Optimization

4.13.1 General Tips

1. **Reduce Polygon Count** - Use lower-poly models when possible
2. **Texture Atlas** - Combine textures to reduce draw calls
3. **Level of Detail (LOD)** - Use simpler models for distant objects
4. **Frustum Culling** - Built-in, but organize scenes efficiently
5. **Bake Lighting** - Pre-calculate lighting for static scenes

4.13.2 Advanced Optimization

Occlusion Culling:

Object -> Check if occluded -> Skip rendering

Batching:

Similar objects -> Batch -> Single draw call

Texture Compression: - Use compressed texture formats (DXT, ETC) - Reduce texture resolution when possible - Use mipmaps for distant objects

Geometry Optimization: - Remove unnecessary vertices - Use indexed geometry - Optimize UV mapping

Shader Optimization: - Minimize texture samples - Use simpler shaders when possible - Avoid branching in shaders

Render Target Optimization: - Use appropriate render target sizes - Don't render at higher resolution than display - Use half-precision floats when possible

4.13.3 Performance Monitoring

Track performance metrics:

PerformanceMonitor

- +++ FPS
- +++ Draw calls
- +++ Triangle count
- +++ Texture memory
- +++ Shader compilation time

4.13.4 Adaptive Quality

Adjust quality based on performance:

- FPS -> If < 30 -> Reduce quality
- +++ Lower LOD
 - +++ Disable effects
 - +++ Reduce particle count

4.14 Common Patterns and Workflows

4.14.1 Pattern: Object Pooling

Reuse objects instead of creating/destroying:

```
Pool of inactive objects
  |
  Activate when needed
  |
  Deactivate when done
  |
  Return to pool
```

4.14.2 Pattern: Component System

Organize object behavior:

```
GameObject
  +-+ Transform component
  +-+ Render component
  +-+ Physics component
  +-+ Script component
```

4.14.3 Pattern: Event System

Decouple object interactions:

```
EventEmitter
  +-+ Subscribe (listener)
  +-+ Emit (event)
  |
Objects react to events
```

4.14.4 Pattern: State Machine

Manage object states:

```
StateMachine
  +-+ Idle state
  +-+ Active state
  +-+ Transition conditions
```

4.15 Debugging 3D Scenes

4.15.1 Visual Debugging

Show Normals:

```
Mesh -> DebugNormals -> Visualize normals
```

Show Bounding Boxes:

```
Mesh -> DebugBounds -> Show bounding boxes
```

Show Wireframe:

```
Material -> Wireframe mode -> See geometry
```

Show Grid:

```
GridHelper -> Visual reference
```

4.15.2 Common Issues

“Objects not visible” - Check camera position and direction - Verify objects are within near/far planes - Check material alpha values - Verify lighting setup

“Shadows look wrong” - Adjust shadow bias - Increase shadow map resolution - Check light shadow settings - Verify shadow receiving objects

“Performance is slow” - Reduce polygon count - Lower texture resolutions - Disable expensive effects - Use LOD system - Optimize shaders

“Materials look incorrect” - Verify texture UV mapping - Check normal map orientation - Verify PBR material values - Check lighting setup

4.16 Best Practices

1. **Start Simple** - Build complexity gradually
2. **Optimize Early** - Consider performance from the start
3. **Use Instancing** - For repeated objects
4. **Organize Scenes** - Use hierarchies and groups
5. **Test on Target Hardware** - Performance varies by device
6. **Use Appropriate Formats** - GLTF for models, compressed textures
7. **Profile Regularly** - Use performance tools
8. **Document Complex Setups** - Add comments to patches
9. **Version Control** - Save iterations of complex scenes
10. **Reuse Assets** - Don't duplicate unnecessarily

4.17 Featured Videos

4.18 Exercises

4.18.1 Beginner

1. Create a solar system with orbiting planets
2. Build a simple room with multiple light sources
3. Load a 3D model and add interactive rotation controls
4. Create a rotating cube with different materials
5. Build a simple scene with fog

4.18.2 Intermediate

6. Create a procedural terrain with noise
7. Build an instanced forest with 100+ trees
8. Implement a three-point lighting setup
9. Create a water surface with animated waves
10. Build a particle system with physics
11. Create a portal effect with dual cameras
12. Implement post-processing effects (bloom, SSAO)
13. Build an audio-reactive 3D visualization
14. Create a morphing object animation
15. Implement a character with skeletal animation

4.18.3 Advanced

16. Build a complete scene with LOD system
17. Create a volumetric fog effect
18. Implement screen-space reflections
19. Build a physics-based simulation
20. Create a procedural city generator
21. Implement a multi-pass rendering pipeline
22. Build an interactive 3D game scene
23. Create advanced post-processing chain
24. Implement custom shader materials
25. Build a complex scene with optimization techniques

4.19 Project Ideas

1. **3D Product Viewer** - Interactive product showcase
2. **Architectural Visualization** - Building walkthrough
3. **Game Prototype** - Simple 3D game mechanics
4. **Data Visualization** - 3D charts and graphs
5. **Virtual Gallery** - 3D art exhibition
6. **Interactive Installation** - Museum or event display
7. **Music Visualizer** - 3D audio-reactive visuals
8. **Procedural World** - Generated landscape exploration
9. **Character Animation** - Animated character showcase
10. **Physics Sandbox** - Interactive physics playground

5 Texturing in Cables.gl

5.1 Introduction to Textures

Textures add detail, color, and realism to your visuals. In cables.gl, textures can come from images, videos, webcams, or be generated procedurally.

5.2 Loading Textures

5.2.1 ImageTexture

Load images from files or URLs:

ImageTexture -> Material (texture input)

Supported Formats: - PNG (with transparency) - JPG - WebP - GIF (first frame or animated)

Key Parameters: - URL - Path to image - Filter - Nearest (pixelated) or Linear (smooth) - Wrap - Repeat, Clamp, Mirror

5.2.2 VideoTexture

Use video as a texture:

VideoTexture -> Material (texture input)

Key Parameters: - URL - Path to video file - Loop - Whether to loop playback - Playback Rate - Speed control - Volume - Audio volume

Supported Formats: - MP4 (H.264) - WebM

5.2.3 WebcamTexture

Live webcam input as a texture:

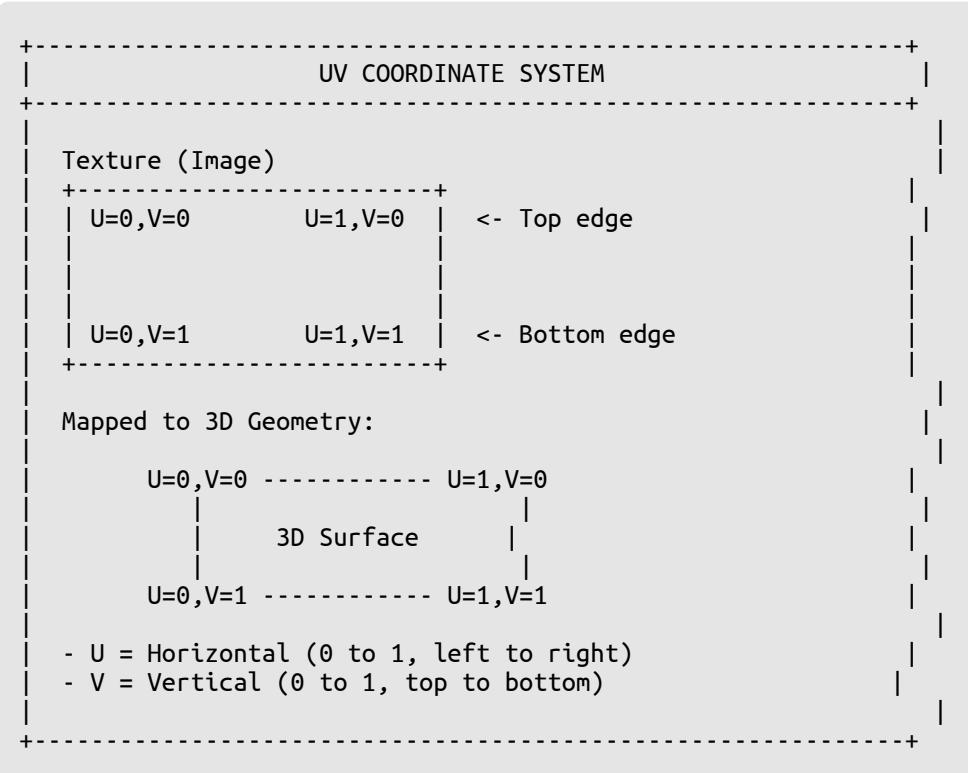
WebcamTexture -> Material (texture input)

Tip: Great for interactive installations!

5.3 Texture Mapping

5.3.1 UV Coordinates

UV coordinates define how textures wrap onto geometry:

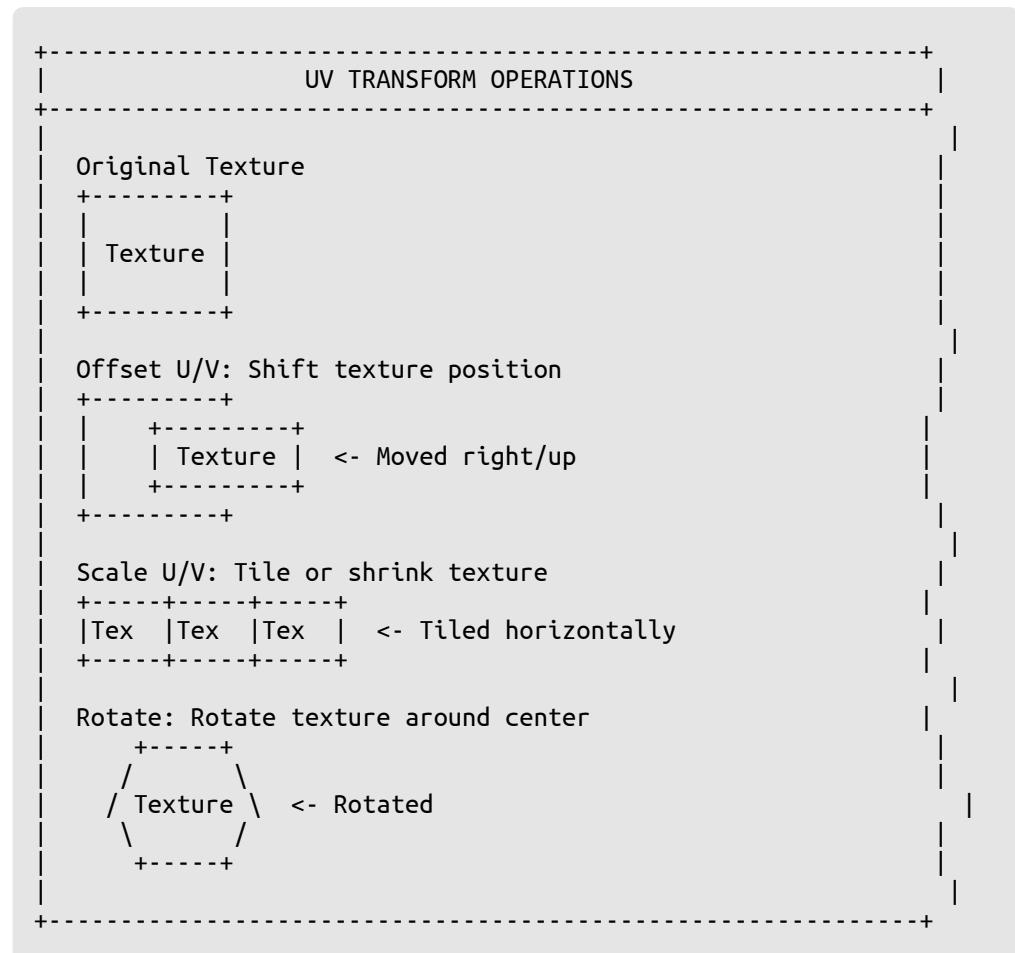


- **U** = Horizontal position (0 to 1)
- **V** = Vertical position (0 to 1)

Most primitive shapes have automatic UV mapping.

5.3.2 UV Transform

Modify texture coordinates:



TextureTransform -> Before texture application

Parameters: -Offset U/V -Shift the texture -Scale U/V -Tile or shrink -Rotate
- Rotate the texture

5.3.3 Tiling Textures

For seamless repeating:

1. Set wrap mode to Repeat
2. Scale UV coordinates > 1

5.4 Advanced Texture Workflow (Production Mindset)

Texturing is where many cables.gl projects move from “cool prototype” to “polished piece”. The two recurring themes are:

- **Correctness:** color space, alpha handling, UVs, aspect ratios, and predictable sampling.
- **Performance:** texture sizes, filtering, mipmaps, compression, and “how many textures are you sampling per pixel”.

5.4.1 Color Space: sRGB vs Linear (Why Your Colors Look “Off”)

Most images you download (JPG/PNG/WebP) are authored in **sRGB** (gamma corrected). Most lighting and shading math expects **linear** values. If your project mixes lit materials (e.g., PBR) with UI-like textures, you can run into:

- washed-out or too-dark textures
- incorrect blending
- “metal looks wrong” in PBR

Practical rule of thumb:

- **Color/albedo** textures are usually **sRGB**.
- **Data** textures (normal maps, roughness/metalness/AO, masks) are usually **linear**.

If a texture looks wrong, verify you’re not treating a data map like a color map (or vice versa).

5.4.2 Alpha (Transparency) Pitfalls

If you see dark/bright halos around transparent textures (logos, sprites), you’re likely looking at one of these issues:

- The texture was exported with a bad matte color (common in PNGs).

- The pipeline expects **premultiplied alpha** but you provided straight alpha (or the other way around).
- Filtering/mipmaps sample transparent pixels and “bleed” colors into edges.

Fix strategies:

- Add padding/bleed around sprites in your source image.
- Prefer power-of-two textures with mipmaps for distant rendering.
- If you have control over asset export, re-export with correct alpha handling.

5.4.3 Filtering, Mipmaps, and Why Textures “Shimmer”

When a textured surface gets small on screen, the GPU needs mipmaps to avoid shimmer and crawling.

- **Nearest** filtering: crisp pixels, great for pixel-art, terrible for most 3D.
- **Linear** filtering: smoother sampling, better for general use.
- **Mipmaps**: essential for 3D surfaces viewed at varying distances.

If a ground texture “crawls” when the camera moves, you typically need mipmaps and (if available) anisotropic filtering.

5.4.4 Power-of-Two Sizes (and When It Matters)

Power-of-two textures (256/512/1024/2048/4096) generally behave better for:

- mipmaps
- repeating wrap modes
- GPU compatibility/performance

Non-power-of-two often still works in modern WebGL, but when things behave oddly, returning to power-of-two sizes is a reliable fix.

5.4.5 Aspect Ratio Correctness (Especially for Video)

Video textures are a frequent source of “why is it stretched?” issues.

- Match the **Plane** aspect ratio to the video’s aspect ratio.
- If you use Fullscreen rectangles, make sure you’re compensating for screen aspect.

5.5 Advanced Techniques and Patch Recipes

These are “building block” patterns you can reuse across many projects.

5.5.1 Recipe: Masked Texture Blend (Two Textures + a Mask)

Use a mask texture (black/white) to blend between two images.

Conceptual chain:

```
ImageTexture (A) -+
                  +-> (blend using mask) -> Material -> Mesh
ImageTexture (B) -+
ImageTexture (Mask)
```

Notes: - The mask should be treated as a data texture (linear). - Great for dirt overlays, decals, and transitions.

5.5.2 Recipe: Animated UVs (Scrolling / Parallax)

Scrolling textures are perfect for conveyor belts, moving backgrounds, water normals, etc.

```
Time -> (speed multiply) -> TextureTransform (Offset U/V)
ImageTexture -> Material (texture input)
Material -> Mesh
```

5.5.3 Recipe: Render-to-Texture for Post-Processing

Render your scene to a texture, apply effects, then output.

```
MainLoop -> Camera -> RenderToTexture
          |
          [Scene]
          |
```

TextureEffects -> Output

Use Cases: - blur/glow chains - color grading - stylized distortion - feedback trails (see next recipe)

5.5.4 Recipe: Feedback / Trails (Texture Feedback Loop)

Feedback is a signature look in real-time visuals.

High-level structure:

```
graph TD
    A[Previous Frame Texture] --> B[TextureEffects (fade/blur)]
    B --> C[Combine with New Frame Content]
    C --> D[RenderToTexture (becomes "previous frame" next tick)]
```

Tip: Keep feedback subtle (small fade each frame). Large blur + high persistence can become very expensive.

5.5.5 Recipe: Planar “Mirror” Reflection (Render-to-Texture)

To fake a mirror floor:

- Render the scene from a reflected camera to a texture.
- Apply that texture onto a plane.

```
MainLoop
  +-> Camera (main) -> [Scene]
  +-> Camera (reflected) -> RenderToTexture -> Plane Material ->
  Mirror Plane
```

5.5.6 Recipe: Environment Reflections (Cubemap/HDR)

Use an environment texture for reflections and more believable PBR materials.

HDRITexture or CubemapTexture -> (environment input) -> PBRMaterial -> Mesh

Tip: Even simple objects look dramatically better with good environment lighting.

5.5.7 Recipe: Video Texture “Billboard” (Reliable Playback)

VideoTexture -> BasicMaterial -> Plane

Checklist: - Use a browser-served URL (avoid file:// in production). - Make sure autoplay policies are satisfied (user interaction may be required). - Use a fallback poster image if video takes time to load.

5.5.8 Recipe: Webcam Texture (Permissions + UX)

WebcamTexture -> BasicMaterial -> Plane

Checklist: - Provide a UI prompt (“Click to enable camera”). - Handle denied permissions gracefully (fallback texture). - Keep resolution reasonable for performance.

5.6 Texture Types for PBR Materials

5.6.1 Albedo/Diffuse Map

The base color of the surface.

5.6.2 Normal Map

Adds surface detail without extra geometry.

NormalMap -> PBRMaterial (normal input)

Tip: Use tangent-space normal maps (blue-purple appearance).

5.6.3 Roughness Map

Controls surface smoothness per-pixel.

- White = rough
- Black = smooth/shiny

5.6.4 Metalness Map

Defines metallic vs. non-metallic regions.

- White = metal
- Black = non-metal (dielectric)

5.6.5 Ambient Occlusion Map

Pre-baked shadow information for crevices.

5.6.6 Height/Displacement Map

Actual geometry displacement (more expensive).

5.6.7 Emissive Map

Self-illuminating regions of the surface.

5.7 Procedural Textures

Generate textures with code/nodes:

5.7.1 Noise Textures

NoiseTexture -> Creates Perlin/Simplex noise

Types: - Perlin noise - Simplex noise - Voronoi - Fractal/FBM

5.7.2 Gradient Textures

GradientTexture -> Creates color gradients

5.7.3 Pattern Generators

- Checkerboard
- Stripes
- Dots
- Custom math-based patterns

5.8 Render to Texture

Capture your scene as a texture for post-processing or effects:

```
MainLoop -> Camera -> RenderToTexture
          |
          [Scene to capture]
          |
          TextureOutput -> Use elsewhere
```

5.8.1 Common Uses:

1. **Post-processing effects** - Apply shaders to the entire scene
2. **Mirrors/Reflections** - Render from reflection viewpoint
3. **Dynamic textures** - Use one patch's output in another

4. **Feedback effects** - Feed output back as input

5.9 Texture Effects

5.9.1 TextureEffects Op

Chain of image processing effects:

```
ImageTexture -> TextureEffects -> Output
```

Available Effects: - Blur - Sharpen - Color correction - Distortion - Edge detection - Pixelation

5.9.2 Custom Shader Effects

Write GLSL for custom texture processing (see Shaders chapter).

5.10 Cubemaps and Environment Maps

5.10.1 CubemapTexture

Six images forming a surrounding environment:

```
CubemapTexture -> Environment lighting
```

Uses: - Skyboxes - Reflections - Image-based lighting (IBL)

5.10.2 HDRITexture

High Dynamic Range images for realistic lighting:

```
HDRITexture -> IBL/Environment
```

5.11 Texture Compression and Optimization

5.11.1 File Size Tips:

1. Use appropriate formats:

- PNG for transparency
- JPG for photos (no transparency)
- WebP for best compression

2. Power of 2 sizes: 256, 512, 1024, 2048, 4096 pixels

3. Mipmaps: Enable for textures viewed at varying distances

4. Compress textures: Use tools like TinyPNG, Squoosh

5.11.2 Memory Considerations:

- 512x512: ~1 MB
- 1024x1024: ~4 MB
- 2048x2048: ~16 MB
- 4096x4096: ~64 MB

5.12 Practical Examples

5.12.1 Example 1: Textured Rotating Cube

```
MainLoop
  |
  PerspectiveCamera
  |
  DirectionalLight
  |
  Time -> RotateY
  |
  ImageTexture -> PhongMaterial (texture input)
  |
  Cube
```

5.12.2 Example 2: Video on a Plane

```
MainLoop
```

```
|  
VideoTexture -> BasicMaterial  
|  
Plane (aspect ratio matching video)
```

5.12.3 Example 3: Animated Noise Background

```
MainLoop  
|  
Time -> NoiseTexture (animate offset)  
|  
BasicMaterial  
|  
FullscreenRectangle
```

5.12.4 Example 4: PBR Textured Material

```
ImageTexture (albedo)  
ImageTexture (normal)  
ImageTexture (roughness)  
ImageTexture (metalness)  
| (all connected to PBRMaterial)  
PBRMaterial  
|  
Mesh
```

5.13 Featured Videos

5.14 Exercises

1. Create a textured cube that rotates and displays different images on each face
2. Build a video wall with multiple video textures
3. Create a procedural noise-based animated background
4. Apply PBR textures to a loaded 3D model

6 Shaders & GLSL in Cables.gl

6.1 Introduction to Shaders

Shaders are programs that run on the GPU, enabling custom visual effects and rendering techniques. Cables.gl provides powerful tools for writing and using GLSL (OpenGL Shading Language) shaders.

6.2 What Are Shaders?

Shaders are small programs that determine how graphics are rendered:

- **Vertex Shaders** - Transform vertex positions
- **Fragment Shaders** - Determine pixel colors

Together, they control everything you see on screen.

6.3 Why Use Custom Shaders?

- Create unique visual effects
- Achieve effects impossible with built-in ops
- Optimize performance for specific use cases
- Learn the fundamentals of graphics programming

6.4 Shader Ops in Cables.gl

6.4.1 ShaderMaterial

Apply custom GLSL code as a material:

```
ShaderMaterial -> Mesh
```

6.4.2 TextureEffect (Shader-based)

Process textures with custom fragment shaders.

6.4.3 CustomShader

Full control over vertex and fragment shaders.

6.5 GLSL Basics

6.5.1 Data Types

```
// Scalars
float a = 1.0;
int b = 5;
bool c = true;

// Vectors
vec2 uv = vec2(0.5, 0.5);
vec3 color = vec3(1.0, 0.0, 0.0); // RGB
vec4 rgba = vec4(1.0, 1.0, 1.0, 1.0);

// Matrices
mat4 transform;

// Samplers (textures)
sampler2D myTexture;
```

6.5.2 Swizzling

Access vector components in any order:

```
vec4 color = vec4(1.0, 0.5, 0.25, 1.0);
vec3 rgb = color.rgb;      // (1.0, 0.5, 0.25)
vec2 rg = color.rg;       // (1.0, 0.5)
float r = color.r;        // 1.0
vec3 bgr = color.bgr;     // (0.25, 0.5, 1.0) - reversed!
```

6.5.3 Built-in Functions

```
// Math
sin(x), cos(x), tan(x)
pow(x, y)
sqrt(x)
```

```
abs(x)
min(a, b), max(a, b)
clamp(x, min, max)

// Interpolation
mix(a, b, t)           // Linear interpolation
smoothstep(edge0, edge1, x)

// Vector operations
length(v)
normalize(v)
dot(a, b)
cross(a, b)
reflect(incident, normal)

// Texture sampling
texture(sampler, uv)
```

6.6 Your First Fragment Shader

A simple color gradient:

```
// Fragment Shader
precision mediump float;

varying vec2 vUV; // UV coordinates from vertex shader

void main() {
    // Create gradient based on UV
    vec3 color = vec3(vUV.x, vUV.y, 0.5);

    gl_FragColor = vec4(color, 1.0);
}
```

6.7 Common Shader Patterns

6.7.1 Solid Color

```
void main() {
    gl_FragColor = vec4(1.0, 0.0, 0.0, 1.0); // Red
}
```

6.7.2 UV Gradient

```
void main() {  
    gl_FragColor = vec4(vUV, 0.0, 1.0);  
}
```

6.7.3 Circle (SDF)

```
void main() {  
    vec2 center = vec2(0.5, 0.5);  
    float dist = length(vUV - center);  
    float circle = step(dist, 0.3);  
  
    gl_FragColor = vec4(vec3(circle), 1.0);  
}
```

6.7.4 Smooth Circle

```
void main() {  
    vec2 center = vec2(0.5, 0.5);  
    float dist = length(vUV - center);  
    float circle = smoothstep(0.3, 0.28, dist);  
  
    gl_FragColor = vec4(vec3(circle), 1.0);  
}
```

6.7.5 Animated Pattern

```
uniform float time;  
  
void main() {  
    float wave = sin(vUV.x * 10.0 + time) * 0.5 + 0.5;  
    gl_FragColor = vec4(vec3(wave), 1.0);  
}
```

6.8 Uniforms

Uniforms are values passed from cables.gl to your shader:

```
uniform float time;          // Current time  
uniform vec2 resolution;    // Canvas size  
uniform sampler2D tex;      // Texture  
uniform vec3 color;         // Custom color
```

In cables.gl, connect ops to shader uniform inputs.

6.9 Advanced Shader Workflows in cables.gl

The biggest jump in quality comes from treating shaders like reusable “modules”:

- a **clear input contract** (uniforms you expect: time, resolution, textures, parameters)
- predictable **coordinate conventions** (UV vs screen space vs world space)
- a **debug strategy** (visualize intermediate values)
- performance awareness (texture samples, loops, precision)

6.9.1 A Practical Uniform “Contract”

In most patches you’ll end up with a small set of recurring uniforms:

- **time** (float): animation driver
- **resolution** (vec2): coordinate normalization
- **tex / tex0 / tex1** (sampler2D): one or more textures
- **amount / strength** (float): effect intensity
- **colorA / colorB** (vec3): palette endpoints

Tip: name your uniforms consistently so you can reuse the same patch wiring across multiple shader materials/effects.

6.9.2 Coordinate Spaces: UV vs Screen Space

- **UV space** (vUV) is normalized 0..1 per surface.
- **Screen space** is often derived from UV + resolution when you need pixel-sized offsets.

Example helper:

```
vec2 pixel(vec2 uv, vec2 resolution) {  
    return 1.0 / resolution;  
}
```

6.9.3 Anti-Aliasing SDFs (Clean Edges)

Hard step() edges often look jagged. A common pattern is to use smooth-step() with a small “feather”:

```
float aa(float dist, float radius) {  
    float edge = 0.002; // tweak for your resolution / style  
    return 1.0 - smoothstep(radius - edge, radius + edge, dist);  
}
```

When available, fwidth() can provide adaptive edge widths, but keep in mind WebGL precision/derivative constraints in some contexts.

6.9.4 Palette Mapping (Better Color Fast)

Instead of picking random RGB values, map a scalar to a palette:

```
vec3 palette(float t, vec3 a, vec3 b, vec3 c, vec3 d) {  
    return a + b * cos(6.28318 * (c * t + d));  
}
```

This gives you rich gradients with a tiny amount of code.

6.10 Advanced Examples (Copy-and-Adapt)

These examples are written so you can drop them into a ShaderMaterial/TextureEffect-style fragment shader and then wire the uniforms from your patch.

6.10.1 Example: Texture Distortion (UV Warp)

```
precision mediump float;  
varying vec2 vUV;  
uniform sampler2D tex;  
uniform float time;  
uniform float amount;  
  
void main() {  
    vec2 uv = vUV;  
    uv.x += sin(uv.y * 10.0 + time) * amount;  
    uv.y += cos(uv.x * 10.0 + time) * amount;  
    gl_FragColor = texture2D(tex, uv);  
}
```

Patch wiring idea: - Time -> time - a slider (0..0.05) -> amount - input texture -> tex

6.10.2 Example: Simple Bloom-ish Glow (Threshold + Blur-ish)

This isn't a full separable blur, but it demonstrates the “sample neighbors” pattern.

```
precision mediump float;  
varying vec2 vUV;  
uniform sampler2D tex;  
uniform vec2 resolution;  
uniform float threshold;  
uniform float strength;  
  
void main() {  
    vec2 px = 1.0 / resolution;  
    vec3 c = texture2D(tex, vUV).rgb;  
  
    // crude 5-tap blur  
    vec3 b = vec3(0.0);  
    b += texture2D(tex, vUV + vec2( 1.0, 0.0 ) * px).rgb;  
    b += texture2D(tex, vUV + vec2(-1.0, 0.0 ) * px).rgb;  
    b += texture2D(tex, vUV + vec2( 0.0, 1.0 ) * px).rgb;  
    b += texture2D(tex, vUV + vec2( 0.0,-1.0 ) * px).rgb;  
    b *= 0.25;
```

```

float luma = dot(c, vec3(0.299, 0.587, 0.114));
vec3 glow = (luma > threshold) ? b : vec3(0.0);

gl_FragColor = vec4(c + glow * strength, 1.0);
}

```

6.10.3 Example: Domain Warping (More Organic Noise)

Domain warping is a standard “make it look expensive” trick: distort the coordinates before sampling noise.

```

precision mediump float;
varying vec2 vUV;
uniform float time;

float hash(vec2 p) {
    return fract(sin(dot(p, vec2(127.1, 311.7))) * 43758.5453);
}

float noise(vec2 p) {
    vec2 i = floor(p);
    vec2 f = fract(p);
    float a = hash(i);
    float b = hash(i + vec2(1.0, 0.0));
    float c = hash(i + vec2(0.0, 1.0));
    float d = hash(i + vec2(1.0, 1.0));
    vec2 u = f * f * (3.0 - 2.0 * f);
    return mix(a, b, u.x) + (c - a) * u.y * (1.0 - u.x) + (d - b) *
u.x * u.y;
}

void main() {
    vec2 uv = vUV * 4.0;
    vec2 warp = vec2(
        noise(uv + time * 0.2),
        noise(uv + vec2(5.2, 1.3) - time * 0.2)
    );
    float n = noise(uv + warp * 2.0);
    gl_FragColor = vec4(vec3(n), 1.0);
}

```

6.11 Debugging Shaders (In Practice)

When something is wrong, render the intermediate value:

- visualize UVs: `gl_FragColor = vec4(vUV, 0.0, 1.0);`
- visualize a scalar: `gl_FragColor = vec4(vec3(val), 1.0);`
- isolate channels: `gl_FragColor = vec4(texture2D(tex, vUV).rrrr, 1.0);`

6.11.1 Common Gotchas

- **Black output:** your shader compiles but outputs 0 (check uniform wiring; check ranges).
- **Solid color:** UVs are constant or your sampling coord is wrong.
- **Stretching:** you’re using UVs but expect square pixels; incorporate resolution.
- **Banding:** precision too low; consider `highp` where supported, or dither slightly.

6.12 Performance Guidelines (Real-Time Friendly)

- **Texture samples are expensive:** keep them minimal and reuse results.
- **Avoid nested loops:** especially dynamic loops in fragment shaders.
- **Prefer simple math over heavy branching:** GPUs dislike divergent branches.
- **Keep effects modular:** multiple simpler passes can be easier to tune than one huge shader.

6.13 Signed Distance Functions (SDFs)

SDFs define shapes mathematically:

6.13.1 SDF Primitives

```

// Circle
float sdCircle(vec2 p, float r) {
    return length(p) - r;
}

// Box

```

```

float sdBox(vec2 p, vec2 b) {
    vec2 d = abs(p) - b;
    return length(max(d, 0.0)) + min(max(d.x, d.y), 0.0);
}

// Line segment
float sdSegment(vec2 p, vec2 a, vec2 b) {
    vec2 pa = p - a, ba = b - a;
    float h = clamp(dot(pa, ba) / dot(ba, ba), 0.0, 1.0);
    return length(pa - ba * h);
}

```

6.13.2 SDF Operations

```

// Union (combine shapes)
float opUnion(float d1, float d2) {
    return min(d1, d2);
}

// Subtraction (cut one from another)
float opSubtract(float d1, float d2) {
    return max(-d1, d2);
}

// Intersection (overlap only)
float opIntersect(float d1, float d2) {
    return max(d1, d2);
}

// Smooth union
float opSmoothUnion(float d1, float d2, float k) {
    float h = clamp(0.5 + 0.5 * (d2 - d1) / k, 0.0, 1.0);
    return mix(d2, d1, h) - k * h * (1.0 - h);
}

```

6.14 Noise Functions

6.14.1 Simple Value Noise

```

float random(vec2 st) {
    return fract(sin(dot(st.xy, vec2(12.9898, 78.233))) *
43758.5453);
}

```

```

float noise(vec2 st) {
    vec2 i = floor(st);
    vec2 f = fract(st);

    float a = random(i);
    float b = random(i + vec2(1.0, 0.0));
    float c = random(i + vec2(0.0, 1.0));
    float d = random(i + vec2(1.0, 1.0));

    vec2 u = f * f * (3.0 - 2.0 * f);

    return mix(a, b, u.x) + (c - a) * u.y * (1.0 - u.x) + (d - b) *
u.x * u.y;
}

```

6.14.2 Fractal Brownian Motion (FBM)

```

float fbm(vec2 st) {
    float value = 0.0;
    float amplitude = 0.5;

    for (int i = 0; i < 5; i++) {
        value += amplitude * noise(st);
        st *= 2.0;
        amplitude *= 0.5;
    }

    return value;
}

```

6.15 Post-Processing Effects

6.15.1 Vignette

```

float vignette = 1.0 - length(vUV - 0.5) * 1.5;
color *= vignette;

```

6.15.2 Chromatic Aberration

```
precision mediump float;
varying vec2 vUV;
uniform sampler2D tex;

void main() {
    vec2 offset = (vUV - 0.5) * 0.01;
    float r = texture2D(tex, vUV + offset).r;
    float g = texture2D(tex, vUV).g;
    float b = texture2D(tex, vUV - offset).b;
    vec3 color = vec3(r, g, b);
    gl_FragColor = vec4(color, 1.0);
}
```

6.15.3 Blur (Box Blur)

```
precision mediump float;
varying vec2 vUV;
uniform sampler2D tex;

void main() {
    vec3 blur = vec3(0.0);
    float samples = 9.0;
    float offset = 0.005;

    for (float x = -1.0; x <= 1.0; x++) {
        for (float y = -1.0; y <= 1.0; y++) {
            blur += texture2D(tex, vUV + vec2(x, y) * offset).rgb;
        }
    }
    blur /= samples;
    gl_FragColor = vec4(blur, 1.0);
}
```

6.15.4 Pixelation

```
precision mediump float;
varying vec2 vUV;
uniform sampler2D tex;

void main() {
    float pixels = 100.0;
```

```
    vec2 pixelUV = floor(vUV * pixels) / pixels;
    vec3 color = texture2D(tex, pixelUV).rgb;
    gl_FragColor = vec4(color, 1.0);
}
```

6.16 Vertex Shader Basics

Modify geometry positions:

```
// Vertex Shader
attribute vec3 position;
attribute vec2 uv;

uniform mat4 modelViewMatrix;
uniform mat4 projectionMatrix;
uniform float time;

varying vec2 vUV;

void main() {
    vUV = uv;

    vec3 pos = position;
    // Wave deformation
    pos.z += sin(pos.x * 5.0 + time) * 0.2;

    gl_Position = projectionMatrix * modelViewMatrix * vec4(pos,
1.0);
}
```

6.17 Debugging Shaders

6.17.1 Visualize Values

```
// Show UV coordinates
gl_FragColor = vec4(vUV, 0.0, 1.0);

// Show a value as grayscale
gl_FragColor = vec4(vec3(someValue), 1.0);

// Show negative values in red
float val = someCalculation;
```

```

if (val < 0.0) {
    gl_FragColor = vec4(-val, 0.0, 0.0, 1.0);
} else {
    gl_FragColor = vec4(0.0, val, 0.0, 1.0);
}

```

6.18 Performance Tips

1. **Avoid branching** - GPUs don't like if/else
2. **Use built-in functions** - They're optimized
3. **Minimize texture samples** - Each sample has cost
4. **Precision matters** - Use `mediump` when possible
5. **Precompute values** - Do math in JavaScript when possible

6.19 Professional Video Projection Mapping in Cables.gl

Projection mapping (also called video mapping or spatial augmented reality) involves projecting images onto real-world surfaces, often requiring geometric correction, multi-projector blending, and specialized color correction. This section provides professional-grade shaders for simulating and preparing projection mapping content within cables.gl.

All shaders in this section are designed for use with cables.gl's built-in `TextureEffect` or `ShaderMaterial` ops - simply paste the shader code into the fragment shader field and connect your inputs. For JavaScript custom op implementations, see the "JavaScript Custom Op Examples" section below.

6.19.1 Understanding Cables.gl Shader Context

Critical Notes for Cables.gl Shaders:

1. **Resolution Handling:** In cables.gl, resolution uniform is typically `vec2(width, height)` in pixels. When working with UV coordinates (`vUV`), remember:
 - `vUV` ranges from 0.0 to 1.0
 - Screen space = $vUV * \text{resolution}$
 - Pixel size = $1.0 / \text{resolution}$
 - **Important:** resolution is NOT automatically provided - you must connect a `CanvasInfo` or `GetResolution` op to the `resolution` port

2. **Texture Sampling:** Always use `texture2D()` (WebGL 1.0 style) in cables.gl, not `texture()`.

3. Coordinate Systems:

- UV space: `vUV` (0.0 to 1.0) - automatically provided
- Screen space: $vUV * \text{resolution}$
- Normalized screen space: $(vUV - 0.5) * 2.0$ (ranges -1.0 to 1.0)

4. **Shader Headers:** Always include precision declaration at the top:

```
precision mediump float;
```

5. Uniform Types:

- `float`, `vec2`, `vec3`, `vec4` - Fully supported, become Number/Vector ports
- `sampler2D` - Fully supported, becomes Texture port
- `mat3`, `mat4` - Supported, but verify with Matrix ops in your cables.gl version
- `int` - **Not recommended** - Use `float` instead and compare with `< 0.5` patterns

6. Auto-Provided Variables:

- `varying vec2 vUV` - Always available (no need to declare in vertex shader for `TextureEffect`)
- `uniform float time` - Available if you connect a `Time` op
- `uniform vec2 resolution` - **NOT auto-provided** - must connect manually

6.19.2 Cables.gl Shader Compliance Checklist

Before using any shader in cables.gl, verify:

- Shader starts with `precision mediump float;`
- Uses `texture2D()` not `texture()` for sampling
- Uses `varying vec2 vUV` (auto-provided, don't declare in vertex shader for `TextureEffect`)
- No `uniform int` - converted to `uniform float` with float comparisons
- All uniforms are properly typed (`float`, `vec2`, `vec3`, `vec4`, `sampler2D`)
- Resolution uniform is documented as requiring manual connection
- Shader compiles without errors

- All texture samples are within 0.0-1.0 UV bounds (or clamped)
- No WebGL 2.0 specific features (use WebGL 1.0 compatible code)

6.19.3 Troubleshooting Common Issues

Issue: "Shader won't compile" - Check for precision medium float; at the top - Verify all texture() calls are texture2D() - Ensure no WebGL 2.0 features are used - Check for syntax errors (missing semicolons, etc.)

Issue: "Black screen or no output" - Verify texture is connected to tex (or appropriate sampler2D) port - Check UV coordinates are in 0.0-1.0 range - Ensure resolution is connected if shader uses it - Check if shader is sampling outside texture bounds

Issue: "Resolution uniform not working" - resolution is NOT automatically provided - Connect CanvasInfo op or GetResolution op to resolution port - Verify resolution values are correct (width, height in pixels)

Issue: "Integer uniforms not working" - Cables.gl may not support uniform int reliably - Convert to uniform float and use float comparisons: - if (direction == 0) -> if (direction < 0.5) - if (direction == 1) -> if (direction > 0.5 && direction < 1.5)

Issue: "Matrix uniforms not working" - Verify your cables.gl version supports mat3/mat4 - Use Matrix ops to create matrix values - Consider using vec4 arrays or separate vec2/vec3 values if matrices aren't supported

Issue: "Performance is poor" - Reduce texture samples per pixel - Use medium precision (already done) - Avoid branching in shaders when possible - Consider breaking into multiple passes - Check if using custom JavaScript ops (adds overhead)

Issue: "Ports not appearing" - Ensure uniform declarations match exactly (case-sensitive) - Check uniform types are supported - Verify shader compiles successfully - Try recompiling the shader in TextureEffect

6.19.4 Using Shaders in Cables.gl: Two Approaches

Cables.gl offers two ways to use custom shaders:

Approach 1: Built-in Shader Ops (Recommended for Most Cases)

ShaderMaterial and **TextureEffect** ops automatically: - Create input ports for each uniform declaration - Provide varying vec2 vUV automatically - Handle

shader compilation and execution on GPU - Require no JavaScript wrapper code

How to Use: 1. Add a TextureEffect op to your patch 2. Paste the shader code into the "Fragment Shader" field 3. Connect your textures and values to the automatically created ports 4. The shader runs directly on the GPU

Auto-Provided Uniforms: - varying vec2 vUV - Always available (0.0 to 1.0) - uniform float time - Available if you connect a Time op - uniform vec2 resolution - Available if you connect a Resolution/CanvasInfo op

Manual Uniforms: - All other uniform declarations become input ports automatically - Connect Texture ops for sampler2D uniforms - Connect Number/Vector ops for float, vec2, vec3, vec4 uniforms - Connect Matrix ops for mat3, mat4 uniforms (if supported)

Example Patch Wiring for Keystone Correction:

```
ImageTexture -> TextureEffect (tex port)
CanvasInfo -> TextureEffect (resolution port)
Vector2 (topLeft) -> TextureEffect (topLeft port)
Vector2 (topRight) -> TextureEffect (topRight port)
Vector2 (bottomLeft) -> TextureEffect (bottomLeft port)
Vector2 (bottomRight) -> TextureEffect (bottomRight port)
```

Approach 2: Custom JavaScript Ops (For Advanced Control)

JavaScript custom ops allow you to: - Wrap shader code with additional logic - Dynamically modify shader uniforms - Create reusable, parameterized shader ops - Add custom UI and port organization - Handle complex texture management

Trade-offs: - More setup required (JavaScript wrapper code) - Potential JavaScript overhead - More control over execution flow - Better for reusable, packaged ops

See the "JavaScript Custom Op Examples" section below for implementation details.

6.19.5 Geometric Distortion Correction

Geometric distortion occurs when projectors are not perpendicular to the projection surface. Common types include keystone distortion, barrel distortion, and pincushion distortion.

Keystone Correction (Perspective Distortion)

Built-in Shader Op Ready - Paste into TextureEffect

Keystone distortion creates a trapezoidal shape. This shader corrects it by applying inverse perspective transformation:

```
precision mediump float;

varying vec2 vUV;
uniform sampler2D tex;
uniform vec2 resolution;

// Keystone correction parameters
// topLeft, topRight, bottomLeft, bottomRight corners in UV space
// (0-1)
uniform vec2 topLeft;
uniform vec2 topRight;
uniform vec2 bottomLeft;
uniform vec2 bottomRight;

// Helper function: bilinear interpolation for perspective
// correction
vec2 perspectiveTransform(vec2 uv, vec2 tl, vec2 tr, vec2 bl, vec2
br) {
    // Convert UV to normalized coordinates (-1 to 1)
    vec2 nuv = (uv - 0.5) * 2.0;

    // Perspective correction using bilinear interpolation
    vec2 top = mix(tl, tr, uv.x);
    vec2 bottom = mix(bl, br, uv.x);
    vec2 corrected = mix(bottom, top, uv.y);

    return corrected;
}

void main() {
    vec2 correctedUV = perspectiveTransform(vUV, topLeft, topRight,
bottomLeft, bottomRight);
```

```
// Clamp to prevent sampling outside texture
correctedUV = clamp(correctedUV, 0.0, 1.0);

vec3 color = texture2D(tex, correctedUV).rgb;
gl_FragColor = vec4(color, 1.0);
}
```

Usage with TextureEffect (Built-in Shader Op):

1. Add a TextureEffect op to your patch
2. Paste the shader code above into the "Fragment Shader" field
3. Connect your inputs:
 - Input texture -> tex port (automatically created)
 - CanvasInfo op -> resolution port (or use GetResolution op)
 - Four Vector2 ops for corners -> topLeft, topRight, bottomLeft, bottomRight ports
4. The output texture will have keystone correction applied

Note: The resolution uniform is not automatically provided. You must connect a Resolution or CanvasInfo op to the resolution port.

Advanced Keystone with Homography Matrix

For more precise control, use a 3x3 homography matrix:

Note: mat3 support may vary in cables.gl versions. Verify with Matrix ops or use the corner-based approach above if matrices aren't supported.

```
precision mediump float;

varying vec2 vUV;
uniform sampler2D tex;
uniform mat3 homographyMatrix; // 3x3 transformation matrix - verify
Matrix op support in your cables.gl version

vec2 applyHomography(mat3 H, vec2 uv) {
    vec3 p = vec3(uv, 1.0);
    vec3 result = H * p;
    return result.xy / result.z;
}

void main() {
    vec2 correctedUV = applyHomography(homographyMatrix, vUV);
```

```

// Check if point is within bounds
if (correctedUV.x < 0.0 || correctedUV.x > 1.0 ||
    correctedUV.y < 0.0 || correctedUV.y > 1.0) {
    gl_FragColor = vec4(0.0, 0.0, 0.0, 1.0); // Black outside
} else {
    vec3 color = texture2D(tex, correctedUV).rgb;
    gl_FragColor = vec4(color, 1.0);
}

```

Barrel Distortion Correction

Built-in Shader Op Ready - Paste into TextureEffect

Barrel distortion creates a “bulging” effect. This shader corrects it:

```

precision mediump float;

varying vec2 vUV;
uniform sampler2D tex;
uniform vec2 resolution;
uniform float barrelStrength; // Typically -0.1 to -0.3 for
correction

vec2 barrelDistortion(vec2 uv, float strength) {
    vec2 center = vec2(0.5, 0.5);
    vec2 coord = uv - center;
    float dist = length(coord);

    // Barrel distortion formula
    float factor = 1.0 + strength * dist * dist;
    vec2 corrected = center + coord * factor;

    return corrected;
}

void main() {
    vec2 correctedUV = barrelDistortion(vUV, barrelStrength);

    // Only sample if within bounds
    if (correctedUV.x < 0.0 || correctedUV.x > 1.0 ||
        correctedUV.y < 0.0 || correctedUV.y > 1.0) {
        gl_FragColor = vec4(0.0, 0.0, 0.0, 1.0);
    }
}

```

```

} else {
    vec3 color = texture2D(tex, correctedUV).rgb;
    gl_FragColor = vec4(color, 1.0);
}

```

Pincushion Distortion Correction

Built-in Shader Op Ready - Paste into TextureEffect

Pincushion distortion creates a “pinched” effect. This shader corrects it:

```

precision mediump float;

varying vec2 vUV;
uniform sampler2D tex;
uniform vec2 resolution;
uniform float pincushionStrength; // Typically 0.1 to 0.3 for
correction

vec2 pincushionDistortion(vec2 uv, float strength) {
    vec2 center = vec2(0.5, 0.5);
    vec2 coord = uv - center;
    float dist = length(coord);

    // Pincushion distortion formula (opposite of barrel)
    float factor = 1.0 - strength * dist * dist;
    vec2 corrected = center + coord * factor;

    return corrected;
}

void main() {
    vec2 correctedUV = pincushionDistortion(vUV,
pincushionStrength);

    if (correctedUV.x < 0.0 || correctedUV.x > 1.0 ||
        correctedUV.y < 0.0 || correctedUV.y > 1.0) {
        gl_FragColor = vec4(0.0, 0.0, 0.0, 1.0);
    } else {
        vec3 color = texture2D(tex, correctedUV).rgb;
        gl_FragColor = vec4(color, 1.0);
    }
}

```

Combined Geometric Correction

A comprehensive shader combining multiple distortion types:

```
precision mediump float;

varying vec2 vUV;
uniform sampler2D tex;
uniform vec2 resolution;

// Keystone corners
uniform vec2 topLeft;
uniform vec2 topRight;
uniform vec2 bottomLeft;
uniform vec2 bottomRight;

// Distortion parameters
uniform float barrelAmount;
uniform float pincushionAmount;
uniform float rotation; // Rotation in radians

vec2 rotateUV(vec2 uv, float angle) {
    vec2 center = vec2(0.5, 0.5);
    vec2 coord = uv - center;
    float c = cos(angle);
    float s = sin(angle);
    mat2 rot = mat2(c, -s, s, c);
    return center + rot * coord;
}

vec2 applyDistortion(vec2 uv, float barrel, float pincushion) {
    vec2 center = vec2(0.5, 0.5);
    vec2 coord = uv - center;
    float dist = length(coord);

    float factor = 1.0 + (barrel + pincushion) * dist * dist;
    return center + coord * factor;
}

vec2 perspectiveTransform(vec2 uv, vec2 tl, vec2 tr, vec2 bl, vec2 br) {
    vec2 top = mix(tl, tr, uv.x);
    vec2 bottom = mix(bl, br, uv.x);
    return mix(bottom, top, uv.y);
}
```

```
void main() {
    vec2 uv = vUV;

    // Apply transformations in order: rotation -> distortion -> keystone
    uv = rotateUV(uv, rotation);
    uv = applyDistortion(uv, barrelAmount, pincushionAmount);
    uv = perspectiveTransform(uv, topLeft, topRight, bottomLeft, bottomRight);

    if (uv.x < 0.0 || uv.x > 1.0 || uv.y < 0.0 || uv.y > 1.0) {
        gl_FragColor = vec4(0.0, 0.0, 0.0, 1.0);
    } else {
        vec3 color = texture2D(tex, uv).rgb;
        gl_FragColor = vec4(color, 1.0);
    }
}
```

6.19.6 Multi-Projector Setups

When using multiple projectors, you need to define projection zones and blend overlapping areas.

Projection Zone Mask

Define which projector covers which area:

```
precision mediump float;

varying vec2 vUV;
uniform sampler2D tex;
uniform vec2 resolution;

// Projection zone definition (in UV space, 0-1)
uniform vec4 zoneRect; // x, y, width, height of this projector's zone
uniform float feather; // Edge feathering amount

float getZoneMask(vec2 uv, vec4 zone) {
    vec2 zoneMin = zone.xy;
    vec2 zoneMax = zone.xy + zone.zw;

    // Distance to zone edges
```

```

vec2 distToMin = uv - zoneMin;
vec2 distToMax = zoneMax - uv;
vec2 distToEdge = min(distToMin, distToMax);

// Create mask with feathering
float mask = 1.0;
if (distToEdge.x < feather) {
    mask *= smoothstep(0.0, feather, distToEdge.x);
}
if (distToEdge.y < feather) {
    mask *= smoothstep(0.0, feather, distToEdge.y);
}

// Check if outside zone
if (uv.x < zoneMin.x || uv.x > zoneMax.x ||
    uv.y < zoneMin.y || uv.y > zoneMax.y) {
    mask = 0.0;
}

return mask;
}

void main() {
    float mask = getZoneMask(vUV, zoneRect);
    vec3 color = texture2D(tex, vUV).rgb;

    gl_FragColor = vec4(color * mask, mask);
}

```

Multi-Projector Blending

Blend multiple projector outputs with smooth transitions:

```

precision mediump float;

varying vec2 vUV;
uniform sampler2D tex;
uniform vec2 resolution;

// Blend zone definition
uniform vec4 blendZone; // x, y, width, height of blend area
uniform float blendWidth; // Width of blend transition
uniform float blendDirection; // 0.0=horizontal, 1.0=vertical,
2.0=both (use float instead of int for cables.gl compatibility)

```

```

float getBlendMask(vec2 uv, vec4 zone, float width, float direction)
{
    vec2 zoneMin = zone.xy;
    vec2 zoneMax = zone.xy + zone.zw;
    vec2 zoneCenter = (zoneMin + zoneMax) * 0.5;

    float mask = 1.0;

    // Use float comparisons instead of int (cables.gl
compatibility)
    if (direction < 0.5 || direction > 1.5) {
        // Horizontal blend (direction == 0.0 or 2.0)
        float distToCenter = abs(uv.x - zoneCenter.x);
        float zoneWidth = zone.z;
        if (distToCenter < zoneWidth * 0.5) {
            float blendDist = (zoneWidth * 0.5 - distToCenter) /
width;
            mask *= smoothstep(0.0, 1.0, blendDist);
        }
    }

    if (direction > 0.5 && direction < 1.5 || direction > 1.5) {
        // Vertical blend (direction == 1.0 or 2.0)
        float distToCenter = abs(uv.y - zoneCenter.y);
        float zoneHeight = zone.w;
        if (distToCenter < zoneHeight * 0.5) {
            float blendDist = (zoneHeight * 0.5 - distToCenter) /
width;
            mask *= smoothstep(0.0, 1.0, blendDist);
        }
    }

    return clamp(mask, 0.0, 1.0);
}

void main() {
    float blendMask = getBlendMask(vUV, blendZone, blendWidth,
blendDirection);
    vec3 color = texture2D(tex, vUV).rgb;

    gl_FragColor = vec4(color * blendMask, blendMask);
}

```

6.19.7 Projector Stacking

Projector stacking involves overlapping multiple projectors to increase brightness and redundancy. This shader combines multiple inputs:

```
precision mediump float;

varying vec2 vUV;
uniform sampler2D tex1; // First projector
uniform sampler2D tex2; // Second projector
uniform sampler2D tex3; // Optional third projector
uniform sampler2D tex4; // Optional fourth projector

uniform float stackCount; // Number of active projectors (1-4)
uniform float blendMode; // 0=additive, 1=average, 2=max

vec3 blendStacked(vec3 c1, vec3 c2, vec3 c3, vec3 c4, float count,
float mode) {
    vec3 result = vec3(0.0);

    if (mode < 0.5) {
        // Additive blending (brightest, but can clip)
        if (count > 0.5) result += c1;
        if (count > 1.5) result += c2;
        if (count > 2.5) result += c3;
        if (count > 3.5) result += c4;
        result = clamp(result, 0.0, 1.0);
    } else if (mode < 1.5) {
        // Average blending (natural, reduces brightness)
        float sum = 0.0;
        if (count > 0.5) { result += c1; sum += 1.0; }
        if (count > 1.5) { result += c2; sum += 1.0; }
        if (count > 2.5) { result += c3; sum += 1.0; }
        if (count > 3.5) { result += c4; sum += 1.0; }
        result /= max(sum, 1.0);
    } else {
        // Maximum blending (preserves highlights)
        result = c1;
        if (count > 1.5) result = max(result, c2);
        if (count > 2.5) result = max(result, c3);
        if (count > 3.5) result = max(result, c4);
    }

    return result;
}
```

```
void main() {
    vec3 c1 = texture2D(tex1, vUV).rgb;
    vec3 c2 = texture2D(tex2, vUV).rgb;
    vec3 c3 = texture2D(tex3, vUV).rgb;
    vec3 c4 = texture2D(tex4, vUV).rgb;

    vec3 result = blendStacked(c1, c2, c3, c4, stackCount,
blendMode);

    gl_FragColor = vec4(result, 1.0);
}
```

6.19.8 Gradient Blend Composition

Gradient blends create smooth transitions between overlapping projectors. This is essential for seamless multi-projector setups.

Linear Gradient Blend

```
precision mediump float;

varying vec2 vUV;
uniform sampler2D tex;
uniform vec2 resolution;

// Blend parameters
uniform float blendStart; // Where blend starts (0-1)
uniform float blendEnd; // Where blend ends (0-1)
uniform float blendAxis; // 0.0=horizontal, 1.0=vertical (use float
instead of int for cables.gl compatibility)
uniform float blendPower; // Blend curve (1.0=linear, 2.0=smooth)

float getLinearBlend(vec2 uv, float start, float end, float axis,
float power) {
    float pos = axis < 0.5 ? uv.x : uv.y; // Use float comparison

    // Calculate blend factor
    float blendFactor = 0.0;
    if (pos < start) {
        blendFactor = 0.0;
    } else if (pos > end) {
        blendFactor = 1.0;
    } else {
        // Normalize to 0-1 range
        float t = (pos - start) / (end - start);
        blendFactor = mix(0.0, 1.0, pow(t, blendPower));
    }
    return blendFactor;
}
```

```

        // Apply power curve
        blendFactor = pow(t, power);
    }

    return blendFactor;
}

void main() {
    float blend = getLinearBlend(vUV, blendStart, blendEnd,
blendAxis, blendPower);
    vec3 color = texture2D(tex, vUV).rgb;

    gl_FragColor = vec4(color * blend, blend);
}

```

Radial Gradient Blend

For circular or elliptical blend zones:

```

precision mediump float;

varying vec2 vUV;
uniform sampler2D tex;
uniform vec2 resolution;

// Radial blend parameters
uniform vec2 center; // Blend center in UV space
uniform float innerRadius; // Inner radius (full opacity)
uniform float outerRadius; // Outer radius (zero opacity)
uniform float aspectRatio; // Aspect ratio correction
uniform float blendPower; // Blend curve

float getRadialBlend(vec2 uv, vec2 center, float innerR, float
outerR, float aspect, float power) {
    vec2 offset = (uv - center) * vec2(aspect, 1.0);
    float dist = length(offset);

    float blendFactor = 0.0;
    if (dist < innerR) {
        blendFactor = 1.0;
    } else if (dist > outerR) {
        blendFactor = 0.0;
    } else {
        float t = (dist - innerR) / (outerR - innerR);
        blendFactor = 1.0 - pow(t, power);
    }
}

```

```

        }

        return blendFactor;
}

void main() {
    float blend = getRadialBlend(vUV, center, innerRadius,
outerRadius, aspectRatio, blendPower);
    vec3 color = texture2D(tex, vUV).rgb;

    gl_FragColor = vec4(color * blend, blend);
}

```

Advanced Feather Blend with Soft Edges

Professional-grade blend with multiple falloff curves:

```

precision mediump float;

varying vec2 vUV;
uniform sampler2D tex;
uniform vec2 resolution;

uniform vec4 blendRect; // x, y, width, height
uniform float featherSize; // Feather size in UV units
uniform float featherCurve; // 0.0=linear, 1.0=smooth, 2.0=very
smooth

float getFeatherBlend(vec2 uv, vec4 rect, float feather, float
curve) {
    vec2 rectMin = rect.xy;
    vec2 rectMax = rect.xy + rect.zw;

    // Calculate distance to each edge
    float distLeft = uv.x - rectMin.x;
    float distRight = rectMax.x - uv.x;
    float distBottom = uv.y - rectMin.y;
    float distTop = rectMax.y - uv.y;

    // Find minimum distance to any edge
    float minDist = min(min(distLeft, distRight), min(distBottom,
distTop));

    // Create feather mask
    float mask = 1.0;

```

```

if (minDist < feather) {
    float t = minDist / feather;
    // Apply curve
    if (curve < 0.5) {
        // Linear
        mask = t;
    } else if (curve < 1.5) {
        // Smoothstep
        mask = smoothstep(0.0, 1.0, t);
    } else {
        // Custom smooth curve
        mask = t * t * (3.0 - 2.0 * t);
        mask = pow(mask, 1.0 / (curve - 0.5));
    }
}

// Check if outside rectangle
if (uv.x < rectMin.x || uv.x > rectMax.x ||
    uv.y < rectMin.y || uv.y > rectMax.y) {
    mask = 0.0;
}

return mask;
}

void main() {
    float blend = getFeatherBlend(vUV, blendRect, featherSize,
featherCurve);
    vec3 color = texture2D(tex, vUV).rgb;

    gl_FragColor = vec4(color * blend, blend);
}

```

6.19.9 Color Correction for Projection Mapping

Projection mapping requires specialized color correction to account for surface colors, ambient light, and projector characteristics.

Basic Color Correction

Built-in Shader Op Ready - Paste into TextureEffect

```
precision mediump float;
```

```

varying vec2 vUV;
uniform sampler2D tex;
uniform vec2 resolution;

// Color correction parameters
uniform float brightness; // -1.0 to 1.0
uniform float contrast; // -1.0 to 1.0
uniform float saturation; // -1.0 to 1.0
uniform float gamma; // Typically 0.5 to 3.0

vec3 applyColorCorrection(vec3 color, float bright, float cont,
float sat, float gam) {
    // Brightness
    color += bright;

    // Contrast
    color = (color - 0.5) * (1.0 + cont) + 0.5;

    // Saturation
    float luma = dot(color, vec3(0.299, 0.587, 0.114));
    color = mix(vec3(luma), color, 1.0 + sat);

    // Gamma
    color = pow(max(color, 0.0), vec3(1.0 / max(gam, 0.01)));

    return clamp(color, 0.0, 1.0);
}

void main() {
    vec3 color = texture2D(tex, vUV).rgb;
    color = applyColorCorrection(color, brightness, contrast,
saturation, gamma);

    gl_FragColor = vec4(color, 1.0);
}

```

Advanced Color Correction with Color Temperature

```

precision mediump float;

varying vec2 vUV;
uniform sampler2D tex;
uniform vec2 resolution;

uniform float brightness;
```

```

uniform float contrast;
uniform float saturation;
uniform float gamma;
uniform float colorTemperature; // -1.0 (cool/blue) to 1.0
(warm/orange)

// Color temperature adjustment
vec3 adjustColorTemperature(vec3 color, float temp) {
    // Convert to warmer (orange) or cooler (blue)
    if (temp > 0.0) {
        // Warmer: increase red/orange, decrease blue
        color.r += temp * 0.2;
        color.b -= temp * 0.1;
    } else {
        // Cooler: increase blue, decrease red
        color.r += temp * 0.1;
        color.b -= temp * 0.2;
    }
    return color;
}

vec3 applyColorCorrection(vec3 color, float bright, float cont,
float sat, float gam, float temp) {
    // Brightness
    color += bright;

    // Contrast
    color = (color - 0.5) * (1.0 + cont) + 0.5;

    // Saturation
    float luma = dot(color, vec3(0.299, 0.587, 0.114));
    color = mix(vec3(luma), color, 1.0 + sat);

    // Color temperature
    color = adjustColorTemperature(color, temp);

    // Gamma
    color = pow(max(color, 0.0), vec3(1.0 / max(gam, 0.01)));

    return clamp(color, 0.0, 1.0);
}

void main() {
    vec3 color = texture2D(tex, vUV).rgb;
    color = applyColorCorrection(color, brightness, contrast,
saturation, gamma, colorTemperature);

    gl_FragColor = vec4(color, 1.0);
}

```

```
}
```

Per-Channel Color Correction

Independent control over RGB channels:

```

precision mediump float;

varying vec2 vUV;
uniform sampler2D tex;
uniform vec2 resolution;

// Per-channel brightness and contrast
uniform vec3 channelBrightness; // R, G, B
uniform vec3 channelContrast; // R, G, B
uniform vec3 channelGamma; // R, G, B

vec3 applyPerChannelCorrection(vec3 color, vec3 bright, vec3 cont,
vec3 gam) {
    // Apply per-channel brightness
    color += bright;

    // Apply per-channel contrast
    color = (color - 0.5) * (1.0 + cont) + 0.5;

    // Apply per-channel gamma
    color = pow(max(color, 0.0), vec3(1.0 / max(gam, vec3(0.01))));

    return clamp(color, 0.0, 1.0);
}

void main() {
    vec3 color = texture2D(tex, vUV).rgb;
    color = applyPerChannelCorrection(color, channelBrightness,
channelContrast, channelGamma);

    gl_FragColor = vec4(color, 1.0);
}

```

Surface Color Compensation

Compensate for colored projection surfaces (e.g., projecting on a red wall):

```

precision mediump float;

varying vec2 vUV;
uniform sampler2D tex;
uniform vec2 resolution;

// Surface color (what color the surface appears)
uniform vec3 surfaceColor;
uniform float compensationStrength; // 0.0 to 1.0

vec3 compensateSurfaceColor(vec3 color, vec3 surface, float strength) {
    // Calculate inverse of surface color
    vec3 inverseSurface = vec3(1.0) - surface;

    // Blend between original and compensated
    vec3 compensated = color / max(surface, vec3(0.01)); // Prevent division by zero
    compensated = clamp(compensated, 0.0, 1.0);

    return mix(color, compensated, strength);
}

void main() {
    vec3 color = texture2D(tex, vUV).rgb;
    color = compensateSurfaceColor(color, surfaceColor,
compensationStrength);

    gl_FragColor = vec4(color, 1.0);
}

```

Advanced LUT-Based Color Correction

Use a 3D Look-Up Table (LUT) for professional color grading:

```

precision mediump float;

varying vec2 vUV;
uniform sampler2D tex;
uniform sampler2D lutTexture; // 3D LUT as 2D texture (typically 64x64 or 32x32)
uniform vec2 resolution;
uniform float lutStrength; // 0.0 to 1.0

```

```

// Sample 3D LUT (stored as 2D texture)
vec3 sampleLUT(sampler2D lut, vec3 color, float lutSize) {
    // Assume LUT is organized as a grid
    // For a 64x64 LUT, we have 8x8 grid of 8x8 color cubes

    float cellSize = 1.0 / 8.0; // 8x8 grid
    float cellPixelSize = 1.0 / 64.0; // 64 pixels per cell

    // Find which cell we're in
    vec3 cell = floor(color * 7.0);
    vec3 cellPos = fract(color * 7.0);

    // Calculate UV coordinates in LUT texture
    float cellIndex = cell.b * 8.0 + cell.r;
    vec2 lutUV = vec2(
        (cellIndex * cellSize) + (cellPos.r * cellPixelSize * 8.0),
        cell.g * cellSize + cellPos.g * cellPixelSize * 8.0
    );

    // Sample LUT
    vec3 lutColor = texture2D(lut, lutUV).rgb;

    return lutColor;
}

void main() {
    vec3 originalColor = texture2D(tex, vUV).rgb;
    vec3 lutColor = sampleLUT(lutTexture, originalColor, 64.0);

    vec3 finalColor = mix(originalColor, lutColor, lutStrength);

    gl_FragColor = vec4(finalColor, 1.0);
}

```

Note: For LUT textures, you'll need to create or load a 3D LUT texture. Common formats include 64x64 (8x8 grid) or 32x32 (4x4 grid) textures.

Shadow and Highlight Recovery

Recover details in shadows and highlights:

```

precision mediump float;

varying vec2 vUV;
uniform sampler2D tex;

```

```

uniform vec2 resolution;

uniform float shadowRecovery; // 0.0 to 1.0
uniform float highlightRecovery; // 0.0 to 1.0
uniform float shadowPoint; // Where shadows start (0.0 to 1.0)
uniform float highlightPoint; // Where highlights start (0.0 to 1.0)

vec3 recoverShadowsHighlights(vec3 color, float shadowRec, float
highlightRec, float shadowPt, float highlightPt) {
    float luma = dot(color, vec3(0.299, 0.587, 0.114));

    // Shadow recovery
    float shadowMask = smoothstep(shadowPt - 0.1, shadowPt, luma);
    color += shadowMask * shadowRec * (1.0 - luma) * 0.5;

    // Highlight recovery (compress highlights)
    float highlightMask = smoothstep(highlightPt, highlightPt + 0.1,
luma);
    color = mix(color, vec3(1.0) - (vec3(1.0) - color) * (1.0 -
highlightRec), highlightMask);

    return clamp(color, 0.0, 1.0);
}

void main() {
    vec3 color = texture2D(tex, vUV).rgb;
    color = recoverShadowsHighlights(color, shadowRecovery,
highlightRecovery, shadowPoint, highlightPoint);

    gl_FragColor = vec4(color, 1.0);
}

```

6.19.10 Complete Projection Mapping Pipeline

Built-in Shader Op Ready - Paste into TextureEffect (Note: This is a complex shader with many uniforms - consider breaking into multiple passes for easier management)

A comprehensive shader combining all projection mapping features:

```

precision mediump float;

varying vec2 vUV;
uniform sampler2D tex;

```

```

uniform vec2 resolution;

// Geometric correction
uniform vec2 topLeft;
uniform vec2 topRight;
uniform vec2 bottomLeft;
uniform vec2 bottomRight;
uniform float barrelAmount;
uniform float rotation;

// Blend parameters
uniform vec4 blendZone;
uniform float blendWidth;
uniform float blendPower;

// Color correction
uniform float brightness;
uniform float contrast;
uniform float saturation;
uniform float gamma;
uniform float colorTemperature;
uniform vec3 surfaceColor;
uniform float surfaceCompensation;

// Helper functions (include all from above)
vec2 perspectiveTransform(vec2 uv, vec2 tl, vec2 tr, vec2 bl, vec2
br) {
    vec2 top = mix(tl, tr, uv.x);
    vec2 bottom = mix(bl, br, uv.x);
    return mix(bottom, top, uv.y);
}

vec2 applyDistortion(vec2 uv, float barrel) {
    vec2 center = vec2(0.5, 0.5);
    vec2 coord = uv - center;
    float dist = length(coord);
    float factor = 1.0 + barrel * dist * dist;
    return center + coord * factor;
}

vec2 rotateUV(vec2 uv, float angle) {
    vec2 center = vec2(0.5, 0.5);
    vec2 coord = uv - center;
    float c = cos(angle);
    float s = sin(angle);
    mat2 rot = mat2(c, -s, s, c);
    return center + rot * coord;
}

```

```

float getBlendMask(vec2 uv, vec4 zone, float width, float power) {
    vec2 zoneMin = zone.xy;
    vec2 zoneMax = zone.xy + zone.zw;
    vec2 zoneCenter = (zoneMin + zoneMax) * 0.5;

    float distToCenter = length(uv - zoneCenter);
    float maxDist = length(zoneMax - zoneCenter);

    if (distToCenter > maxDist) return 0.0;

    float blendDist = (maxDist - distToCenter) / width;
    return pow(clamp(blendDist, 0.0, 1.0), power);
}

vec3 applyColorCorrection(vec3 color, float bright, float cont,
float sat, float gam, float temp, vec3 surface, float comp) {
    color += bright;
    color = (color - 0.5) * (1.0 + cont) + 0.5;

    float luma = dot(color, vec3(0.299, 0.587, 0.114));
    color = mix(vec3(luma), color, 1.0 + sat);

    if (temp > 0.0) {
        color.r += temp * 0.2;
        color.b -= temp * 0.1;
    } else {
        color.r += temp * 0.1;
        color.b -= temp * 0.2;
    }

    vec3 compensated = color / max(surface, vec3(0.01));
    color = mix(color, clamp(compensated, 0.0, 1.0), comp);

    color = pow(max(color, 0.0), vec3(1.0 / max(gam, 0.01)));

    return clamp(color, 0.0, 1.0);
}

void main() {
    // Step 1: Geometric correction
    vec2 uv = vUV;
    uv = rotateUV(uv, rotation);
    uv = applyDistortion(uv, barrelAmount);
    uv = perspectiveTransform(uv, topLeft, topRight, bottomLeft,
    bottomRight);

    // Step 2: Sample texture
}

```

```

if (uv.x < 0.0 || uv.x > 1.0 || uv.y < 0.0 || uv.y > 1.0) {
    gl_FragColor = vec4(0.0, 0.0, 0.0, 0.0);
    return;
}

vec3 color = texture2D(tex, uv).rgb;

// Step 3: Color correction
color = applyColorCorrection(color, brightness, contrast,
saturation, gamma, colorTemperature, surfaceColor,
surfaceCompensation);

// Step 4: Apply blend mask
float blend = getBlendMask(vUV, blendZone, blendWidth,
blendPower);
color *= blend;

gl_FragColor = vec4(color, blend);
}

```

6.19.11 JavaScript Custom Op Examples

For cases where you need more control, reusable components, or dynamic shader management, you can wrap shaders in JavaScript custom ops. Here are examples for key projection mapping features:

Keystone Correction Custom Op

```

// Custom Op: KeystoneCorrection
// Name: Ops.User.ProjectionMapping.KeystoneCorrection

const inTexture = op.inTexture("Input Texture");
const inTopLeft = op.inVec2("Top Left", [0.0, 1.0]);
const inTopRight = op.inVec2("Top Right", [1.0, 1.0]);
const inBottomLeft = op.inVec2("Bottom Left", [0.0, 0.0]);
const inBottomRight = op.inVec2("Bottom Right", [1.0, 0.0]);
const inResolution = op.inVec2("Resolution", [1920.0, 1080.0]);
const outTexture = op.outTexture("Output");

// Shader code as string
const shaderCode = `precision mediump float;
varying vec2 vUV;
uniform sampler2D tex;

```

```

uniform vec2 resolution;
uniform vec2 topLeft;
uniform vec2 topRight;
uniform vec2 bottomLeft;
uniform vec2 bottomRight;

vec2 perspectiveTransform(vec2 uv, vec2 tl, vec2 tr, vec2 bl, vec2 br) {
    vec2 top = mix(tl, tr, uv.x);
    vec2 bottom = mix(bl, br, uv.x);
    return mix(bottom, top, uv.y);
}

void main() {
    vec2 correctedUV = perspectiveTransform(vUV, topLeft, topRight,
bottomLeft, bottomRight);
    correctedUV = clamp(correctedUV, 0.0, 1.0);
    vec3 color = texture2D(tex, correctedUV).rgb;
    gl_FragColor = vec4(color, 1.0);
}
`;

let shaderMaterial = null;

function updateShader() {
    const tex = inTexture.get();
    if (!tex) return;

    // Create or update shader material
    if (!shaderMaterial) {
        shaderMaterial = new op.patch.cgl.ShaderMaterial({
            fragmentShader: shaderCode,
            uniforms: {}
        });
    }

    // Update uniforms
    shaderMaterial.uniforms.tex = { value: tex };
    shaderMaterial.uniforms.resolution = { value: inResolution.get() };
    shaderMaterial.uniforms.topLeft = { value: inTopLeft.get() };
    shaderMaterial.uniforms.topRight = { value: inTopRight.get() };
    shaderMaterial.uniforms.bottomLeft = { value: inBottomLeft.get() };
    shaderMaterial.uniforms.bottomRight = { value: inBottomRight.get() };

    // Render to texture
}

```

```

const renderTarget = op.patch.cgl.createRenderTarget(
    inResolution.get()[0],
    inResolution.get()[1]
);

// Apply shader and render
op.patch.cgl.render(renderTarget, shaderMaterial);

outTexture.set(renderTarget.texture);
}

inTexture.onChange = updateShader;
inTopLeft.onChange = updateShader;
inTopRight.onChange = updateShader;
inBottomLeft.onChange = updateShader;
inBottomRight.onChange = updateShader;
inResolution.onChange = updateShader;

```

Note: The above example shows the concept, but cables.gl's actual API may differ. In practice, you might use TextureEffect programmatically or create a render pass.

Color Correction Custom Op

```

// Custom Op: ColorCorrection
// Name: Ops.User.ProjectionMapping.ColorCorrection

const inTexture = op.inTexture("Input Texture");
const inBrightness = op.inFloat("Brightness", 0.0);
const inContrast = op.inFloat("Contrast", 0.0);
const inSaturation = op.inFloat("Saturation", 0.0);
const inGamma = op.inFloat("Gamma", 1.0);
const inColorTemperature = op.inFloat("Color Temperature", 0.0);
const outTexture = op.outTexture("Output");

const shaderCode = `
precision mediump float;
varying vec2 vUV;
uniform sampler2D tex;
uniform float brightness;
uniform float contrast;
uniform float saturation;
uniform float gamma;
uniform float colorTemperature;

vec3 adjustColorTemperature(vec3 color, float temp) {

```

```

if (temp > 0.0) {
    color.r += temp * 0.2;
    color.b -= temp * 0.1;
} else {
    color.r += temp * 0.1;
    color.b -= temp * 0.2;
}
return color;
}

vec3 applyColorCorrection(vec3 color, float bright, float cont,
float sat, float gam, float temp) {
    color += bright;
    color = (color - 0.5) * (1.0 + cont) + 0.5;

    float luma = dot(color, vec3(0.299, 0.587, 0.114));
    color = mix(vec3(luma), color, 1.0 + sat);

    color = adjustColorTemperature(color, temp);
    color = pow(max(color, 0.0), vec3(1.0 / max(gam, 0.01)));

    return clamp(color, 0.0, 1.0);
}

void main() {
    vec3 color = texture2D(tex, vUV).rgb;
    color = applyColorCorrection(color, brightness, contrast,
saturation, gamma, colorTemperature);
    gl_FragColor = vec4(color, 1.0);
}
`;

// Implementation similar to keystone op above
// (Actual implementation depends on cables.gl's rendering API)

```

Blend Composition Custom Op

```

// Custom Op: BlendComposition
// Name: Ops.User.ProjectionMapping.BlendComposition

const inTexture = op.inTexture("Input Texture");
const inBlendStart = op.inFloat("Blend Start", 0.0);
const inBlendEnd = op.inFloat("Blend End", 1.0);
const inBlendAxis = op.inFloat("Blend Axis", 0.0); // 0.0=horizontal, 1.0=vertical
const inBlendPower = op.inFloat("Blend Power", 1.0);

```

```

const inResolution = op.inVec2("Resolution", [1920.0, 1080.0]);
const outTexture = op.outTexture("Output");
const outAlpha = op.outNumber("Alpha Mask"); // For compositing

const shaderCode =
precision mediump float;
varying vec2 vUV;
uniform sampler2D tex;
uniform vec2 resolution;
uniform float blendStart;
uniform float blendEnd;
uniform float blendAxis;
uniform float blendPower;

float getLinearBlend(vec2 uv, float start, float end, float axis,
float power) {
    float pos = axis < 0.5 ? uv.x : uv.y;
    float blendFactor = 0.0;

    if (pos < start) {
        blendFactor = 0.0;
    } else if (pos > end) {
        blendFactor = 1.0;
    } else {
        float t = (pos - start) / (end - start);
        blendFactor = pow(t, power);
    }

    return blendFactor;
}

void main() {
    float blend = getLinearBlend(vUV, blendStart, blendEnd,
blendAxis, blendPower);
    vec3 color = texture2D(tex, vUV).rgb;
    gl_FragColor = vec4(color * blend, blend);
}
`;

// Implementation with uniform updates
// Note: This is a conceptual example - actual cables.gl API may
vary

```

Important Notes for JavaScript Custom Ops:

- Texture Handling:** You need to manage texture creation, rendering, and cleanup
- Render Targets:** May need to create render targets for shader output

3. **Performance:** JavaScript overhead can impact real-time performance
4. **API Differences:** Cables.gl's internal API may differ from these examples
5. **Best Practice:** Use built-in TextureEffect when possible; use custom ops for complex logic or reusable components

6.19.12 Comparison: Built-in Shader Ops vs Custom JavaScript Ops

Code Cleanliness

Built-in Shader Ops (TextureEffect/ShaderMaterial): - Pure GLSL code - no wrapper needed - Minimal boilerplate - Easy to read and maintain - Direct shader editing in cables.gl UI - No JavaScript knowledge required

Custom JavaScript Ops: - [!] Requires JavaScript wrapper code - [!] Shader code stored as string (less readable) - [!] More complex file structure - [!] Requires understanding of both GLSL and JavaScript - Can organize shader code in separate files - Can add pre/post processing logic

Winner: Built-in Shader Ops - cleaner, more maintainable for pure shader effects

Integration Ease

Built-in Shader Ops: - Paste shader code directly into TextureEffect - Ports created automatically from uniforms - Immediate visual feedback - No compilation step - Works out of the box - [!] Limited customization of port UI - [!] Can't add custom logic around shader

Custom JavaScript Ops: - [!] Must create op, write wrapper code - [!] Must manually create and configure ports - [!] More setup time - [!] Requires testing and debugging - Full control over port organization - Can add port groups, custom UI - Can add validation, error handling - Reusable across patches

Winner: Built-in Shader Ops - significantly easier to get started

Performance

Built-in Shader Ops: - Direct GPU execution - Minimal overhead - Optimized by cables.gl - No JavaScript execution per frame - Efficient texture passing - Automatic shader compilation caching

Custom JavaScript Ops: - [!] Potential JavaScript overhead per frame - [!] Texture copying may be required - [!] Render target management overhead - [!] Uniform updates in JavaScript (CPU work) - Can optimize with dirty flags - Can batch operations - Can cache render targets

Performance Comparison: - Built-in: ~0.1-0.5ms overhead (shader execution only) - Custom: ~1-5ms overhead (JavaScript + shader execution) - **Winner:** Built-in Shader Ops - better performance for real-time applications

When to Use Each Approach

Use Built-in Shader Ops (TextureEffect/ShaderMaterial) when: - You have pure shader effects (no complex logic) - You want quick prototyping - Performance is critical - You're learning shaders - You need immediate visual feedback - You don't need custom port organization

Use Custom JavaScript Ops when: - You need reusable, packaged shader components - You need complex pre/post processing logic - You need dynamic shader generation - You want custom port UI and organization - You're building a library of shader ops - You need conditional shader selection - You need to manage multiple render passes

Hybrid Approach: - Use built-in shader ops for individual effects - Use custom JavaScript ops to orchestrate multiple shader passes - Use custom ops for complex parameter management - Use built-in ops for simple, one-off effects

6.19.13 Quick Reference: Using These Shaders

Step-by-Step Guide:

1. **Add TextureEffect Op:**
 - Click "+" in your patch
 - Search for "TextureEffect"
 - Add it to your patch
2. **Paste Shader Code:**
 - Click on the TextureEffect op
 - Find the "Fragment Shader" field
 - Paste the shader code (including precision mediump float; and varying vec2 vUV;)
3. **Connect Inputs:**
 - Input texture -> tex port (or tex0, tex1, etc. for multi-texture shaders)
 - CanvasInfo or GetResolution -> resolution port (if shader uses it)

- Number/Vector ops -> parameter ports (brightness, contrast, corners, etc.)

4. Get Output:

- Connect TextureEffect output to your render target or next effect

Common Port Types: - sampler2D tex -> Texture port (connect ImageTexture, VideoTexture, etc.) - vec2 resolution -> Vec2 port (connect CanvasInfo or GetResolution) - float brightness -> Number port (connect Number op or slider) - vec2 topLeft -> Vec2 port (connect Vector2 op) - vec3 color -> Vec3 port (connect Vector3 op or Color op)

6.19.14 Best Practices For Projection Mapping in Cables.gl

1. Resolution Handling: Always use resolution uniform for pixel-perfect calculations. Convert between UV space and screen space as needed. **Remember:** resolution is NOT auto-provided - connect it manually.

2. Performance: Projection mapping shaders can be expensive. Consider:

- Using lower precision where possible (mediump instead of highp)
- Minimizing texture samples
- Pre-computing values in JavaScript ops when possible

3. Modular Approach: Break complex setups into multiple shader passes:

- First pass: Geometric correction
- Second pass: Color correction
- Third pass: Blending

4. Testing: Always test with actual projection surfaces when possible. Screen simulation can differ from real-world results.

5. Calibration: Use test patterns (grids, color bars) to calibrate geometric and color corrections.

6. Masking: Use alpha channel output for blend masks to composite multiple projectors correctly.

6.19.15 Debug Visualization Shaders

Helpful shaders for debugging projection mapping setups:

Grid Overlay

```
precision mediump float;

varying vec2 vUV;
uniform vec2 resolution;
uniform float gridSize; // Grid divisions
uniform vec3 gridColor;
uniform float gridOpacity;

void main() {
    vec2 gridUV = vUV * gridSize;
    // Use manual derivative calculation instead of fwidth() for
    better WebGL 1.0 compatibility
    vec2 grid = abs(fract(gridUV - 0.5) - 0.5);
    // Approximate derivative using step function
    float line = min(grid.x, grid.y) * gridSize * 100.0; // Scale
    factor for visibility
    float gridMask = 1.0 - min(line, 1.0);

    vec3 color = mix(vec3(0.0), gridColor, gridMask * gridOpacity);
    gl_FragColor = vec4(color, 1.0);
}
```

Corner Pin Visualization

```
precision mediump float;

varying vec2 vUV;
uniform vec2 resolution;
uniform vec2 topLeft;
uniform vec2 topRight;
uniform vec2 bottomLeft;
uniform vec2 bottomRight;
uniform vec3 cornerColor;

void main() {
    vec3 color = vec3(0.0);

    // Draw corner points
    float cornerSize = 0.02;
    float dist1 = length(vUV - topLeft);
    float dist2 = length(vUV - topRight);
    float dist3 = length(vUV - bottomLeft);
    float dist4 = length(vUV - bottomRight);
```

```

float minDist = min(min(dist1, dist2), min(dist3, dist4));
if (minDist < cornerSize) {
    color = cornerColor;
}

// Draw lines between corners
// (Simplified - you'd use line SDF for proper lines)

gl_FragColor = vec4(color, 1.0);
}

```

6.19.16 Summary: Shader Compliance and Usage

All shaders in this projection mapping section are:

Compliant with cables.gl's built-in shader ops (TextureEffect/ShaderMaterial) **Ready to paste directly** into the fragment shader field **WebGL 1.0 compatible** (using texture2D(), mediump precision) **Properly formatted** with required headers and declarations **Uniform types verified** (float instead of int, proper vector types)

Key Compliance Features: - All shaders start with precision mediump float;
 - All use texture2D() for texture sampling - All use varying vec2 vUV (auto-provided by cables.gl) - Integer uniforms converted to float with float comparisons - Resolution handling documented (requires manual connection) - Matrix uniforms noted with version compatibility warnings

Usage Pattern: 1. Copy shader code 2. Paste into TextureEffect op's fragment shader field 3. Connect inputs to automatically created ports 4. Get output texture

For Advanced Use Cases: - See "JavaScript Custom Op Examples" section for wrapper implementations - See "Comparison" section for when to use each approach - See "Troubleshooting" section for common issues

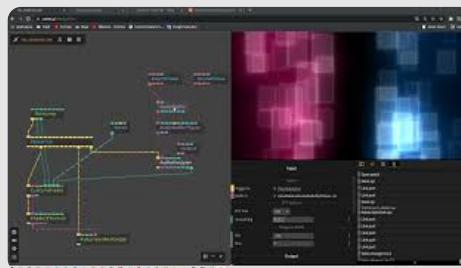
6.20 Featured Videos



<https://youtu.be/Zfhn8xSM0SE>
Coding with cables - custom shader op
 by cables_gl



https://youtu.be/j_ins4RW0c8
Shadertoy to cables - part 01
 by cables_gl



<https://youtu.be/nil-HkZgNZ8>
Programmation d'un shadertoy avec Cables.gl Partie 8.
 by Meletou1

6.21 Resources

- The Book of Shaders - Excellent GLSL learning resource
- Shadertoy - Shader examples and inspiration
- GLSL Sandbox - More shader experiments

6.22 Exercises

1. Create a animated gradient that shifts colors over time
2. Build a kaleidoscope effect using UV manipulation
3. Write an SDF shader that draws a morphing shape
4. Create a post-processing glow effect
5. **Projection Mapping:** Implement keystone correction for a trapezoidal projection
6. **Projection Mapping:** Create a multi-projector blend setup with gradient transitions
7. **Projection Mapping:** Build a color correction shader that compensates for a colored projection surface
8. **Projection Mapping:** Combine geometric correction, color correction, and blending in a single shader pipeline
9. **Projection Mapping:** Create a debug visualization shader showing projection zones and blend areas
10. **Projection Mapping:** Implement projector stacking with additive and average blend modes

7 JavaScript & Custom Ops in Cables.gl

7.1 Introduction

While cables.gl's visual node system is powerful, sometimes you need custom functionality. JavaScript allows you to create your own operators (ops) and extend cables.gl's capabilities.

7.2 When to Use Custom Ops

- Processing data in ways built-in ops don't support
- Integrating external APIs or libraries
- Creating reusable custom functionality
- Performance optimization for specific tasks
- Complex mathematical operations

7.3 Creating Your First Op

7.3.1 Step 1: Open the Op Editor

1. In your patch, click the "+" button
2. Select "Create Op"
3. Choose a name (e.g., Ops.User.YourName.MyFirstOp)

7.3.2 Step 2: Understanding the Structure

```
// Ports (inputs and outputs)
const inputValue = op.inFloat("Input Value", 0);
const outResult = op.outNumber("Result");

// When input changes, recalculate
inputValue.onChange = function() {
    outResult.set(inputValue.get() * 2);
};
```

7.4 Port Types

7.4.1 Input Ports

```
// Trigger (execution flow)
const inTrigger = op.inTrigger("Trigger");

// Numbers
const inFloat = op.inFloat("Float Value", 0.0);
const inInt = op.inInt("Integer", 0);
const inValue = op.inValue("Value", 0);

// Boolean
const inBool = op.inBool("Enabled", true);

// String
const inString = op.inString("Text", "default");

// Objects (textures, arrays, etc.)
const inObject = op.inObject("Object");
const inTexture = op.inTexture("Texture");
const inArray = op.inArray("Array");
```

7.4.2 Output Ports

```
// Trigger
const outTrigger = op.outTrigger("Trigger Out");

// Numbers
const outNumber = op.outNumber("Number Out");
const outValue = op.outValue("Value Out");

// Boolean
const outBool = op.outBool("Bool Out");

// String
const outString = op.outString("String Out");

// Objects
const outObject = op.outObject("Object Out");
const outTexture = op.outTexture("Texture Out");
const outArray = op.outArray("Array Out");
```

7.5 Handling Events

7.5.1 Trigger Execution

```
const inTrigger = op.inTrigger("Execute");
const outNext = op.outTrigger("Next");

inTrigger.onTriggered = function() {
    // Do something when triggered
    console.log("Op was triggered!");

    // Continue the chain
    outNext.trigger();
};
```

7.5.2 Value Changes

```
const inValue = op.inFloat("Value", 0);
const outDouble = op.outNumber("Double");

inValue.onChange = function() {
    const val = inValue.get();
    outDouble.set(val * 2);
};
```

7.5.3 Linking Ports

```
// Automatically update output when input changes
const inValue = op.inFloat("Value", 0);
const outValue = op.outNumber("Value Out");

inValue.onChange = outValue.setRef.bind(outValue, inValue);
// or simply:
// inValue.onChange = () => outValue.set(inValue.get());
```

7.6 Working with Arrays

```
const inArray = op.inArray("Input Array");
const outArray = op.outArray("Output Array");

inArray.onChange = function() {
    const arr = inArray.get();
    if (!arr) return;

    // Process array
    const result = arr.map(x => x * 2);

    outArray.set(result);
};
```

7.7 Working with Objects

```
const inObject = op.inObject("Input");
const outObject = op.outObject("Output");

inObject.onChange = function() {
    const obj = inObject.get();
    if (!obj) return;

    // Process or wrap the object
    const processed = {
        ...obj,
        processed: true
    };

    outObject.set(processed);
};
```

7.8 Render Loop Integration

For ops that need to run every frame:

```
const inTrigger = op.inTrigger("Render");
const outNext = op.outTrigger("Next");

let time = 0;
```

```
inTrigger.onTriggered = function() {
    time += op.patch.timer.getDelta();

    // Do per-frame calculations
    outNext.trigger();
};
```

7.9 UI Port Groups

Organize your ports into collapsible groups:

```
// Create ports
const inX = op.inFloat("X", 0);
const inY = op.inFloat("Y", 0);
const inZ = op.inFloat("Z", 0);

// Group them
op.setPortGroup("Position", [inX, inY, inZ]);
```

7.10 Port UI Types

Change how ports appear in the UI:

```
// Slider
const inValue = op.inFloat("Value", 0.5);
op.setUiAttrib({ "type": "slider", "min": 0, "max": 1 });

// Color picker
const inR = op.inFloat("R", 1);
const inG = op.inFloat("G", 1);
const inB = op.inFloat("B", 1);
op.setPortGroup("Color", [inR, inG, inB]);
inR.setUiAttribs({ colorPick: true });

// Dropdown
const inMode = op.inSwitch("Mode", ["Option1", "Option2",
"Option3"], "Option1");
```

7.11 Accessing Patch Resources

7.11.1 Timer and Time

```
// Current time
const time = op.patch.timer.getTime();

// Delta time (time since last frame)
const delta = op.patch.timer.getDelta();

// FPS
const fps = op.patch.timer.getFPS();
```

7.11.2 Canvas and Context

```
// Canvas element
const canvas = op.patch.cgl.canvas;

// WebGL context
const gl = op.patch.cgl.gl;
```

7.11.3 Loading External Resources

```
const inUrl = op.inString("URL", "");
const outData = op.outObject("Data");

inUrl.onChange = function() {
    const url = inUrl.get();
    if (!url) return;

    fetch(url)
        .then(response => response.json())
        .then(data => {
            outData.set(data);
        })
        .catch(error => {
            op.logError("Failed to load:", error);
        });
};
```

7.12 Using External Libraries

7.12.1 Including Libraries

```
// In op's code, load an external script
const script = document.createElement("script");
script.src = "https://cdn.example.com/library.js";
script.onload = function() {
    // Library is ready
    initLibrary();
};
document.head.appendChild(script);
```

7.12.2 Or use op.patch.loading for proper load tracking:

```
op.patch.loading.start();

const script = document.createElement("script");
script.src = "https://cdn.example.com/library.js";
script.onload = function() {
    op.patch.loading.finished();
    initLibrary();
};
script.onerror = function() {
    op.patch.loading.finished();
    op.logError("Failed to load library");
};
document.head.appendChild(script);
```

7.13 Error Handling

```
try {
    // Risky operation
    const result = riskyFunction();
    outResult.set(result);
} catch (error) {
    op.logError("Operation failed:", error);
    op.setUiError("error", error.message);
}

// Clear error when fixed
op.setUiError("error", null);
```

7.14 Example: Custom Math Op

```
// Custom clamp with smoothing

const inValue = op.inFloat("Value", 0);
const inMin = op.inFloat("Min", 0);
const inMax = op.inFloat("Max", 1);
const inSmoothing = op.inFloat("Smoothing", 0);
const outValue = op.outNumber("Result");

let currentValue = 0;

function update() {
    let val = inValue.get();
    const min = inMin.get();
    const max = inMax.get();
    const smooth = inSmoothing.get();

    // Clamp
    val = Math.max(min, Math.min(max, val));

    // Smooth
    if (smooth > 0) {
        currentValue += (val - currentValue) * (1 - smooth);
    } else {
        currentValue = val;
    }

    outValue.set(currentValue);
}

inValue.onChange = update;
inMin.onChange = update;
inMax.onChange = update;
inSmoothing.onChange = update;
```

7.15 Example: Array Processor

```
// Sum all values in an array

const inArray = op.inArray("Values");
const outSum = op.outNumber("Sum");
const outAverage = op.outNumber("Average");
const outCount = op.outNumber("Count");
```

```
inArray.onChange = function() {
    const arr = inArray.get();

    if (!arr || arr.length === 0) {
        outSum.set(0);
        outAverage.set(0);
        outCount.set(0);
        return;
    }

    const sum = arr.reduce((a, b) => a + b, 0);
    const count = arr.length;
    const average = sum / count;

    outSum.set(sum);
    outAverage.set(average);
    outCount.set(count);
};
```

7.16 Example: API Fetcher

```
// Fetch data from an API

const inUrl = op.inString("API URL", "");
const inFetch = op.inTriggerButton("Fetch");
const outData = op.outObject("Data");
const outLoading = op.outBool("Loading");
const outError = op.outString("Error");

inFetch.onTriggered = async function() {
    const url = inUrl.get();
    if (!url) return;

    outLoading.set(true);
    outError.set("");

    try {
        const response = await fetch(url);
        const data = await response.json();
        outData.set(data);
    } catch (error) {
        outError.set(error.message);
        outData.set(null);
    } finally {
        outLoading.set(false);
    }
}
```

```
};
```

7.17 Debugging Tips

```
// Log to console
console.log("Value:", inValue.get());

// Op-specific logging (shows in cables UI)
op.log("This is a log message");
op.logWarn("This is a warning");
op.logError("This is an error");

// Visual debugging
op.setUiAttrib({ "error": "Something went wrong" });
```

7.18 Advanced Patterns (How to Build “Good” Ops)

Once you start writing more than a couple custom ops, quality becomes less about JavaScript syntax and more about **behavior**:

- **Determinism**: given the same inputs, the op produces the same outputs.
- **Clear execution model**: value changes vs trigger-based evaluation are intentional.
- **Performance**: avoid unnecessary allocations and expensive work per frame.
- **Good UI/UX**: errors are visible, defaults are sane, ports are grouped and labeled.

7.18.1 Pattern: Separate “Compute” from “Trigger”

A clean approach is:

- collect values in `onChange`
- do the heavy compute in one `update()` function
- call `update()` from whichever events are relevant

```
const inTrigger = op.inTrigger("Update");
const inA = op.inFloat("A", 0);
```

```
const inB = op.inFloat("B", 0);
const outResult = op.outNumber("Result");
const outNext = op.outTrigger("Next");

function update() {
    outResult.set(inA.get() + inB.get());
}

inA.onChange = update;
inB.onChange = update;

inTrigger.onTriggered = function () {
    update();
    outNext.trigger();
};
```

7.18.2 Pattern: “Only Recompute When Dirty”

If an op gets triggered every frame but its inputs rarely change, cache the result:

```
const inTrigger = op.inTrigger("Render");
const outNext = op.outTrigger("Next");

const inValue = op.inFloat("Value", 0);
const outProcessed = op.outNumber("Processed");

let dirty = true;
let cached = 0;

function recompute() {
    const v = inValue.get();
    // pretend this is expensive:
    cached = Math.sin(v) * Math.cos(v) * 1000;
    outProcessed.set(cached);
    dirty = false;
}

inValue.onChange = function () {
    dirty = true;
};

inTrigger.onTriggered = function () {
    if (dirty) recompute();
```

```
    outNext.trigger();
};
```

7.18.3 Pattern: Debounce (Stabilize Noisy Inputs)

Useful for sliders, mouse input, or network-driven values.

```
const inValue = op.inFloat("Value", 0);
const inDelayMs = op.inInt("Delay (ms)", 200);
const outValue = op.outNumber("Debounced");

let t = null;

inValue.onChange = function () {
  if (t) clearTimeout(t);
  const v = inValue.get();
  t = setTimeout(() => outValue.set(v), inDelayMs.get());
};
```

7.18.4 Pattern: Rate-Limit (Prevent Flooding Downstream)

Useful when sending values to other systems (e.g., API calls, heavy compute, UI).

```
const inTrigger = op.inTrigger("Trigger");
const inMinIntervalMs = op.inInt("Min Interval (ms)", 100);
const outNext = op.outTrigger("Next");

let last = 0;

inTrigger.onTriggered = function () {
  const now = performance.now();
  if (now - last >= inMinIntervalMs.get()) {
    last = now;
    outNext.trigger();
  }
};
```

7.18.5 Pattern: Stateful Ops (Resettable Systems)

Any op that accumulates state should expose a reset trigger.

```
const inAdd = op.inTrigger("Add");
const inReset = op.inTrigger("Reset");
const inValue = op.inFloat("Value", 1);
const outSum = op.outNumber("Sum");

let sum = 0;

function emit() {
  outSum.set(sum);
}

inAdd.onTriggered = function () {
  sum += inValue.get();
  emit();
};

inReset.onTriggered = function () {
  sum = 0;
  emit();
};
```

7.19 Async Ops (Fetching Data Safely)

When you talk to the network, the two most important qualities are:

- **cancellation**: don't keep old requests alive if the user changes the URL
- **loading/error UX**: surface the state to the patch (and optionally the UI)

7.19.1 Example: Fetch JSON with Cancellation

```
const inUrl = op.inString("URL", "");
const inFetch = op.inTriggerButton("Fetch");

const outData = op.outObject("Data");
const outLoading = op.outBool("Loading");
const outError = op.outString("Error");

let controller = null;
```

```

inFetch.onTriggered = async function () {
  const url = inUrl.get();
  if (!url) return;

  // cancel previous request
  if (controller) controller.abort();
  controller = new AbortController();

  outLoading.set(true);
  outError.set("");

  try {
    const res = await fetch(url, { signal: controller.signal });
    if (!res.ok) throw new Error(`HTTP ${res.status}`);
    const json = await res.json();
    outData.set(json);
  } catch (e) {
    // ignore abort errors as "expected"
    if (e && e.name === "AbortError") return;
    outError.set(String(e && e.message ? e.message : e));
    outData.set(null);
  } finally {
    outLoading.set(false);
  }
};

```

7.19.2 Loading Semantics (Patch-Friendly)

If an op blocks the patch from being “ready” until something loads, use the patch loading tracking mechanism shown earlier (`op.patch.loading.start()`/`finished()`), and keep those calls paired even on error paths.

7.20 Performance Tips for Custom Ops

- **Avoid allocations in per-frame triggers:** reuse arrays/objects when possible.
- **Minimize DOM work:** avoid creating elements repeatedly; cache references.
- **Don’t spam logs:** logging inside every-frame triggers will kill performance.
- **Prefer simple math:** it’s easy to do too much in JS when the GPU could do it (shader).

7.21 Featured Videos

7.22 Exercises

1. Create a custom op that formats a number with a prefix and suffix
2. Build an array shuffler op
3. Create a simple state machine op
4. Build an op that fetches and parses CSV data

8 Audio & Sound in Cables.gl

8.1 Introduction

Cables.gl has powerful audio capabilities, enabling you to create audio-reactive visuals, music visualizations, and interactive sound experiences.

8.2 Audio Sources

8.2.1 AudioFile

Load and play audio files:

```
AudioFile -> AudioAnalyzer -> Visual ops
```

Supported Formats: - MP3 - WAV - OGG

Key Parameters: - URL - Path to audio file - Loop - Repeat playback - Volume - Playback volume - Playback Rate - Speed control

8.2.2 Microphone

Capture live audio input:

```
Microphone -> AudioAnalyzer -> Visual ops
```

Note: Requires user permission in browser.

8.2.3 AudioBuffer

Load audio into memory for precise control.

8.2.4 WebAudio Oscillator

Generate synthetic sounds:

```
Oscillator -> Audio output
```

Types: - Sine - Square - Sawtooth - Triangle

8.3 Audio Analysis

8.3.1 AudioAnalyzer

The core op for audio-reactive visuals:

```
 AudioSource -> AudioAnalyzer  
|  
Outputs: FFT, Volume, Bass, Mid, High
```

Key Outputs: - FFT Array - Frequency spectrum data - Volume - Overall loudness - Bass - Low frequency level - Mid - Middle frequency level - High - High frequency level

8.3.2 FFT (Fast Fourier Transform)

Breaks audio into frequency bands:

```
 AudioAnalyzer -> FFTArray -> ArrayIterator  
|  
Visualize each band
```

FFT Size Options: - 32, 64, 128, 256, 512, 1024, 2048, 4096 - Larger = more detail, but slower

8.3.3 Smoothing

Apply smoothing to prevent jittery visuals:

```
 AudioValue -> Smooth -> Visual parameter
```

8.4 Common Audio-Reactive Patterns

8.4.1 Volume-Based Scaling

AudioAnalyzer (volume) -> Scale input of shape

8.4.2 Frequency Band Visualization

```
MainLoop
  |
  BasicMaterial
  |
  AudioAnalyzer -> FFTArray
  |
  ArrayIterator
  |
  Transform (X position from index)
  |
  Transform (Y scale from FFT value)
  |
  Rectangle
```

8.4.3 Color from Audio

AudioAnalyzer (bass) -> Hue input of HSBtoRGB
HSBtoRGB -> BasicMaterial (color input)

8.4.4 Beat Detection

AudioAnalyzer (volume) -> Threshold -> Trigger
 |
 (triggers on beat)

8.5 Audio Effects

8.5.1 Gain

Control volume:

AudioSource -> Gain -> Output

8.5.2 Filter

Shape the frequency content:

AudioSource -> Filter -> Output

Filter Types:

- Lowpass - Removes high frequencies
- Highpass - Removes low frequencies
- Bandpass - Keeps only middle frequencies
- Notch - Removes specific frequency

8.5.3 Delay

Add echo effect:

AudioSource -> Delay -> Output

8.5.4 Reverb

Add space/ambience:

AudioSource -> Reverb -> Output

8.5.5 Compressor

Even out dynamics:

```
 AudioSource -> Compressor -> Output
```

8.6 Building a Visualizer

8.6.1 Step 1: Set Up Audio

```
 AudioFile (your music)
  |
  AudioAnalyzer
```

8.6.2 Step 2: Create Base Render

```
 MainLoop
  |
  Camera (for 3D) or BasicMaterial (for 2D)
```

8.6.3 Step 3: Add Audio-Reactive Elements

Example: Pulsing Circle

```
 MainLoop -> BasicMaterial
  |
  AudioAnalyzer (volume)
  |
  Smooth (for smoother animation)
  |
  Math (multiply by desired scale)
  |
  Circle (size input)
```

8.6.4 Step 4: Add Frequency Visualization

```
 AudioAnalyzer -> FFTArray
  |
  ArrayIterator (iterate through frequencies)
  |
  Index -> Calculate X position
  |
  FFT Value -> Calculate height/color
  |
  Rectangle (bar for each frequency)
```

8.7 Synchronizing to Music

8.7.1 BPM and Beat Sync

```
 AudioFile
  |
  BPMSync (set your song's BPM)
  |
  Beat triggers for animations
```

8.7.2 Timeline with Audio

1. Load audio file
2. Add to timeline
3. Use timeline markers for sync points
4. Keyframe animations to match audio

8.8 Advanced Audio Techniques (Make It Feel “Musical”)

Audio-reactive visuals often fail in the same way: they're *too jittery* and *too literal*. The goal is usually:

- stable motion with **musical** response (not “random noise” response)
- clear separation between **slow energy** (overall level) and **fast transients** (kicks/snare hits)
- mappings that feel good: log frequency, clamped ranges, smoothing that doesn't lag

8.8.1 Technique: Energy vs Transient (Two-Signal Approach)

Treat audio as two complementary control signals:

- **Energy**: smoothed volume/bass/mid/high (drives slow changes: camera drift, fog density, palette)
- **Transients**: thresholded + debounced triggers (drives discrete events: flashes, spawns, scene cuts)

Typical building blocks:

```
AudioAnalyzer (volume/bass/mid/high)
  +-> Smooth (slow) -> Energy signal
  +-> Threshold -> (optional Delay/Interval gating) -> Transient
       trigger
```

8.8.2 Technique: Log Frequency Mapping (Better Spectra)

FFT bins are linear in frequency, but our hearing is closer to logarithmic. If your spectrum visualization looks “all action on the left”, try mapping indices in a non-linear way:

- compress the low bins less (give bass more space)
- compress high bins more (reduce over-detail)

Conceptually:

```
Index -> Normalize (0..1) -> Pow (curve) -> Sample FFT
```

8.8.3 Technique: Peak Hold (Readable Visuals)

Human-friendly meters often have a “peak hold” that decays slowly. You can build this by:

- capturing the max value over a short window
- then decaying it over time

Conceptually:

```
AudioValue -> Max (with previous peak) -> Decay over time -> Peak
       output
```

8.8.4 Technique: Band-Specific Control (Bass Drives Scale, High Drives Detail)

Instead of driving everything from overall volume:

- **bass** -> big scale/position changes
- **mid** -> color shifts or mid-size motion
- **high** -> small jitter/detail/particles

This makes visuals feel much more “mixed”.

8.8.5 Technique: Audio -> Shader (The “Pro” Move)

Shading is where audio-reactive projects often become cinematic.

High-level pattern:

```
AudioAnalyzer (energy) -> Smooth -> Shader uniform (e.g., amount)
FFTArray -> (reduce / select bands) -> Shader uniform(s)
Time -> Shader uniform (time)
```

Then, in the shader, use audio as a **modulation source**, not as the final value.
(Example: warp UVs slightly, not wildly.)

8.9 Advanced Patch Recipes

8.9.1 Recipe: Stable Beat Trigger (Avoid Double-Triggers)

The simplest fix for “machine-gun” beats is gating:

```
AudioAnalyzer (volume or bass)
  |
Threshold (set just above noise floor)
```

```
|  
|(Gate / minimum time between triggers)  
|  
Trigger (spawn / flash / step timeline)
```

8.9.2 Recipe: Audio-Reactive Post-Processing

Drive a texture effect strength from music:

```
MainLoop -> Camera -> RenderToTexture -> TextureEffect -> Output  
|  
AudioAnalyzer (volume) -> Smooth -> Map -> effect strength
```

8.9.3 Recipe: Audio-Reactive 3D Equalizer (Optimized)

If you build an equalizer with many bars:

- keep geometry simple
- reduce FFT size to what you need
- avoid doing heavy work per bar per frame

Conceptually:

```
AudioAnalyzer -> FFTArray  
|  
ArrayIterator (N bands)  
|  
Transform (X from index, Y scale from FFT)  
|  
Cube (bar)
```

8.9.4 Recipe: Audio-Driven Palette

Map energy to hue/saturation to get coherent color shifts:

```
AudioAnalyzer (mid) -> Smooth -> Map -> Hue  
AudioAnalyzer (bass) -> Smooth -> Map -> Saturation  
HSBtoRGB -> BasicMaterial (color)
```

8.10 Practical Examples

8.10.1 Example 1: Bass-Reactive Background

```
MainLoop  
|  
AudioFile -> AudioAnalyzer (bass)  
|  
Smooth (0.9)  
|  
Map (0-1 to desired range)  
|  
HSBtoRGB (bass controls saturation) -> BasicMaterial (color input)  
|  
BasicMaterial  
|  
FullscreenRectangle
```

8.10.2 Example 2: Circular Spectrum

```
MainLoop  
|  
BasicMaterial  
|  
AudioAnalyzer -> FFTArray  
|  
ArrayIterator  
|  
Transform (rotate based on index)  
|  
Transform (translate by FFT value)  
|  
Circle (small)
```

8.10.3 Example 3: Waveform Display

```
MainLoop
  |
  BasicMaterial
  |
  AudioAnalyzer -> WaveformArray
  |
  PointCloud or LineStrip
```

```
// In custom op or patch
document.addEventListener('click', () => {
  if (audioContext.state === 'suspended') {
    audioContext.resume();
  }
}, { once: true });
```

8.10.4 Example 4: 3D Audio Visualization

```
MainLoop
  |
  Camera -> OrbitControls
  |
  AudioAnalyzer -> FFTArray
  |
  ArrayIterator (creates ring)
  |
  Transform (position in circle)
  |
  Transform (scale Y by FFT)
  |
  Cube
```

8.11 Performance Considerations

1. **FFT Size** - Use smallest size that gives needed detail
2. **Smoothing** - Higher smoothing = less CPU for animations
3. **Update Rate** - Don't need 60fps for all audio analysis
4. **Visualizer Complexity** - Balance detail with performance

8.12 Browser Audio Policies

Modern browsers require user interaction before playing audio:

1. Add a "Start" button
2. Start audio on button click
3. Or use `AudioContext.resume()` on first interaction

8.13 Featured Videos

8.14 Exercises

1. Create a simple volume meter with animated bars
2. Build a circular frequency spectrum visualizer
3. Make a 3D landscape that morphs to music
4. Create a beat-triggered strobe effect

9 Animation & Timeline in Cables.gl

9.1 Introduction

Cables.gl provides multiple ways to create animations, from simple time-based movements to complex keyframed sequences using the timeline.

9.2 Types of Animation

9.2.1 1. Procedural Animation

Using math and time to create continuous motion.

9.2.2 2. Keyframe Animation

Defining specific values at specific times.

9.2.3 3. Physics-Based Animation

Simulating natural motion with springs, gravity, etc.

9.2.4 4. Data-Driven Animation

Animating based on input data or user interaction.

9.3 Procedural Animation

9.3.1 The Time Op

The foundation of procedural animation:

Time -> Outputs current time in seconds

Uses: - Input for trigonometric functions - Driving continuous rotation - Creating loops and cycles

9.3.2 Basic Movement Patterns

Linear Movement:

Time -> Modulo (loop duration) -> Position

Oscillation (Sine Wave):

Time -> Sin -> Scale/Position

Bounce:

Time -> Sin -> Abs -> Position

Circular Motion:

Time -> Cos -> X position
Time -> Sin -> Y position

9.3.3 Easing Functions

Transform linear time into smooth curves:

Ease In (slow start):

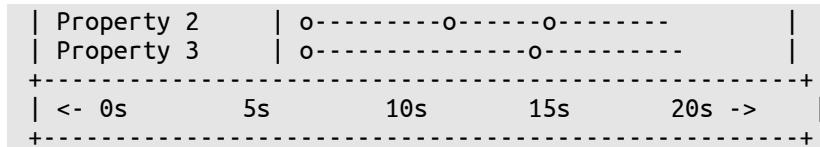
$t * t$ // Quadratic
 $t * t * t$ // Cubic

Ease Out (slow end):

$1 - (1 - t) * (1 - t)$

Ease In-Out (smooth both):

```
t < 0.5 ? 2 * t * t : 1 - pow(-2 * t + 2, 2) / 2
```



9.3.4 The Smooth Op

Smoothly interpolate towards target values:

```
TargetValue -> Smooth -> AnimatedValue
```

Parameter: - Smoothing - Higher = slower, smoother transitions

9.3.5 Spring Animation

Create bouncy, natural motion:

```
TargetValue -> Spring -> AnimatedValue
```

Parameters: - Stiffness - How quickly it moves - Damping - How quickly it settles

9.4 Timeline Animation

9.4.1 Opening the Timeline

1. Click the timeline icon in the toolbar
2. Or press T to toggle timeline visibility

9.4.2 Timeline Interface

```
+-----+  
| [Play][Pause][Stop] [Time: 00:00:00] [BPM: 120] |  
+-----+  
| Property Name | o-----o-----o-----o-----|
```

9.4.3 Adding Keyframes

1. Select the op with the property to animate
2. Move the timeline playhead to the desired time
3. Set the value
4. Click the keyframe button (or right-click the property)

9.4.4 Keyframe Types

- **Linear** - Straight line between keyframes
- **Step** - Instant change at keyframe
- **Ease In** - Slow start
- **Ease Out** - Slow end
- **Ease In-Out** - Smooth start and end
- **Bezier** - Custom curve with handles

9.4.5 Editing Keyframes

- **Move:** Drag keyframe left/right (time) or up/down (value)
- **Delete:** Select and press Delete
- **Copy/Paste:** Ctrl+C, Ctrl+V
- **Multi-select:** Shift+click or drag box

9.4.6 Timeline Tracks

Organize animations into tracks:

- **Property tracks** - Individual values
- **Trigger tracks** - Fire events at specific times
- **Audio tracks** - Sync with music

9.5 Non-Linear Animation Clips (New Animation System - November 2025)

The new animation system in Cables.gl introduces powerful non-linear animation capabilities through **animation clips**. Clips are reusable, addable, and mixable animation sequences that can be layered and blended to create complex motion.

9.5.1 What Are Animation Clips?

Animation clips are self-contained animation sequences that can be:

- **Reusable** - Create once, apply to multiple parameters
- **Addable** - Layer multiple clips together (additive blending)
- **Mixable** - Blend between clips with different weights
- **Non-linear** - Don't require strict sequential playback

9.5.2 Creating Animation Clips

Step 1: Enable Clip Mode

1. Add an **Anim** operator to your patch
2. Connect it to the parameter you want to animate
3. Open the Anim operator's properties
4. Enable the **Clip** option
5. Assign a **Clip Name** (e.g., "bounce", "fadeIn", "rotate360")

```
Parameter -> Anim (Clip enabled, Name: "myClip") -> Animated Value
```

Step 2: Define Keyframes

1. With the Anim operator selected, open the Timeline
2. Set keyframes for your animation sequence
3. Adjust easing curves and timing
4. The animation is now stored as a named clip

Step 3: Apply Clips to Other Parameters

Once created, clips can be applied to any other Anim operator:

1. Add another Anim operator

2. In the Timeline, right-click on a keyframe
3. Select "Apply Clip" and choose your clip name
4. The clip's animation will be applied at that keyframe

9.5.3 Clip Properties and Options

Looping Modes

Clips support different looping behaviors:

- **None** - Play once and stop
- **Repeat** - Loop from start to end
- **Mirror** - Play forward, then backward
- **Offset** - Continue from end value

Interpolation Methods

- **Linear** - Straight interpolation
- **Ease In/Out** - Smooth acceleration/deceleration
- **Bezier** - Custom curve control
- **Step** - Instant value changes

9.5.4 Additive Animation (Layering Clips)

Multiple clips can be **added together** to create combined effects:

```
Base Value
  |
  Anim Clip 1 ("bounce") -> Add
  |
  Anim Clip 2 ("rotate") -> Add
  |
  Anim Clip 3 ("scale") -> Add
  |
  Final Animated Value
```

Use Cases: - Base idle animation + triggered bounce effect - Procedural motion + keyframed structure - Multiple independent motion layers

Example: Character Animation

```
Idle Clip (continuous breathing)
|
Walk Clip (additive, triggered on movement)
|
Jump Clip (additive, triggered on jump)
|
Final Position
```

9.5.5 Mixable Animation (Blending Clips)

Clips can be **mixed** with different weights to blend between animations:

```
Clip A ("walk") -> Mix (weight: 0.7)
Clip B ("run")  -> Mix (weight: 0.3)
|
Blended Animation
```

Blending Modes: - **Linear Blend** - Simple weighted average - **Smooth Blend** - Eased transition between clips - **Additive Blend** - Add clips together with weights

Example: Walk-to-Run Transition

```
Walk Clip -> Mix (weight: 1.0 - runProgress)
Run Clip  -> Mix (weight: runProgress)
|
Smooth transition from walk to run
```

9.5.6 Clip Management

Organizing Clips

Clips are stored within your project and can be: - **Renamed** - Right-click clip in timeline -> Rename - **Duplicated** - Copy clip to create variations - **Deleted** - Remove unused clips - **Exported/Imported** - Share clips between projects

Clip Library

Access all clips in your project: 1. Open Timeline 2. Click "Clips" tab 3. View all available clips 4. Drag clips onto timeline tracks

9.5.7 Advanced Clip Techniques

Clip Offsets and Time Remapping

Apply clips at different time offsets:

```
Clip "bounce" (duration: 2s)
|
Apply at t=0s: Full clip
Apply at t=5s: Clip starts here
Apply at t=10s: Clip with 0.5x speed (time remap)
```

Clip Masking

Use clips to mask or modulate other animations:

```
Base Animation -> Multiply
Clip "mask" (0 to 1) -> Multiply
|
Masked Animation (only active where mask = 1)
```

Conditional Clip Playback

Control clip playback based on conditions:

```
Condition -> If
  +-> True: Play Clip A
  +-> False: Play Clip B
```

9.6 JavaScript Custom Op Integration with Animation System

The new animation system integrates seamlessly with JavaScript custom operators, allowing programmatic control and extension of animation capabilities.

9.6.1 Accessing Animation Data from Custom Ops

Reading Animation Values

```
// Get current animation value from an Anim op
const animOp = op.patch.findOpByName("MyAnimOp");
if (animOp) {
    const currentValue = animOp.outValue.get();
    // Use the animated value
}
```

Monitoring Animation State

```
const inTrigger = op.inTrigger("Render");
const outAnimValue = op.outNumber("Animation Value");
const outIsPlaying = op.outBool("Is Playing");

let animOp = null;

// Find the Anim op (call once on init)
op.onInit = function() {
    animOp = op.patch.findOpByName("MyAnimOp");
};

inTrigger.onTriggered = function() {
    if (animOp) {
        // Get current animated value
        outAnimValue.set(animOp.outValue.get());

        // Check if timeline is playing
        const timeline = op.patch.timeline;
        if (timeline) {
            outIsPlaying.set(timeline.isPlaying());
        }
    }
};
```

9.6.2 Controlling Timeline from Custom Ops

Playback Control

```
const inPlay = op.inTriggerButton("Play");
const inPause = op.inTriggerButton("Pause");
const inStop = op.inTriggerButton("Stop");
const inSeek = op.inFloat("Seek Time", 0);
const inSeekTrigger = op.inTrigger("Seek");

inPlay.onTriggered = function() {
    const timeline = op.patch.timeline;
    if (timeline) timeline.play();
};

inPause.onTriggered = function() {
    const timeline = op.patch.timeline;
    if (timeline) timeline.pause();
};

inStop.onTriggered = function() {
    const timeline = op.patch.timeline;
    if (timeline) timeline.stop();
};

inSeekTrigger.onTriggered = function() {
    const timeline = op.patch.timeline;
    if (timeline) {
        timeline.seek(inSeek.get());
    }
};
```

Timeline Time and Progress

```
const inTrigger = op.inTrigger("Render");
const outTime = op.outNumber("Current Time");
const outProgress = op.outNumber("Progress (0-1)");
const outDuration = op.outNumber("Total Duration");

inTrigger.onTriggered = function() {
    const timeline = op.patch.timeline;
    if (timeline) {
        const currentTime = timeline.getTime();
        const duration = timeline.getDuration();

        outTime.set(currentTime);
    }
};
```

```

        outDuration.set(duration);
        outProgress.set(duration > 0 ? currentTime / duration : 0);
    }
};

```

9.6.3 Creating Animation Clips Programmatically

Generating Clip Data

```

// Custom op that generates animation clip data
const inDuration = op.inFloat("Duration", 2.0);
const inAmplitude = op.inFloat("Amplitude", 1.0);
const inFrequency = op.inFloat("Frequency", 1.0);
const inGenerate = op.inTriggerButton("Generate Clip");
const outClipData = op.outObject("Clip Data");

inGenerate.onTriggered = function() {
    const duration = inDuration.get();
    const amplitude = inAmplitude.get();
    const freq = inFrequency.get();
    const sampleRate = 60; // samples per second
    const numSamples = Math.floor(duration * sampleRate);

    const keyframes = [];
    for (let i = 0; i <= numSamples; i++) {
        const t = i / numSamples;
        const time = t * duration;
        // Generate sine wave animation
        const value = Math.sin(time * freq * Math.PI * 2) *
amplitude;
        keyframes.push({
            time,
            value,
            easing: "easeInOut"
        });
    }

    outClipData.set({
        name: "generatedSine",
        duration: duration,
        keyframes: keyframes,
        loop: "repeat"
    });
};

```

9.6.4 Manipulating Animation Clips

Blending Multiple Clips

```

// Custom op that blends multiple animation clips
const inClipA = op.inObject("Clip A Data");
const inClipB = op.inObject("Clip B Data");
const inBlendFactor = op.inFloat("Blend Factor", 0.5); // 0 = A, 1 =
B
const inTime = op.inFloat("Time", 0);
const outBlendedValue = op.outNumber("Blended Value");

inTime.onChange = function() {
    const clipA = inClipA.get();
    const clipB = inClipB.get();
    const blend = inBlendFactor.get();
    const t = inTime.get();

    if (!clipA || !clipB) return;

    // Sample both clips at time t
    const valueA = sampleClip(clipA, t);
    const valueB = sampleClip(clipB, t);

    // Blend
    const blended = valueA * (1 - blend) + valueB * blend;
    outBlendedValue.set(blended);
};

function sampleClip(clip, time) {
    const keyframes = clip.keyframes;
    if (!keyframes || keyframes.length === 0) return 0;

    // Clamp time to clip duration
    time = time % clip.duration;

    // Find surrounding keyframes
    for (let i = 0; i < keyframes.length - 1; i++) {
        if (time >= keyframes[i].time && time <= keyframes[i +
1].time) {
            // Interpolate
            const t0 = keyframes[i].time;
            const t1 = keyframes[i + 1].time;
            const v0 = keyframes[i].value;
            const v1 = keyframes[i + 1].value;

            const t = (time - t0) / (t1 - t0);
            return v0 + (v1 - v0) * t;
        }
    }
}

```

```

        }
    }

    return keyframes[keyframes.length - 1].value;
}

```

Additive Clip Combination

```

// Custom op that adds multiple clips together
const inClips = op.inArray("Clips Array");
const inTime = op.inFloat("Time", 0);
const outCombinedValue = op.outNumber("Combined Value");

inTime.onChange = function() {
    const clips = inClips.get();
    const t = inTime.get();

    if (!clips || clips.length === 0) {
        outCombinedValue.set(0);
        return;
    }

    let sum = 0;
    for (let i = 0; i < clips.length; i++) {
        const clip = clips[i];
        if (clip && clip.keyframes) {
            sum += sampleClip(clip, t);
        }
    }

    outCombinedValue.set(sum);
};

```

9.6.5 Advanced: Custom Easing Functions

```

// Custom op with advanced easing functions
const inValue = op.inFloat("Input (0-1)", 0);
const inEasingType = op.inSwitch("Easing",
    ["linear", "easeInQuad", "easeOutQuad", "easeInOutQuad",
     "easeInCubic", "easeOutCubic", "easeInOutCubic",
     "easeInElastic", "easeOutBounce"],
    "easeInOutQuad");
const outEased = op.outNumber("Eased Value");

```

```

inValue.onChange = function() {
    const t = Math.max(0, Math.min(1, inValue.get()));
    const type = inEasingType.get();
    let eased = 0;

    switch(type) {
        case "linear":
            eased = t;
            break;
        case "easeInQuad":
            eased = t * t;
            break;
        case "easeOutQuad":
            eased = 1 - (1 - t) * (1 - t);
            break;
        case "easeInOutQuad":
            eased = t < 0.5
                ? 2 * t * t
                : 1 - Math.pow(-2 * t + 2, 2) / 2;
            break;
        case "easeInCubic":
            eased = t * t * t;
            break;
        case "easeOutCubic":
            eased = 1 - Math.pow(1 - t, 3);
            break;
        case "easeInOutCubic":
            eased = t < 0.5
                ? 4 * t * t * t
                : 1 - Math.pow(-2 * t + 2, 3) / 2;
            break;
        case "easeInElastic":
            const c4 = (2 * Math.PI) / 3;
            eased = t === 0 ? 0 : t === 1 ? 1
                : -Math.pow(2, 10 * t - 10) * Math.sin((t * 10 -
10.75) * c4);
            break;
        case "easeOutBounce":
            const n1 = 7.5625;
            const d1 = 2.75;
            if (t < 1 / d1) {
                eased = n1 * t * t;
            } else if (t < 2 / d1) {
                eased = n1 * (t -= 1.5 / d1) * t + 0.75;
            } else if (t < 2.5 / d1) {
                eased = n1 * (t -= 2.25 / d1) * t + 0.9375;
            } else {

```

```

        eased = n1 * (t -= 2.625 / d1) * t + 0.984375;
    }
    break;
}

outEased.set(eased);
};

```

9.6.6 Real-Time Animation Modification

```

// Custom op that modifies animation in real-time based on input
const inBaseAnim = op.inObject("Base Animation Clip");
const inModifier = op.inFloat("Modifier", 1.0);
const inTime = op.inFloat("Time", 0);
const outModifiedValue = op.outNumber("Modified Value");

inTime.onChange = function() {
    const clip = inBaseAnim.get();
    const mod = inModifier.get();
    const t = inTime.get();

    if (!clip) return;

    // Sample base animation
    let value = sampleClip(clip, t);

    // Apply modifier (could be scale, offset, etc.)
    value *= mod;

    outModifiedValue.set(value);
};

```

9.6.7 Integration Example: Physics-Driven Animation

```

// Custom op that combines physics simulation with animation clips
const inAnimClip = op.inObject("Animation Clip");
const inPhysicsForce = op.inFloat("Physics Force", 0);
const inDamping = op.inFloat("Damping", 0.9);
const inTime = op.inFloat("Time", 0);
const outCombinedValue = op.outNumber("Combined Value");

let velocity = 0;
let position = 0;

```

```

inTime.onChange = function() {
    const clip = inAnimClip.get();
    const force = inPhysicsForce.get();
    const damp = inDamping.get();
    const t = inTime.get();

    // Get base animation value
    const animValue = clip ? sampleClip(clip, t) : 0;

    // Apply physics
    velocity += force;
    velocity *= damp;
    position += velocity;

    // Combine animation + physics
    const combined = animValue + position;
    outCombinedValue.set(combined);
};

```

9.6.8 Best Practices for Animation + Custom Ops

- Cache Clip Sampling** - If sampling clips every frame, cache results when time hasn't changed
- Batch Operations** - Process multiple clips in one op rather than multiple ops
- Use Native Anim Op When Possible** - Only use custom ops when you need functionality beyond built-in features
- Optimize Keyframe Lookups** - Use binary search for large clip keyframe arrays
- Handle Edge Cases** - Always check for null/undefined clips and handle time out of bounds

9.6.9 Example: Complete Animation Controller Op

```

// Comprehensive animation controller custom op
const inPlay = op.inTriggerButton("Play");
const inPause = op.inTriggerButton("Pause");
const inStop = op.inTriggerButton("Stop");
const inSeek = op.inFloat("Seek", 0);
const inSpeed = op.inFloat("Speed", 1.0);
const inLoop = op.inBool("Loop", true);

```

```

const outTime = op.outNumber("Current Time");
const outProgress = op.outNumber("Progress");
const outIsPlaying = op.outBool("Is Playing");

let currentTime = 0;
let isPlaying = false;
let lastFrameTime = 0;

op.onInit = function() {
    lastFrameTime = op.patch.timer.getTime();
};

const inRender = op.inTrigger("Render");
inRender.onTriggered = function() {
    const now = op.patch.timer.getTime();
    const delta = now - lastFrameTime;
    lastFrameTime = now;

    if (isPlaying) {
        currentTime += delta * inSpeed.get();

        const timeline = op.patch.timeline;
        if (timeline) {
            const duration = timeline.getDuration();
            if (currentTime >= duration) {
                if (inLoop.get()) {
                    currentTime = currentTime % duration;
                } else {
                    currentTime = duration;
                    isPlaying = false;
                }
            }
            timeline.seek(currentTime);
        }
    }

    timeline.seek(currentTime);
}

outTime.set(currentTime);
const timeline = op.patch.timeline;
if (timeline) {
    const duration = timeline.getDuration();
    outProgress.set(duration > 0 ? currentTime / duration : 0);
}
outIsPlaying.set(isPlaying);
};

inPlay.onTriggered = function() {
    isPlaying = true;
}

```

```

const timeline = op.patch.timeline;
if (timeline) timeline.play();
};

inPause.onTriggered = function() {
    isPlaying = false;
    const timeline = op.patch.timeline;
    if (timeline) timeline.pause();
};

inStop.onTriggered = function() {
    isPlaying = false;
    currentTime = 0;
    const timeline = op.patch.timeline;
    if (timeline) {
        timeline.stop();
        timeline.seek(0);
    }
};

inSeek.onChange = function() {
    currentTime = inSeek.get();
    const timeline = op.patch.timeline;
    if (timeline) timeline.seek(currentTime);
};

```

9.7 Sequence and Timing Ops

9.7.1 Sequence

Chain multiple actions in order:

```

Trigger -> Sequence
    +-> Action 1
    +-> Action 2 (after delay)
    +-> Action 3 (after delay)

```

9.7.2 Delay

Pause before triggering:

Trigger -> Delay (seconds) -> DelayedAction

9.7.3 Timer

Count down or up:

StartTrigger -> Timer -> TimeValue

9.7.4 Interval

Trigger repeatedly:

Interval (every X seconds) -> RepeatedAction

9.8 Animation Patterns

9.8.1 Staggered Animation

Animate multiple items with offset timing:

```
ArrayIterator  
|  
Index -> Delay offset  
|  
AnimatedProperty
```

9.8.2 Loop with Pause

```
Time -> Modulo (total duration)  
-> If < activeTime: animate  
-> Else: hold at end value
```

9.8.3 Ping-Pong (Back and Forth)

Time -> Sin -> Map to range -> Property

Or with timeline: set keyframes to go forward then backward.

9.8.4 One-Shot Animation

Trigger -> SetValue (start)
-> Smooth -> AnimatedValue

9.9 State Machines

Create complex animation logic:

9.9.1 Simple States

```
// In custom op  
let state = "idle";  
  
function setState(newState) {  
    state = newState;  
    switch(state) {  
        case "idle":  
            // Set idle animation params  
            break;  
        case "active":  
            // Set active animation params  
            break;  
        case "exit":  
            // Set exit animation params  
            break;  
    }  
}
```

9.9.2 Transition Between States

Use Smooth or Spring ops to blend between state values.

9.10 Interactive Animation

9.10.1 Mouse-Based

MouseX -> Map to range -> Target value -> Smooth -> Property

9.10.2 Scroll-Based

ScrollPosition -> Map (0 to page height) -> (0 to 1) -> Animation progress

9.10.3 Click-Triggered

MouseClicked -> Toggle state -> Smooth -> Animated property

9.11 Advanced Animation Systems (How to Build "Scenes")

As patches grow, animation becomes less about a single value moving and more about **systems**:

- multiple objects animated together ("shots" / "scenes")
- blending procedural motion with keyframed structure
- sequencing events reliably (no double-triggers, no race conditions)
- keeping things readable and maintainable

9.11.1 Layering: Timeline for Structure, Procedural for Life

A reliable pattern is:

- **Timeline**: controls the big structure (when things appear, when the camera moves, when a section starts/ends)
- **Procedural**: adds micro-motion (subtle noise, breathing, idle motion, wobble)

Example idea:

Timeline -> Base position
Time -> Sin (small) -> Add
Result -> Transform position

9.11.2 Shot-Based Timelines (Cinematic Organization)

Instead of one giant timeline track list, treat the timeline as a set of "shots":

- Shot 1: intro framing
- Shot 2: reveal
- Shot 3: close-up detail
- Shot 4: outro / logo

Each shot has:

- a start time, end time
- a camera pose
- a set of object visibility/alpha states

9.11.3 Animation Curves: Clamp Early, Map Late

If you see overshoot or sudden jumps, it's usually a range mismatch.

Good practice:

- normalize to 0..1 early
- clamp to 0..1 before sensitive operations
- map to target range at the end

Conceptually:

t (0..1) -> Clamp -> Ease -> Map (min..max)

9.11.4 Reusable "Rig" Pattern

For any object you animate often, create a mini rig:

- one Transform for position
- one Transform for rotation
- one Transform for scale

- optional “wobble” layer

This makes it easy to swap animation sources later without rewiring the whole patch.

9.11.5 Avoiding Jitter in Interactive Animation

If input is noisy (mouse, audio, sensors):

- map input into a safe range
- apply Smooth/Spring
- optionally add dead zones

```
Input -> Map -> Clamp -> Smooth -> Property
```

9.11.6 Choreographing Triggers Reliably

For sequences of actions:

- use Sequence for deterministic ordering
- use Delay for spacing
- use Interval for periodic triggers

The key is to avoid “implicit timing” where the order depends on frame timing.

9.12 Advanced Recipes

9.12.1 Recipe: Scroll-Driven Scene (Interactive Story-telling)

Use scroll position as a normalized progress value:

```
ScrollPosition -> Map (0..pageHeight -> 0..1) -> Clamp -> progress  
progress -> Ease -> Drive camera/object parameters
```

Then you can tie multiple properties to the same progress signal for a coherent experience.

9.12.2 Recipe: Beat-Synced Timeline Sections

Use BPM sync to trigger timeline jumps or section changes:

```
AudioFile -> BPMSync -> Beat trigger  
Beat trigger -> Sequence -> (advance state) -> set target animation  
values
```

9.12.3 Recipe: One-Shot “Punch” Animation (No Keyframes)

Great for UI hits, impacts, kick drums:

```
Trigger -> SetValue (1)  
-> Smooth (fast decay) -> scale/brightness
```

You can combine a fast rise + slower decay by chaining two Smooth ops with different parameters.

9.12.4 Recipe: Camera Rig (Orbit + Handheld Micro Motion)

```
Time -> Sin/Cos -> Orbit position  
Random (small) -> Smooth -> micro offset  
Add (orbit + micro) -> Camera position  
LookAt -> Camera aim
```

This produces camera movement that feels “alive” but still controlled.

9.13 Practical Examples

9.13.1 Example 1: Bouncing Ball

```
MainLoop  
|  
BasicMaterial
```

```
Time -> Sin -> Abs -> Y position  
|  
Transform  
|  
Circle
```

```
+-- 4s: Object rotates  
+-- 6s: Color change  
+-- 8s: Fade out
```

9.13.2 Example 2: Rotating Carousel

```
MainLoop  
|  
Camera  
|  
ArrayIterator (items)  
|  
Time + (Index * offset) -> Cos -> X position  
Time + (Index * offset) -> Sin -> Z position  
|  
Transform  
|  
Item
```

9.13.3 Example 3: Fade In Sequence

```
MainLoop  
|  
BasicMaterial  
|  
ArrayIterator  
|  
Time - (Index * staggerDelay) -> Clamp (0, 1) -> BasicMaterial  
(alpha input)  
|  
Shape
```

9.13.4 Example 4: Timeline-Based Scene

```
Timeline  
+-- 0s: Camera position keyframe  
+-- 2s: Object appears (alpha 0->1)
```

9.13.5 Example 5: Layered Animation Clips (Additive)

Create a character with multiple animation layers:

```
Base Position (0, 0, 0)  
|  
Anim Clip "idleBreath" (vertical oscillation) -> Add  
|  
Anim Clip "walkCycle" (horizontal movement, triggered) -> Add  
|  
Anim Clip "jump" (vertical boost, triggered) -> Add  
|  
Final Position -> Transform
```

Setup: 1. Create “idleBreath” clip: 2-second vertical sine wave (amplitude: 0.1) 2. Create “walkCycle” clip: 1-second horizontal movement (0 to 1, repeat) 3. Create “jump” clip: 0.5-second vertical boost (0 to 2, one-shot) 4. Connect all three Anim ops to Add ops in sequence 5. Trigger walkCycle and jump clips via user input

9.13.6 Example 6: Blended Animation Clips (Mixable)

Smooth transition between walk and run:

```
Walk Clip -> Anim (weight: 1.0 - runBlend)  
Run Clip -> Anim (weight: runBlend)  
|  
Mix -> Final Position
```

Setup: 1. Create “walk” clip: slow horizontal movement 2. Create “run” clip: fast horizontal movement 3. Use a Smooth op to blend between 0 (walk) and 1 (run) 4. Connect both clips to Mix op with blend factor

9.13.7 Example 7: Reusable Clip System

Create a library of reusable animation clips:

```
Clip Library:  
- "fadeIn" (alpha 0->1, 1s, easeOut)  
- "fadeOut" (alpha 1->0, 1s, easeIn)  
- "bounce" (scale 1->1.2->1, 0.5s, easeOut)  
- "slideInLeft" (x: -100->0, 1s, easeOut)  
- "rotate360" (rotation 0->360, 2s, linear)
```

Apply to multiple objects:

```
Object 1: fadeIn at t=0s, bounce at t=2s  
Object 2: slideInLeft at t=1s, fadeOut at t=5s  
Object 3: rotate360 at t=3s (looping)
```

9.13.8 Example 8: JavaScript-Controlled Animation

Custom op that controls animation based on game state:

```
Game State -> Custom Op  
  +-> State = "idle": Play "idle" clip  
  +-> State = "walk": Play "walk" clip  
  +-> State = "run": Play "run" clip  
  +-> State = "jump": Play "jump" clip (one-shot)  
  |  
 Selected Clip -> Anim -> Position
```

Custom Op Code:

```
const inState = op.inString("State", "idle");  
const inTime = op.inFloat("Time", 0);  
const outClipName = op.outString("Clip Name");  
const outValue = op.outNumber("Animation Value");  
  
let currentClip = null;  
  
inState.onChange = function() {  
  const state = inState.get();
```

```
    switch(state) {  
      case "idle":  
        currentClip = "idle";  
        break;  
      case "walk":  
        currentClip = "walk";  
        break;  
      case "run":  
        currentClip = "run";  
        break;  
      case "jump":  
        currentClip = "jump";  
        break;  
    }  
    outClipName.set(currentClip);  
};  
  
inTime.onChange = function() {  
  // Sample the current clip  
  if (currentClip) {  
    const animOp = op.patch.findOpByName("Anim_" + currentClip);  
    if (animOp) {  
      outValue.set(animOp.outValue.get());  
    }  
  }  
};
```

9.13.9 Example 9: Physics + Animation Clip Hybrid

Combine procedural physics with keyframed animation:

```
Anim Clip "baseMotion" (keyframed path)  
|  
Add  
Physics Force (gravity, wind) -> Integrate -> Add  
|  
Final Position
```

Custom Op for Physics Integration:

```
const inAnimValue = op.inFloat("Animation Value", 0);
```

```

const inPhysicsForce = op.inFloat("Physics Force", 0);
const inDamping = op.inFloat("Damping", 0.95);
const inRender = op.inTrigger("Render");
const outCombined = op.outNumber("Combined Value");

let velocity = 0;
let position = 0;

inRender.onTriggered = function() {
    const delta = op.patch.timer.getDelta();
    const anim = inAnimValue.get();
    const force = inPhysicsForce.get();
    const damp = inDamping.get();

    // Update physics
    velocity += force * delta;
    velocity *= damp;
    position += velocity * delta;

    // Combine with animation
    outCombined.set(anim + position);
};

```

9.13.10 Example 10: Conditional Clip Playback

Play different clips based on conditions:

```

Condition A -> If (True: Clip A, False: Clip B)
Condition B -> If (True: Clip C, False: Clip D)
|
Mix (blend between conditional results)
|
Final Animation

```

9.14 Performance Tips

- 1. Limit active animations** - Don't animate everything
- 2. Use requestAnimationFrame** - Built into cables.gl
- 3. Cache calculations** - Don't recalculate every frame
- 4. Simplify when far** - Reduce animation complexity for distant objects
- 5. Use GPU** - Animate in shaders when possible

9.15 Debugging Animation

9.15.1 Slow Motion

Time -> Multiply (0.1) -> SlowTime

9.15.2 Visualize Values

Add a DrawNumber op to see animated values in real-time.

9.15.3 Pause at Problem

Use timeline pause to inspect a specific frame.

9.16 Featured Videos

9.17 Exercises

9.17.1 Basic Animation

1. Create a loading animation with staggered dots
2. Build an interactive hover animation
3. Design a full intro sequence with timeline
4. Create a physics-based pendulum

9.17.2 Animation Clips

5. Create a reusable "bounce" clip and apply it to 5 different objects
6. Build a character animation system with 3 additive clips (idle, walk, jump)
7. Create a smooth walk-to-run transition using clip blending
8. Design a clip library with 5 common animations (fade, slide, scale, rotate, bounce)

9.17.3 JavaScript Integration

9. Build a custom op that generates a sine wave animation clip programmatically
10. Create an animation controller op with play/pause/stop/seek functionality

11. Design a custom op that blends two animation clips with a configurable blend factor
12. Build a state machine op that switches between different animation clips based on input

9.17.4 Advanced

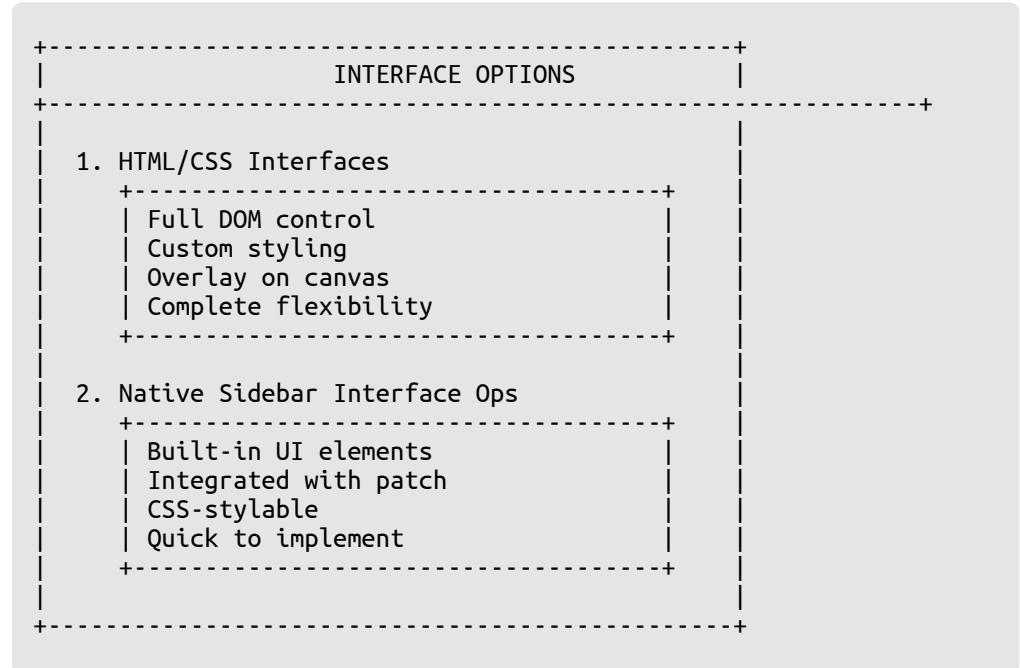
13. Combine procedural animation (Time -> Sin) with a keyframed clip using additive blending
14. Create a custom easing function op and apply it to an animation clip
15. Build a system that plays different animation clips based on user interaction (mouse, keyboard, touch)
16. Design a complex scene with multiple objects, each using a combination of clips and procedural motion

10 Interfaces in Cables.gl

10.1 Introduction

Cables.gl provides multiple ways to create user interfaces for your patches. You can build interfaces using HTML and CSS for full customization, or use native Cables sidebar interface operators for quick, integrated controls. This chapter covers both approaches in detail.

10.2 Interface Approaches Overview



10.3 HTML/CSS Interfaces

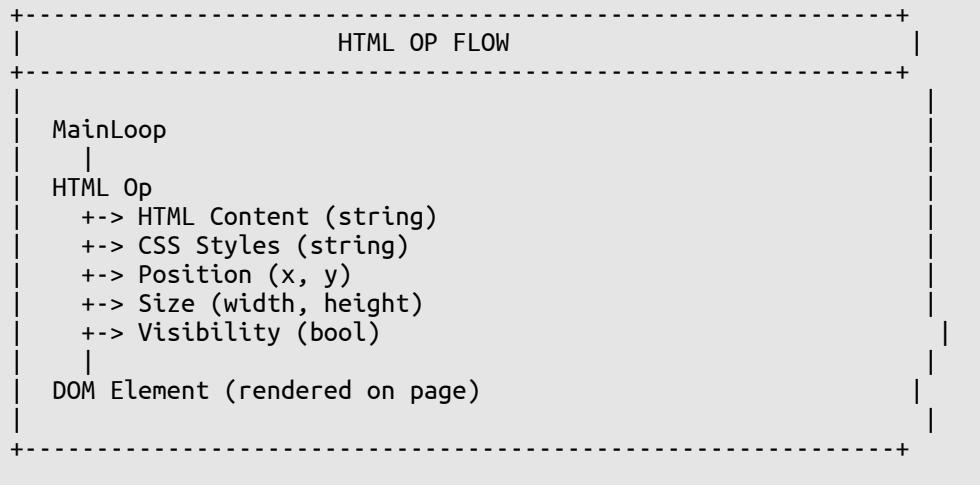
10.3.1 Overview

HTML/CSS interfaces give you complete control over the user interface. You can create custom overlays, forms, buttons, and any HTML element positioned over or alongside your canvas.

10.3.2 The HTML Op

The HTML op allows you to create and manipulate DOM elements directly within your patch.

Basic HTML Op Setup



Creating a Simple HTML Interface

Step 1: Add HTML Op

1. Add a MainLoop op
2. Add an HTML op
3. Connect MainLoop -> HTML

Step 2: Define HTML Content

In the HTML op's "HTML" parameter, enter your HTML:

```
<div id="myInterface">
  <h1>My Interface</h1>
  <button id="myButton">Click Me</button>
  <input type="range" id="mySlider" min="0" max="100" value="50">
  <p id="myText">Value: <span id="valueDisplay">50</span></p>
</div>
```

Step 3: Add CSS Styling

In the HTML op's "CSS" parameter:

```
#myInterface {
  position: absolute;
  top: 20px;
  left: 20px;
  background: rgba(30, 30, 30, 0.9);
  padding: 20px;
  border-radius: 8px;
  color: white;
  font-family: Arial, sans-serif;
  z-index: 1000;
}

#myButton {
  background: #4a9eff;
  color: white;
  border: none;
  padding: 10px 20px;
  border-radius: 4px;
  cursor: pointer;
  font-size: 16px;
}

#myButton:hover {
  background: #5aaeff;
}

#mySlider {
  width: 200px;
  margin: 10px 0;
}

#myText {
  margin-top: 10px;
  font-size: 14px;
}
```

Step 4: Position the Interface

Set the HTML op's position parameters: - X: 0 (or desired x position) - Y: 0 (or desired y position) - Width: 300 - Height: 200

10.3.3 Connecting HTML to Patch Logic

Using JavaScript Custom Op for Interaction

To make HTML elements interactive with your patch, use a JavaScript custom op:

```
// Custom Op: HTML Controller
const inTrigger = op.inTrigger("Render");
const outSliderValue = op.outNumber("Slider Value");
const outButtonClicked = op.outTrigger("Button Clicked");

let sliderValue = 50;
let buttonClicked = false;

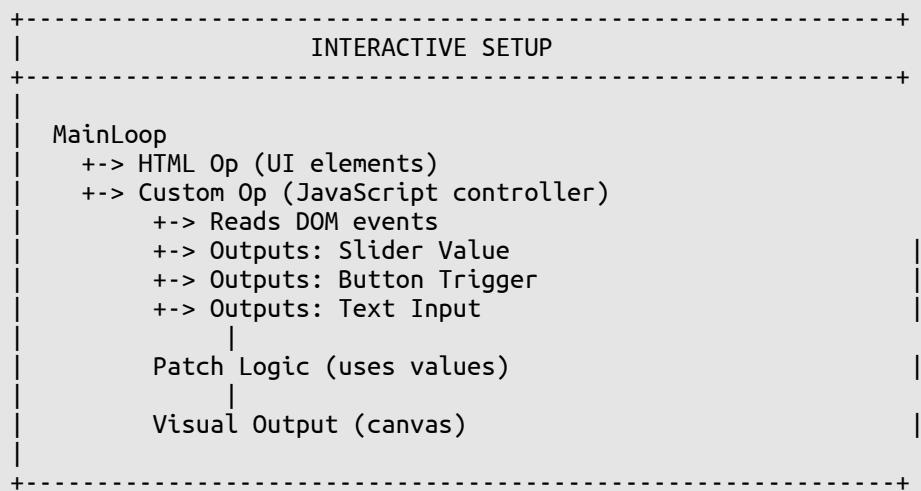
// Access DOM elements
op.onInit = function() {
    const slider = document.getElementById("mySlider");
    const button = document.getElementById("myButton");
    const display = document.getElementById("valueDisplay");

    if (slider) {
        slider.addEventListener("input", function(e) {
            sliderValue = parseFloat(e.target.value);
            if (display) {
                display.textContent = sliderValue;
            }
            outSliderValue.set(sliderValue);
        });
    }

    if (button) {
        button.addEventListener("click", function() {
            buttonClicked = true;
            outButtonClicked.trigger();
        });
    }
};

inTrigger.onTriggered = function() {
    outSliderValue.set(sliderValue);
    if (buttonClicked) {
        buttonClicked = false;
    }
};
```

Complete Example: Interactive Control Panel



HTML Content:

```
<div id="controlPanel">
    <h2>Animation Controls</h2>

    <div class="control-group">
        <label>Speed:</label>
        <input type="range" id="speedSlider" min="0.1" max="5"
step="0.1" value="1">
        <span id="speedValue">1.0</span>
    </div>

    <div class="control-group">
        <label>Color:</label>
        <input type="color" id="colorPicker" value="#4a9eff">
    </div>

    <div class="control-group">
        <label>Mode:</label>
        <select id="modeSelect">
            <option value="normal">Normal</option>
            <option value="fast">Fast</option>
            <option value="slow">Slow</option>
        </select>
    </div>
```

```

<button id="resetButton">Reset</button>
<button id="playButton">Play/Pause</button>
</div>

```

CSS Styling:

```

#controlPanel {
    position: fixed;
    top: 20px;
    right: 20px;
    width: 280px;
    background: linear-gradient(135deg, #1e1e1e 0%, #2d2d2d 100%);
    padding: 24px;
    border-radius: 12px;
    box-shadow: 0 8px 32px rgba(0, 0, 0, 0.4);
    border: 1px solid rgba(255, 255, 255, 0.1);
    font-family: 'Segoe UI', Tahoma, Geneva, Verdana, sans-serif;
    z-index: 1000;
}

#controlPanel h2 {
    margin: 0 0 20px 0;
    color: #ffffff;
    font-size: 20px;
    font-weight: 600;
    border-bottom: 2px solid #4a9eff;
    padding-bottom: 10px;
}

.control-group {
    margin-bottom: 20px;
}

.control-group label {
    display: block;
    color: #b0b0b0;
    font-size: 14px;
    margin-bottom: 8px;
    font-weight: 500;
}

#speedSlider {
    width: 100%;
    height: 6px;
    border-radius: 3px;
}

```

```

background: #3a3a3a;
outline: none;
-webkit-appearance: none;
}

#speedSlider::-webkit-slider-thumb {
    -webkit-appearance: none;
    appearance: none;
    width: 18px;
    height: 18px;
    border-radius: 50%;
    background: #4a9eff;
    cursor: pointer;
    box-shadow: 0 2px 4px rgba(0, 0, 0, 0.3);
}

#speedSlider::-moz-range-thumb {
    width: 18px;
    height: 18px;
    border-radius: 50%;
    background: #4a9eff;
    cursor: pointer;
    border: none;
    box-shadow: 0 2px 4px rgba(0, 0, 0, 0.3);
}

#speedValue {
    color: #4a9eff;
    font-weight: 600;
    margin-left: 10px;
}

#colorPicker {
    width: 100%;
    height: 40px;
    border: 2px solid #3a3a3a;
    border-radius: 6px;
    cursor: pointer;
    background: transparent;
}

#modeSelect {
    width: 100%;
    padding: 10px;
    background: #3a3a3a;
    color: #ffffff;
    border: 2px solid #3a3a3a;
    border-radius: 6px;
}

```

```

        font-size: 14px;
        cursor: pointer;
    }

#modeSelect:hover {
    border-color: #4a9eff;
}

#modeSelect:focus {
    outline: none;
    border-color: #4a9eff;
}

button {
    width: 100%;
    padding: 12px;
    margin-top: 10px;
    background: #4a9eff;
    color: white;
    border: none;
    border-radius: 6px;
    font-size: 14px;
    font-weight: 600;
    cursor: pointer;
    transition: all 0.2s ease;
}

button:hover {
    background: #5aaeff;
    transform: translateY(-1px);
    box-shadow: 0 4px 12px rgba(74, 158, 255, 0.3);
}

button:active {
    transform: translateY(0);
}

```

10.3.4 Advanced HTML Interface Patterns

Pattern 1: Responsive Overlay

```
#myInterface {
    position: fixed;
    top: 0;
    left: 0;
    width: 100vw;
```

```

    height: 100vh;
    background: rgba(0, 0, 0, 0.8);
    display: flex;
    align-items: center;
    justify-content: center;
    z-index: 10000;
}

#myInterface .content {
    background: #2d2d2d;
    padding: 40px;
    border-radius: 12px;
    max-width: 500px;
    width: 90%;
}
```

Pattern 2: Sidebar Panel

```

#sidebar {
    position: fixed;
    top: 0;
    right: 0;
    width: 300px;
    height: 100vh;
    background: #1e1e1e;
    box-shadow: -4px 0 16px rgba(0, 0, 0, 0.3);
    padding: 20px;
    overflow-y: auto;
    z-index: 1000;
    transform: translateX(0);
    transition: transform 0.3s ease;
}

#sidebar.hidden {
    transform: translateX(100%);
```

Pattern 3: HUD (Heads-Up Display)

```
#hud {
    position: fixed;
    top: 0;
    left: 0;
    width: 100%;
```

```

height: 100%;
pointer-events: none;
z-index: 100;
}

#hud .info {
position: absolute;
top: 20px;
left: 20px;
color: white;
font-family: monospace;
font-size: 14px;
text-shadow: 2px 2px 4px rgba(0, 0, 0, 0.8);
}

#hud .crosshair {
position: absolute;
top: 50%;
left: 50%;
transform: translate(-50%, -50%);
width: 20px;
height: 20px;
border: 2px solid rgba(255, 255, 255, 0.5);
border-radius: 50%;
}

```

10.4 Native Sidebar Interface Ops

10.4.1 Overview

Cables.gl provides native interface operators that create UI elements directly in the sidebar. These are faster to set up and integrate seamlessly with the patch system.

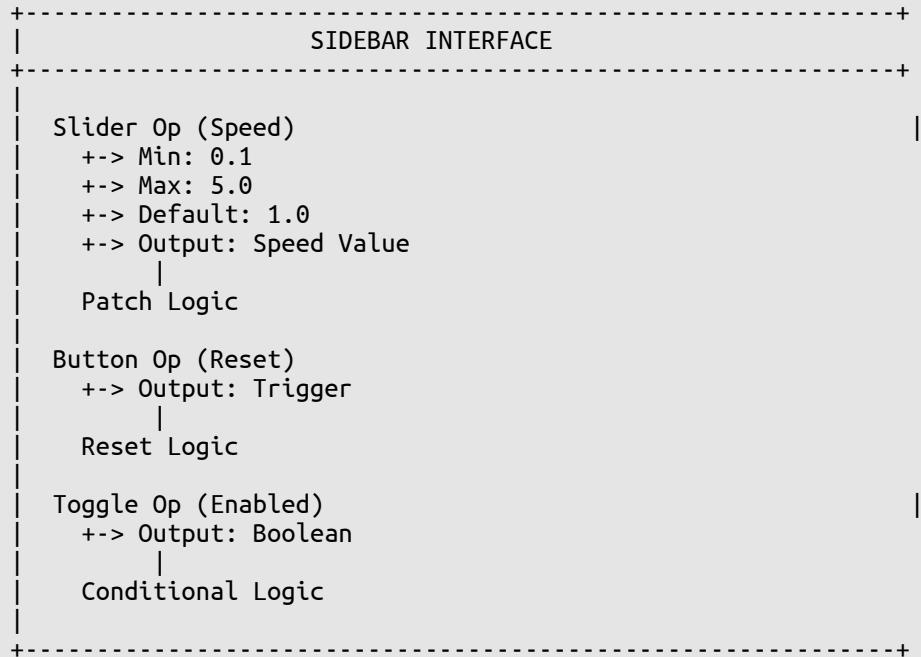
10.4.2 Available Interface Ops

- | NATIVE INTERFACE OPS | |
|--|--|
| <ul style="list-style-type: none"> Slider Button Toggle Text Input | <ul style="list-style-type: none"> - Numeric input with range - Clickable trigger - Boolean on/off switch - String input field |

- Color Picker - Color selection
- Dropdown - Selection from options
- Number Input - Direct numeric input
- Text Display - Display text/values

10.4.3 Basic Interface Op Setup

Example: Simple Control Panel



Step-by-Step: Creating a Sidebar Interface

Step 1: Add Interface Ops

1. Add a Slider op for speed control
2. Add a Button op for actions
3. Add a Toggle op for enable/disable
4. Add a ColorPicker op for color selection

Step 2: Configure Each Op

Slider Op: - Name: "Speed" - Min: 0.1 - Max: 5.0 - Default: 1.0 - Step: 0.1

Button Op: - Name: "Reset" - Label: "Reset Animation"

Toggle Op: - Name: "Enabled" - Default: true

ColorPicker Op: - Name: "Base Color" - Default: #4a9eff

Step 3: Connect to Patch

```
Speed Slider -> Multiply -> Animation Speed  
Reset Button -> SetValue -> Reset Position  
Enabled Toggle -> If -> Conditional Execution  
ColorPicker -> SetColor -> Material Color
```

10.4.4 Styling Native Sidebar with CSS

This is a powerful technique that allows you to customize the appearance of native sidebar interface ops using CSS.

Understanding the Sidebar Structure

The sidebar interface ops render in a specific DOM structure that you can target with CSS:

```
+-----+  
|       SIDEBAR DOM STRUCTURE |  
+-----+  
  
<div class="cables-sidebar">  
  <div class="cables-sidebar-content">  
    <div class="cables-op-slider" data-op-name="Speed">  
      <label>Speed</label>  
      <input type="range" ...>  
      <span class="value">1.0</span>  
    </div>  
    <div class="cables-op-button" data-op-name="Reset">  
      <button>Reset</button>  
    </div>  
    ...  
  </div>  
</div>
```

Method 1: Global CSS Injection

Use an HTML op to inject CSS that styles the entire sidebar:

HTML Op Setup:

```
<style id="sidebar-styles">  
/* Sidebar styling will go here */  
</style>
```

CSS Content:

```
/* Target the entire sidebar */  
.cables-sidebar {  
  background: linear-gradient(180deg, #1a1a1a 0%, #2d2d2d 100%);  
  border-left: 2px solid #4a9eff;  
}  
  
/* Style all interface ops */  
.cables-sidebar-content > div {  
  background: rgba(255, 255, 255, 0.05);  
  border-radius: 8px;  
  padding: 16px;  
  margin-bottom: 12px;  
  border: 1px solid rgba(255, 255, 255, 0.1);  
  transition: all 0.2s ease;  
}  
  
.cables-sidebar-content > div:hover {  
  background: rgba(255, 255, 255, 0.08);  
  border-color: #4a9eff;  
}  
  
/* Style slider ops specifically */  
.cables-op-slider {  
  /* Custom slider container */  
}  
  
.cables-op-slider label {
```

```

color: #b0b0b0;
font-size: 14px;
font-weight: 500;
margin-bottom: 8px;
display: block;
text-transform: uppercase;
letter-spacing: 0.5px;
}

.cables-op-slider input[type="range"] {
width: 100%;
height: 6px;
border-radius: 3px;
background: #3a3a3a;
outline: none;
-webkit-appearance: none;
margin: 10px 0;
}

.cables-op-slider input[type="range"]::-webkit-slider-thumb {
-webkit-appearance: none;
appearance: none;
width: 20px;
height: 20px;
border-radius: 50%;
background: #4a9eff;
cursor: pointer;
box-shadow: 0 2px 8px rgba(74, 158, 255, 0.4);
transition: all 0.2s ease;
}

.cables-op-slider input[type="range"]::-webkit-slider-thumb:hover {
background: #5aaeff;
transform: scale(1.1);
box-shadow: 0 4px 12px rgba(74, 158, 255, 0.6);
}

.cables-op-slider input[type="range"]::-moz-range-thumb {
width: 20px;
height: 20px;
border-radius: 50%;
background: #4a9eff;
cursor: pointer;
border: none;
box-shadow: 0 2px 8px rgba(74, 158, 255, 0.4);
}

.cables-op-slider .value {

```

```

color: #4a9eff;
font-weight: 600;
font-size: 16px;
float: right;
margin-top: -24px;
}

/* Style button ops */
.cables-op-button button {
width: 100%;
padding: 12px 24px;
background: linear-gradient(135deg, #4a9eff 0%, #3a8eef 100%);
color: white;
border: none;
border-radius: 6px;
font-size: 14px;
font-weight: 600;
cursor: pointer;
transition: all 0.2s ease;
text-transform: uppercase;
letter-spacing: 1px;
box-shadow: 0 4px 12px rgba(74, 158, 255, 0.3);
}

.cables-op-button button:hover {
background: linear-gradient(135deg, #5aaeff 0%, #4a9eff 100%);
transform: translateY(-2px);
box-shadow: 0 6px 16px rgba(74, 158, 255, 0.4);
}

.cables-op-button button:active {
transform: translateY(0);
box-shadow: 0 2px 8px rgba(74, 158, 255, 0.3);
}

/* Style toggle ops */
.cables-op-toggle {
display: flex;
align-items: center;
justify-content: space-between;
}

.cables-op-toggle label {
color: #b0b0b0;
font-size: 14px;
font-weight: 500;
}
```

```

.cables-op-toggle input[type="checkbox"] {
  width: 50px;
  height: 26px;
  -webkit-appearance: none;
  appearance: none;
  background: #3a3a3a;
  border-radius: 13px;
  position: relative;
  cursor: pointer;
  transition: background 0.3s ease;
  border: 2px solid #2a2a2a;
}

.cables-op-toggle input[type="checkbox"]:checked {
  background: #4a9eff;
  border-color: #4a9eff;
}

.cables-op-toggle input[type="checkbox"]::before {
  content: '';
  position: absolute;
  width: 20px;
  height: 20px;
  border-radius: 50%;
  background: white;
  top: 1px;
  left: 1px;
  transition: transform 0.3s ease;
  box-shadow: 0 2px 4px rgba(0, 0, 0, 0.3);
}

.cables-op-toggle input[type="checkbox"]:checked::before {
  transform: translateX(24px);
}

/* Style color picker ops */
.cables-op-colorpicker {
  display: flex;
  align-items: center;
  gap: 12px;
}

.cables-op-colorpicker label {
  color: #b0b0b0;
  font-size: 14px;
  font-weight: 500;
  flex: 1;
}

```

```

.cables-op-colorpicker input[type="color"] {
  width: 60px;
  height: 40px;
  border: 2px solid #3a3a3a;
  border-radius: 6px;
  cursor: pointer;
  background: transparent;
  transition: border-color 0.2s ease;
}

.cables-op-colorpicker input[type="color"]:hover {
  border-color: #4a9eff;
}

/* Style text input ops */
.cables-op-textinput input[type="text"] {
  width: 100%;
  padding: 10px 12px;
  background: #3a3a3a;
  color: #ffffff;
  border: 2px solid #3a3a3a;
  border-radius: 6px;
  font-size: 14px;
  transition: all 0.2s ease;
}

.cables-op-textinput input[type="text"]:focus {
  outline: none;
  border-color: #4a9eff;
  background: #404040;
  box-shadow: 0 0 3px rgba(74, 158, 255, 0.1);
}

/* Style dropdown ops */
.cables-op-dropdown select {
  width: 100%;
  padding: 10px 12px;
  background: #3a3a3a;
  color: #ffffff;
  border: 2px solid #3a3a3a;
  border-radius: 6px;
  font-size: 14px;
  cursor: pointer;
  transition: all 0.2s ease;
}

.cables-op-dropdown select:hover {

```

```

    border-color: #4a9eff;
}

.cables-op-dropdown select:focus {
    outline: none;
    border-color: #4a9eff;
    box-shadow: 0 0 0 3px rgba(74, 158, 255, 0.1);
}

```

Method 2: Targeted Op Styling

Style specific ops by their data attributes:

```

/* Style a specific slider by op name */
.cables-op-slider[data-op-name="Speed"] {
    background: rgba(74, 158, 255, 0.1);
    border: 2px solid #4a9eff;
}

.cables-op-slider[data-op-name="Speed"] label {
    color: #4a9eff;
    font-weight: 600;
}

/* Style a specific button */
.cables-op-button[data-op-name="Reset"] button {
    background: linear-gradient(135deg, #ff4a4a 0%, #ef3a3a 100%);
}

.cables-op-button[data-op-name="Reset"] button:hover {
    background: linear-gradient(135deg, #ff5a5a 0%, #ff4a4a 100%);
}

```

Method 3: Dynamic CSS with JavaScript Custom Op

Create a custom op that injects CSS based on patch state:

```

// Custom Op: Dynamic Sidebar Styling
const inTheme = op.inSwitch("Theme", ["dark", "light", "neon"],
    "dark");
const inAccentColor = op.inString("Accent Color", "#4a9eff");

```

```

let currentTheme = "dark";
let currentAccent = "#4a9eff";

function updateStyles() {
    const theme = inTheme.get();
    const accent = inAccentColor.get();

    if (theme === currentTheme && accent === currentAccent) return;

    currentTheme = theme;
    currentAccent = accent;

    let styleElement =
document.getElementById("dynamic-sidebar-styles");
    if (!styleElement) {
        styleElement = document.createElement("style");
        styleElement.id = "dynamic-sidebar-styles";
        document.head.appendChild(styleElement);
    }

    let css = ``;

    if (theme === "dark") {
        css = `
            .cables-sidebar {
                background: linear-gradient(180deg, #1a1a1a 0%,
#2d2d2d 100%);
            }
            .cables-sidebar-content > div {
                background: rgba(255, 255, 255, 0.05);
                border-color: rgba(255, 255, 255, 0.1);
            }
        `;
    } else if (theme === "light") {
        css = `
            .cables-sidebar {
                background: linear-gradient(180deg, #f5f5f5 0%,
#e0e0e0 100%);
            }
            .cables-sidebar-content > div {
                background: rgba(0, 0, 0, 0.05);
                border-color: rgba(0, 0, 0, 0.1);
            }
            .cables-op-slider label,
            .cables-op-button label {
                color: #333;
            }
        `;
    }
    styleElement.innerHTML = css;
}

```

```

    `;
} else if (theme === "neon") {
  css =
    `.cables-sidebar {
      background: #0a0a0a;
      border-left: 2px solid ${accent};
      box-shadow: -4px 0 20px ${accent}40;
    }
    .cables-sidebar-content > div {
      background: rgba(0, 0, 0, 0.5);
      border: 1px solid ${accent}40;
      box-shadow: 0 0 10px ${accent}20;
    }
  `;
}

// Apply accent color
css += `
  .cables-op-slider input[type="range"]::-webkit-slider-thumb {
    background: ${accent};
    box-shadow: 0 2px 8px ${accent}60;
  }
  .cables-op-button button {
    background: linear-gradient(135deg, ${accent} 0%, ${adjustBrightness(accent, -20)} 100%);
  }
  .cables-op-toggle input[type="checkbox"]:checked {
    background: ${accent};
  }
`;
styleElement.textContent = css;
}

function adjustBrightness(color, percent) {
  // Simple brightness adjustment (simplified)
  const num = parseInt(color.replace("#", ""), 16);
  const r = Math.max(0, Math.min(255, (num >> 16) + percent));
  const g = Math.max(0, Math.min(255, ((num >> 8) & 0x00FF) + percent));
  const b = Math.max(0, Math.min(255, (num & 0x0000FF) + percent));
  return "#" + ((r << 16) | (g << 8) | b).toString(16).padStart(6, "0");
}

inTheme.onChange = updateStyles;
inAccentColor.onChange = updateStyles;

```

```

op.onInit = function() {
  updateStyles();
};

```

10.4.5 Complete Styling Example: Professional Control Panel

Here's a complete example that styles all interface ops with a cohesive, professional design:

HTML Op (CSS Injection):

```

<style id="professional-sidebar-styles">
/* Professional Sidebar Styling */

/* Sidebar Container */
.cables-sidebar {
  background: linear-gradient(180deg,
    #1a1a1a 0%,
    #1e1e1e 50%,
    #2d2d2d 100%);
  border-left: 3px solid #4a9eff;
  box-shadow: -4px 0 24px rgba(0, 0, 0, 0.5);
  font-family: 'Inter', 'Segoe UI', system-ui, sans-serif;
}

/* Sidebar Header (if exists) */
.cables-sidebar-header {
  padding: 20px;
  border-bottom: 2px solid rgba(74, 158, 255, 0.2);
  background: rgba(74, 158, 255, 0.05);
}

.cables-sidebar-header h2 {
  margin: 0;
  color: #ffffff;
  font-size: 18px;
  font-weight: 600;
  text-transform: uppercase;
  letter-spacing: 1px;
}

/* Content Container */

```

```

.cables-sidebar-content {
  padding: 16px;
}

/* All Interface Op Containers */
.cables-sidebar-content > div {
  background: rgba(255, 255, 255, 0.03);
  border: 1px solid rgba(255, 255, 255, 0.08);
  border-radius: 10px;
  padding: 18px;
  margin-bottom: 16px;
  transition: all 0.3s cubic-bezier(0.4, 0, 0.2, 1);
  position: relative;
  overflow: hidden;
}

.cables-sidebar-content > div::before {
  content: '';
  position: absolute;
  top: 0;
  left: 0;
  width: 100%;
  height: 2px;
  background: linear-gradient(90deg,
    transparent 0%,
    #4a9eff 50%,
    transparent 100%);
  opacity: 0;
  transition: opacity 0.3s ease;
}

.cables-sidebar-content > div:hover {
  background: rgba(255, 255, 255, 0.06);
  border-color: rgba(74, 158, 255, 0.3);
  transform: translateX(4px);
  box-shadow: 0 4px 16px rgba(0, 0, 0, 0.3);
}

.cables-sidebar-content > div:hover::before {
  opacity: 1;
}

/* Slider Styling */
.cables-op-slider label {
  display: block;
  color: #b0b0b0;
  font-size: 12px;
  font-weight: 600;
}

```

```

margin-bottom: 10px;
text-transform: uppercase;
letter-spacing: 0.5px;
}

.cables-op-slider input[type="range"] {
  width: 100%;
  height: 8px;
  border-radius: 4px;
  background: linear-gradient(90deg,
    #2a2a2a 0%,
    #3a3a3a 100%);
  outline: none;
  -webkit-appearance: none;
  margin: 12px 0;
  position: relative;
}

.cables-op-slider input[type="range"]::-webkit-slider-thumb {
  -webkit-appearance: none;
  appearance: none;
  width: 24px;
  height: 24px;
  border-radius: 50%;
  background: linear-gradient(135deg, #4a9eff 0%, #3a8eef 100%);
  cursor: pointer;
  box-shadow:
    0 2px 8px rgba(74, 158, 255, 0.4),
    0 0 0 4px rgba(74, 158, 255, 0.1),
    inset 0 1px 0 rgba(255, 255, 255, 0.2);
  transition: all 0.2s ease;
  border: 2px solid rgba(255, 255, 255, 0.1);
}

.cables-op-slider input[type="range"]::-webkit-slider-thumb:hover {
  background: linear-gradient(135deg, #5aaeff 0%, #4a9eff 100%);
  transform: scale(1.15);
  box-shadow:
    0 4px 12px rgba(74, 158, 255, 0.6),
    0 0 0 6px rgba(74, 158, 255, 0.15),
    inset 0 1px 0 rgba(255, 255, 255, 0.3);
}

.cables-op-slider input[type="range"]::-webkit-slider-thumb:active {
  transform: scale(1.05);
}

```

```

.cables-op-slider input[type="range"]::-moz-range-thumb {
  width: 24px;
  height: 24px;
  border-radius: 50%;
  background: linear-gradient(135deg, #4a9eff 0%, #3a8eef 100%);
  cursor: pointer;
  border: 2px solid rgba(255, 255, 255, 0.1);
  box-shadow:
    0 2px 8px rgba(74, 158, 255, 0.4),
    0 0 4px rgba(74, 158, 255, 0.1);
}

.cables-op-slider .value {
  color: #4a9eff;
  font-weight: 700;
  font-size: 18px;
  float: right;
  margin-top: -32px;
  font-variant-numeric: tabular-nums;
  text-shadow: 0 0 8px rgba(74, 158, 255, 0.5);
}

/* Button Styling */
.cables-op-button button {
  width: 100%;
  padding: 14px 24px;
  background: linear-gradient(135deg, #4a9eff 0%, #3a8eef 100%);
  color: white;
  border: none;
  border-radius: 8px;
  font-size: 14px;
  font-weight: 600;
  cursor: pointer;
  transition: all 0.3s cubic-bezier(0.4, 0, 0.2, 1);
  text-transform: uppercase;
  letter-spacing: 1.2px;
  box-shadow:
    0 4px 12px rgba(74, 158, 255, 0.3),
    inset 0 1px 0 rgba(255, 255, 255, 0.2);
  position: relative;
  overflow: hidden;
}

.cables-op-button button::before {
  content: '';
  position: absolute;
  top: 50%;
  left: 50%;
}

```

```

  width: 0;
  height: 0;
  border-radius: 50%;
  background: rgba(255, 255, 255, 0.3);
  transform: translate(-50%, -50%);
  transition: width 0.6s, height 0.6s;
}

.cables-op-button button:hover {
  background: linear-gradient(135deg, #5aaeff 0%, #4a9eff 100%);
  transform: translateY(-2px);
  box-shadow:
    0 6px 20px rgba(74, 158, 255, 0.4),
    inset 0 1px 0 rgba(255, 255, 255, 0.3);
}

.cables-op-button button:hover::before {
  width: 300px;
  height: 300px;
}

.cables-op-button button:active {
  transform: translateY(0);
  box-shadow:
    0 2px 8px rgba(74, 158, 255, 0.3),
    inset 0 1px 0 rgba(255, 255, 255, 0.1);
}

/* Toggle Styling */
.cables-op-toggle {
  display: flex;
  align-items: center;
  justify-content: space-between;
}

.cables-op-toggle label {
  color: #b0b0b0;
  font-size: 14px;
  font-weight: 500;
  flex: 1;
}

.cables-op-toggle input[type="checkbox"] {
  width: 56px;
  height: 30px;
  -webkit-appearance: none;
  appearance: none;
  background: #2a2a2a;
}

```

```

border-radius: 15px;
position: relative;
cursor: pointer;
transition: all 0.3s cubic-bezier(0.4, 0, 0.2, 1);
border: 2px solid #1a1a1a;
box-shadow: inset 0 2px 4px rgba(0, 0, 0, 0.3);
}

.cables-op-toggle input[type="checkbox"]:checked {
background: linear-gradient(135deg, #4a9eff 0%, #3a8eef 100%);
border-color: #4a9eff;
box-shadow:
  inset 0 2px 4px rgba(0, 0, 0, 0.2),
  0 0 12px rgba(74, 158, 255, 0.4);
}

.cables-op-toggle input[type="checkbox"]::before {
content: '';
position: absolute;
width: 24px;
height: 24px;
border-radius: 50%;
background: linear-gradient(135deg, #ffffff 0%, #f0f0f0 100%);
top: 1px;
left: 1px;
transition: transform 0.3s cubic-bezier(0.4, 0, 0.2, 1);
box-shadow:
  0 2px 6px rgba(0, 0, 0, 0.3),
  inset 0 1px 0 rgba(255, 255, 255, 0.5);
}

.cables-op-toggle input[type="checkbox"]:checked::before {
  transform: translateX(26px);
}

/* Color Picker Styling */
.cables-op-colorpicker {
  display: flex;
  align-items: center;
  gap: 16px;
}

.cables-op-colorpicker label {
  color: #b0b0b0;
  font-size: 14px;
  font-weight: 500;
  flex: 1;
}

```

```

.cables-op-colorpicker input[type="color"] {
width: 70px;
height: 50px;
border: 3px solid #3a3a3a;
border-radius: 8px;
cursor: pointer;
background: transparent;
transition: all 0.3s ease;
box-shadow: 0 2px 8px rgba(0, 0, 0, 0.3);
}

.cables-op-colorpicker input[type="color"]::hover {
border-color: #4a9eff;
transform: scale(1.05);
box-shadow:
  0 4px 12px rgba(0, 0, 0, 0.4),
  0 0 0 4px rgba(74, 158, 255, 0.1);
}

/* Text Input Styling */
.cables-op-textinput label {
display: block;
color: #b0b0b0;
font-size: 12px;
font-weight: 600;
margin-bottom: 8px;
text-transform: uppercase;
letter-spacing: 0.5px;
}

.cables-op-textinput input[type="text"] {
width: 100%;
padding: 12px 16px;
background: #2a2a2a;
color: #ffffff;
border: 2px solid #3a3a3a;
border-radius: 8px;
font-size: 14px;
transition: all 0.3s ease;
box-sizing: border-box;
}

.cables-op-textinput input[type="text"]::focus {
outline: none;
border-color: #4a9eff;
background: #333333;
box-shadow:

```

```

        0 0 0 4px rgba(74, 158, 255, 0.1),
        inset 0 2px 4px rgba(0, 0, 0, 0.2);
    }

    /* Dropdown Styling */
.cables-op-dropdown label {
    display: block;
    color: #b0b0b0;
    font-size: 12px;
    font-weight: 600;
    margin-bottom: 8px;
    text-transform: uppercase;
    letter-spacing: 0.5px;
}

.cables-op-dropdown select {
    width: 100%;
    padding: 12px 16px;
    background: #2a2a2a;
    color: #ffffff;
    border: 2px solid #3a3a3a;
    border-radius: 8px;
    font-size: 14px;
    cursor: pointer;
    transition: all 0.3s ease;
    appearance: none;
    background-image: url("data:image/svg+xml,%3Csvg
xmlns='http://www.w3.org/2000/svg' width='12' height='12'
viewBox='0 0 12 12'%3E%3Cpath fill='%234a9eff' d='M6 9L1
4h10z'%3E%3C/svg%3E");
    background-repeat: no-repeat;
    background-position: right 12px center;
    padding-right: 40px;
}

.cables-op-dropdown select:hover {
    border-color: #4a9eff;
    background-color: #333333;
}

.cables-op-dropdown select:focus {
    outline: none;
    border-color: #4a9eff;
    box-shadow:
        0 0 0 4px rgba(74, 158, 255, 0.1),
        inset 0 2px 4px rgba(0, 0, 0, 0.2);
}

```

```

    /* Number Input Styling */
.cables-op-numberinput {
    display: flex;
    align-items: center;
    gap: 12px;
}

.cables-op-numberinput label {
    color: #b0b0b0;
    font-size: 14px;
    font-weight: 500;
    flex: 1;
}

.cables-op-numberinput input[type="number"] {
    width: 100px;
    padding: 10px 12px;
    background: #2a2a2a;
    color: #ffffff;
    border: 2px solid #3a3a3a;
    border-radius: 6px;
    font-size: 14px;
    text-align: center;
    transition: all 0.3s ease;
}

.cables-op-numberinput input[type="number"]:focus {
    outline: none;
    border-color: #4a9eff;
    background: #333333;
    box-shadow: 0 0 0 3px rgba(74, 158, 255, 0.1);
}

/* Text Display Styling */
.cables-op-textdisplay {
    padding: 12px;
    background: rgba(74, 158, 255, 0.1);
    border: 1px solid rgba(74, 158, 255, 0.3);
    border-radius: 6px;
    color: #4a9eff;
    font-family: 'Courier New', monospace;
    font-size: 14px;
    text-align: center;
    font-weight: 600;
}

/* Responsive adjustments */
@media (max-width: 768px) {

```

```

.cables-sidebar {
    width: 100% !important;
    height: auto !important;
    position: relative !important;
}

```

10.4.6 Advanced CSS Techniques

Technique 1: Animated Transitions

```

.cables-sidebar-content > div {
    animation: slideIn 0.3s ease-out;
}

@keyframes slideIn {
    from {
        opacity: 0;
        transform: translateX(-20px);
    }
    to {
        opacity: 1;
        transform: translateX(0);
    }
}

/* Stagger animation delays */
.cables-sidebar-content > div:nth-child(1) { animation-delay: 0.05s; }
.cables-sidebar-content > div:nth-child(2) { animation-delay: 0.10s; }
.cables-sidebar-content > div:nth-child(3) { animation-delay: 0.15s; }
.cables-sidebar-content > div:nth-child(4) { animation-delay: 0.20s; }

```

Technique 2: Custom Scrollbar

```

.cables-sidebar-content::-webkit-scrollbar {
    width: 8px;
}

```

```

.cables-sidebar-content::-webkit-scrollbar-track {
    background: #1a1a1a;
    border-radius: 4px;
}

.cables-sidebar-content::-webkit-scrollbar-thumb {
    background: #4a9eff;
    border-radius: 4px;
    border: 2px solid #1a1a1a;
}

.cables-sidebar-content::-webkit-scrollbar-thumb:hover {
    background: #5aaeff;
}

```

Technique 3: Glassmorphism Effect

```

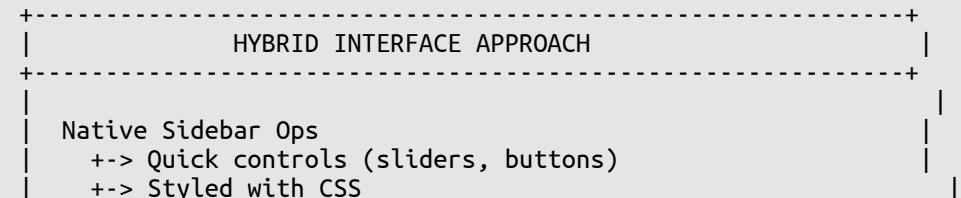
.cables-sidebar {
    background: rgba(30, 30, 30, 0.7);
    backdrop-filter: blur(20px);
    -webkit-backdrop-filter: blur(20px);
    border-left: 1px solid rgba(255, 255, 255, 0.1);
}

.cables-sidebar-content > div {
    background: rgba(255, 255, 255, 0.05);
    backdrop-filter: blur(10px);
    -webkit-backdrop-filter: blur(10px);
    border: 1px solid rgba(255, 255, 255, 0.1);
}

```

10.5 Combining HTML and Native Interfaces

You can combine both approaches for maximum flexibility:



```
HTML Overlay
  +-> Complex UI elements
  +-> Custom layouts
  +-> Interactive components
```

```
JavaScript Custom Op
  +-> Bridges both systems
  +-> Syncs values
  +-> Handles interactions
```

10.6 Best Practices

10.6.1 1. Performance

- **Minimize DOM Manipulation:** Cache element references
- **Use CSS Transforms:** For animations instead of position changes
- **Debounce Inputs:** For sliders and text inputs that trigger heavy computations

10.6.2 2. Accessibility

- **Labels:** Always provide clear labels for controls
- **Keyboard Navigation:** Ensure keyboard accessibility
- **Color Contrast:** Maintain sufficient contrast ratios
- **Focus States:** Provide visible focus indicators

10.6.3 3. Responsive Design

```
/* Mobile-first approach */
.cables-sidebar {
  width: 100%;
  height: auto;
  position: relative;
}

@media (min-width: 768px) {
  .cables-sidebar {
    width: 320px;
    height: 100vh;
    position: fixed;
```

```
}
```

10.6.4 4. Organization

- **Group Related Controls:** Use visual grouping
- **Clear Hierarchy:** Use size, color, and spacing
- **Consistent Spacing:** Maintain uniform margins and padding

10.7 Practical Examples

10.7.1 Example 1: Animation Control Panel

Create a comprehensive control panel for animation parameters:

```
Speed Slider -> Animation Speed
Color Picker -> Material Color
Toggle (Loop) -> Loop Animation
Button (Reset) -> Reset Animation
Text Display -> Current Frame
```

10.7.2 Example 2: Game UI Overlay

HTML overlay for game-like interface:

```
<div id="gameUI">
  <div class="hud-top">
    <div class="score">Score: <span id="score">0</span></div>
    <div class="health">Health: <span
      id="health">100</span></div>
  </div>
  <div class="hud-bottom">
    <button id="pauseBtn">Pause</button>
    <button id="menuBtn">Menu</button>
  </div>
</div>
```

10.7.3 Example 3: Data Visualization Dashboard

Combine native ops with HTML for a data dashboard:

- Native sliders for filtering
- HTML charts and graphs
- Real-time data display

10.8 Debugging Interface Issues

10.8.1 Common Issues

1. CSS Not Applying

- Check selector specificity
- Verify CSS is injected after sidebar renders
- Use !important sparingly

2. Elements Not Visible

- Check z-index values
- Verify position properties
- Check for overflow: hidden

3. Events Not Firing

- Ensure JavaScript runs after DOM is ready
- Check event listener attachment
- Verify element selectors

10.8.2 Debugging Tools

```
// Log sidebar structure
console.log(document.querySelector('.cables-sidebar'));

// Check computed styles
const element = document.querySelector('.cables-op-slider');
console.log(window.getComputedStyle(element));

// Monitor style changes
const observer = new MutationObserver((mutations) => {
  console.log('DOM changed:', mutations);
});
observer.observe(document.querySelector('.cables-sidebar'), {
  childList: true,
  subtree: true,
  attributes: true
});
```

10.9 Exercises

1. **Basic HTML Interface:** Create a simple HTML overlay with a button and slider that control patch parameters
2. **Styled Sidebar:** Style native sidebar ops with a cohesive color scheme and modern design
3. **Responsive Panel:** Create a sidebar that adapts to different screen sizes
4. **Interactive Dashboard:** Build a complete control panel combining HTML and native ops
5. **Theme Switcher:** Create a custom op that dynamically changes sidebar styling based on user selection
6. **Advanced Styling:** Implement glassmorphism or other modern design trends in your sidebar

11 Export & Deployment in Cables.gl

11.1 Introduction

Once you've created your cables.gl project, you'll want to share it with the world. This chapter covers all the ways to export and deploy your creations.

11.2 Export Options

11.2.1 1. Public Patch Link

The simplest way to share - just make your patch public and share the URL.

Pros: - Instant sharing - Always up-to-date - No hosting needed

Cons: - Requires internet - Cables.gl branding - Limited customization

11.2.2 2. Embedded iframe

Embed your patch in any website:

```
<iframe  
  src="https://cables.gl/view/YOUR_PATCH_ID"  
  width="800"  
  height="600"  
  frameborder="0"  
  allowfullscreen>  
</iframe>
```

11.2.3 3. Standalone Export

Download your patch as a standalone web application.

Includes: - HTML file - JavaScript bundle - Assets (textures, models, audio) - No cables.gl dependency

11.2.4 4. npm Package Export

Export as an npm package for integration with other JavaScript projects.

11.3 Standalone Export Process

11.3.1 Step 1: Prepare Your Patch

1. Test thoroughly in the editor
2. Optimize assets (compress images, reduce model complexity)
3. Remove unused ops and connections
4. Set default camera/view position

11.3.2 Step 2: Export

1. Click the export/download button in the editor
2. Choose "Standalone" export
3. Configure options:
 - Include minified code
 - Include source maps (for debugging)
 - Asset optimization level

11.3.3 Step 3: Download

You'll receive a ZIP file containing:

```
exported-patch/  
  +- index.html          # Main HTML file  
  +- js/  
    |  +- cables.min.js  # Cables runtime  
    |  +- ops.js         # Your patch's operators  
    |  +- patch.js        # Patch configuration  
  +- assets/  
    |  +- textures/      # Image files  
    |  +- audio/          # Sound files  
    |  +- models/         # 3D models  
  +- css/  
    +- style.css         # Optional styles
```

11.3.4 Step 4: Test Locally

```
# Using Python  
python -m http.server 8000  
  
# Using Node.js  
npx serve .  
  
# Using PHP  
php -S localhost:8000
```

Then open <http://localhost:8000> in your browser.

11.4 Customizing the Export

11.4.1 Custom HTML Template

```
<!DOCTYPE html>  
<html>  
<head>  
    <meta charset="utf-8">  
    <meta name="viewport" content="width=device-width,  
initial-scale=1">  
    <title>My Cables Project</title>  
    <style>  
        body { margin: 0; overflow: hidden; }  
        #cables-container { width: 100vw; height: 100vh; }  
    </style>  
</head>  
<body>  
    <div id="cables-container"></div>  
  
    <script src="js/cables.min.js"></script>  
    <script src="js/ops.js"></script>  
    <script>  
        CABLES.patch = new CABLES.Patch({  
            patchFile: 'js/patch.js',  
            prefixAssetPath: 'assets/',  
            glCanvasId: 'cables-container',  
            onFinishedLoading: function() {  
                console.log('Patch loaded!');  
            }  
        });  
    </script>  
</body>
```

```
</html>
```

11.4.2 Configuration Options

```
new CABLES.Patch({  
    patchFile: 'js/patch.js',  
    prefixAssetPath: 'assets/',  
    glCanvasId: 'myCanvas',  
    glCanvasResizeToWindow: true,  
    onFinishedLoading: callback,  
    onError: errorCallback,  
    variables: {  
        // Pass custom variables to the patch  
        customColor: '#ff0000',  
        userName: 'Guest'  
    }  
});
```

11.5 Communicating with Your Patch

11.5.1 Setting Variables from JavaScript

```
// Get the patch instance  
const patch = CABLES.patch;  
  
// Set a variable  
patch.setVariable('myValue', 42);  
patch.setVariable('myColor', [1, 0, 0, 1]);
```

11.5.2 Getting Values from the Patch

```
// Get a variable  
const value = patch.getVariable('myValue');  
  
// Listen for variable changes  
patch.on('variableChanged', function(name, value) {  
    console.log(name, 'changed to', value);  
});
```

11.5.3 Triggering Events

```
// Trigger an op  
patch.getOpById('YOUR_OP_ID').trigger();  
  
// Or use variables as triggers  
patch.setVariable('doSomething', true);
```

11.6 Advanced Embedding & Integration

When cables.gl becomes part of a larger website/app, you want the embed to be **robust**:

- correct sizing and device pixel ratio handling
- pause/resume behavior when the tab is hidden
- a clean integration API (events in, telemetry out)
- predictable asset paths across dev/staging/prod

11.6.1 Responsive Canvas: Beyond Width/Height

If you embed into dynamic layouts (resizable panels, CSS grid, etc.), treat resize as a first-class event:

- call your resize function on load
- call it on resize
- call it when layout changes (route changes, UI toggles, etc.)

11.6.2 Pausing When Not Visible

For performance and battery life, consider pausing expensive animation when the page is hidden:

```
document.addEventListener("visibilitychange", () => {  
  if (!window.CABLES || !CABLES.patch) return;  
  // Depending on your patch/runtime, you may gate updates via a  
  // variable:  
  CABLES.patch.setVariable("isVisible", !document.hidden);  
});
```

Then in your patch, use `isVisible` to reduce workload (lower particle count, skip effects, etc.).

11.6.3 postMessage Integration (iframe Control)

If you embed via iframe, `postMessage` is the clean way to send commands and data.

Parent page -> iframe:

```
const iframe = document.getElementById("cablesFrame");  
iframe.contentWindow.postMessage(  
  { type: "CABLES_SET", name: "myValue", value: 0.75 },  
  "*"  
);
```

Inside the exported patch wrapper page:

```
window.addEventListener("message", (event) => {  
  const msg = event.data;  
  if (!msg || !window.CABLES || !CABLES.patch) return;  
  
  if (msg.type === "CABLES_SET") {  
    CABLES.patch.setVariable(msg.name, msg.value);  
  }  
});
```

11.6.4 Environment-Specific Configuration (dev / test / prod)

Keep environment differences in **configuration**, not in the patch logic:

- dev: verbose logging, source maps, local asset path
- test/staging: production-like hosting + debug overlays
- prod: minified, caching enabled, stable URLs

Common patterns:

- query string flags: ?debug=1
- separate config.json loaded at runtime

- environment variables handled by the site that embeds the patch

11.6.5 Asset Path Gotchas

Most “works locally but not in prod” issues come down to:

- wrong prefixAssetPath
- case-sensitive paths on Linux hosts
- missing assets in the exported zip upload

If you deploy under a sub-path (e.g., <https://site.com/myproject/>), ensure all paths are relative or correctly prefixed.

11.7 Hosting Options

11.7.1 Static Hosting

Your exported patch is static files - host anywhere:

- **GitHub Pages** - Free, great for projects
- **Netlify** - Free tier, easy deployment
- **Vercel** - Free tier, automatic deploys
- **Amazon S3** - Scalable, pay-per-use
- **Any web server** - Apache, Nginx, etc.

11.7.2 GitHub Pages Deployment

```
# Create a gh-pages branch
git checkout -b gh-pages

# Add your exported files
git add .
git commit -m "Deploy cables patch"

# Push to GitHub
git push origin gh-pages
```

Enable GitHub Pages in repository settings.

11.7.3 Netlify Deployment

1. Connect your GitHub repository
2. Set build command: (none needed for static)
3. Set publish directory: / or your export folder
4. Deploy!

11.8 Embedding in Existing Websites

11.8.1 As a Background

```
<style>
  #cables-bg {
    position: fixed;
    top: 0;
    left: 0;
    width: 100%;
    height: 100%;
    z-index: -1;
  }
</style>
<canvas id="cables-bg"></canvas>
<script>
  CABLES.patch = new CABLES.Patch({
    patchFile: 'patch.js',
    glCanvasId: 'cables-bg'
  });
</script>
```

11.8.2 As a Hero Section

```
<section class="hero">
  <div id="cables-hero"></div>
  <div class="hero-content">
    <h1>Welcome</h1>
    <p>Your content here</p>
  </div>
</section>
```

11.8.3 Responsive Embedding

```
function resizeCables() {
  const container = document.getElementById('cables-container');
  container.style.width = window.innerWidth + 'px';
  container.style.height = window.innerHeight + 'px';

  // Notify cables of resize
  if (CABLES.patch) {
    CABLES.patch.cgl.setSize(window.innerWidth,
    window.innerHeight);
  }
}

window.addEventListener('resize', resizeCables);
resizeCables();
```

```
onLoadingProgress: function(percent) {
  document.getElementById('loader').style.width = percent +
  '%';
},
onFinishedLoading: function() {
  document.getElementById('loader').style.display = 'none';
}
});
```

11.9 Performance Optimization

11.9.1 Before Export

1. **Remove unused ops** - Clean up your patch
2. **Optimize textures** - Use appropriate sizes
3. **Reduce polygon count** - Simplify 3D models
4. **Minimize audio files** - Compress audio

11.9.2 Asset Optimization

Images: - Use WebP format when possible - Use power-of-2 dimensions - Compress with tools like TinyPNG

3D Models: - Use glTF/GLB format - Remove unnecessary detail - Use Draco compression

Audio: - Use MP3 or OGG - Compress appropriately - Consider streaming for long files

11.9.3 Loading Optimization

```
// Show loading progress
CABLES.patch = new CABLES.Patch({
  patchFile: 'patch.js',
```

11.10 Deployment Checklist (The Stuff That Breaks at the Worst Time)

Before you publish, run through this list:

- **Loading:** Do you show a loader/progress bar for heavy patches?
- **Autoplay policies:** If you use audio/video/webcam, do you require a user click?
- **Mobile sanity:** Does it run on a mid-tier phone without overheating?
- **Resize:** Does it handle orientation changes and dynamic layout resizing?
- **Asset paths:** Are all assets included and paths correct on a case-sensitive host?
- **Cache behavior:** Are you accidentally serving old JS after updates?
- **Console:** Is the browser console clean (no noisy logs, no repeated warnings)?

11.10.1 Cache Busting and Versioning

Static hosts cache aggressively. If you deploy a new version and still see the old one:

- add a version/hash to filenames (e.g. ops.v123.js)
- or configure cache headers (short cache for HTML, long cache for hashed assets)

11.10.2 MIME Types (Especially for Wasm / Binary Assets)

Some servers mis-serve file types. If a resource fails to load, check response headers:

- .wasm should be served as application/wasm
- .json as application/json

- textures as correct image mime types

11.10.3 CORS (Cross-Origin Assets)

If you load assets from another domain:

- ensure that server sends correct CORS headers
- prefer hosting assets alongside the patch when possible (simpler)

11.10.4 Content Security Policy (CSP)

If your patch is embedded into a site with strict CSP, you may need to allow:

- fetching assets from required domains
- media playback sources

When possible, avoid “unsafe-inline” and instead rely on your host app’s approved patterns.

11.11 CI/CD Ideas (Optional, But Great for Teams)

If you repeatedly export and deploy:

- treat the export zip as a build artifact
- deploy to staging on every change
- promote to prod when approved

Even a simple workflow that publishes static files to GitHub Pages can save time and reduce mistakes.

11.12 Offline/PWA

Make your patch work offline as a Progressive Web App:

11.12.1 manifest.json

```
{
  "name": "My Cables App",
  "short_name": "CablesApp",
  "start_url": "/",
}
```

```
"display": "standalone",
"background_color": "#000000",
"theme_color": "#000000",
"icons": [
  {
    "src": "icon-192.png",
    "sizes": "192x192",
    "type": "image/png"
  },
  {
    "src": "icon-512.png",
    "sizes": "512x512",
    "type": "image/png"
  }
]
```

11.12.2 Service Worker

```
// sw.js
const CACHE_NAME = 'cables-app-v1';
const urlsToCache = [
  '/',
  '/index.html',
  '/js/cables.min.js',
  '/js/ops.js',
  '/js/patch.js',
  // Add your assets
];

self.addEventListener('install', event => {
  event.waitUntil(
    caches.open(CACHE_NAME)
      .then(cache => cache.addAll(urlsToCache))
  );
});

self.addEventListener('fetch', event => {
  event.respondWith(
    caches.match(event.request)
      .then(response => response || fetch(event.request))
  );
});
```

11.13 Electron Desktop Applications

For a truly native desktop experience, you can package your cables.gl export as an Electron application. Electron allows you to create cross-platform desktop apps using web technologies, perfect for distributing your cables.gl creations as standalone applications.

11.13.1 Why Electron?

Advantages: - Native desktop experience (menus, system tray, notifications)
- Full file system access - Better performance control - No browser UI chrome
- Can work offline completely - Access to native OS APIs - Professional distribution via installers

Considerations: - Larger app size (~100-200MB) - Requires code signing for distribution - More complex build process - Platform-specific considerations

11.13.2 Getting Started with Electron

Project Structure

After exporting your cables.gl patch, set up an Electron project:

```
electron-app/
  +- package.json
  +- main.js          # Main Electron process
  +- preload.js       # Preload script (optional)
  +- renderer/
    |   +- index.html    # Your exported cables HTML
    |   +- js/
    |     +- cables.min.js
    |     +- ops.js
    |     +- patch.js
    |   +- assets/        # Your exported assets
  +- assets/
    |   +- icon.ico      # Windows icon
    |   +- icon.icns      # macOS icon
    |   +- icon.png       # Linux icon
  +- build/           # Build configuration
    +- mac/
    +- win/
    +- linux/
```

Initial Setup

package.json:

```
{
  "name": "my-cables-app",
  "version": "1.0.0",
  "description": "My Cables.gl Desktop App",
  "main": "main.js",
  "scripts": {
    "start": "electron .",
    "build": "electron-builder",
    "build:mac": "electron-builder --mac",
    "build:win": "electron-builder --win",
    "build:linux": "electron-builder --linux"
  },
  "build": {
    "appId": "com.yourcompany.cablesapp",
    "productName": "My Cables App",
    "directories": {
      "output": "dist"
    },
    "files": [
      "main.js",
      "preload.js",
      "renderer/**/*"
    ],
    "mac": {
      "icon": "assets/icon.icns",
      "category": "public.app-category.graphics-design"
    },
    "win": {
      "icon": "assets/icon.ico",
      "target": ["nsis", "portable"]
    },
    "linux": {
      "icon": "assets/icon.png",
      "target": ["AppImage", "deb"]
    }
  },
  "devDependencies": {
    "electron": "^28.0.0",
    "electron-builder": "^24.9.1"
  }
}
```

Install dependencies:

```
npm install --save-dev electron electron-builder
```

11.13.3 Main Process (main.js)

The main process controls the application lifecycle and creates windows:

```
const { app, BrowserWindow, Menu, ipcMain, dialog, shell } =
require('electron');
const path = require('path');
const fs = require('fs').promises;

// Keep a global reference of the window object
let mainWindow;
let splashWindow;

// Determine if we're in development
const isDev = process.env.NODE_ENV === 'development' ||
!app.isPackaged;

function createSplashWindow() {
  splashWindow = new BrowserWindow({
    width: 400,
    height: 300,
    frame: false,
    transparent: true,
    alwaysOnTop: true,
    resizable: false,
    webPreferences: {
      nodeIntegration: false,
      contextIsolation: true
    }
  });

  // Load splash screen HTML
  splashWindow.loadFile('splash.html');

  // Center the window
  splashWindow.center();

  return splashWindow;
}
```

```
}
}

function createMainWindow() {
  // Create the browser window
  mainWindow = new BrowserWindow({
    width: 1280,
    height: 720,
    minWidth: 800,
    minHeight: 600,
    show: false, // Don't show until ready
    frame: true,
    titleBarStyle: process.platform === 'darwin' ? 'hiddenInset' :
'default',
    backgroundColor: '#000000',
    icon: getIconPath(),
    webPreferences: {
      nodeIntegration: false, // Security: don't expose Node.js
      contextIsolation: true, // Security: isolate context
      preload: path.join(__dirname, 'preload.js'), // Preload script
      webSecurity: !isDev, // Disable in dev for easier debugging
      enableRemoteModule: false
    }
  });

  // Load your exported cables.gl patch
  if (isDev) {
    mainWindow.loadFile('renderer/index.html');
    // Open DevTools in development
    mainWindow.webContents.openDevTools();
  } else {
    mainWindow.loadFile(path.join(__dirname,
'renderer/index.html'));
  }

  // Show window when ready to prevent visual flash
  mainWindow.once('ready-to-show', () => {
    if (splashWindow) {
      splashWindow.close();
      splashWindow = null;
    }
    mainWindow.show();

    // Focus the window
    if (isDev) {
      mainWindow.focus();
    }
  });
}
```

```

// Handle window closed
mainWindow.on('closed', () => {
  mainWindow = null;
});

// Handle external links
mainWindow.webContents.setWindowOpenHandler(({ url }) => {
  shell.openExternal(url);
  return { action: 'deny' };
});

// Prevent navigation to external URLs
mainWindow.webContents.on('will-navigate', (event, navigationUrl)
=> {
  const parsedUrl = new URL(navigationUrl);

  if (parsedUrl.origin !== 'file://') {
    event.preventDefault();
    shell.openExternal(navigationUrl);
  }
});

return mainWindow;
}

function getIconPath() {
  if (process.platform === 'win32') {
    return path.join(__dirname, 'assets/icon.ico');
  } else if (process.platform === 'darwin') {
    return path.join(__dirname, 'assets/icon.icns');
  } else {
    return path.join(__dirname, 'assets/icon.png');
  }
}

function createMenu() {
  const template = [
    {
      label: 'File',
      submenu: [
        {
          label: 'Load Settings',
          accelerator: 'CmdOrCtrl+O',
          click: async () => {
            const result = await dialog.showOpenDialog(mainWindow, {
              properties: ['openFile'],
              filters: [
                { name: 'JSON Files', extensions: ['json'] },
              ]
            });
          }
        }
      ]
    }
  ];
}

```

```

        { name: 'All Files', extensions: ['*'] }
      ],
    });
  }

  if (!result.canceled && result.filePaths.length > 0) {
    mainWindow.webContents.send('load-settings',
    result.filePath);
  }
}

{
  label: 'Save Settings',
  accelerator: 'CmdOrCtrl+S',
  click: async () => {
    const result = await dialog.showSaveDialog(mainWindow, {
      filters: [
        { name: 'JSON Files', extensions: ['json'] },
        { name: 'All Files', extensions: ['*'] }
      ],
      defaultPath: 'settings.json'
    });

    if (!result.canceled) {
      mainWindow.webContents.send('save-settings',
      result.filePath);
    }
  }
},
{ type: 'separator' },
{
  label: 'Exit',
  accelerator: process.platform === 'darwin' ? 'Cmd+Q' :
  'Ctrl+Q',
  click: () => {
    app.quit();
  }
}
],
{
  label: 'Edit',
  submenu: [
    { role: 'undo', label: 'Undo' },
    { role: 'redo', label: 'Redo' },
    { type: 'separator' },
    { role: 'cut', label: 'Cut' },
    { role: 'copy', label: 'Copy' },
    { role: 'paste', label: 'Paste' },
  ]
}
];
}

```

```

        { role: 'selectAll', label: 'Select All' }
    ],
},
{
    label: 'View',
    submenu: [
        { role: 'reload', label: 'Reload' },
        { role: 'forceReload', label: 'Force Reload' },
        { role: 'toggleDevTools', label: 'Toggle Developer Tools' },
        { type: 'separator' },
        { role: 'resetZoom', label: 'Actual Size' },
        { role: 'zoomIn', label: 'Zoom In' },
        { role: 'zoomOut', label: 'Zoom Out' },
        { type: 'separator' },
        { role: 'togglefullscreen', label: 'Toggle Fullscreen' }
    ]
},
{
    label: 'Window',
    submenu: [
        { role: 'minimize', label: 'Minimize' },
        { role: 'close', label: 'Close' }
    ]
},
{
    label: 'Help',
    submenu: [
        {
            label: 'About',
            click: () => {
                dialog.showMessageBox(mainWindow, {
                    type: 'info',
                    title: 'About',
                    message: 'My Cables App',
                    detail: 'Version 1.0.0\nBuilt with cables.gl and
Electron'
                });
            }
        }
    ]
},
];
// macOS specific menu adjustments
if (process.platform === 'darwin') {
    template.unshift({
        label: app.getName(),
        submenu: [

```

```

        { role: 'about', label: 'About ' + app.getName() },
        { type: 'separator' },
        { role: 'services', label: 'Services' },
        { type: 'separator' },
        { role: 'hide', label: 'Hide ' + app.getName() },
        { role: 'hideOthers', label: 'Hide Others' },
        { role: 'unhide', label: 'Show All' },
        { type: 'separator' },
        { role: 'quit', label: 'Quit ' + app.getName() }
    ]);
}

// Window menu
template[4].submenu = [
    { role: 'close', label: 'Close' },
    { role: 'minimize', label: 'Minimize' },
    { role: 'zoom', label: 'Zoom' },
    { type: 'separator' },
    { role: 'front', label: 'Bring All to Front' }
];
}

const menu = Menu.buildFromTemplate(template);
Menu.setApplicationMenu(menu);
}

// IPC Handlers for inter-process communication
function setupIpcHandlers() {
    // Handle file reading
    ipcMain.handle('read-file', async (event, filePath) => {
        try {
            const data = await fs.readFile(filePath, 'utf-8');
            return { success: true, data: JSON.parse(data) };
        } catch (error) {
            return { success: false, error: error.message };
        }
    });
}

// Handle file writing
ipcMain.handle('write-file', async (event, filePath, data) => {
    try {
        await fs.writeFile(filePath, JSON.stringify(data, null, 2),
'utf-8');
        return { success: true };
    } catch (error) {
        return { success: false, error: error.message };
    }
});
}
```

```

// Get app version
ipcMain.handle('get-app-version', () => {
  return app.getVersion();
});

// Get user data path
ipcMain.handle('get-user-data-path', () => {
  return app.getPath('userData');
});

// Window control
ipcMain.on('window-minimize', () => {
  if (mainWindow) mainWindow.minimize();
});

ipcMain.on('window-maximize', () => {
  if (mainWindow) {
    if (mainWindow.isMaximized()) {
      mainWindow.unmaximize();
    } else {
      mainWindow.maximize();
    }
  }
});

ipcMain.on('window-close', () => {
  if (mainWindow) mainWindow.close();
});

// App event handlers
app.whenReady().then(() => {
  // Create splash screen
  createSplashWindow();

  // Create main window after a short delay (simulate loading)
  setTimeout(() => {
    createMainWindow();
    createMenu();
    setupIpcHandlers();
  }, 1500);

  app.on('activate', () => {
    // On macOS, re-create window when dock icon is clicked
    if (BrowserWindow.getAllWindows().length === 0) {
      createMainWindow();
    }
  });
});

```

```

  });

  app.on('window-all-closed', () => {
    // On macOS, keep app running even when all windows are closed
    if (process.platform !== 'darwin') {
      app.quit();
    }
  });

  // Security: Prevent new window creation
  app.on('web-contents-created', (event, contents) => {
    contents.on('new-window', (event, navigationUrl) => {
      event.preventDefault();
      shell.openExternal(navigationUrl);
    });
  });
}

```

11.13.4 Preload Script (preload.js)

The preload script safely exposes Node.js APIs to the renderer process:

```

const { contextBridge, ipcRenderer } = require('electron');

// Expose protected methods that allow the renderer process
// to use ipcRenderer without exposing the entire object
contextBridge.exposeInMainWorld('electronAPI', {
  // File operations
  readFile: (filePath) => ipcRenderer.invoke('read-file', filePath),
  writeFile: (filePath, data) => ipcRenderer.invoke('write-file',
  filePath, data),

  // App info
  getAppVersion: () => ipcRenderer.invoke('get-app-version'),
  getUserDataPath: () => ipcRenderer.invoke('get-user-data-path'),

  // Window control
  minimizeWindow: () => ipcRenderer.send('window-minimize'),
  maximizeWindow: () => ipcRenderer.send('window-maximize'),
  closeWindow: () => ipcRenderer.send('window-close'),

  // Listen for messages from main process
  onLoadSettings: (callback) => {

```

```

    ipcRenderer.on('load-settings', (event, filePath) =>
callback(filePath));
},
onSaveSettings: (callback) => {
    ipcRenderer.on('save-settings', (event, filePath) =>
callback(filePath));
},
// Remove listeners
removeAllListeners: (channel) => {
    ipcRenderer.removeAllListeners(channel);
}
});

```

11.13.5 Advanced Window Configuration

Window Options Deep Dive

```

const mainWindow = new BrowserWindow({
// Size and position
width: 1280,
height: 720,
minWidth: 800,
minHeight: 600,
maxWidth: 3840,
maxHeight: 2160,
x: undefined, // Center if undefined
y: undefined,
center: true, // Center on screen

// Appearance
frame: true, // Show window frame
titleBarStyle: 'default', // 'default', 'hidden', 'hiddenInset',
'customButtonsOnHover'
transparent: false, // Transparent window (performance impact)
backgroundColor: '#000000', // Background color before content
loads
opacity: 1.0, // Window opacity (0.0 to 1.0)
vibrancy: 'ultra-dark', // macOS only: 'appearance-based',
'light', 'dark', etc.
visualEffectState: 'active', // macOS only: 'active', 'inactive',
'followsWindowActiveState'

// Behavior
show: false, // Don't show until ready

```

```

alwaysOnTop: false, // Keep window on top
fullscreen: false, // Start in fullscreen
fullscreenable: true, // Allow fullscreen
simpleFullscreen: false, // macOS simple fullscreen
skipTaskbar: false, // Don't show in taskbar
kiosk: false, // Kiosk mode (fullscreen, no exit)
closable: true, // Allow closing
minimizable: true, // Allow minimizing
maximizable: true, // Allow maximizing
resizable: true, // Allow resizing
movable: true, // Allow moving
focusable: true, // Can receive focus

// Window state
autoHideMenuBar: false, // Auto-hide menu bar
useContentSize: false, // Use content size instead of window size
title: 'My Cables App', // Window title

// Icon
icon: getIconPath(), // Window icon

// Web preferences
webPreferences: {
    nodeIntegration: false,
    contextIsolation: true,
    preload: path.join(__dirname, 'preload.js'),
    webSecurity: true,
    allowRunningInsecureContent: false,
    experimentalFeatures: false,
    enableBlinkFeatures: '',
    disableBlinkFeatures: '',
    sandbox: false, // Enable sandbox for extra security
    enableRemoteModule: false,
    backgroundThrottling: true, // Throttle when backgrounded
    offscreen: false, // Use offscreen rendering
    webviewTag: false // Disable webview tag
})
});
```

Window State Persistence

Save and restore window position and size:

```
const Store = require('electron-store');
```

```

const store = new Store({
  name: 'window-state',
  defaults: {
    width: 1280,
    height: 720,
    x: undefined,
    y: undefined,
    isMaximized: false
  }
});

function createMainWindow() {
  const windowState = store.get('windowState', {});

  const mainWindow = new BrowserWindow({
    width: windowState.width || 1280,
    height: windowState.height || 720,
    x: windowState.x,
    y: windowState.y,
    // ... other options
  });

  // Restore maximized state
  if (windowState.isMaximized) {
    mainWindow.maximize();
  }

  // Save window state on move/resize
  const saveWindowState = () => {
    const bounds = mainWindow.getBounds();
    store.set('windowState', {
      width: bounds.width,
      height: bounds.height,
      x: bounds.x,
      y: bounds.y,
      isMaximized: mainWindow.isMaximized()
    });
  };

  mainWindow.on('moved', saveWindowState);
  mainWindow.on('resized', saveWindowState);
  mainWindow.on('maximize', () => {
    store.set('windowState.isMaximized', true);
  });
  mainWindow.on('unmaximize', () => {
    store.set('windowState.isMaximized', false);
  });
}

```

```

    return mainWindow;
}

```

Install electron-store:

```
npm install electron-store
```

11.13.6 Inter-Window Communication

Electron supports multiple windows with various communication patterns:

Method 1: IPC (Inter-Process Communication)

Main Process -> Renderer Process:

```

// In main.js
mainWindow.webContents.send('message-from-main', {
  type: 'update',
  data: { value: 42 }
});

// In renderer (index.html or your cables patch)
window.electronAPI.onMessage((data) => {
  console.log('Received:', data);
});

```

Renderer Process -> Main Process:

```

// In preload.js
contextBridge.exposeInMainWorld('electronAPI', {
  sendToMain: (channel, data) => {
    ipcRenderer.send(channel, data);
  },
  onMessage: (callback) => {
    ipcRenderer.on('message-from-main', (event, data) =>
      callback(data));
  }
});

```

```
// In renderer
window.electronAPI.sendToMain('message-from-renderer', {
  action: 'save',
  data: { settings: {...} }
});
```

Method 2: Multiple Windows Communication

```
// In main.js
let windows = [];

function createWindow(id) {
  const window = new BrowserWindow({
    // ... window options
    webPreferences: {
      // ... web preferences
    }
  });

  window.id = id;
  windows.push(window);

  window.on('closed', () => {
    windows = windows.filter(w => w.id !== id);
  });

  return window;
}

// Broadcast to all windows
function broadcastToAllWindows(channel, data) {
  windows.forEach(window => {
    if (window && !window.isDestroyed()) {
      window.webContents.send(channel, data);
    }
  });
}

// Send to specific window
function sendToWindow(windowId, channel, data) {
  const window = windows.find(w => w.id === windowId);
  if (window && !window.isDestroyed()) {
    window.webContents.send(channel, data);
  }
}
```

```
// Example: Sync settings across windows
ipcMain.on('update-settings', (event, settings) => {
  // Save settings
  store.set('settings', settings);

  // Broadcast to all windows
  broadcastToAllWindows('settings-updated', settings);
});
```

Method 3: Shared Data via Main Process

```
// In main.js
let sharedData = {
  settings: {},
  state: {}
};

// Get shared data
ipcMain.handle('get-shared-data', (event, key) => {
  return sharedData[key];
});

// Set shared data
ipcMain.handle('set-shared-data', (event, key, value) => {
  sharedData[key] = value;
  // Notify all windows
  broadcastToAllWindows('shared-data-changed', { key, value });
  return true;
});
```

Method 4: Window-to-Window via Main Process

```
// Window A sends message to Window B
ipcMain.on('send-to-window', (event, targetWindowId, channel, data) => {
  sendToWindow(targetWindowId, channel, data);
});

// In preload.js
contextBridge.exposeInMainWorld('electronAPI', {
  sendToWindow: (targetWindowId, channel, data) => {
    ipcRenderer.send('send-to-window', targetWindowId, channel, data);
  }
});
```

```

},
onWindowMessage: (callback) => {
  ipcRenderer.on('window-message', (event, data) =>
  callback(data));
}
});

```

11.13.7 Splash Screen Implementation

A professional splash screen improves perceived performance:

splash.html:

```

<!DOCTYPE html>
<html>
<head>
  <meta charset="UTF-8">
  <style>
    * {
      margin: 0;
      padding: 0;
      box-sizing: border-box;
    }

    body {
      width: 400px;
      height: 300px;
      background: linear-gradient(135deg, #667eea 0%, #764ba2 100%);
      display: flex;
      flex-direction: column;
      justify-content: center;
      align-items: center;
      font-family: -apple-system, BlinkMacSystemFont, 'Segoe UI',
      Roboto, sans-serif;
      color: white;
      overflow: hidden;
    }

    .logo {
      width: 80px;
      height: 80px;
      margin-bottom: 20px;
      animation: pulse 2s ease-in-out infinite;
    }
  </style>
</head>

```

```

  @keyframes pulse {
    0%, 100% { transform: scale(1); opacity: 1; }
    50% { transform: scale(1.1); opacity: 0.8; }
  }

  .app-name {
    font-size: 24px;
    font-weight: 600;
    margin-bottom: 10px;
  }

  .version {
    font-size: 12px;
    opacity: 0.8;
    margin-bottom: 30px;
  }

  .loader {
    width: 200px;
    height: 4px;
    background: rgba(255, 255, 255, 0.2);
    border-radius: 2px;
    overflow: hidden;
    position: relative;
  }

  .loader-bar {
    height: 100%;
    background: white;
    width: 0%;
    animation: loading 2s ease-in-out infinite;
    border-radius: 2px;
  }

  @keyframes loading {
    0% { width: 0%; }
    50% { width: 70%; }
    100% { width: 100%; }
  }

  .status {
    margin-top: 20px;
    font-size: 12px;
    opacity: 0.7;
  }
</style>
</head>

```

```

<body>
  <div class="logo">
    <!-- Your logo SVG or image -->
    <svg viewBox="0 0 100 100" fill="white">
      <circle cx="50" cy="50" r="40" stroke="white" stroke-width="2" fill="none"/>
      <path d="M30 50 L45 65 L70 35" stroke="white" stroke-width="3" fill="none"/>
    </svg>
  </div>
  <div class="app-name">My Cables App</div>
  <div class="version">Version 1.0.0</div>
  <div class="loader">
    <div class="loader-bar"></div>
  </div>
  <div class="status" id="status">Loading...</div>

  <script>
    // Update status from main process
    const { ipcRenderer } = require('electron');

    ipcRenderer.on('splash-status', (event, message) => {
      document.getElementById('status').textContent = message;
    });

    ipcRenderer.on('splash-progress', (event, percent) => {
      document.querySelector('.loader-bar').style.width = percent + '%';
    });
  </script>
</body>
</html>

```

Enhanced main.js with splash screen:

```

function createSplashWindow() {
  splashWindow = new BrowserWindow({
    width: 400,
    height: 300,
    frame: false,
    transparent: true,
    alwaysOnTop: true,
    resizable: false,
    webPreferences: {
      nodeIntegration: true, // Needed for splash screen
      contextIsolation: false
    }
  });
}

```

```

  });
}

splashWindow.loadFile('splash.html');
splashWindow.center();

// Update splash screen status
const updateSplashStatus = (message) => {
  if (splashWindow && !splashWindow.isDestroyed()) {
    splashWindow.webContents.send('splash-status', message);
  }
};

const updateSplashProgress = (percent) => {
  if (splashWindow && !splashWindow.isDestroyed()) {
    splashWindow.webContents.send('splash-progress', percent);
  }
};

// Simulate loading progress
updateSplashStatus('Initializing...');

setTimeout(() => {
  updateSplashStatus('Loading assets...');

  updateSplashProgress(40);
}, 300);

setTimeout(() => {
  updateSplashStatus('Preparing renderer...');

  updateSplashProgress(70);
}, 800);

setTimeout(() => {
  updateSplashStatus('Almost ready...');

  updateSplashProgress(90);
}, 1200);

return { splashWindow, updateSplashStatus, updateSplashProgress };
}

// In app.whenReady()
app.whenReady().then(() => {
  const { splashWindow: splash, updateSplashStatus } =
createSplashWindow();

  updateSplashStatus('Creating main window...');
}

```

```

setTimeout(() => {
  createMainWindow();
  createMenu();
  setupIpcHandlers();

  // Close splash when main window is ready
  mainWindow.once('ready-to-show', () => {
    setTimeout(() => {
      if (splash && !splash.isDestroyed()) {
        splash.close();
      }
      mainWindow.show();
    }, 500); // Small delay for smooth transition
  });
}, 1500);
});

```

11.13.8 JSON File Operations

Saving and loading JSON data is essential for app settings, user preferences, and state persistence:

Method 1: Using IPC Handlers (Recommended)

In `main.js`:

```

const fs = require('fs').promises;
const path = require('path');

// Get user data directory
const getUserDataPath = () => {
  return app.getPath('userData');
};

// Ensure directory exists
async function ensureDirectory(dirPath) {
  try {
    await fs.mkdir(dirPath, { recursive: true });
  } catch (error) {
    console.error('Error creating directory:', error);
  }
}

```

```

// IPC Handlers for JSON operations
ipcMain.handle('save-json', async (event, filename, data) => {
  try {
    const userDataPath = getUserDataPath();
    const filePath = path.join(userDataPath, filename);

    await ensureDirectory(path.dirname(filePath));
    await fs.writeFile(filePath, JSON.stringify(data, null, 2), 'utf-8');

    return { success: true, path: filePath };
  } catch (error) {
    console.error('Error saving JSON:', error);
    return { success: false, error: error.message };
  }
});

ipcMain.handle('load-json', async (event, filename) => {
  try {
    const userDataPath = getUserDataPath();
    const filePath = path.join(userDataPath, filename);

    const data = await fs.readFile(filePath, 'utf-8');
    return { success: true, data: JSON.parse(data) };
  } catch (error) {
    if (error.code === 'ENOENT') {
      // File doesn't exist, return default
      return { success: true, data: null };
    }
    console.error('Error loading JSON:', error);
    return { success: false, error: error.message };
  }
});

ipcMain.handle('delete-json', async (event, filename) => {
  try {
    const userDataPath = getUserDataPath();
    const filePath = path.join(userDataPath, filename);

    await fs.unlink(filePath);
    return { success: true };
  } catch (error) {
    if (error.code === 'ENOENT') {
      return { success: true }; // Already deleted
    }
    console.error('Error deleting JSON:', error);
    return { success: false, error: error.message };
  }
});

```

```

});  
  

ipcMain.handle('list-json-files', async (event, directory = '') => {
  try {
    const userDataPath = getUserDataPath();
    const dirPath = path.join(userDataPath, directory);  
  

    const files = await fs.readdir(dirPath);
    const jsonFiles = files.filter(file => file.endsWith('.json'));  
  

    return { success: true, files: jsonFiles };
  } catch (error) {
    console.error('Error listing JSON files:', error);
    return { success: false, error: error.message };
  }
});

```

In preload.js:

```

contextBridge.exposeInMainWorld('electronAPI', {
  // JSON file operations
  saveJSON: async (filename, data) => {
    return await ipcRenderer.invoke('save-json', filename, data);
  },
  
  

  loadJSON: async (filename) => {
    return await ipcRenderer.invoke('load-json', filename);
  },
  
  

  deleteJSON: async (filename) => {
    return await ipcRenderer.invoke('delete-json', filename);
  },
  
  

  listJSONFiles: async (directory = '') => {
    return await ipcRenderer.invoke('list-json-files', directory);
  }
});

```

In your renderer (cables patch or HTML):

```

// Save settings
async function saveSettings(settings) {

```

```

  const result = await window.electronAPI.saveJSON('settings.json', settings);
  if (result.success) {
    console.log('Settings saved to:', result.path);
  } else {
    console.error('Failed to save settings:', result.error);
  }
}  
  

// Load settings
async function loadSettings() {
  const result = await window.electronAPI.loadJSON('settings.json');
  if (result.success) {
    if (result.data) {
      console.log('Settings loaded:', result.data);
      return result.data;
    } else {
      // Return default settings
      return getDefaultSettings();
    }
  } else {
    console.error('Failed to load settings:', result.error);
    return getDefaultSettings();
  }
}  
  

// Example usage with cables.gl patch
async function initializeApp() {
  // Load saved settings
  const settings = await loadSettings();  
  

  // Apply settings to cables patch
  if (window.CABLES && window.CABLES.patch) {
    Object.keys(settings).forEach(key => {
      window.CABLES.patch.setVariable(key, settings[key]);
    });
  }
  
  

  // Listen for settings changes and auto-save
  if (window.CABLES && window.CABLES.patch) {
    window.CABLES.patch.on('variableChanged', async (name, value) =>
    {
      const currentSettings = await loadSettings();
      currentSettings[name] = value;
      await saveSettings(currentSettings);
    });
  }
}

```

```

// Save cables patch state
async function savePatchState() {
  if (!window.CABLES || !window.CABLES.patch) return;

  const state = {
    timestamp: new Date().toISOString(),
    variables: {},
    camera: {
      position: window.CABLES.patch.cgl?.camera?.position || null,
      rotation: window.CABLES.patch.cgl?.camera?.rotation || null
    }
  };

  // Save all variables
  // (You'll need to track variable names or get them from your
  patch)
  const variableNames = ['color', 'speed', 'intensity']; // Your
  variable names
  variableNames.forEach(name => {
    state.variables[name] = window.CABLES.patch.getVariable(name);
  });

  await window.electronAPI.saveJSON('patch-state.json', state);
}

// Load patch state
async function loadPatchState() {
  const result = await
  window.electronAPI.loadJSON('patch-state.json');
  if (result.success && result.data) {
    const state = result.data;

    // Restore variables
    Object.keys(state.variables).forEach(name => {
      window.CABLES.patch.setVariable(name, state.variables[name]);
    });

    // Restore camera if available
    if (state.camera && window.CABLES.patch.cgl?.camera) {
      // Camera restoration depends on your cables setup
    }
  }
}

```

Method 2: Using electron-store (Simpler)

```
npm install electron-store
```

```

// In main.js
const Store = require('electron-store');

const store = new Store({
  name: 'app-settings',
  defaults: {
    theme: 'dark',
    windowState: {
      width: 1280,
      height: 720
    },
    cablesSettings: {
      color: [1, 0, 0, 1],
      speed: 1.0
    }
  }
});

// Expose store to renderer
ipcMain.handle('store-get', (event, key) => {
  return store.get(key);
});

ipcMain.handle('store-set', (event, key, value) => {
  store.set(key, value);
  return true;
});

ipcMain.handle('store-delete', (event, key) => {
  store.delete(key);
  return true;
});

ipcMain.handle('store-clear', () => {
  store.clear();
  return true;
});

ipcMain.handle('store-all', () => {
  return store.store;
});

```

```
// In preload.js
contextBridge.exposeInMainWorld('electronAPI', {
  store: {
    get: (key) => ipcRenderer.invoke('store-get', key),
    set: (key, value) => ipcRenderer.invoke('store-set', key, value),
    delete: (key) => ipcRenderer.invoke('store-delete', key),
    clear: () => ipcRenderer.invoke('store-clear'),
    all: () => ipcRenderer.invoke('store-all')
  }
});
```

```
// In renderer
// Get setting
const theme = await window.electronAPI.store.get('theme');

// Set setting
await window.electronAPI.store.set('cablesSettings.color', [0, 1, 0, 1]);

// Get all settings
const allSettings = await window.electronAPI.store.all();
```

11.13.9 Code Signing for Distribution

Code signing is essential for smooth app distribution on macOS and Windows. Unsigned apps trigger security warnings and may be blocked.

macOS Code Signing

Requirements: - Apple Developer Account (\$99/year) - Valid code signing certificate - Notarization (required for macOS 10.15+)

package.json configuration:

```
{
  "build": {
    "appId": "com.yourcompany.cablesapp",
    "mac": {
```

```
"icon": "assets/icon.icns",
"category": "public.app-category.graphics-design",
"target": [
  {
    "target": "dmg",
    "arch": ["x64", "arm64"]
  },
  {
    "target": "zip",
    "arch": ["x64", "arm64"]
  }
],
"hardenedRuntime": true,
"gatekeeperAssess": false,
"entitlements": "build/mac/entitlements.mac.plist",
"entitlementsInherit": "build/mac/entitlements.mac.plist"
},
"afterSign": "scripts/notarize.js",
"notarize": {
  "teamId": "YOUR_TEAM_ID"
}
}
```

entitlements.mac.plist:

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE plist PUBLIC "-//Apple//DTD PLIST 1.0//EN"
"http://www.apple.com/DTDs/PropertyList-1.0.dtd">
<plist version="1.0">
<dict>
  <key>com.apple.security.cs.allow-jit</key>
  <true/>
  <key>com.apple.security.cs.allow-unsigned-executable-memory</key>
  <true/>
  <key>com.apple.security.cs.allow-dyld-environment-variables</key>
  <true/>
  <key>com.apple.security.cs.disable-library-validation</key>
  <true/>
</dict>
</plist>
```

scripts/notarize.js:

```

const { notarize } = require('@electron/notarize');

exports.default = async function notarizing(context) {
  const { electronPlatformName, appOutDir } = context;

  if (electronPlatformName !== 'darwin') {
    return;
  }

  const appName = context.packager.appInfo.productFilename;

  return await notarize({
    AppBundleId: 'com.yourcompany.cablesapp',
    appPath: `${appOutDir}/${appName}.app`,
    appleId: process.env.APPLE_ID,
    appleIdPassword: process.env.APPLE_ID_PASSWORD,
    teamId: process.env.APPLE_TEAM_ID
  });
};

```

Environment variables (.env or export):

```

export APPLE_ID="your@email.com"
export APPLE_ID_PASSWORD="app-specific-password"
export APPLE_TEAM_ID="YOUR_TEAM_ID"

```

Build command:

```
npm run build:mac
```

Windows Code Signing

Requirements: - Code signing certificate (purchased from certificate authority) - Or use self-signed certificate for testing (not recommended for distribution)

package.json configuration:

```

{
  "build": {
    "win": {
      "icon": "assets/icon.ico",
      "target": [
        {
          "target": "nsis",
          "arch": ["x64", "ia32"]
        },
        {
          "target": "portable",
          "arch": ["x64"]
        }
      ],
      "signingHashAlgorithms": ["sha256"],
      "sign": "build/win/sign.js",
      "certificateFile": "path/to/certificate.pfx",
      "certificatePassword": "${env.CERTIFICATE_PASSWORD}"
    }
  }
}

```

build/win/sign.js:

```

const path = require('path');

exports.default = async function(configuration) {
  const { path: filePath } = configuration;

  // Only sign on Windows
  if (process.platform !== 'win32') {
    return;
  }

  // Use electron-builder's built-in signing
  // Or use signtool directly
  const { execSync } = require('child_process');

  const certPath = process.env.CERTIFICATE_PATH;
  const certPassword = process.env.CERTIFICATE_PASSWORD;

  if (!certPath || !certPassword) {
    console.warn('Certificate not configured, skipping signing');
    return;
  }
}

```

```

try {
  execSync(
    `signtool sign /f "${certPath}" /p "${certPassword}" /t
http://timestamp.digicert.com /d "My Cables App" "${filePath}"`,
    { stdio: 'inherit' }
  );
} catch (error) {
  console.error('Signing failed:', error);
  throw error;
}
};

```

Alternative: Using electron-builder's built-in signing:

```

{
  "build": {
    "win": {
      "certificateFile": "path/to/certificate.pfx",
      "certificatePassword": "${env.CERTIFICATE_PASSWORD}",
      "signingHashAlgorithms": ["sha256"],
      "signDlgs": true
    }
  }
}

```

Build command:

```
npm run build:win
```

App Registration and Metadata

package.json - Complete build configuration:

```

{
  "name": "my-cables-app",
  "version": "1.0.0",
  "description": "My amazing Cables.gl application",
  "author": {
    "name": "Your Name",
    "email": "your@email.com"
  },
  "license": "MIT",
  "main": "main.js",
  "build": {
    "appId": "com.yourcompany.cablesapp",
    "productName": "My Cables App",
    "copyright": "Copyright © 2024 Your Company",
    "directories": {
      "output": "dist",
      "buildResources": "build"
    },
    "files": [
      "main.js",
      "preload.js",
      "renderer/**/*",
      "!renderer/**/*.map"
    ],
    "extraResources": [
      {
        "from": "assets/",
        "to": "assets/",
        "filter": ["**/*"]
      }
    ],
    "mac": {
      "icon": "assets/icon.icns",
      "category": "public.app-category.graphics-design",
      "minimumSystemVersion": "10.13",
      "darkModeSupport": true,
      "target": [
        {
          "target": "dmg",
          "arch": ["x64", "arm64"]
        }
      ],
      "hardenedRuntime": true,
      "entitlements": "build/mac/entitlements.mac.plist",
      "entitlementsInherit": "build/mac/entitlements.mac.plist"
    },
    "win": {
      "icon": "assets/icon.ico",
      "target": [
        {
          "target": "nsis",
          "arch": ["x64"]
        }
      ]
    }
  }
}

```

```

],
"publisherName": "Your Company Name",
"verifyUpdateCodeSignature": false
},
"linux": {
  "icon": "assets/icon.png",
  "target": [
    {
      "target": "AppImage",
      "arch": ["x64"]
    },
    {
      "target": "deb",
      "arch": ["x64"]
    }
  ],
  "category": "Graphics"
},
"nsis": {
  "oneClick": false,
  "allowToChangeInstallationDirectory": true,
  "createDesktopShortcut": true,
  "createStartMenuShortcut": true,
  "shortcutName": "My Cables App"
},
"dmg": {
  "title": "${productName} ${version}",
  "icon": "assets/icon.icns",
  "background": "build/mac/dmg-background.png",
  "contents": [
    {
      "x": 410,
      "y": 150,
      "type": "link",
      "path": "/Applications"
    },
    {
      "x": 130,
      "y": 150,
      "type": "file"
    }
  ],
  "window": {
    "width": 540,
    "height": 380
  }
}
}

```

```
}
```

11.13.10 Building and Distributing

Development Build

```
# Start in development mode
npm start
```

Production Build

```
# Build for current platform
npm run build

# Build for specific platforms
npm run build:mac
npm run build:win
npm run build:linux

# Build for all platforms (requires platform-specific tools)
npm run build:all
```

Distribution Checklist

Before Building: - [] Update version in package.json - [] Test app thoroughly - [] Optimize assets - [] Prepare code signing certificates - [] Set up environment variables - [] Test on target platforms

After Building: - [] Test installer on clean system - [] Verify code signing - [] Test auto-updater (if implemented) - [] Check file associations - [] Verify menu items work - [] Test file operations - [] Check window state persistence

11.13.11 Advanced Electron Features

Auto-Updater

```
npm install electron-updater
```

```
// In main.js
const { autoUpdater } = require('electron-updater');

autoUpdater.checkForUpdatesAndNotify();

autoUpdater.on('update-available', () => {
  dialog.showMessageBox(mainWindow, {
    type: 'info',
    title: 'Update Available',
    message: 'A new version is available. It will be downloaded in the background.',
    buttons: ['OK']
  });
});

autoUpdater.on('update-downloaded', () => {
  dialog.showMessageBox(mainWindow, {
    type: 'info',
    title: 'Update Ready',
    message: 'Update downloaded. The application will restart to apply the update.',
    buttons: ['Restart Now', 'Later']
  }).then(result => {
    if (result.response === 0) {
      autoUpdater.quitAndInstall();
    }
  });
});
```

System Tray

```
const { Tray, Menu } = require('electron');
const path = require('path');

let tray = null;

function createTray() {
  const iconPath = path.join(__dirname, 'assets', 'tray-icon.png');
  tray = new Tray(iconPath);

  const contextMenu = Menu.buildFromTemplate([
    {
      label: 'Show App',
      click: () => {
        mainWindow.show();
      }
    }
  ]);
}

function startTray() {
  createTray();
}
```

```
  },
  [
    {
      label: 'Quit',
      click: () => {
        app.quit();
      }
    }
  ]);
}

tray.setToolTip('My Cables App');
tray.setContextMenu(contextMenu);

tray.on('click', () => {
  mainWindow.isVisible() ? mainWindow.hide() : mainWindow.show();
});
```

Native Notifications

```
const { Notification } = require('electron');

function showNotification(title, body) {
  if (Notification.isSupported()) {
    new Notification({
      title: title,
      body: body,
      icon: getIconPath()
    }).show();
  }
}
```

11.13.12 Performance Optimization for Electron

- Disable Node Integration in Renderer** - Use contextBridge instead
- Enable Context Isolation** - Better security and performance
- Use Hardware Acceleration** - Enabled by default
- Optimize Asset Loading** - Lazy load when possible
- Throttle Background Processes** - Use backgroundThrottling: true
- Monitor Memory Usage** - Use DevTools memory profiler

11.13.13 Security Best Practices

1. **Never use nodeIntegration: true** - Use preload scripts instead
2. **Always use contextIsolation: true** - Isolates your code
3. **Validate all IPC messages** - Don't trust renderer input
4. **Use Content Security Policy** - Restrict resource loading
5. **Keep Electron updated** - Security patches are important
6. **Sanitize file paths** - Prevent directory traversal attacks

11.13.14 Troubleshooting Electron Issues

App won't start: - Check main.js for syntax errors - Verify all dependencies are installed - Check console for error messages

Window is blank: - Verify file paths are correct - Check DevTools for errors - Ensure renderer files are included in build

Code signing fails: - Verify certificate is valid - Check environment variables are set - Ensure certificate password is correct

App is slow: - Check for memory leaks - Optimize asset loading - Use performance profiling tools

11.14 Troubleshooting

11.14.1 Common Issues

"Assets not loading" - Check file paths are correct - Ensure CORS headers are set for cross-origin assets - Verify assets are included in export

"Blank screen" - Check browser console for errors - Verify all JavaScript files loaded - Test on a local server (not file://)

"Poor performance" - Reduce canvas resolution - Lower texture sizes - Simplify shaders - Check for memory leaks

"Works locally but not on server" - Check file paths (case-sensitive on Linux) - Verify all files uploaded - Check server MIME types

11.15 Featured Videos



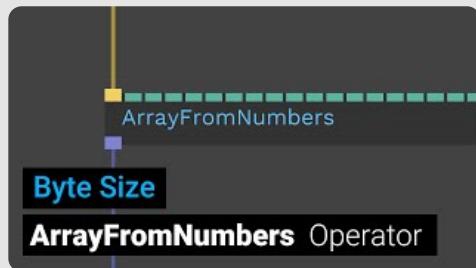
<https://youtu.be/hVrxXhH7vQ>
Cables.gl Standalone (Offline) Build: Create Without Limits!
by Decode GL

11.16 Exercises

1. Export a simple patch and host it on GitHub Pages
2. Embed a cables patch as a website background
3. Create a loading screen for your patch
4. Set up communication between your patch and external JavaScript
5. **Electron Exercise:** Package your cables.gl export as an Electron app with a custom splash screen
6. **Electron Exercise:** Implement JSON save/load functionality to persist your patch settings
7. **Electron Exercise:** Set up code signing for macOS or Windows (requires developer account/certificate)
8. **Electron Exercise:** Create a multi-window Electron app with inter-window communication
9. **Electron Exercise:** Implement window state persistence (save/restore window position and size)
10. **Electron Exercise:** Add a system tray icon with context menu for your Electron app

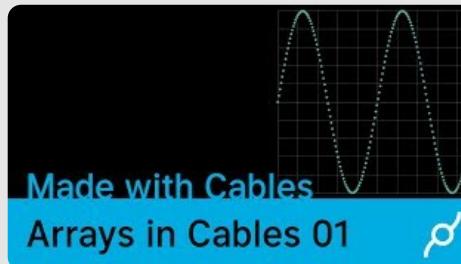
12 Video Tutorials

12.1 Getting Started & Overviews



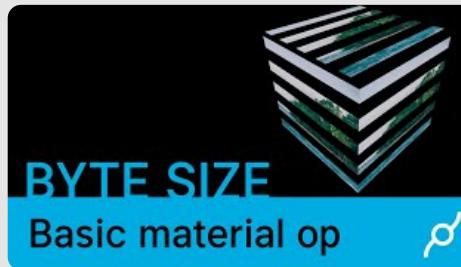
<https://youtu.be/iXKo7mU422M>

Array from Numbers Operator tutorial - byte size
by cables_gl



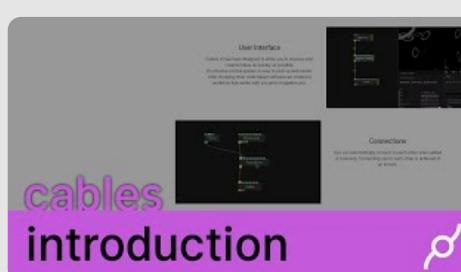
<https://youtu.be/FRFfVgWFcs>

Arrays in cables tutorial 01
by cables_gl



<https://youtu.be/F-CUdHq40Pc>

Basic material op tutorial - Byte size
by cables_gl



<https://youtu.be/EPFNHYah9F4>

cables gl introduction
by cables_gl



<https://youtu.be/MOdVmJ6MYQE>

Creating your own cables.gl operators - custom and user ops tutorial
by cables_gl



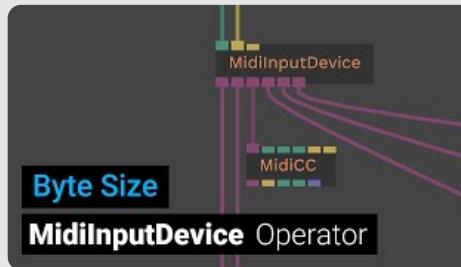
<https://youtu.be/7xlElfMWgw>

MeshInstancer tutorial 01
by cables_gl



<https://youtu.be/EzV5CRAMyTA>

Depth texture op tutorial - Byte size
by cables_gl



<https://youtu.be/XvVBnPakE28>

Midi Input Device - intro to MIDI in cables - Byte Size
by cables_gl



<https://youtu.be/knGnukutZeM>

Lights and Shadows Operators - getting started - Video Tutorial
by cables_gl



<https://youtu.be/Ds4fPcxyBvM>

Noise Texture Operator for generating color palettes for various design techniques - Video Tutorial
by cables_gl



<https://youtu.be/P6esDOFM6w>
Particle system in cables tutorial 01
by cables_gl



<https://youtu.be/Nre7LH0OVw4>
Particle system in cables tutorial 02
by cables_gl



<https://youtu.be/x2jKZgmFVq4>
Post processing tutorial for beginners
by cables_gl



<https://youtu.be/z1Qf9dE67-w>
Text Texture op tutorial - Byte size
by cables_gl



<https://youtu.be/mQN8VtV0ltQ>
Texture2ColorArray op tutorial
by cables_gl



<https://youtu.be/wzpKR7vbCXg>
Timeline - Part 1: Overview
by cables_gl



<https://youtu.be/SaKWF6Rnsyl>
Transform Vertex Operator tutorial (GPU vs CPU based animation) - byte size
by cables_gl



<https://youtu.be/B9GyRzov5Bg>
tutorial demo effect / render2textures world position target tricks
by cables_gl



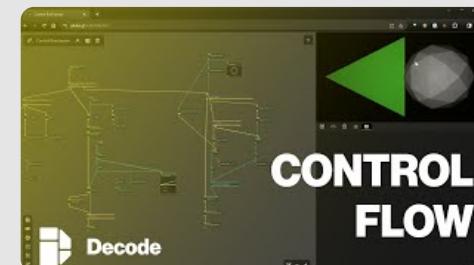
<https://youtu.be/T0djoWQkBew>
Cables.GL: Introduction
by Creative Tech Talks



<https://youtu.be/sbML3B3Vu4g>
Cables.GL: Tutorial
by Creative Tech Talks



<https://youtu.be/kgXpXsLtv1M>
Assets (6/13) - Intro to Cables.gl
by Decode GL



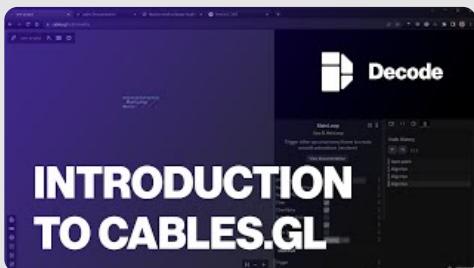
<https://youtu.be/vzWrCGfU7uw>
Control Flow (3/13) - Intro to Cables.gl
by Decode GL



<https://youtu.be/2YFB4MuN8y8>
Data Types (2/13) - Intro to Cables.gl
by Decode GL



<https://youtu.be/Z4gReZ34SHU>
Interactions (5/13) - Intro to Cables.gl
by Decode GL



<https://youtu.be/VsS4gaJ7pMw>
Introduction to Cables.gl (1/13)
by Decode GL



<https://youtu.be/RhbId-kUWig>
Texture Effects (8/13) - Intro to Cables.gl
by Decode GL



<https://youtu.be/qEno30S8CBc>
Glitch Art Tutorial using Cables.gl
by Jaalibandar



<https://youtu.be/goO3PhuenB>
First Steps in Cables.gl - Tutorial
by The Interactive & Immersive HQ

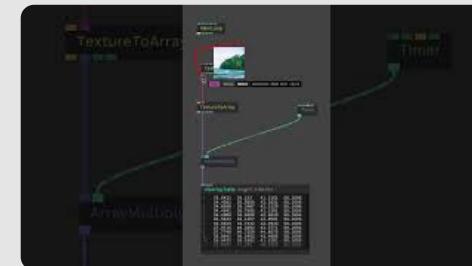
12.2 Core Concepts & Workflow



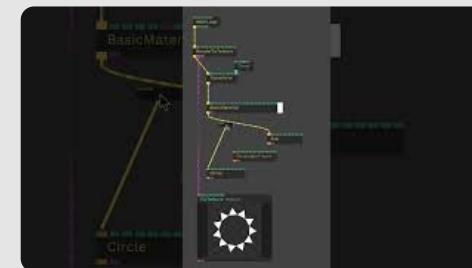
<https://youtu.be/lj6REnNZU0s>
converter ops
by cables_gl



<https://youtu.be/M1A8S98UOuI>
how to reroute cables #gui #uxdesign #motiondesign
by cables_gl



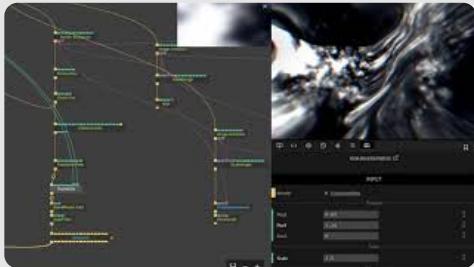
<https://youtu.be/ZCKrhswQiyc>
you can cut cables with the [Y] key #animation #motiondesign #design
#web #3danimation
by cables_gl



<https://youtu.be/xawlfxKpxRQ>
you can replace cables that easy #animation #motiondesign #design #web
by cables_gl



https://youtu.be/GQc6JF_jy6M
Debug View in Cables.gl | Setting up multiple views in your patch
by Jaalibandar



<https://youtu.be/uzqplBUGMWg>
01 Jam Sessions : Generative Fluid Graphic in Cables.gl
by FahmiMursyid



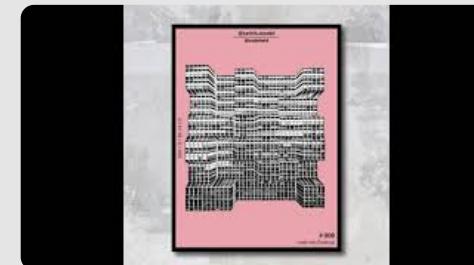
<https://youtu.be/wERboDg6zOI>
Impactful Transitions under 10 minutes using cables.gl | Genuary 04: Intersections
by Jaalibandar



https://youtu.be/_CltN9uQhoU
Procedurally generated plants in Cables.gl #genuary
by Jaalibandar



<https://youtu.be/5Jc3woVozNc>
Cables.gl | Generative Poster 05
by Karthik Dondeti



<https://youtu.be/DsSPcNSLyAw>
Cables.gl | Generative Poster 06
by Karthik Dondeti



<https://youtu.be/gRV0DqpSd-4>
Cables.gl | Generative Poster 09
by Karthik Dondeti



New Update

February 2022 Release Chat

<https://youtu.be/3tZQtsEiicw>

February 2022 Release Chat - cables.gl updated - PBR, Geometry from Textures, Teams, EXR support
by cables_gl



Video Tutorial

Vertex Displacement & Normals

<https://youtu.be/a56wk9Xm9dY>

Using Vertex Displacement with Normal maps in cables.gl
by cables_gl



BYTE SIZE

Vertex Displacement op



<https://youtu.be/NjG85QbbI0w>

Vertex displacement op - byte size
by cables_gl



3D VIDEO GALLERY

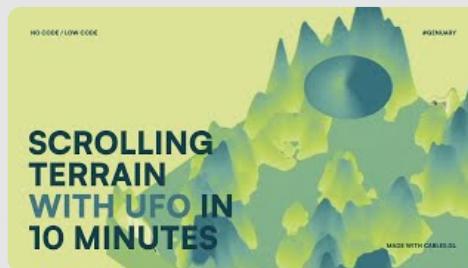
https://youtu.be/lOMplXy_JV0

Visualize any YouTube playlist in 3D with n8n.io & cables.gl (part 1)
by Decode GL



<https://youtu.be/AZrWNl3MwHQ>

Scrolling Terrain with UFO in 10 minutes using cables.gl
by Jaalibandar



<https://youtu.be/sbqE83ZHiTU>

Scrolling Terrain with UFO in 10 minutes using cables.gl
by Jaalibandar

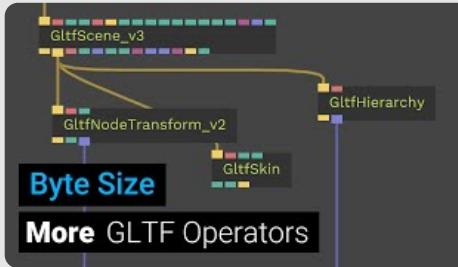


<https://youtu.be/3KSS1nrv6t0>
cables.gl web demo - realtime visualizer soundcloud globe | Exyl - Ping! Moai
by stobelights

12.3 3D / 3D Meshes



<https://youtu.be/iqIXSb-kAws>
Importing GLTF 3D Scenes with Camera positions and animating them in cables.gl
by cables_gl



https://youtu.be/l_eD5nml_5A
More GLTF operators - animated rig support, position data, separate animation timing - Byte Size
by cables_gl



<https://youtu.be/DW9U5tv1GHM>
Varying Mesh Instances with color, animation and textures - Video Tutorial
by cables_gl



<https://youtu.be/PrkdENo8wQ>
Vertex Textures - Point Clouds and Mesh Instancing from Textures - Introduction
by cables_gl

12.4 Textures / Post-Processing



<https://youtu.be/uwoj7R52yU8>

PBR Material & PBR Environment Light Op - Byte Size - Physically Based Rendering in Cables
by cables_gl



<https://youtu.be/Yf84KQc9jzU>

Copy Texture operator deep dive - basics and use cases
by cables_gl



<https://youtu.be/cc5Vlmvlq6A>

Pixel displace op - byte size
by cables_gl

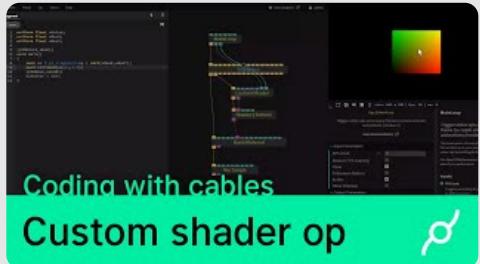


<https://youtu.be/rtDA2S9SPQ4>

Exploring Matcap Creator by bagoof - a new tool made with cables
by cables_gl

12.5 Shaders / Shadertoy / GLSL

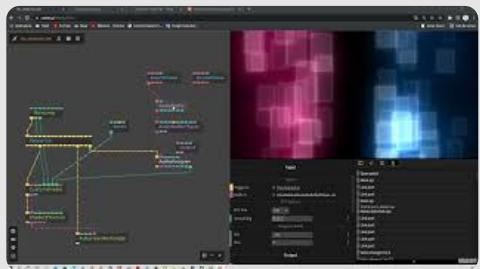
12.6 Audio / Music / MIDI



<https://youtu.be/Zfhn8xSM0SE>
Coding with cables - custom shader op
by cables_gl



https://youtu.be/j_ins4RW0c8
Shadertoy to cables - part 01
by cables_gl



<https://youtu.be/nil-HkZgNZ8>
Programmation d'un shadertoy avec Cables.gl Partie 8.
by Meletou1



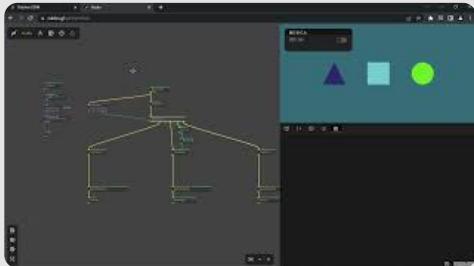
<https://youtu.be/SFXvtm-vkvE>
Introduction to Generative Music and Audio Reactive Systems with Cables.gl
by Jaalibandar



<https://youtu.be/h20ZH-xD8Ts>
Microphone Input & Audio Reactivity in Cables.gl - Tutorial
by The Interactive & Immersive HQ



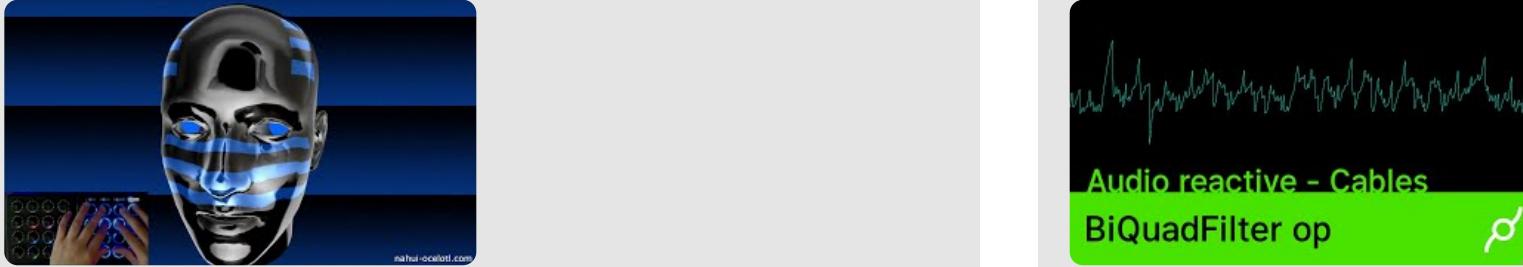
<https://youtu.be/uYk7-9dZ8Ys>
MidiFighter cables.gl Vjing
by Alberto Barrios L. (nahui-ocelotl.com)



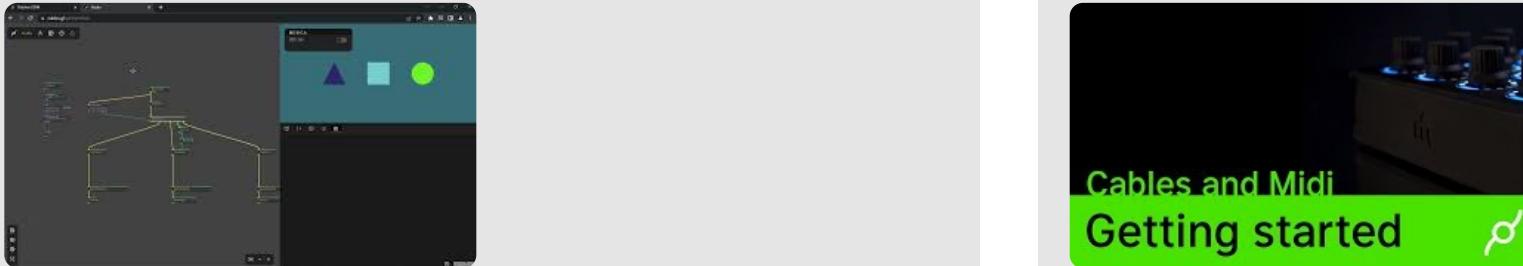
<https://youtu.be/KZbhVClahv4>
Páginas WEB Interactivas con cables.gl | 13 Audio
by Alberto Barrios L. (nahui-ocelotl.com)



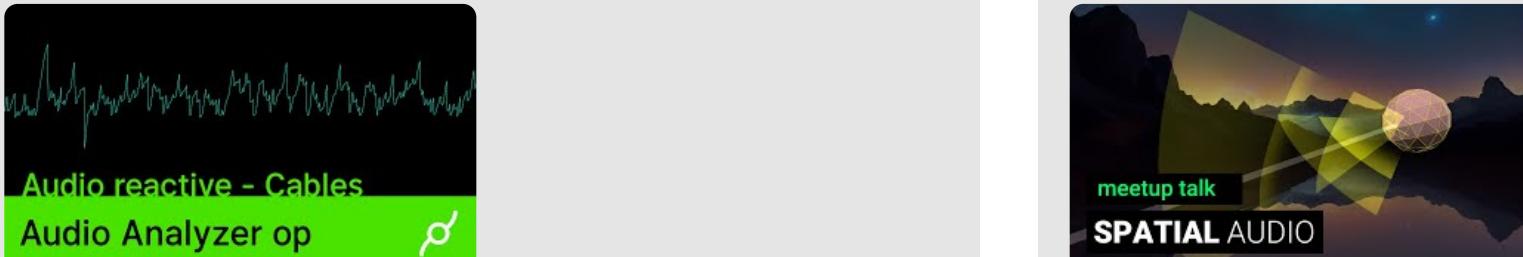
<https://youtu.be/3m-2F2T1f6w>
Audio analyzer op - audio reactive
by cables_gl



<https://youtu.be/68iSILnuLnA>
BiQuadFilter op- audio reactive tut
by cables_gl



https://youtu.be/eDlaFD_d5lc
Connecting Midi controllers to Cables
by cables_gl



<https://youtu.be/wKQN2BZPtyU>
Exploring Spatial Audio in Cables.gl
by cables_gl

Let's make a



<https://youtu.be/3owzslzvkdQ>

Let's make some noise! Building a drum machine with Cables.gl.

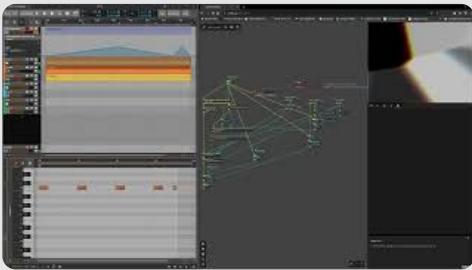
by Kirell Benzi



<https://youtu.be/KtREXHa9tS8>

Programmation Cables.gl Audio Analyzer Partie 7.

by Meletou1



<https://youtu.be/TyElawM-lI0>

Syncing Cables.gl with Bitwig Studio

by Stefan Sauer



<https://youtu.be/TlDHrXS06-A>

[animatic] Better! // bitwig studio, cables.gl

by voz-h-kc



<https://youtu.be/S-KyCySVucM>

[HD] Sidereal Collapse // cables.gl, Bitwig Studio

by voz-h-kc

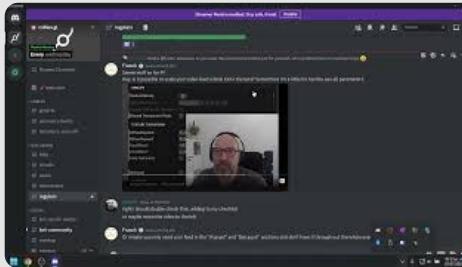
12.7 Physics



https://youtu.be/hlmNF_42raY
AmmoRaycast Operator - creating a simple 3D menu UI - Tutorial
by cables_gl



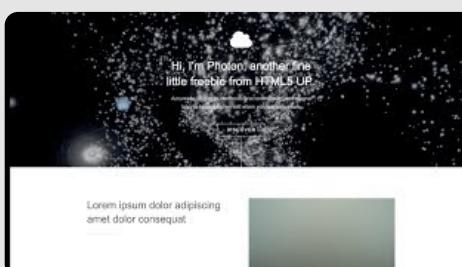
https://youtu.be/TAhAqgY_EEs
AmmoWorld and AmmoBody Operators - physics simulations in cables.gl - Video Tutorial
by cables_gl



https://youtu.be/DX0s1SkR_Hg
Páginas WEB Interactivas con cables.gl | 20 Exportación
by Alberto Barrios L. (nahui-ocelotl.com)



<https://youtu.be/J8yJtcd1Jeg>
CABLES Command Line export
by cables_gl



https://youtu.be/YUAYs_NcwTA
embed a cables patch into a html website
by cables_gl

12.8 Export / Deployment / Embedding

12.9 Hardware / External Tools



<https://youtu.be/B4M9FddXk1I>

Exporting your Project - .zip Export - Byte Size
by cables_gl



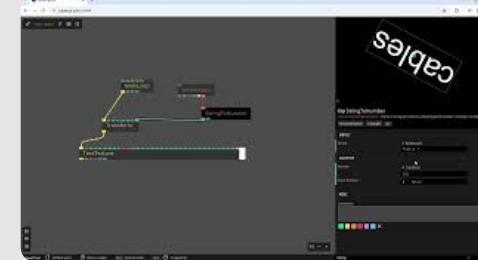
<https://youtu.be/L5BGMs7vKuI>

Exporting your Project - Netlify export - Byte Size
by cables_gl



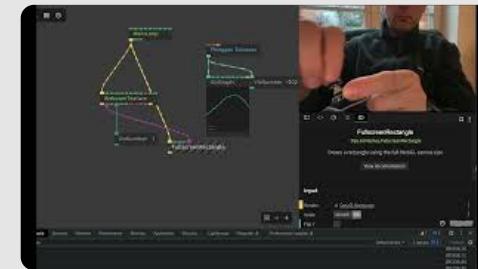
<https://youtu.be/hVxrxXhH7vQ>

Cables.gl Standalone (Offline) Build: Create Without Limits!
by Decode GL



<https://youtu.be/vebGfUp9vJ4>

Getting cables.gl to talk to hardware, using Chataigne!
by Rob Duarte



<https://youtu.be/4YsuGFAEvEE>

Phidget Encoder in cables.gl
by wirmachenbunt

12.10 Talks / Meetups / Release Notes



https://youtu.be/FvC3Ec_38Jo

Inércia 2023 | Seminar: Cables.gl as a demo making tool by anticore feat. liquibe
by Associação Inércia



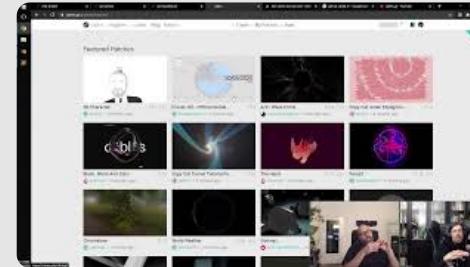
<https://youtu.be/C2FjpdRWPxw>

Updated Physically Based Rendering Operators - discussion with the developer AMajesticSeaFlapFlap
by cables_gl



<https://youtu.be/xLBLo6O1kXg>

cables.gl october meetup
by cables_gl



<https://youtu.be/v4rYqHuT-0E>

Seminar: Making demos with cables.gl (speaker: pandur)
by psenough



<https://youtu.be/xRbg1Az0k8k>

November Update - cables.gl monthly meetup
by cables_gl

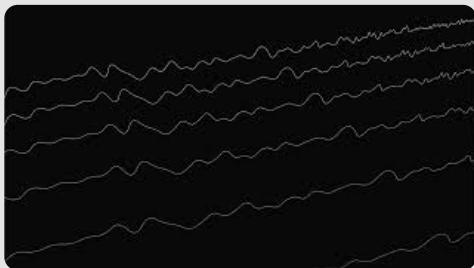
12.11 Showcases / Demos / Visualizers



<https://youtu.be/oLPsJd0e4Gc>
antonymph - vylet pony (avoset remix; cables.gl visualiser)
by avoset



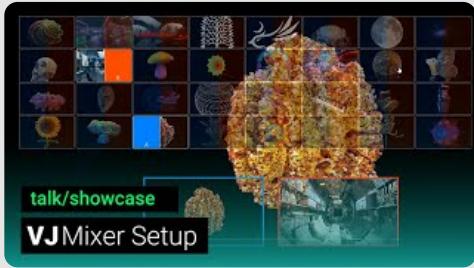
<https://youtu.be/84pXsmJghdM>
demomaking with cables
by cables_gl



<https://youtu.be/CfPJZMAXcTU>
Lines / Live experience with Cables.gl
by BoatBoat_Station



<https://youtu.be/M8Is131LSzE>
hydra - demo by mfx
by cables_gl



https://youtu.be/Zr_7wRBmRmA
Building a VJ patch mixer with cables.gl
by cables_gl



<https://youtu.be/R9-D4SxBd90>
Ninja de Gaia - Inércia 2023 - creating a demo with cables.gl
by cables_gl



<https://youtu.be/auvD8oSxMew>
cables.gl - Drifting Apart (FXHash Project)
by Creative Exploration /w Purz



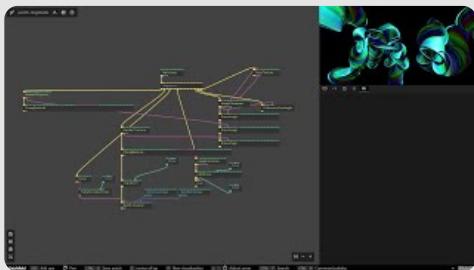
<https://youtu.be/EO3UdeBQ9m0>
EroLogo - Visual Demo Length 12:37 made with Cables.gl
by faktisProductions



https://youtu.be/9vZzrXX_2jM
cables.gl - purzOS - Low Poly Lavalamp (FXHash Project)
by Creative Exploration /w Purz

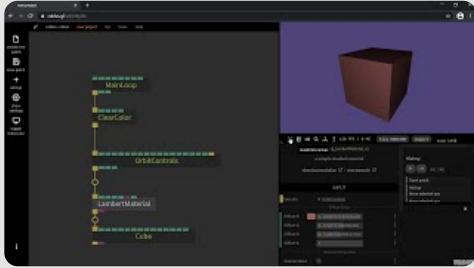


<https://youtu.be/xba3e91Fum4>
Design Designs Design - "Smorp" (A Cables.gl demo for Evoke 2022)
by Jan-Jozef Tuigstra



<https://youtu.be/a0IJ8DF-v8o>
cables.gl - purzOS - Ring Worlds (Screensaver)
by Creative Exploration /w Purz

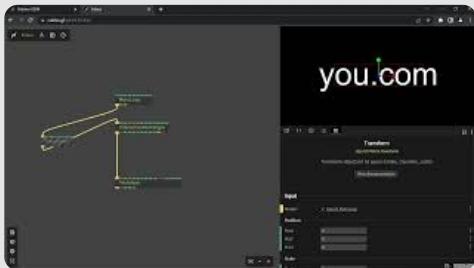
12.12 Unsorted (Still cables.gl-related)



<https://youtu.be/1FqBKJ1RXdY>

Entornos virtuales WEB con programación visual en cables.gl Parte 1

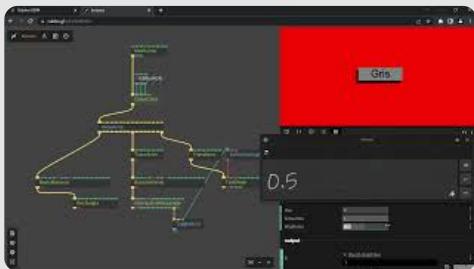
by Alberto Barrios L. (nahui-ocelotl.com)



https://youtu.be/oBoH_7uHv-E

Páginas WEB Interactivas con cables.gl | 02 Enlace

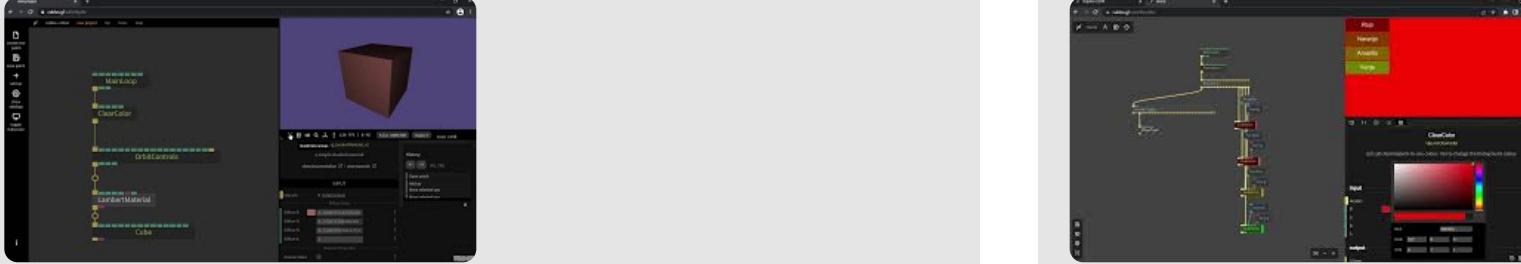
by Alberto Barrios L. (nahui-ocelotl.com)



<https://youtu.be/-9QrZSoAPPQ>

Páginas WEB Interactivas con cables.gl | 07 Botones

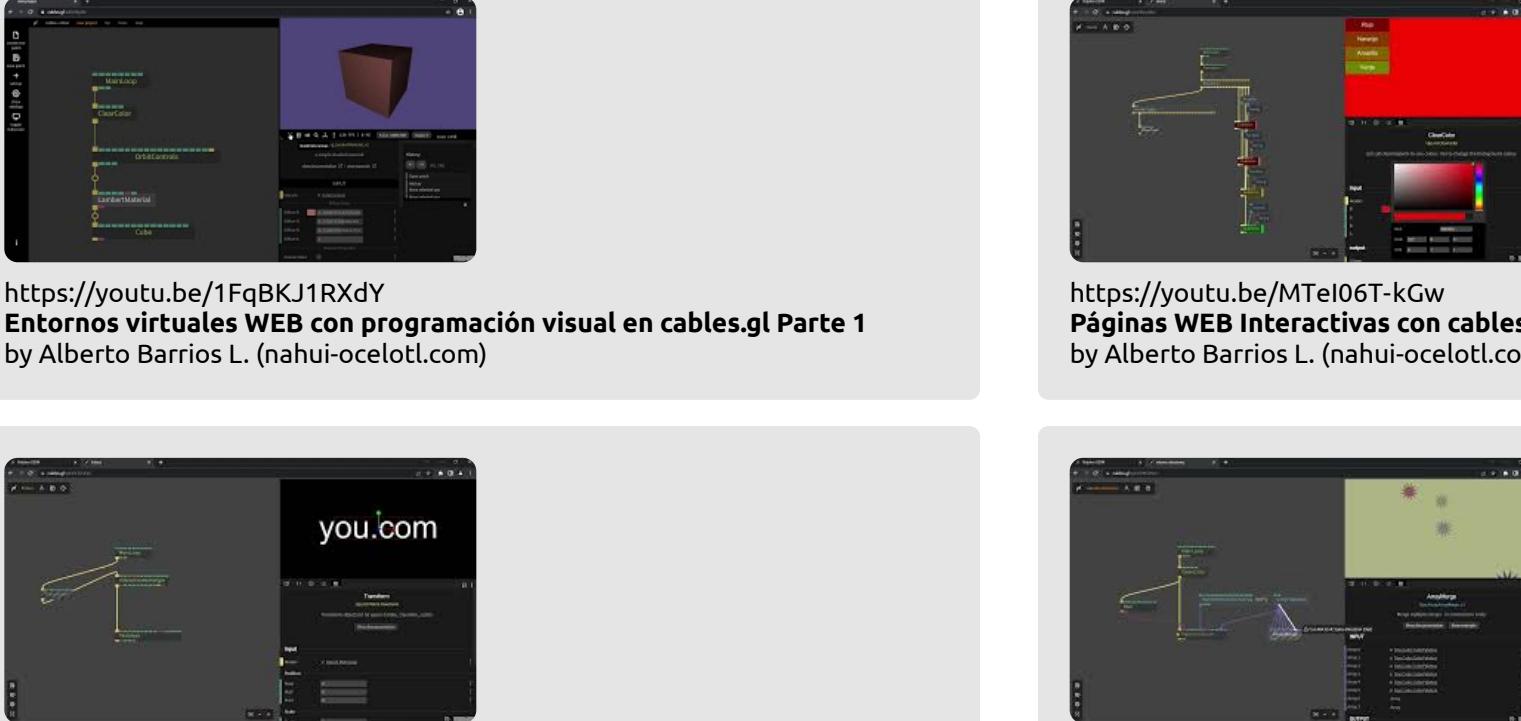
by Alberto Barrios L. (nahui-ocelotl.com)



<https://youtu.be/MTel06T-kGw>

Páginas WEB Interactivas con cables.gl | 08 Menu

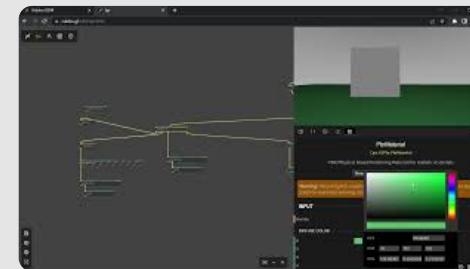
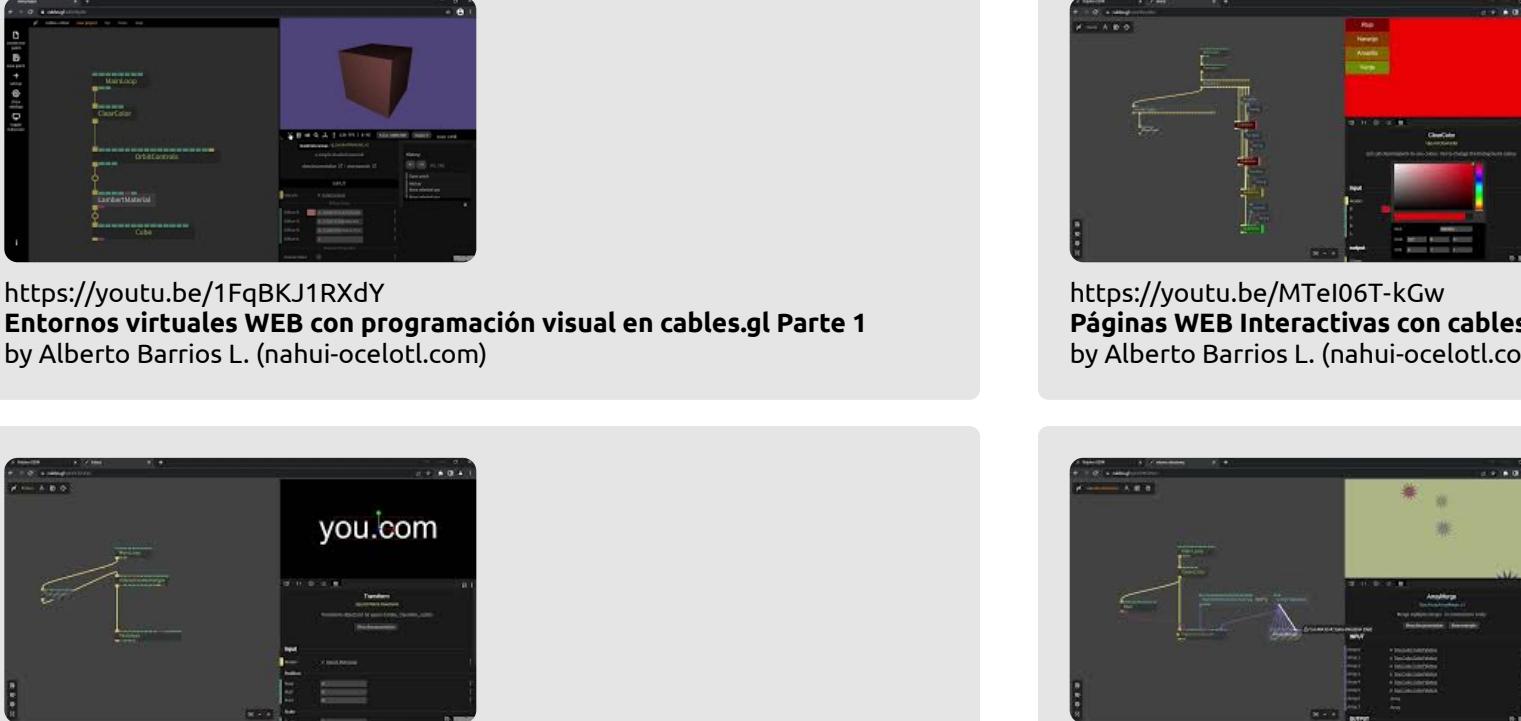
by Alberto Barrios L. (nahui-ocelotl.com)



<https://youtu.be/iFDD4tm7-Uw>

Páginas WEB Interactivas con cables.gl | 15 Valores Aleatorios

by Alberto Barrios L. (nahui-ocelotl.com)



<https://youtu.be/a2H8vk3Ko1M>

Páginas WEB Interactivas con cables.gl | 18 FPS

by Alberto Barrios L. (nahui-ocelotl.com)



<https://youtu.be/cVpC9IS6kl0>

Substitution Pattern / Testing / CABLES.GL /
by Antiguo Autómata Mexicano



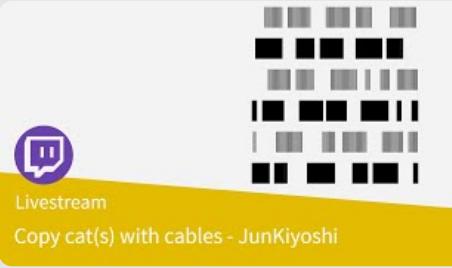
<https://youtu.be/7BiDxNc7D7g>

Create awesome Visuals using OpenDAW and cables.gl!
by BeatMax_Prediction



<https://youtu.be/omIK1YOtB70>

Copy cat with cables- live stream - Inconvergent
by cables_gl



<https://youtu.be/tu49qg8BpBU>

copy cat(s) with cables live stream - Junkiyoshi
by cables_gl



https://youtu.be/Gr3iVMUs_hA

Copycat with Cables - Tyler hobbs - Untitled
by cables_gl



<https://youtu.be/hZQZh5UHSE>

did you know, you can add multiple ops one go
by cables_gl



<https://youtu.be/jiOLZaMUH78>
Repeat op tut 01 - Byte size
by cables_gl



<https://youtu.be/00Rvb749wrc>
Smooth Operator - Byte Size
by cables_gl



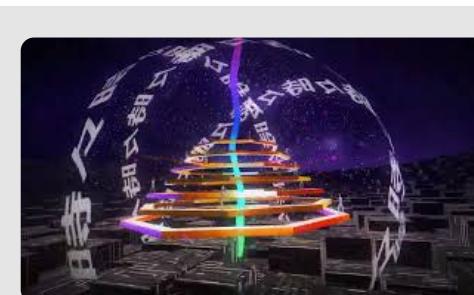
<https://youtu.be/8Lfr8iLLbMA>
Infinite Looping Motion Graphic in 10 minutes using cables.gl
by Jaalibandar



<https://youtu.be/WGoM1AmfW7g>
Getting data from an API with cables.gl - data-driven gradient from geo-located weather - part 1
by Kirell Benzi



<https://youtu.be/G1HKysL8iVw>
Présentation du logiciel Cables.gl par les étudiants en UI/UX design
by L'École de design Nantes Atlantique



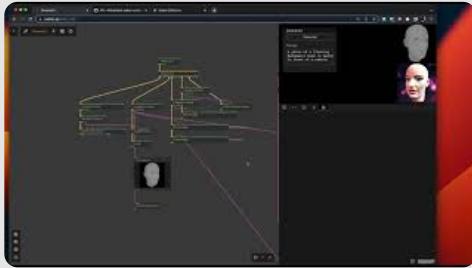
<https://youtu.be/4Op74ulzH5c>
Retour sur le programme Cables.gl
by Meletou1



<https://youtu.be/tdbTTxDu7Qk>

Cables.gl

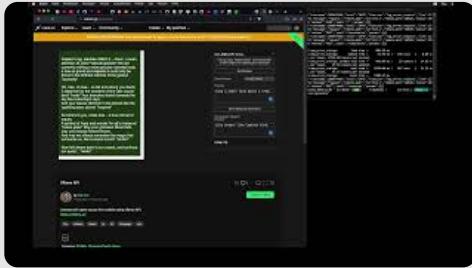
by Nathan Sonzogni



<https://youtu.be/n4UPiZhbcRU>

StableDiffusion and ControlNet in Cables.gl via the WebUI

by Neight Allen



<https://youtu.be/lImv9ZJshUE>

cables.gl and ollama API

by Tobias Hartmann



<https://youtu.be/vOVKpppw1ds>

Class 30: Learning how to mint a cables.gl patch on fx hash w/ Somaticbits

by VERTICAL



<https://youtu.be/4PsWzWHsiV4>

cables.gl ink spill

by Video Art Duo



<https://youtu.be/9UR8upg0g54>

Pod005 - Flicker | Distortion | cables.gl

by zuggamasta

13 Ops.Anim

13.1 AnimNumber



Full Name: Ops.Anim.AnimNumber

Description: Always animates to the current value

> Inputs

- **Exe** (Trigger)
- **Value** (Number)
- **Duration** (Number)
- **Easing Index** (Number: Integer)

< Output

- **Next** (Trigger)
- **Result** (Number)
- **Finished** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Anim.AnimNumber>

13.2 Bang



Full Name: Ops.Anim.Bang

Description: Trigger a simple bang animation going from 1 to 0

> Inputs

- **Update** (Trigger)
- **Bang** (Trigger)
- **Duration** (Number)
- **Invert** (Number: Boolean)

< Output

- **Trigger Out** (Trigger)
- **Value** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Anim.Bang>

13.3 BoolAnim



Full Name: Ops.Anim.BoolAnim

Description: Animate between two numbers based on a boolean value

> Inputs

- **Exe** (Trigger)
- **Bool** (Number: Boolean)
- **Easing Index** (Number: Integer)
- **Duration** (Number)
- **Direction Index** (Number: Integer)
- **Value False** (Number)
- **Value True** (Number)

< Output

- **Trigger** (Trigger)
- **Value** (Number)
- **Finished** (booleanNumber)
- **Finished Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Anim.BoolAnim>

13.4 Crossfade



Full Name: Ops.Anim.Crossfade

Description: Crossfade between 2 values

> Inputs

- **Crossfade** (Number)
- **Out Min** (Number)
- **Out Max** (Number)
- **Easing Index** (Number: Integer)

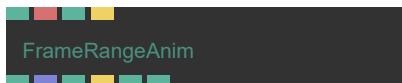
< Output

- **A** (Number)
- **B** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Anim.Crossfade>

13.5 FrameRangeAnim_v2



Full Name: Ops.Anim.FrameRangeAnim_v2

Description: Parses string containing ranges of frames and play as coherent animation

> Inputs

- **Time** (Number)
- **Frames** (String)
- **frame range** (ex. "0-10")
- **Loop** (Number: Boolean)
- **Rewind** (Trigger)

< Output

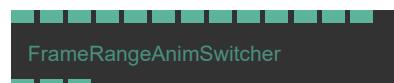
- **Result Time** (Number)
- **Expanded Frames** (Array)
- **Finished** (booleanNumber)
- **Finished Trigger** (Trigger)

- **Anim Length** (Number)
- **Progress** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Anim.FrameRangeAnim_v2

13.6 FrameRangeAnimSwitcher



Full Name: Ops.Anim.FrameRangeAnimSwitcher

Description: Switch between multiple anim ranges of a keyframed 3d scene

> Inputs

- **Index** (Number: Integer)
- **Duration** (Number)
- **Easing Index** (Number: Integer)
- **Value 0** (Number)
- **Value 1** (Number)
- **Value 2** (Number)
- **Value 3** (Number)
- **Value 4** (Number)
- **Value 5** (Number)
- **Value 6** (Number)
- **Value 7** (Number)
- **Value 8** (Number)
- **Value 9** (Number)

< Output

- **Time 1** (Number)
- **Time Fade** (Number)
- **Time 2** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Anim.FrameRangeAnimSwitcher>

13.7 InOutInAnim



Full Name: Ops.Anim.InOutInAnim

Description: Animates after a trigger from 1 to 0 to 1

> Inputs

- **Update** (Trigger)
- **Duration In** (Number)
- **Easing In Index** (Number: Integer)
- **Value In** (Number)
- **Hold Duration** (Number)
- **Duration Out** (Number)
- **Easing Out Index** (Number: Integer)
- **Value Out** (Number)
- **Start** (Trigger)

< Output

- **Next** (Trigger)
- **Result** (Number)
- **Started** (Trigger)
- **Middle** (Trigger)
- **Finished** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Anim.InOutInAnim>

13.8 LFO_v3



Full Name: Ops.Anim.LFO_v3

Description: Low-frequency oscillation for animations

> Inputs

- **Time** (Number)
- **Frequency** (Number)
- **Type Index** (Number: Integer)
- **Phase** (Number)
- **Range Min** (Number)
- **Range Max** (Number)

< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Anim.LFO_v3

13.9 RandomAnim_v2



Full Name: Ops.Anim.RandomAnim_v2

Description: Animates between random values defined by a min and max value

> Inputs

- **Exe** (Trigger)
- **Min** (Number)
- **Max** (Number)
- **Duration** (Number)
- **Pause Between** (Number)
- **Easing Index** (Number: Integer)

< Output

- **Next** (Trigger)
- **Result** (Number)
- **Looped** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Anim.RandomAnim_v2

13.10 SimpleAnim



Full Name: Ops.Anim.SimpleAnim

Description: Simple animation between two values

> Inputs

- **Exe** (Trigger)
- **Reset** (Trigger)
- **Rewind** (Trigger)
- **Start** (Number)
- **End** (Number)
- **Duration** (Number)
- **Loop** (Number: Boolean)
- **Wait For Reset** (Number: Boolean)
- **Easing Index** (Number: Integer)

< Output

- **Next** (Trigger)
- **Result** (Number)
- **Finished** (Number)
- **Finished Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Anim.SimpleAnim>

13.11 SineAnim



Full Name: Ops.Anim.SineAnim

Description: Animation in the form of a sine/cosine curve (sinus/cos)

> Inputs

- **Exe** (Trigger)
- **Mode Index** (Number: Integer)

- **Phase** (Number)
- **Frequency** (Number)
- **Amplitude** (Number)

< Output

- **Trigger Out** (Trigger)
- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Anim.SineAnim>

13.12 Smooth



Full Name: Ops.Anim.Smooth

Description: Smooths out jumps in values (AverageInterpolation)

> Inputs

- **Update** (Trigger)
- **Value** (Number)
- **Dec Factor** (Number)

< Output

- **Next** (Trigger)
- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Anim.Smooth>

13.13 Snap



Full Name: Ops.Anim.Snap

Description: Snap at certain points (e.g. while scrolling)

> Inputs

- **Delta** (Number)
- **Snap At Values** (Array)
- **Snap Distance** (Number)
- **Snap Distance Release** (Number)

- **Slowdown** (Number)
- **Block Input After Snap** (Number)
- **Reset** (Trigger)
- **Min** (Number)
- **Max** (Number)
- **Value Mul** (Number)
- **Enabled** (Number: Boolean)

< Output

- **Result** (Number)
- **Distance** (Number)
- **Snapped** (Number)
- **Was Snapped** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Anim.Snap>

13.14 Spring



Full Name: Ops.Anim.Spring

Description: Spring simulation based on input target value.

> Inputs

- **Exe** (Trigger)
- **Value** (Number)
- **Damping** (Number)
- **Stiffness** (Number)

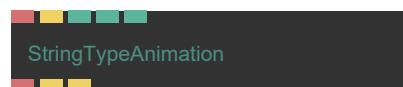
< Output

- **Trigger** (Trigger)
- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Anim.Spring>

13.15 StringTypeAnimation_v2



Full Name: Ops.Anim.StringTypeAnimation_v2

Description: Animates a text/string, like it is being typed out by a person

> Inputs

- **Text** (String)
- **Restart** (Trigger)
- **Speed** (Number)
- **Speed Variation** (Number)
- **Show Cursor** (Number: Boolean)

< Output

- **Result** (String)
- **Changed** (Trigger)
- **Finished** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Anim.StringTypeAnimation_v2

13.16 TimeDelta



Full Name: Ops.Anim.TimeDelta

Description: Measure the time difference between two triggers

> Inputs

- **Exe** (Trigger)
- **Smooth** (Number: Boolean)
- **Seconds** (Number: Boolean)

< Output

- **Trigger** (Trigger)
- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Anim.TimeDelta>

13.17 Timer_v2



Full Name: Ops.Anim.Timer_v2

Description: A timer that can be started, paused and reset by triggering

> Inputs

- **Speed** (Number)
- **Play** (Number: Boolean)
- **Reset** (Trigger)
- **Sync To Timeline** (Number: Boolean)

< Output

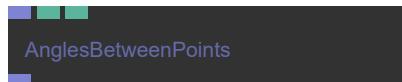
- **Time** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Anim.Timer_v2

14 Ops.Array

14.1 AnglesBetweenPoints



Full Name: Ops.Array.AnglesBetweenPoints

Description: Outputs the angle between points in 3D space (degree)

> Inputs

- **Points** (Array)
- **Theta** (Number)
- **Phi** (Number)

< Output

- **Rotations** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.AnglesBetweenPoints>

14.2 AnimArray_v2



Full Name: Ops.Array.AnimArray_v2

Description: Animate values in an array to another array

> Inputs

- **Update** (Trigger)
- **Next Array** (Array)
- **Duration** (Number)
- **Easing Index** (Number: Integer)

< Output

- **Next** (Trigger)
- **Matrix** (Array)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Array.AnimArray_v2

14.3 Array1toX_v2



Full Name: Ops.Array.Array1toX_v2

Description: convert an array1 to array2,3,4 by choosing content for new axis

> Inputs

- **Array1x** (Array)

< Output

- **Array3x** (Array)
- **Total Points** (Number)
- **Array Length** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Array.Array1toX_v2

14.4 Array2To3



Full Name: Ops.Array.Array2To3

Description: Inserts zeroes every third item

> Inputs

- **Array2x** (Array)

< Output

- **Array3x** (Array)
- **Total Points** (Number)
- **Array Length** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.Array2To3>

14.5 Array3



Full Name: Ops.Array.Array3

Description: Create an array of num triplets set to default values xyz

> Inputs

- **Num Triplets** (Number: Integer)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)

< Output

- **Array** (Array)
- **Total Points** (Number)
- **Array Length** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.Array3>

14.6 Array3GetAverage



Full Name: Ops.Array.Array3GetAverage

Description: Average x,y,z values of an array3x

> Inputs

- **Array** (Array)

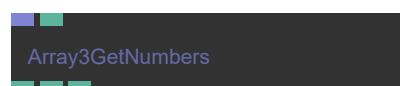
< Output

- **Average X** (Number)
- **Average Y** (Number)
- **Average Z** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.Array3GetAverage>

14.7 Array3GetNumbers



Full Name: Ops.Array.Array3GetNumbers

Description: Get 3 values XYZ from an array

> Inputs

- **Array** (Array)
- **Index** (Number: Integer)

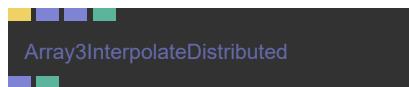
< Output

- **X** (Number)
- **Y** (Number)
- **Z** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.Array3GetNumbers>

14.8 Array3InterpolateDistributed



Full Name: Ops.Array.Array3InterpolateDistributed

Description: Interpolate between two arrays

> Inputs

- **Update** (Trigger)
- **Array 1** (Array)
- **Array 2** (Array)
- **Progress** (Number)

< Output

- **Result** (Array)
- **Array Length** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.Array3InterpolateDistributed>

14.9 Array3Iterator



Full Name: Ops.Array.Array3Iterator

Description: Iterate over an array in steps of three and outputs three values

> Inputs

- **Execute** (Trigger)
- **Array** (Array)
- **Step** (Number)

< Output

- **Trigger** (Trigger)
- **Triggers for every iteration step** (triplet in the array)
- **Index** (Number)

- **Value 1** (Number)
- **First value of the current triplet** (e.g. x)
- **Value 2** (Number)
- **Second value of the current triplet** (e.g. y)
- **Value 3** (Number)
- **Third value of the current triplet** (e.g. z)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.Array3Iterator>

14.10 Array3Multiply



Full Name: Ops.Array.Array3Multiply

Description: Multiply every XYZ member of array3x

> Inputs

- **Array3x** (Array)
- **Mul X** (Number)
- **Mul Y** (Number)
- **Mul Z** (Number)

< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.Array3Multiply>

14.11 Array3PushNumbers_v2



Full Name: Ops.Array.Array3PushNumbers_v2

Description: Push three numbers to the end of an array (was ArrayPushValue3x)

> Inputs

- **Execute** (Trigger)
- **Array** (Array)
- **Value 1** (Number)
- **Value 2** (Number)

- **Value 3** (Number)
- **Reset** (Trigger)

< Output

- **Next** (Trigger)
- **Result Array** (Array)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Array.Array3PushNumbers_v2

14.12 Array3RandomSelection



Full Name: Ops.Array.Array3RandomSelection

Description: Extract definable amount of random xyz points from an array

> Inputs

- **Array** (Array)
- **Elements** (Number: Integer)
- **Seed** (Number)

< Output

- **Result** (Array)
- **Total Points** (Number)
- **Array Length** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.Array3RandomSelection>

14.13 Array3SetNumber



Full Name: Ops.Array.Array3SetNumber

Description: Set three numbers at index in an array

> Inputs

- **Array** (Array)
- **Index** (Number: Integer)
- **Value X** (Number)
- **Value Y** (Number)
- **Value Z** (Number)

< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.Array3SetNumber>

14.14 Array3Sum



Full Name: Ops.Array.Array3Sum

Description: Add number to every XYZ member of array3x

> Inputs

- **Array3x** (Array)
- **Add X** (Number)
- **Add Y** (Number)
- **Add Z** (Number)

< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.Array3Sum>

14.15 Array3To2



Full Name: Ops.Array.Array3To2

Description: Remove every 3rd item of an array - changes array length

> Inputs

- **Array3x** (Array)

< Output

- **Array2x** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.Array3To2>

14.16 Array3To4



Full Name: Ops.Array.Array3To4

Description: Convert an array3 to an array4 by filling it up with 1

> Inputs

- **Array3x** (Array)

< Output

- **Array4x** (Array)
- **Total Points** (Number)
- **Array Length** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.Array3To4>

- **Num Quadruplets** (Number: Integer)

- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **W** (Number)

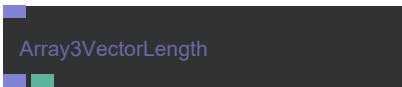
< Output

- **Array** (Array)
- **Total Quadruplets** (Number)
- **Array Length** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.Array4>

14.17 Array3VectorLength



Full Name: Ops.Array.Array3VectorLength

Description: Return the length of a vector from an array 3

> Inputs

- **Array In** (Array)

< Output

- **Array Out** (Array)
- **Array Lengths** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.Array3VectorLength>

14.18 Array4

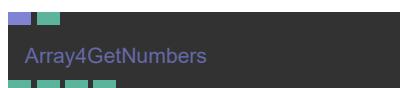


Full Name: Ops.Array.Array4

Description: Create an array of num quadruples set to default values xyz

> Inputs

14.19 Array4GetNumbers



Full Name: Ops.Array.Array4GetNumbers

Description: Get 4 values from an array

> Inputs

- **Array** (Array)
- **Index** (Number: Integer)

< Output

- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **W** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.Array4GetNumbers>

14.20 Array4SetNumber



Full Name: Ops.Array.Array4SetNumber

Description: Set four numbers at index in an array

> Inputs

- **Array** (Array)

- **Index** (Number: Integer)
- **Value X** (Number)
- **Value Y** (Number)
- **Value Z** (Number)
- **Value W** (Number)

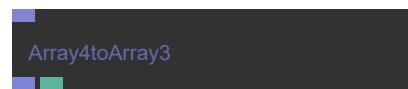
< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.Array4SetNumber>

14.21 Array4toArray3



Full Name: Ops.Array.Array4toArray3

Description: Convert an array4 to array3 by dropping every 4th number

> Inputs

- **Array** (Array)

< Output

- **Result** (Array)
- **Array Length** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.Array4toArray3>

14.22 Array_v3



Full Name: Ops.Array.Array_v3

Description: Can generate 3 kinds of arrays: Number - 1,2,3,4 - Normalized - (ContinuousNumberArray)

> Inputs

- **Array Length** (Number: Integer)
- **Mode Select Index** (Number: Integer)
- **Default Value** (Number)
- **Reverse** (Number: Boolean)

< Output

- **Array** (Array)
- **Array Length Out** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Array.Array_v3

14.23 ArrayAbs



Full Name: Ops.Array.ArrayAbs

Description: Converts array contents to absolute values - converts all negative numbers to positive numbers

> Inputs

- **In** (Array)

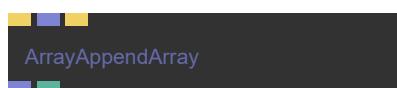
< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayAbs>

14.24 ArrayAppendArray



Full Name: Ops.Array.ArrayAppendArray

Description: Append an array to an existing array

> Inputs

- **Join** (Trigger)
- **Array** (Array)
- **Reset** (Trigger)

< Output

- **Result** (Array)
- **Array Length** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayAppendArray>

14.25 ArrayBuffer



Full Name: Ops.Array.ArrayBuffer

Description: Store values in an array / fifo array buffer

> Inputs

- **Exec** (Trigger)
- **Value** (Number)
- **Max Length** (Number: Integer)
- **Reset** (Trigger)

< Output

- **Trigger Out** (Trigger)
- **Result** (Array)
- **Array Length** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayBuffer>

14.26 ArrayBuffer3



Full Name: Ops.Array.ArrayBuffer3

Description: Circular buffer for xyz values

> Inputs

- **Exec** (Trigger)
- **Max Num Elements** (Number)
- **Value X** (Number)
- **Value Y** (Number)
- **Value Z** (Number)
- **Reset** (Trigger)

< Output

- **Trigger Out** (Trigger)
- **Result** (Array)
- **Array Length** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayBuffer3>

14.27 ArrayCeil



Full Name: Ops.Array.ArrayCeil

Description: Round numbers up

> Inputs

- **In** (Array)

< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayCeil>

14.28 ArrayChunk



Full Name: Ops.Array.ArrayChunk

Description: Extracts x elements from an array

> Inputs

- **Input Array** (Array)
- **Begin Index** (Number: Integer)
- **Chunk Size** (Number: Integer)
- **Circular** (Number: Boolean)

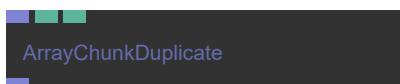
< Output

- **Output Array** (Array)
- **Array Length** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayChunk>

14.29 ArrayChunkDuplicate



Full Name: Ops.Array.ArrayChunkDuplicate

Description: Repeat chunks of an array multiple times

> Inputs

- **Array** (Array)
- **Chunk Size** (Number: Integer)
- **Repeats** (Number: Integer)

< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayChunkDuplicate>

14.30 ArrayClamp



Full Name: Ops.Array.ArrayClamp

Description: Clamp the values of an array to a min and max value

> Inputs

- **Array In** (Array)
- **Min** (Number)
- **Max** (Number)

< Output

- **Array Out** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayClamp>

14.31 ArrayContains_v2



Full Name: Ops.Array.ArrayContains_v2

Description: Check if an array contains a number (find,search,indexOf)

> Inputs

- **Array** (Array)
- **SearchValue** (Number)

< Output

- **Found** (booleanNumber)
- **Index** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Array.ArrayContains_v2

14.32 ArrayDivide



Full Name: Ops.Array.ArrayDivide

Description: Divide all values in an array by one number

> Inputs

- **Array In** (Array)
- **Value** (Number)

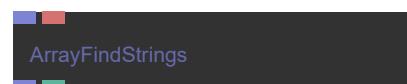
< Output

- **Array Out** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayDivide>

14.33 ArrayFindStrings



Full Name: Ops.Array.ArrayFindStrings

Description: Return all the indexes of a string in an array

> Inputs

- **Array** (Array)
- **SearchValue** (String)

< Output

- **Index** (Array)
- **Found** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayFindStrings>

14.34 ArrayFloor

ArrayFloor

Full Name: Ops.Array.ArrayFloor

Description: Round numbers down

> Inputs

- In (Array)

< Output

- Result (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayFloor>

14.35 ArrayFract

ArrayFract

Full Name: Ops.Array.ArrayFract

Description: Return the fractional remainder of all values in an array

> Inputs

- In (Array)

< Output

- Result (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayFract>

14.36 ArrayFromNumbers

ArrayFromNumbers

Full Name: Ops.Array.ArrayFromNumbers

Description: Simple way to create small arrays of numbers

> Inputs

- Update (Trigger)
- Limit (Number: Integer)
- Slider (Number: Boolean)
- Index 0 (Number)

- Index 1 (Number)

- Index 2 (Number)

- Index 3 (Number)

- Index 4 (Number)

- Index 5 (Number)

- Index 6 (Number)

- Index 7 (Number)

- Index 8 (Number)

- Index 9 (Number)

- Index 10 (Number)

- Index 11 (Number)

- Index 12 (Number)

- Index 13 (Number)

- Index 14 (Number)

- Index 15 (Number)

- Index 16 (Number)

- Index 17 (Number)

- Index 18 (Number)

- Index 19 (Number)

- Index 20 (Number)

- Index 21 (Number)

- Index 22 (Number)

- Index 23 (Number)

- Index 24 (Number)

- Index 25 (Number)

- Index 26 (Number)

- Index 27 (Number)

- Index 28 (Number)

- Index 29 (Number)

< Output

- Next (Trigger)

- Array (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayFromNumbers>

14.37 ArrayGetArray

ArrayGetArray

Full Name: Ops.Array.ArrayGetArray

Description: Get an array from an array of arrays

> Inputs

- **Array Of Arrays** (Array)
- **Index** (Number: Integer)

< Output

- **Result Array** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayGetArray>

14.38 ArrayGetNumber



Full Name: Ops.Array.ArrayGetNumber

Description: Return a value from an array

> Inputs

- **Array** (Array)
- **Index** (Number: Integer)
- **Value Invalid Index** (Number)

< Output

- **Value** (Number)
- **Valid Index** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayGetNumber>

14.39 ArrayGetObject



Full Name: Ops.Array.ArrayGetObject

Description: Get an object from an array

> Inputs

- **Array** (Array)
- **Index** (Number: Integer)

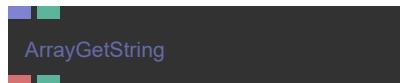
< Output

- **Value** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayGetObject>

14.40 ArrayGetString_v2



Full Name: Ops.Array.ArrayGetString_v2

Description: Get a string from an array at [index]

> Inputs

- **Array** (Array)
- **Index** (Number: Integer)

< Output

- **Result** (String)
- **Found** (booleanNumber)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Array.ArrayGetString_v2

14.41 ArrayGetTexture



Full Name: Ops.Array.ArrayGetTexture

Description: Get texture from array at index

> Inputs

- **Array** (Array)
- **Index** (Number: Integer)

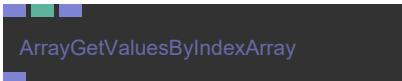
< Output

- **Value** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayGetTexture>

14.42 ArrayGetValuesByIndexArray



Full Name: Ops.Array.ArrayGetValuesByIndexArray

Description: Pick values from input array at given indices and stride

> Inputs

- **Array** (Array)
- **Array Stride Index** (Number: Integer)
- **Indices** (Array)

< Output

- **Results** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayGetValuesByIndexArray>

14.43 ArrayIndexBetween



Full Name: Ops.Array.ArrayIndexBetween

Description: Output index where value is greater than number and smaller than next number

> Inputs

- **Array** (Array)
- **Value** (Number)

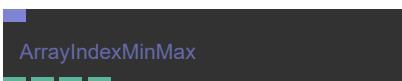
< Output

- **Index** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayIndexBetween>

14.44 ArrayIndexMinMax



Full Name: Ops.Array.ArrayIndexMinMax

Description: Find lowest/highest numbers in an array

> Inputs

- **Array** (Array)

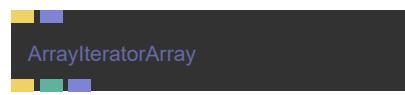
< Output

- **Max** (Number)
- **Index Max** (Number)
- **Min** (Number)
- **Index Min** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayIndexMinMax>

14.45 ArrayIteratorArray



Full Name: Ops.Array.ArrayIteratorArray

Description: Iterate over an array of arrays

> Inputs

- **Exe** (Trigger)
- **Array** (Array)

< Output

- **Trigger** (Trigger)
- **Index** (Number)
- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayIteratorArray>

14.46 ArrayIteratorNumbers



Full Name: Ops.Array.ArrayIteratorNumbers

Description: Loop over every element of an array

> Inputs

- **Exe** (Trigger)
- **Array** (Array)

< Output

- **Trigger** (Trigger)
- **Index** (Number)
- **Value** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayIteratorNumbers>

14.47 ArrayIteratorObjects



Full Name: Ops.Array.ArrayIteratorObjects

Description: Iterate over an array of objects

> Inputs

- **Exe** (Trigger)
- **Array** (Array)

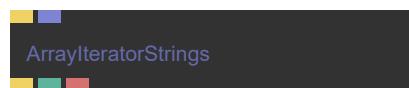
< Output

- **Trigger** (Trigger)
- **Finished** (Trigger)
- **Index** (Number)
- **Value** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayIteratorObjects>

14.48 ArrayIteratorStrings



Full Name: Ops.Array.ArrayIteratorStrings

Description: Loop over every element of an array

> Inputs

- **Exe** (Trigger)
- **Array** (Array)

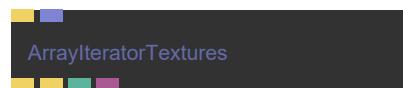
< Output

- **Trigger** (Trigger)
- **Index** (Number)
- **Value** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayIteratorStrings>

14.49 ArrayIteratorTextures



Full Name: Ops.Array.ArrayIteratorTextures

Description: Iterate over an array of objects

> Inputs

- **Exe** (Trigger)
- **Array** (Array)

< Output

- **Trigger** (Trigger)
- **Finished** (Trigger)
- **Index** (Number)
- **Value** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayIteratorTextures>

14.50 ArrayLength_v2



Full Name: Ops.Array.ArrayLength_v2

Description: Number of items in an array

> Inputs

- **Array** (Array)

< Output

- **Length** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Array.ArrayLength_v2

14.51 ArrayLogic



Full Name: Ops.Array.ArrayLogic

Description: Performs logical comparison operations on a single array of numbers

> Inputs

- **Array 0** (Array)
- **Comparison Mode Index** (Number: Integer)
- **Number For Comparison** (Number)
- **Value If True** (Number)
- **Value If False** (Number)

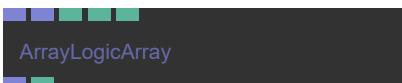
< Output

- **Array Result** (Array)
- **Array Length** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayLogic>

14.52 ArrayLogicArray



Full Name: Ops.Array.ArrayLogicArray

Description: Performs logical comparison operations on two arrays

> Inputs

- **Array 0** (Array)
- **Array 1** (Array)
- **Value If True** (Number)
- **Value If False** (Number)
- **Comparison Mode Index** (Number: Integer)

< Output

- **Array Result** (Array)
- **Array Length** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayLogicArray>

14.53 ArrayLogicBetween_v2



Full Name: Ops.Array.ArrayLogicBetween_v2

Description: If value of array is between min and max then the value is 1 else 0

> Inputs

- **Array** (Array)
- **Min** (Number)
- **Max** (Number)
- **Pass Value When True** (Number: Boolean)

< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Array.ArrayLogicBetween_v2

14.54 ArrayLookup



Full Name: Ops.Array.ArrayLookup

Description: Create an array that is filled with values looked up by index from another array

> Inputs

- **Indices** (Array)
- **Values** (Array)
- **Stride** (Number: Integer)

< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayLookup>

14.55 ArrayMath



Full Name: Ops.Array.ArrayMath

Description: Pick from multiple mathematical modes which can all be applied to a single array

> Inputs

- **Array 0** (Array)
- **Number For Math** (Number)
- **Math Function Index** (Number: Integer)

< Output

- **Array Result** (Array)
- **Array Length** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayMath>

14.56 ArrayMathArray



Full Name: Ops.Array.ArrayMathArray

Description: Perform a math operations on two arrays

> Inputs

- **Array 0** (Array)
- **Array 1** (Array)
- **Math Function Index** (Number: Integer)

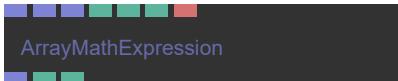
< Output

- **Array Result** (Array)
- **Array Length** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayMathArray>

14.57 ArrayMathExpression



Full Name: Ops.Array.ArrayMathExpression

Description: Calculate a user-defined mathematical expression

> Inputs

- **A** (Array)
- **B** (Array)
- **C** (Array)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **Expression** (String)

< Output

- **Result Array** (Array)
- **Array Length** (Number)
- **Expression Valid** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayMathExpression>

14.58 ArrayMathExpressionTrigger



Full Name: Ops.Array.ArrayMathExpressionTrigger

Description: Calculate a user-defined mathematical expression

> Inputs

- **Update** (Trigger)
- **A** (Array)
- **B** (Array)
- **C** (Array)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **Expression** (String)

< Output

- **Next** (Trigger)

- **Result Array** (Array)
- **Array Length** (Number)
- **Expression Valid** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayMathExpressionTrigger>

14.59 ArrayMax



Full Name: Ops.Array.ArrayMax

Description: Apply a max operation to all values in an array

> Inputs

- **Array In** (Array)
- **Value** (Number)

< Output

- **Array Out** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayMax>

14.60 ArrayMerge_v3



Full Name: Ops.Array.ArrayMerge_v3

Description: Merge multiple arrays - in consecutive order

> Inputs

- **Array 0** (Array)
- **Array 1** (Array)
- **Array 2** (Array)
- **Array 3** (Array)
- **Array 4** (Array)
- **Array 5** (Array)
- **Array 6** (Array)
- **Array 7** (Array)

< Output

- **Result** (Array)

- **Array Length** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Array.ArrayMerge_v3

14.61 ArrayMergeTrigger



Full Name: Ops.Array.ArrayMergeTrigger

Description: Merge / concatenate arrays by trigger

> Inputs

- **Merge** (Trigger)
- **Array 0** (Array)
- **Array 1** (Array)
- **Array 2** (Array)
- **Array 3** (Array)
- **Array 4** (Array)
- **Array 5** (Array)
- **Array 6** (Array)
- **Array 7** (Array)
- **Array 8** (Array)
- **Array 9** (Array)
- **Array 10** (Array)
- **Array 11** (Array)

< Output

- **Next** (Trigger)
- **Result** (Array)
- **Array Length** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayMergeTrigger>

14.62 ArrayMin



Full Name: Ops.Array.ArrayMin

Description: Apply a min operation to all values in an array

> Inputs

- **Array In** (Array)
- **Value** (Number)

< Output

- **Array Out** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayMin>

14.63 ArrayModulo



Full Name: Ops.Array.ArrayModulo

Description: Apply a modulo operation to all values in an array

> Inputs

- **Array In** (Array)
- **Value** (Number)

< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayModulo>

14.64 ArrayMultiply



Full Name: Ops.Array.ArrayMultiply

Description: Multiply every number in an array

> Inputs

- **In** (Array)
- **Value** (Number)

< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayMultiply>

14.65 ArrayNumberRamp_v2



Full Name: Ops.Array.ArrayNumberRamp_v2

Description: Create an array that contains X numbers between start and end values

> Inputs

- **Start Value** (Number)
- **End Value** (Number)
- **Entries** (Number: Integer)

< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Array.ArrayNumberRamp_v2

14.66ArrayOfArrays



Full Name: Ops.Array.ArrayOfArrays

Description: Create an array filled with other arrays

> Inputs

- **Update** (Trigger)
- **Array 0** (Array)
- **Array 1** (Array)
- **Array 2** (Array)
- **Array 3** (Array)
- **Array 4** (Array)
- **Array 5** (Array)
- **Array 6** (Array)
- **Array 7** (Array)
- **Array 8** (Array)
- **Array 9** (Array)

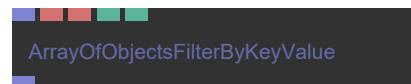
< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayOfArrays>

14.67 ArrayOfObjectsFilterByKeyValue_v3



Full Name: Ops.Array.ArrayOfObjectsFilterByKeyValue_v3

Description: Filter key-value pairs in objects in an array of objects

> Inputs

- **Array** (Array)
- **Filter Key** (String)
- **Filter Value** (String)
- **Invert Filter** (Number: Boolean)
- **invert result** (discard all objects that have key-value pair)

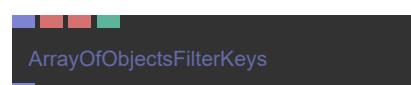
< Output

- **ArrayOut** (Array)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Array.ArrayOfObjectsFilterByKeyValue_v3

14.68 ArrayOfObjectsFilterKeys



Full Name: Ops.Array.ArrayOfObjectsFilterKeys

Description: Remove key-value pairs from objects in an array of objects

> Inputs

- **Array** (Array)
- **Keys** (String)
- **Separator** (String)
- **Invert Filter** (Number: Boolean)

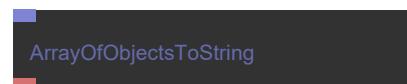
< Output

- **Array Out** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayOfObjectsFilterKeys>

14.69 ArrayOfObjectsToString



Full Name: Ops.Array.ArrayOfObjectsToString

Description: Convert an array of objects into readable string format

> Inputs

- **Array In** (Array)

< Output

- **String** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayOfObjectsToString>

14.70 ArrayPack



Full Name: Ops.Array.ArrayPack

Description: Pack multiple arrays into a new array

> Inputs

- **Array 0** (Array)
- **Array 1** (Array)
- **Array 2** (Array)
- **Array 3** (Array)
- **Array 4** (Array)
- **Array 5** (Array)
- **Array 6** (Array)
- **Array 7** (Array)

< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayPack>

14.71 ArrayPack2



Full Name: Ops.Array.ArrayPack2

Description: Pack two individual arrays into a new array

> Inputs

- **Trigger In** (Trigger)
- **Array 1** (Array)
- **Array 2** (Array)

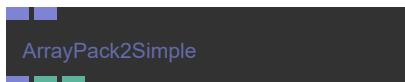
< Output

- **Trigger Out** (Trigger)
- **Array Out** (Array)
- **Array Length** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayPack2>

14.72 ArrayPack2Simple



Full Name: Ops.Array.ArrayPack2Simple

Description: Pack 2 individual arrays into an array2 - without needing a trigger

> Inputs

- **Array 1** (Array)
- **Array 2** (Array)

< Output

- **Array Out** (Array)
- **Num Points** (Number)
- **Array Length** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayPack2Simple>

14.73 ArrayPack3



Full Name: Ops.Array.ArrayPack3

Description: Pack 3 individual arrays into a xyz array

> Inputs

- **Trigger In** (Trigger)
- **Array 1** (Array)
- **Array 2** (Array)
- **Array 3** (Array)

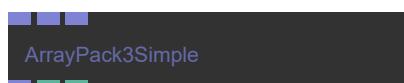
< Output

- **Trigger Out** (Trigger)
- **Array Out** (Array)
- **Num Points** (Number)
- **Array Length** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayPack3>

14.74 ArrayPack3Simple



Full Name: Ops.Array.ArrayPack3Simple

Description: Pack 3 individual arrays into an array3 - without needing a trigger

> Inputs

- **Array 1** (Array)
- **Array 2** (Array)
- **Array 3** (Array)

< Output

- **Array Out** (Array)
- **Num Points** (Number)
- **Array Length** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayPack3Simple>

14.75 ArrayPack4



Full Name: Ops.Array.ArrayPack4

Description: Pack 4 arrays into one array

> Inputs

- **Trigger In** (Trigger)
- **Array 1** (Array)
- **Array 2** (Array)
- **Array 3** (Array)
- **Array 4** (Array)

< Output

- **Trigger Out** (Trigger)
- **Array Out** (Array)
- **Array Length** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayPack4>

14.76 ArrayPack4Simple



Full Name: Ops.Array.ArrayPack4Simple

Description: Pack 3 individual arrays into an array3 - without needing a trigger

> Inputs

- **Array 1** (Array)
- **Array 2** (Array)
- **Array 3** (Array)
- **Array 4** (Array)

< Output

- **Array Out** (Array)
- **Num Points** (Number)
- **Array Length** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayPack4Simple>

14.77 ArrayPow



Full Name: Ops.Array.ArrayPow

Description: Values below 0 are not accepted. 1 = Array in is unaltered

> Inputs

- **Array In** (Array)
- **Pow Factor** (Number)

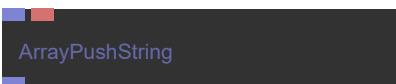
< Output

- **Array Out** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayPow>

14.78 ArrayPushString



Full Name: Ops.Array.ArrayPushString

Description: Push/Append a string to the end of an array

> Inputs

- **Array** (Array)
- **String** (String)

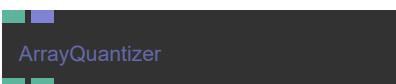
< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayPushString>

14.79 ArrayQuantizer



Full Name: Ops.Array.ArrayQuantizer

Description: Quantize input to nearest number in array

> Inputs

- **Value** (Number)
- **Constraints Array Input** (Array)

< Output

- **Quantized Value** (Number)
- **Quantization Error** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayQuantizer>

14.80 ArrayRandomSelection



Full Name: Ops.Array.ArrayRandomSelection

Description: Extract a definable amount of values from an array

> Inputs

- **Array** (Array)
- **Elements** (Number: Integer)
- **Seed** (Number)

< Output

- **Result** (Array)
- **Array Length** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayRandomSelection>

14.81 ArrayRemoveFalsy



Full Name: Ops.Array.ArrayRemoveFalsy

Description: Remove falsy items from an array

> Inputs

- **Array** (Array)
- **Remove Falsy** (Number: Boolean)

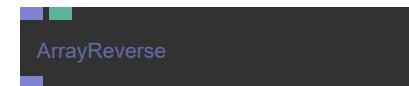
< Output

- **Result Array** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayRemoveFalsy>

14.82 ArrayReverse



Full Name: Ops.Array.ArrayReverse

Description: Reverse an array

> Inputs

- **Active** (Number: Boolean)

< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayReverse>

14.83 ArrayRound



Full Name: Ops.Array.ArrayRound

Description: Round numbers up

> Inputs

- **In** (Array)
- **Method Index** (Number: Integer)
- **Decimal Places** (Number: Integer)

< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayRound>

14.84 ArraySetNumber_v3



Full Name: Ops.Array.ArraySetNumber_v3

Description: Set a number at index in an array

> Inputs

- **Array** (Array)
- **Index** (Number: Integer)
- **Number** (Number)

< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Array.ArraySetNumber_v3

14.85 ArrayGetString



Full Name: Ops.Array.ArrayGetString

Description: Set a string at index in an array

> Inputs

- **Array** (Array)
- **Index** (Number: Integer)
- **Value** (String)

< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayGetString>

14.86 ArraySin



Full Name: Ops.Array.ArraySin

Description: Perform a sin or cos operation on the contents of an array

> Inputs

- **Array In** (Array)
- **Math Function Index** (Number: Integer)
- **Phase** (Number)

- **Frequency** (Number)

- **Amplitude** (Number)

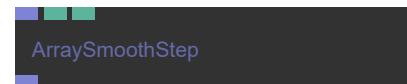
< Output

- **Array Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArraySin>

14.87 ArraySmoothStep



Full Name: Ops.Array.ArraySmoothStep

Description: The fancy way of saying it is Perform Hermite interpolation between two values

> Inputs

- **Array In** (Array)
- **Min** (Number)
- **Max** (Number)

< Output

- **Array Out** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArraySmoothStep>

14.88 ArraySqrt



Full Name: Ops.Array.ArraySqrt

Description: Return the square root of all values in the array

> Inputs

- **In** (Array)

< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArraySqrt>

14.89 ArraysToArrayMultiPort



ArraysToArrayMultiPort

Full Name: Ops.Array.ArraysToArrayMultiPort

Description: Create an array from multiple string

> Inputs

- **Arrays_0** (Array)
- **Arrays_1** (Array)
- **Add Port** (Array)

< Output

- **Result** (Array)
- **Num Values** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArraysToArrayMultiPort>

14.90 ArraySubtract



ArraySubtract

Full Name: Ops.Array.ArraySubtract

Description: Subtract one number from all values in an array

> Inputs

- **Array In** (Array)
- **Value** (Number)

< Output

- **Array Out** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArraySubtract>

14.91 ArraySum



ArraySum

Full Name: Ops.Array.ArraySum

Description: Add one number to all values in an array

> Inputs

- **In** (Array)
- **Value** (Number)

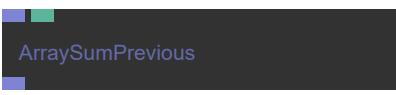
< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArraySum>

14.92 ArraySumPrevious



ArraySumPrevious

Full Name: Ops.Array.ArraySumPrevious

Description: Sum up every number in an array with the sum of the previous

> Inputs

- **Array** (Array)
- **Padding** (Number)

< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArraySumPrevious>

14.93 ArraySumUp



ArraySumUp

Full Name: Ops.Array.ArraySumUp

Description: Sum of every number in an array

> Inputs

- **Array** (Array)

< Output

- **Sum** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArraySumUp>

14.94 ArraySwizzle



Full Name: Ops.Array.ArraySwizzle

Description: Manage/re-order components of an array (stride)

> Inputs

- **Array** (Array)

< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArraySwizzle>

14.95 ArrayToArrays



Full Name: Ops.Array.ArrayToArrays

Description: Split an array up into an array of arrays

> Inputs

- **Array** (Array)
- **Stride** (Number: Integer)

< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayToArrays>

14.96 ArrayToByteBuffer



Full Name: Ops.Array.ArrayToByteBuffer

Description: Convert an array to a byte buffer (Uint8ClampedArray)

> Inputs

- **Array** (Array)

< Output

- **Buffer** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayToByteBuffer>

14.97 ArrayToString_v3



Full Name: Ops.Array.ArrayToString_v3

Description: Join array values to a string (concat)

> Inputs

- **Array** (Array)
- **Separator** (String)
- **New Line** (Number: Boolean)

< Output

- **Result** (String)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Array.ArrayToString_v3

14.98 ArrayTrigger



Full Name: Ops.Array.ArrayTrigger

Description: Trigger an array

> Inputs

- **Exec** (Trigger)
- **Array** (Array)

< Output

- **Trigger Out** (Trigger)
- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayTrigger>

14.99 ArrayUnique



Full Name: Ops.Array.ArrayUnique

Description: Filter an array for duplicate items and returns all unique items in a new array

> Inputs

- **Array** (Array)
- **Format Index** (Number: Integer)
- **Format** (String)

< Output

- **ArrayOut** (Array)
- **Array Length Out** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayUnique>

14.100 ArrayUniqueItemInfo



Full Name: Ops.Array.ArrayUniqueItemInfo

Description: Return information about the count of “duplicates” in an array, as an object

> Inputs

- **Array** (Array)

< Output

- **ObjectOut** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayUniqueItemInfo>

14.101 ArrayUnpack2



Full Name: Ops.Array.ArrayUnpack2

Description: Unpack an xy array into separate arrays

> Inputs

- **Array In Xyz** (Array)

< Output

- **Array 1 Out** (Array)
- **Array 2 Out** (Array)
- **Array Lengths** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayUnpack2>

14.102 ArrayUnpack3



Full Name: Ops.Array.ArrayUnpack3

Description: Split an xyz array into 3 individual arrays

> Inputs

- **Array In Xyz** (Array)

< Output

- **Array 1 Out** (Array)
- **Array 2 Out** (Array)
- **Array 3 Out** (Array)
- **Array Lengths** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayUnpack3>

14.103 ArrayUnpack4



Full Name: Ops.Array.ArrayUnpack4

Description: Split an xyzw array into 4 individual arrays

> Inputs

- **Array In Xyzw** (Array)

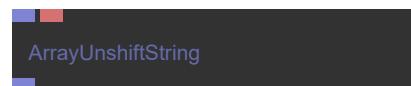
< Output

- **Array 1 Out** (Array)
- **Array 2 Out** (Array)
- **Array 3 Out** (Array)
- **Array 4 Out** (Array)
- **Array Lengths** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayUnpack4>

14.104 ArrayUnshiftString



Full Name: Ops.Array.ArrayUnshiftString

Description: Insert/add/unshift a string to the beginning of an array

> Inputs

- **Array** (Array)
- **String** (String)

< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ArrayUnshiftString>

14.105 AverageArray



Full Name: Ops.Array.AverageArray

Description: Smooth/average values in an array

> Inputs

- **Array** (Array)
- **Iterations** (Number: Integer)
- **Mode Index** (Number: Integer)

< Output

- **Smoothed Array** (Array)
- **Array Length** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.AverageArray>

14.106 BoolStateArray



Full Name: Ops.Array.BoolStateArray

Description: Array filled with 0, only one can be 1

> Inputs

- **Array Length** (Number)
- **Active Index** (Number)
- **Inactive Value** (Number)
- **Active Value** (Number)

< Output

- **State Array** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.BoolStateArray>

14.107 CopyArray



Full Name: Ops.Array.CopyArray

Description: Copy an array with a trigger, reset to use a default array

> Inputs

- **Exec** (Trigger)
- **Array** (Array)
- **Reset** (Trigger)
- **Default** (Array)

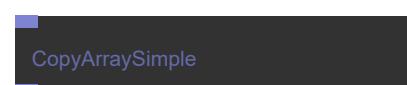
< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.CopyArray>

14.108 CopyArraySimple



Full Name: Ops.Array.CopyArraySimple

Description: Create a copy of an array

> Inputs

- Visit *Ops.Array.CopyArraySimple documentation for input port details*

< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.CopyArraySimple>

14.109 CropArray



Full Name: Ops.Array.CropArray

Description: The array to crop

> Inputs

- **Source Array** (Array)
- **Start Index** (Number: Integer)
- **New Length** (Number: Integer)

< Output

- **Cropped Array** (Array)
- **Array Length** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.CropArray>

14.110 CutArray



Full Name: Ops.Array.CutArray

Description: Remove elements from an array from the beginning and/or the end

> Inputs

- **Source Array** (Array)
- **Remove From Start** (Number: Integer)
- **Remove From End** (Number: Integer)

< Output

- **Cut Array** (Array)
- **Array Length** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.CutArray>

14.111 EaseArray



Full Name: Ops.Array.EaseArray

Description: Apply easing curve to numbers in an array

> Inputs

- **Array** (Array)
- **Min** (Number)
- **Max** (Number)
- **Easing Index** (Number: Integer)

< Output

- **Result Array** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.EaseArray>

14.112 EmptyArray



Full Name: Ops.Array.EmptyArray

Description: Visit documentation for details

> Inputs

- Visit *Ops.Array.EmptyArray documentation for input port details*

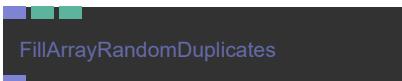
< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.EmptyArray>

14.113 FillArrayRandomDuplicates_v2



FillArrayRandomDuplicates

Full Name: Ops.Array.FillArrayRandomDuplicates_v2

Description: Fill an array with random duplicates

> Inputs

- **Array** (Array)
- **Num Elements** (Number: Integer)
- **Random Seed** (Number)

< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Array.FillArrayRandomDuplicates_v2

14.114 FilterArray



Full Name: Ops.Array.FilterArray

Description: Compare elements from an array and remove not matching ones

> Inputs

- **Array** (Array)
- **Stride Index** (Number: Integer)
- **the type of the array** (Array3, Array2, ...)
- **Compare Element Index** (Number: Integer)
- **which element to compare** (see stride)
- **Filter Method Index** (Number: Integer)
- **Compare To** (Number)

< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.FilterArray>

14.115 FilterValidArray



FilterValidArray

Full Name: Ops.Array.FilterValidArray

Description: Filter valid arrays

> Inputs

- **Array** (Array)
- **Invalid When Length Is 0** (Number: Boolean)

< Output

- **Last Valid Array** (Array)
- **Is Valid** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.FilterValidArray>

14.116 FlattenArray



Full Name: Ops.Array.FlattenArray

Description: Create a new array with all sub-array elements concatenated into it

> Inputs

- **Array** (Array)

< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.FlattenArray>

14.117 FreezeArray



14.117 FreezeArray



Full Name: Ops.Array.FreezeArray

Description: Capture the current input and copy it to the output, even after a reload

> Inputs

- **Number** (Array)
- **Button** (Trigger)

< Output

- **Frozen Array** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.FreezeArray>

14.118 GateArray_v2



Full Name: Ops.Array.GateArray_v2

Description: Only allow an array through if pass through is true

> Inputs

- **Array In** (Array)
- **Pass Through** (Number: Boolean)

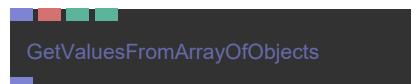
< Output

- **Array Out** (Array)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Array.GateArray_v2

14.119 GetValuesFromArrayOfObjects



Full Name: Ops.Array.GetValuesFromArrayOfObjects

Description: Get an array of values by key of objects in an array

> Inputs

- **Array** (Array)
- **Key** (String)
- **Numbers Only** (Number: Boolean)

< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.GetValuesFromArrayOfObjects>

14.120 HSBtoRGBArray



Full Name: Ops.Array.HSBtoRGBArray

Description: Generate an RGBA array from up to 4 arrays (HSBA)

> Inputs

- **Trigger Input** (Trigger)
- **In Hue Array** (Array)
- **In Saturation Array** (Array)
- **In Brightness Array** (Array)
- **In Alpha Array** (Array)

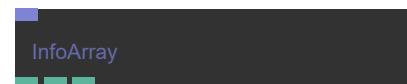
< Output

- **Trigger Output** (Trigger)
- **Result Array** (Array)
- **Array Length** (Number)
- **RGBA Tuple Length** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.HSBtoRGBArray>

14.121 InfoArray



Full Name: Ops.Array.InfoArray

Description: Min, Max and Average value from an array

> Inputs

- **Array** (Array)

< Output

- **Min** (Number)
- **Max** (Number)
- **Average** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.InfoArray>

14.122 InfoArray2



Full Name: Ops.Array.InfoArray2

Description: Min, Max and Average values of an array2

> Inputs

- **Array** (Array)

< Output

- **Num Items** (Number)
- **Min X** (Number)
- **Max X** (Number)
- **Average X** (Number)
- **Min Y** (Number)
- **Max Y** (Number)
- **Average Y** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.InfoArray2>

- **Center X** (Number)
- **Center Y** (Number)
- **Center Z** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.InfoArray3>

14.123 InfoArray3



Full Name: Ops.Array.InfoArray3

Description: Min, Max and Average values of an array3

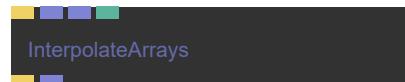
> Inputs

- **Array** (Array)

< Output

- **Num Items** (Number)
- **Min X** (Number)
- **Min Y** (Number)
- **Min Z** (Number)
- **Max X** (Number)
- **Max Y** (Number)
- **Max Z** (Number)
- **Average X** (Number)
- **Average Y** (Number)
- **Average Z** (Number)

14.124 InterpolateArrays



Full Name: Ops.Array.InterpolateArrays

Description: Interpolate between two arrays (lerp) - linear interpolation

> Inputs

- **Exe** (Trigger)
- **Array 1** (Array)
- **Array 2** (Array)
- **Perc** (Number)

< Output

- **Next** (Trigger)
- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.InterpolateArrays>

14.125 InterpolateArraysRange



Full Name: Ops.Array.InterpolateArraysRange

Description: Interpolate between two arrays, only a few numbers at the same time

> Inputs

- **Exe** (Trigger)
- **Array 1** (Array)
- **Array 2** (Array)
- **Pos** (Number)
- **Width** (Number)
- **Easing Index** (Number: Integer)

- **Reverse** (Number: Boolean)

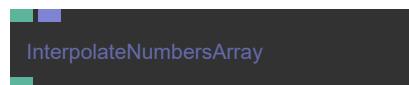
< Output

- **Next** (Trigger)
- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.InterpolateArraysRange>

14.126 InterpolateNumbersArray



Full Name: Ops.Array.InterpolateNumbersArray

Description: Interpolate between all values of an array

> Inputs

- **Index Position** (Number)
- **Array** (Array)

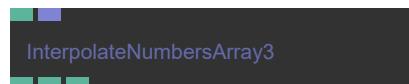
< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.InterpolateNumbersArray>

14.127 InterpolateNumbersArray3



Full Name: Ops.Array.InterpolateNumbersArray3

Description: Get interpolated values between the indices of an array 3x

> Inputs

- **Index Position** (Number)
- **Array** (Array)

< Output

- **X** (Number)
- **Y** (Number)
- **Z** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.InterpolateNumbersArray3>

14.128 LissajouseSpline



Full Name: Ops.Array.LissajouseSpline

Description: Generate spline using lissajous formulas

> Inputs

- **Formula Index** (Number: Integer)
- **A** (Number: Integer)
- **B** (Number: Integer)
- **C** (Number: Integer)
- **D** (Number: Integer)

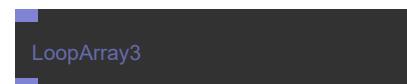
< Output

- **Result** (Array)
- **Total Points** (Number)
- **Array Length** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.LissajouseSpline>

14.129 LoopArray3



Full Name: Ops.Array.LoopArray3

Description: Make the 1st and last point of an array the same, good for closing splines and shapes

> Inputs

- **Array In** (Array)

< Output

- **Array Out** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.LoopArray3>

14.130 MapRangeArray



Full Name: Ops.Array.MapRangeArray

Description: Map values in an array from one range into another.

> Inputs

- **Array** (Array)
- **Old Min** (Number)
- **Old Max** (Number)
- **New Min** (Number)
- **New Max** (Number)
- **Easing Index** (Number: Integer)

< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.MapRangeArray>

14.131 NumbersToArrayMultiPort_v2



Full Name: Ops.Array.NumbersToArrayMultiPort_v2

Description: Create an array from multiple number inputs

> Inputs

- **Numbers_0** (Number)
- **Add Port** (Number)

< Output

- **Result** (Array)
- **Num Values** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Array.NumbersToArrayMultiPort_v2

14.132 ObjectIteratorKeys



Full Name: Ops.Array.ObjectIteratorKeys

Description: Iterate over an array of objects

> Inputs

- **Exe** (Trigger)
- **Array** (Array)

< Output

- **Trigger** (Trigger)
- **Finished** (Trigger)
- **Index** (Number)
- **Value** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ObjectIteratorKeys>

14.133 PaletteLibrary



Full Name: Ops.Array.PaletteLibrary

Description: Contains a collection of color palettes in groups of 5 in an array

> Inputs

• Visit *Ops.Array.PaletteLibrary documentation* for input port details

< Output

- **Palette Array Out** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.PaletteLibrary>

14.134 PerlinArray



Full Name: Ops.Array.PerlinArray

Description: Create an array filled with Perlin noise values

> Inputs

- **Array In X** (Array)
- **Array Time** (Array)
- **Time In Y** (Number)
- **Seed 0-1** (Number)
- **Frequency** (Number)

< Output

- **Array Out** (Array)
- **Array Length Out** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.PerlinArray>

14.135 Phyllotaxis



Full Name: Ops.Array.Phyllotaxis

Description: Coordinate generation like arrangement of leaves in some plants

> Inputs

- **Render** (Trigger)
- **Num** (Number: Integer)
- **Scale** (Number)
- **Param** (Number)

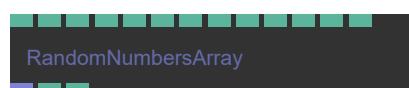
< Output

- **Coordinates** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.Phyllotaxis>

14.136 RandomNumbersArray_v4



Full Name: Ops.Array.RandomNumbersArray_v4

Description: Create a random array of 1 to 4 dimensions

> Inputs

- **Num Values** (Number: Integer)

- **Mode Index** (Number: Integer)
- **Random Seed** (Number)
- **Integer** (Number: Boolean)
- **Min A** (Number)
- **Max A** (Number)
- **Min B** (Number)
- **Max B** (Number)
- **Min C** (Number)
- **Max C** (Number)
- **Min D** (Number)
- **Max D** (Number)

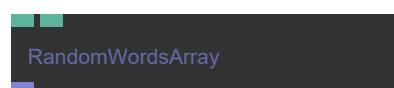
< Output

- **Array Out** (Array)
- **Chunks Amount** (Number)
- **Array Length** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Array.RandomNumbersArray_v4

14.137 RandomWordsArray



Full Name: Ops.Array.RandomWordsArray

Description: Generate an array filled with random english words

> Inputs

- **Random Seed** (Number)
- **Content Index** (Number: Integer)

< Output

- **Words** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.RandomWordsArray>

14.138 ReduceArray3_v3



Full Name: Ops.Array.ReduceArray3_v3

Description: Remove points from an array, e.g. xth points, random, duplicates

> Inputs

- **Array** (Array)
- **Remove Index** (Number: Integer)
- **Every Xth Item** (Number: Integer)
- **Threshold** (Number)
- **Seed** (Number)

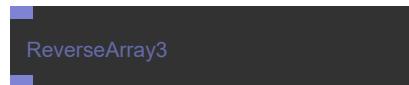
< Output

- **Result Array** (Array)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Array.ReduceArray3_v3

14.139 ReverseArray3



Full Name: Ops.Array.ReverseArray3

Description: Reverse an array with value triplets [x, y, z, ...]

> Inputs

- **Array** (Array)
- **The Array you want to reverse** (containing triplets)

< Output

- **Reversed Array** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.ReverseArray3>

14.140 RingBuffer



Full Name: Ops.Array.RingBuffer

Description: Array of fixed size, index is automatically incremented and restarts after reaching the end

> Inputs

- **Value** (Number)

- **Write** (Trigger)

- **Length** (Number: Integer)

- **Reset Index** (Trigger)

< Output

- **Result** (Array)
- **Index** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.RingBuffer>

14.141 RotateArray



Full Name: Ops.Array.RotateArray

Description: Shift array contents based upon rotate amount

> Inputs

- **Array In** (Array)
- **Rotate Amount** (Number: Integer)

< Output

- **ArrayOut** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.RotateArray>

14.142 RouteArray



Full Name: Ops.Array.RouteArray

Description: Route an array to an output port

> Inputs

- **Index** (Number: Integer)
- **Array In** (Array)
- **Default Array** (Array)

< Output

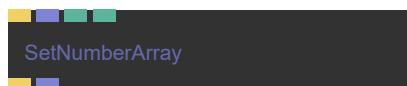
- **Index 0 Array** (Array)
- **Index 1 Array** (Array)
- **Index 2 Array** (Array)

- **Index 3 Array** (Array)
- **Index 4 Array** (Array)
- **Index 5 Array** (Array)
- **Index 6 Array** (Array)
- **Index 7 Array** (Array)
- **Index 8 Array** (Array)
- **Index 9 Array** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.RouteArray>

14.143 SetNumberArray



Full Name: Ops.Array.SetNumberArray

Description: Change the number of an array at an index

> Inputs

- **Exe** (Trigger)
- **Array** (Array)
- **Index** (Number: Integer)
- **Value** (Number)

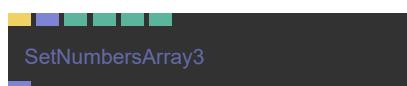
< Output

- **Next** (Trigger)
- **Values** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.SetNumberArray>

14.144 SetNumbersArray3



Full Name: Ops.Array.SetNumbersArray3

Description: Set three values at position index in an array

> Inputs

- **Exe** (Trigger)
- **Array** (Array)
- **Index** (Number: Integer)

- **Value 1** (Number)
- **Value 2** (Number)
- **Value 3** (Number)

< Output

- **Values** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.SetNumbersArray3>

14.145 ShuffleArray3_v3



Full Name: Ops.Array.ShuffleArray3_v3

Description: Shuffle/Randomize the order of an array of triplets

> Inputs

- **Array3** (Array)
- **Seed** (Number)

< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Array.ShuffleArray3_v3

14.146 ShuffleArray_v3



Full Name: Ops.Array.ShuffleArray_v3

Description: Randomize the order of elements inside an array

> Inputs

- **Array3** (Array)
- **Seed** (Number)

< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Array.ShuffleArray_v3

14.147 SimplexArray



Full Name: Ops.Array.SimplexArray

Description: Create an array filled with Simplex noise values (Range: -1, 1)

> Inputs

- **Array In X** (Array)
- **Array Time** (Array)
- **Time In Y** (Number)
- **Seed 0-1** (Number)
- **Frequency** (Number)

< Output

- **Array Out** (Array)
- **Array Length Out** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.SimplexArray>

14.148 SmoothArray



Full Name: Ops.Array.SmoothArray

Description: Smooth out changes in values of an array

> Inputs

- **Execute** (Trigger)
- **Array In** (Array)
- **Inc Factor** (Number)
- **Dec Factor** (Number)

< Output

- **Next** (Trigger)
- **Array Out** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.SmoothArray>

14.149 SortArray



Full Name: Ops.Array.SortArray

Description: Sort an array of numbers with one of two modes - ascending or descending

> Inputs

- **Array To Sort** (Array)

< Output

- **Sorted Array** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.SortArray>

14.150 SortArray3



Full Name: Ops.Array.SortArray3

Description: Sort an array with the lowest values of the selected component.

> Inputs

- **Array** (Array)
- **What Index** (Number: Integer)

< Output

- **Result** (Array)
- **The sorted array** (new array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.SortArray3>

14.151 SortArrayOfObjects



Full Name: Ops.Array.SortArrayOfObjects

Description: Sort an array of objects by the values of a key

> Inputs

- **Array** (Array)
- **Key** (String)
- **Reverse** (Number: Boolean)

< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.SortArrayOfObjects>

14.152 SortArrayWithIndices_v2



Full Name: Ops.Array.SortArrayWithIndices_v2

Description: Sort an array of numbers and also get sorted indices

> Inputs

- **Array To Sort** (Array)
- **Sorting Mode Index** (Number: Integer)

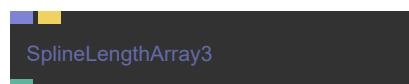
< Output

- **Sorted Array** (Array)
- **Sorted Indices** (Array)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Array.SortArrayWithIndices_v2

14.153 SplineLengthArray3



Full Name: Ops.Array.SplineLengthArray3

Description: Return a number with the total distance between the points/items in an array3

> Inputs

- **Array3x** (Array)
- **Calculate** (Trigger)

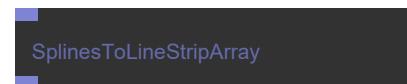
< Output

- **Length** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.SplineLengthArray3>

14.154 SplinesToLineStripArray



Full Name: Ops.Array.SplinesToLineStripArray

Description: Convert an array of splines to one "line stripped" array

> Inputs

- **Array** (Array)

< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.SplinesToLineStripArray>

14.155 StringToArray_v2



Full Name: Ops.Array.StringToArray_v2

Description: Parse a string into an array (create, split string, stringToArray)

> Inputs

- **Text** (String)
- **Separator** (String)
- **Numbers** (Number: Boolean)
- **Trim** (Number: Boolean)
- **Split Lines** (Number: Boolean)

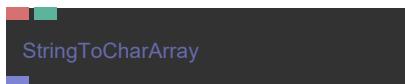
< Output

- **Array** (Array)
- **Parsed** (Trigger)
- **Length** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Array.StringToArray_v2

14.156 StringToArray



Full Name: Ops.Array.StringToArray

Description: Turn a string into an array of single characters or ASCII numbers

> Inputs

- **String** (String)
- **Convert To Numbers** (Number: Boolean)

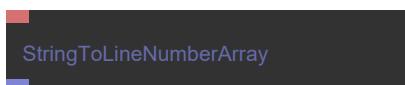
< Output

- **Array Out** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.StringToArray>

14.157 StringToLineNumberArray



Full Name: Ops.Array.StringToLineNumberArray

Description: Output an array containing a line number for every character

> Inputs

- **String** (String)

< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.StringToLineNumberArray>

14.158 SubdivideArray1



Full Name: Ops.Array.SubdivideArray1

Description: For subdividing splines, smoothing lines using cubic bezier interpolation

> Inputs

- **Points** (Array)
- **Num Subdivs** (Number: Integer)
- **Smooth** (Number: Boolean)

< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.SubdivideArray1>

14.159 SwitchArray



Full Name: Ops.Array.SwitchArray

Description: Switch between multiple arrays

> Inputs

- **Index** (Number: Integer)
- **Array 0** (Array)
- **Array 1** (Array)
- **Array 2** (Array)
- **Array 3** (Array)
- **Array 4** (Array)
- **Array 5** (Array)
- **Array 6** (Array)
- **Array 7** (Array)
- **Array 8** (Array)
- **Array 9** (Array)

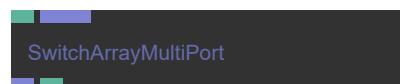
< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.SwitchArray>

14.160 SwitchArrayMultiPort_v2



Full Name: Ops.Array.SwitchArrayMultiPort_v2

Description: Switch between multiple input arrays

> Inputs

- **Index** (Number: Integer)
- **Arrays_0** (Array)
- **Add Port** (Array)

< Output

- **Number** (Array)
- **Num Values** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Array.SwitchArrayMultiPort_v2

14.161 SwitchArrayOnTrigger



Full Name: Ops.Array.SwitchArrayOnTrigger

Description: Switch between multiple arrays on trigger

> Inputs

- **Trigger 1** (Trigger)
- **Array 1** (Array)
- **Trigger 2** (Trigger)
- **Array 2** (Array)
- **Trigger 3** (Trigger)
- **Array 3** (Array)
- **Trigger 4** (Trigger)
- **Array 4** (Array)
- **Trigger 5** (Trigger)
- **Array 5** (Array)
- **Trigger 6** (Trigger)
- **Array 6** (Array)
- **Trigger 7** (Trigger)
- **Array 7** (Array)
- **Trigger 8** (Trigger)
- **Array 8** (Array)

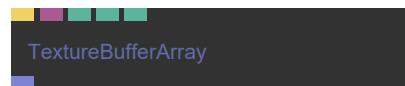
< Output

- **Out Array** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.SwitchArrayOnTrigger>

14.162 TextureBufferArray



Full Name: Ops.Array.TextureBufferArray

Description: Store various textures in an array, starts at the beginning again when end reached

> Inputs

- **Write** (Trigger)
- **Texture** (Object:Texture)
- **Num** (Number: Integer)
- **The size of the ring buffer** (how many textures it can hold)
- **Order** (Number: Boolean)
- **Clear** (Number: Boolean)

< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.TextureBufferArray>

14.163 WeaveArrays



Full Name: Ops.Array.WeaveArrays

Description: Weave two arrays together (combine, join, merge)

> Inputs

- **Array 1** (Array)
- **Array 2** (Array)
- **Chunk Size** (Number)

< Output

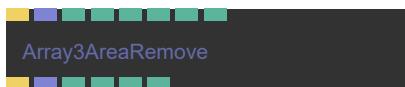
- **Combined Array** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.WeaveArrays>

15 Ops.Array.PointArray

15.1 Array3AreaRemove



Full Name: Ops.Array.PointArray.Array3AreaRemove

Description: Remove points from an array3 with different shapes

> Inputs

- **In Trigger** (Trigger)
- **In Array** (Array)
- **Mode Index** (Number: Integer)
- **Size** (Number)
- **Invert** (Number: Boolean)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)

< Output

- **Out Trigger** (Trigger)
- **Out Array** (Array)
- **Array Length** (Number)
- **Out X** (Number)
- **Out Y** (Number)
- **Out Z** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.PointArray.Array3AreaRemove>

15.2 Array3PointEditor



Full Name: Ops.Array.PointArray.Array3PointEditor

Description: Visually edit positions in an array of point coordinates

> Inputs

- **Execute** (Trigger)

- **Total Points** (Number: Integer)
- **Edit** (Number: Boolean)
- **Index** (Number: Integer)
- **Copy From Index** (Number: Integer)
- **Copy Coordinates** (Trigger)
- **Reset** (Trigger)

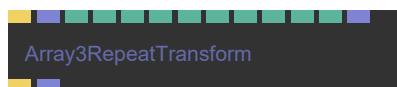
< Output

- **Next** (Trigger)
- **Coordinates** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.PointArray.Array3PointEditor>

15.3 Array3RepeatTransform



Full Name: Ops.Array.PointArray.Array3RepeatTransform

Description: Repeat an array by transforming it x times

> Inputs

- **Trigger** (Trigger)
- **Array** (Array)
- **Times** (Number: Integer)
- **Translate X** (Number)
- **Translate Y** (Number)
- **Translate Z** (Number)
- **Scale X** (Number)
- **Scale Y** (Number)
- **Scale Z** (Number)
- **Rotation X** (Number)
- **Rotation Y** (Number)
- **Rotation Z** (Number)
- **Position Array** (Array)

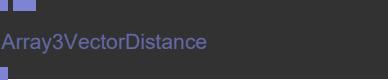
< Output

- **Next** (Trigger)
- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.PointArray.Array3RepeatTransform>

15.4 Array3VectorDistance



Array3VectorDistance

Full Name: Ops.Array.PointArray.Array3VectorDistance

Description: Return the distance between 2 points from an array

> Inputs

- **Array In 1** (Array)
- **Array In 2** (Array)

< Output

- **Array Out** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.PointArray.Array3VectorDistance>

15.5 ArraySpray



ArraySpray

Full Name: Ops.Array.PointArray.ArraySpray

Description: Particle spray simulation

> Inputs

- **Exe** (Trigger)
- **Time** (Number)
- **Num** (Number)
- **Size X** (Number)
- **Size Y** (Number)
- **Size Z** (Number)
- **Movement X** (Number)
- **Movement Y** (Number)
- **Movement Z** (Number)
- **Center X** (Number: Boolean)
- **Center Y** (Number: Boolean)
- **Center Z** (Number: Boolean)
- **Reset** (Trigger)
- **Lifetime** (Number)
- **Lifetime Minimum** (Number)

< Output

- **Trigger Out** (Trigger)

- **Positions** (Array)

- **Lifetime** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.PointArray.ArraySpray>

15.6 CircularPoints_v2



CircularPoints

Full Name: Ops.Array.PointArray.CircularPoints_v2

Description: Create arrays for circular shapes, helix, circle, etc.

> Inputs

- **Radius** (Number)
- **Round Segments** (Number)
- **Rounds** (Number)
- **Radius Add Round** (Number)
- **Radius Add Point** (Number)
- **Offset** (Number)
- **Point Offset XY** (Number)
- **Point Offset Z** (Number)
- **Offset Rotation** (Number)
- **Loop** (Number: Boolean)

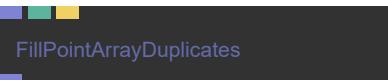
< Output

- **Points** (Array)
- **Rotation** (Array)
- **Total Points** (Number)
- **Array Lengths** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Array.PointArray.CircularPoints_v2

15.7 FillPointArrayDuplicates



FillPointArrayDuplicates

Full Name: Ops.Array.PointArray.FillPointArrayDuplicates

Description: Fill an XYZ array with existing duplicate points until it reaches the length

> Inputs

- **Array** (Array)
- **Num Elements** (Number: Integer)
- **Calculate** (Trigger)

< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.PointArray.FillPointArrayDuplicates>

15.8 PointsCube



Full Name: Ops.Array.PointArray.PointsCube

Description: Generate a 3d point field with controllable amount of xyz points
(was PointsField3d)

> Inputs

- **Num X** (Number: Integer)
- **Num Y** (Number: Integer)
- **Num Z** (Number: Integer)
- **Mul** (Number)
- **Center** (Number: Boolean)

< Output

- **Array Out** (Array)
- **Total Points** (Number)
- **Array Length** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.PointArray.PointsCube>

15.9 PointsHexagonGrid



Full Name: Ops.Array.PointArray.PointsHexagonGrid

Description: Generate coordinates for a hexagon grid, outputs array3x

> Inputs

- **Rows** (Number: Integer)

> Inputs

- **Columns** (Number: Integer)
- **Hex Facing Index** (Number: Integer)
- **Hex Facing** (String)
- **Flip Corners** (Number: Boolean)
- **Tile X Offset** (Number)
- **Tile Y Offset** (Number)
- **Multiplier** (Number)

< Output

- **Array Out** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.PointArray.PointsHexagonGrid>

15.10 PointsPlane_v2



Full Name: Ops.Array.PointArray.PointsPlane_v2

Description: Generate coordinates for a rectangular field / grid of points

> Inputs

- **Rows** (Number: Integer)
- **Columns** (Number: Integer)
- **Width** (Number)
- **Height** (Number)
- **Row Offset** (Number)
- **Center** (Number: Boolean)

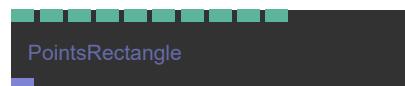
< Output

- **Result** (Array)
- **Total Points** (Number)
- **Array Length** (Number)
- **Row Numbers** (Array)
- **Column Numbers** (Array)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Array.PointArray.PointsPlane_v2

15.11 PointsRectangle_v2



Full Name: Ops.Array.PointArray.PointsRectangle_v2

Description: Generate an array of XYZ coordinates of an rectangle

> Inputs

- **Line Strip** (Number: Boolean)
- **Segments** (Number: Integer)
- **Width** (Number)
- **Height** (Number)
- **Border Radius** (Number)
- **Loop** (Number: Boolean)
- **Top Left** (Number: Boolean)
- **Top Right** (Number: Boolean)
- **Bottom Left** (Number: Boolean)
- **Bottom Right** (Number: Boolean)

< Output

- **Points** (Array)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Array.PointArray.PointsRectangle_v2

15.12 PointsRectangleRounded_v2



PointsRectangleRounded

Full Name: Ops.Array.PointArray.PointsRectangleRounded_v2

Description: Generate an array of points of a rectangle with rounded corners

> Inputs

- **Render** (Trigger)
- **Segments** (Number: Integer)
- **Width** (Number)
- **Height** (Number)
- **Border Radius** (Number)
- **Top Left** (Number: Boolean)
- **Top Right** (Number: Boolean)
- **Bottom Left** (Number: Boolean)
- **Bottom Right** (Number: Boolean)
- **Draw** (Number: Boolean)

< Output

- **Trigger** (Trigger)
- **Points** (Array)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Array.PointArray.PointsRectangleRounded_v2

15.13 PointsSphereRandom



PointsSphereRandom

Full Name: Ops.Array.PointArray.PointsSphereRandom

Description: Generate a point field mapped to the surface of a sphere

> Inputs

- **Amount Of Points** (Number: Integer)
- **Sphere Size** (Number)
- **Random Seed** (Number)
- **Random Distance From Sphere** (Number)
- **Distribution Index** (Number: Integer)

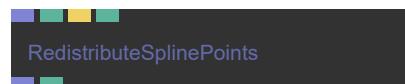
< Output

- **Array Out** (Array)
- **Total Points** (Number)
- **Array Length** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.PointArray.PointsSphereRandom>

15.14 RedistributeSplinePoints



RedistributeSplinePoints

Full Name: Ops.Array.PointArray.RedistributeSplinePoints

Description: Recalculate a spline / change number of points of a spline

> Inputs

- **Array3x** (Array)
- **Num Points** (Number: Integer)
- **Calculate** (Trigger)
- **Normalized** (Number: Boolean)

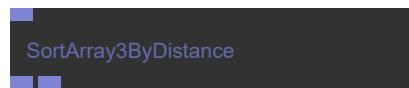
< Output

- **Result** (Array)
- **Spline Length** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.PointArray.RedistributeSplinePoints>

15.15 SortArray3ByDistance



Full Name: Ops.Array.PointArray.SortArray3ByDistance

Description: Sort an array3, by the distance of each point to the previous point

> Inputs

- **Array** (Array)

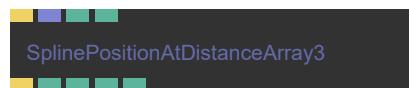
< Output

- **Result** (Array)
- **Result Index** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.PointArray.SortArray3ByDistance>

15.16 SplinePositionAtDistanceArray3



Full Name: Ops.Array.PointArray.SplinePositionAtDistanceArray3

Description: Get position in array3/spline at distance from start

> Inputs

- **Calculate** (Trigger)
- **Array3x** (Array)
- **Distance** (Number)
- **Normalized** (Number: Boolean)

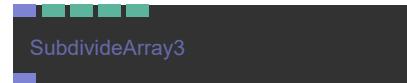
< Output

- **Next** (Trigger)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **Spline Length** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.PointArray.SplinePositionAtDistanceArray3>

15.17 SubdivideArray3_v2



Full Name: Ops.Array.PointArray.SubdivideArray3_v2

Description: For subdividing splines, smoothing lines using cubic bezier interpolation

> Inputs

- **Points** (Array)
- **Num Subdivs** (Number: Integer)
- **Smooth** (Number: Boolean)
- **Loop** (Number: Boolean)

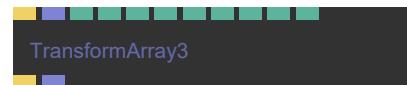
< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Array.PointArray.SubdivideArray3_v2

15.18 TransformArray3



Full Name: Ops.Array.PointArray.TransformArray3

Description: Transform (translate, rotate, scale) positions in an array3x

> Inputs

- **Transform** (Trigger)
- **Array** (Array)
- **Translate X** (Number)
- **Translate Y** (Number)
- **Translate Z** (Number)
- **Scale X** (Number)
- **Scale Y** (Number)
- **Scale Z** (Number)
- **Rotation X** (Number)
- **Rotation Y** (Number)

- **Rotation Z** (Number)

◀ Output

- **Next** (Trigger)
- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Array.PointArray.TransformArray3>

16 Ops.Audio

16.1 BpmTap



Full Name: Ops.Audio.BpmTap

Description: Let's you tap in a beat, useful to synchronise visuals to music (VJ, sync, sound)

➢ Inputs

- **Exe** (Trigger)
- **Tap** (Trigger)
- **Sync** (Trigger)
- **NudgeLeft** (Trigger)
- **NudgeRight** (Trigger)
- **Active** (Number: Boolean)

◀ Output

- **Beat** (Trigger)
- **Bpm** (Number)
- **The resulting BPM** (beats per minute)
- **States** (Array)
- **Beat Index** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Audio.BpmTap>

16.2 MidiJson



Full Name: Ops.Audio.MidiJson

Description: read MIDI information at time x

➢ Inputs

- **MidiJson** (Object)
- **Time** (Number)

◀ Output

- **Beat** (Number)
- **Track Names** (Array)
- **Names** (Array)
- **Progress** (Array)
- **Velocity** (Array)
- **Num Tracks** (Number)
- **BPM** (Number)
- **Data** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Audio.MidiJson>

16.3 MidiJsonNote_v2



Full Name: Ops.Audio.MidiJsonNote_v2

Description: Filter MidiJson for notes

> Inputs

- **Data** (Object)
- **Note** (String)
- **Channel** (Number: String)
- **Beat Start** (Number: Integer)
- **Beat End** (Number: Integer)

< Output

- **Count** (Number)
- **Progress** (Number)
- **Time Since Last** (Number)
- **Trigger** (Trigger)
- **Reseted** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Audio.MidiJsonNote_v2

17 Ops.Boolean

17.1 And



Full Name: Ops.Boolean.And

Description: Outputs true if both input values are true (boolean)

> Inputs

- **Bool 1** (Number: Boolean)
- **Bool 2** (Number: Boolean)

< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Boolean.And>

17.2 AndMultiPort_v2



Full Name: Ops.Boolean.AndMultiPort_v2

Description: Outputs true if all input values are true (boolean)

> Inputs

- **Booleans_0** (Number: Boolean)
- **Add Port** (Number: Boolean)

< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Boolean.AndMultiPort_v2

17.3 BoolByTrigger



Full Name: Ops.Boolean.BoolByTrigger

Description: Trigger true or false values

> Inputs

- **True** (Trigger)
- **False** (Trigger)

< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Boolean.BoolByTrigger>

- **R True** (Number)
- **G True** (Number)
- **B True** (Number)
- **A True** (Number)
- **R False** (Number)
- **G False** (Number)
- **B False** (Number)
- **A False** (Number)

< Output

- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Boolean.BoolToColor>

17.4 Boolean



Full Name: Ops.Boolean.Boolean

Description: Stores a boolean value

> Inputs

- **Value** (Number: Boolean)

< Output

- **Result** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Boolean.Boolean>

17.5 BoolToColor



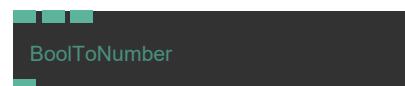
Full Name: Ops.Boolean.BoolToColor

Description: Convert boolean to RGB color

> Inputs

- **Boolean** (Number: Boolean)

17.6 BoolToNumber_v2



Full Name: Ops.Boolean.BoolToNumber_v2

Description: Switches two number values using a boolean

> Inputs

- **Use Value 1** (Number: Boolean)
- **Value 0** (Number)
- **Value 1** (Number)

< Output

- **Out Value** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Boolean.BoolToNumber_v2

17.7 BoolToString



Full Name: Ops.Boolean.BoolToString

Description: convert boolean to string

> Inputs

- **Boolean** (Number: Boolean)
- **False** (String)
- **True** (String)

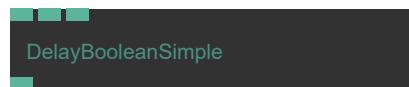
< Output

- **String** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Boolean.BoolToString>

17.8 DelayBooleanSimple



Full Name: Ops.Boolean.DelayBooleanSimple

Description: Delay the input/output of a boolean by x seconds

> Inputs

- **Value** (Number)
- **Delay True** (Number)
- **Delay False** (Number)

< Output

- **Out Value** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Boolean.DelayBooleanSimple>

17.9 IfFalseThen



Full Name: Ops.Boolean.IfFalseThen

Description: Triggers if input value is false

> Inputs

- **Exe** (Trigger)
- **Boolean** (Number: Boolean)

< Output

- **Exe** (Trigger)
- **Boolean** (Number: Boolean)

- **Then** (Trigger)

- **Else** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Boolean.IfFalseThen>

17.10 IfTrueThen_v2



Full Name: Ops.Boolean.IfTrueThen_v2

Description: Switch, trigger one or the other trigger port based on the input value

> Inputs

- **Exe** (Trigger)
- **Boolean** (Number: Boolean)

< Output

- **Then** (Trigger)
- **Else** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Boolean.IfTrueThen_v2

17.11 IsOne



Full Name: Ops.Boolean.IsOne

Description: Returns true if input value is 1

> Inputs

- **Value** (Number)

< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Boolean.IsOne>

17.12 IsZero



IsZero

Full Name: Ops.Boolean.IsZero

Description: Returns true if input value is 0

> Inputs

- Value (Number)

< Output

- Result (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Boolean.IsZero>

17.13 MonoFlop



MonoFlop

Full Name: Ops.Boolean.MonoFlop

Description: Sets output to 1 when triggered, turns back to 0 automatically after x seconds

> Inputs

- Trigger (Trigger)
- Duration (Number)
- Value True (Number)
- Value False (Number)
- Reset (Trigger)

< Output

- Activated (Trigger)
- Ended (Trigger)
- Result (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Boolean.MonoFlop>

17.14 Not



Not

Full Name: Ops.Boolean.Not

Description: result is false if input is true and vice versa (negate/toggle/switch/!=)

> Inputs

- Boolean (Number: Boolean)

< Output

- Result (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Boolean.Not>

17.16 OrNumber_v2



Full Name: Ops.Boolean.OrNumber_v2

Description: Output another number if input number is zero

> Inputs

- **Number** (Number)
- **Number 2** (Number)
- **Number 3** (Number)
- **Number 4** (Number)
- **Number 5** (Number)
- **Number 6** (Number)
- **Number 7** (Number)
- **Number 8** (Number)

< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Boolean.OrNumber_v2

17.17 ParseBoolean_v2



Full Name: Ops.Boolean.ParseBoolean_v2

Description: parse boolean from string/number

> Inputs

- **String** (String)

< Output

- **Result** (booleanNumber)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Boolean.ParseBoolean_v2

17.18 RouteBoolean



Full Name: Ops.Boolean.RouteBoolean

Description: Route a boolean to an output port

> Inputs

- **Index** (Number: Integer)
- **Boolean In** (Number: Boolean)
- **Default Boolean** (Number: Boolean)

< Output

- **Index 0 Boolean** (booleanNumber)
- **Index 1 Boolean** (booleanNumber)
- **Index 2 Boolean** (booleanNumber)
- **Index 3 Boolean** (booleanNumber)
- **Index 4 Boolean** (booleanNumber)
- **Index 5 Boolean** (booleanNumber)
- **Index 6 Boolean** (booleanNumber)
- **Index 7 Boolean** (booleanNumber)
- **Index 8 Boolean** (booleanNumber)
- **Index 9 Boolean** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Boolean.RouteBoolean>

17.19 ToggleBool_v2



Full Name: Ops.Boolean.ToggleBool_v2

Description: Toggle a boolean value by triggering

> Inputs

- **Trigger** (Trigger)
- **Reset** (Trigger)
- **Default** (Number: Boolean)

< Output

- **Next** (Trigger)
- **Result** (booleanNumber)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Boolean.ToggleBool_v2

17.20 TriggerChangedFalse



Full Name: Ops.Boolean.TriggerChangedFalse

Description: Triggers next only after value has changed to false

> Inputs

- Value (Number: Boolean)

< Output

- Next (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Boolean.TriggerChangedFalse>

- Value (Number: Boolean)

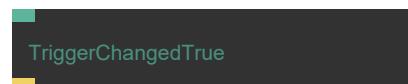
< Output

- True (Trigger)
- False (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Boolean.TriggerOnChangeBoolean_v2

17.21 TriggerChangedTrue



Full Name: Ops.Boolean.TriggerChangedTrue

Description: Triggers next only after value has changed to true

> Inputs

- Value (Number: Boolean)

< Output

- Next (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Boolean.TriggerChangedTrue>

17.22 TriggerOnChangeBoolean_v2



Full Name: Ops.Boolean.TriggerOnChangeBoolean_v2

Description: Triggers when boolean value has changed

> Inputs

18 Ops.Cables

18.1 AssetPathURL



AssetPathURL

Full Name: Ops.Cables.AssetPathURL

Description: outputs the path to the assets

> **Inputs**

- **Filename** (String)

< **Output**

- **Path** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Cables.AssetPathURL>

18.2 CablesInfo



CablesInfo

Full Name: Ops.Cables.CablesInfo

Description: Output the cables URL of the current editor environment

> **Inputs**

- Visit *Ops.Cables.CablesInfo documentation for input port details*

< **Output**

- **URL** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Cables.CablesInfo>

18.3 CallBack_v2



CallBack

Full Name: Ops.Cables.CallBack_v2

Description: Useful when a cables patch is embedded into a website. All parameters (Value 1, Value 2, Value 3) will be sent as a parameter array. So e.g. if Callback Name is foo cables would call: CABLES.patch.config.foo([Value 1, Value 2, Value 3])

> **Inputs**

- **Exe** (Trigger)
- **Callback Name** (String)
- **Parameter 1** (String)
- **Parameter 2** (String)
- **Parameter 3** (String)
- **Public** (7): LANDINGPORTAFOLIO
- **LOGICX BED** (PUBLIC): wirmachenbunt - Published Sep 30, 2021 at 12:25

< **Output**

- Visit *Ops.Cables.CallBack_v2 documentation for output port details*

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Cables.CallBack_v2

18.4 FPS_v2



FPS

Full Name: Ops.Cables.FPS_v2

Description: output current frames per second

> **Inputs**

- Visit *Ops.Cables.FPS_v2 documentation for input port details*

< **Output**

- **FPS** (Number)
- **MS** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Cables.FPS_v2

18.5 Function_v2



Function

Full Name: Ops.Cables.Function_v2

Description: trigger from external function when embedded into a website

> Inputs

- **Function Name** (String)
- **Trigger** (Trigger)
- **Default Parameter 1** (String)
- **Default Parameter 2** (String)
- **Default Parameter 3** (String)

< Output

- **Next** (Trigger)
- **Parameter 1** (String)
- **Parameter 2** (String)
- **Parameter 3** (String)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Cables.Function_v2

18.6 GetOpName



Full Name: Ops.Cables.GetOpName

Description: Get op name by id

> Inputs

- **OpId** (String)

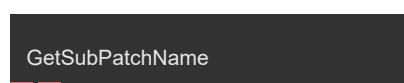
< Output

- **Found** (booleanNumber)
- **Name** (String)
- **Shortname** (String)
- **Version** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Cables.GetOpName>

18.7 GetSubPatchName



Full Name: Ops.Cables.GetSubPatchName

Description: Outputs the current subpatch op name

> Inputs

- Visit [Ops.Cables.GetSubPatchName documentation](#) for input port details

< Output

- **Name** (String)
- **ShortName** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Cables.GetSubPatchName>

18.8 LoadingJob



Full Name: Ops.Cables.LoadingJob

Description: Create a loading job while input is true

> Inputs

- **Loading Active** (Number: Boolean)

< Output

- Visit [Ops.Cables.LoadingJob documentation](#) for output port details

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Cables.LoadingJob>

18.9 LoadingStatus_v2



Full Name: Ops.Cables.LoadingStatus_v2

Description: trigger events / get information about asset-loading status

> Inputs

- **Exe** (Trigger)
- **Play Timeline** (Number: Boolean)

< Output

- **Next** (Trigger)
- **Finished Initial Loading** (booleanNumber)
- **Loading** (booleanNumber)
- **Progress** (Number)
- **Jobs** (Array)
- **Trigger Loading Finished** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Cables.LoadingStatus_v2

18.10 PatchInfo_v2



Full Name: Ops.Cables.PatchInfo_v2

Description: read patch config when embedding on another page

> Inputs

- Visit *Ops.Cables.PatchInfo_v2 documentation for input port details*

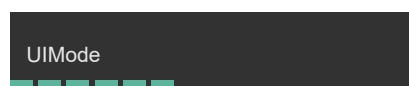
< Output

- **Config** (Object)
- **Name** (String)
- **Patch Id** (String)
- **Namespace** (String)
- **Last Saved** (Number)
- **Last Exported** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Cables.PatchInfo_v2

18.11 UIMode



Full Name: Ops.Cables.UIMode

Description: Outputs true if patch is executed in the cables editor (UI)

> Inputs

- Visit *Ops.Cables.UIMode documentation for input port details*

< Output

- **UI** (booleanNumber)
- **Overlay Mode** (booleanNumber)
- **Remote Viewer** (booleanNumber)
- **Is Standalone** (booleanNumber)
- **Canvas Mode** (Number)
- **Patch Field Visible** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Cables.UIMode>

18.12 UploadAsset



Full Name: Ops.Cables.UploadAsset

Description: Upload a file into the cables patch assets using a base64 string

> Inputs

- **Filename** (String)
- **Base64 String** (String)
- **Upload** (Trigger)

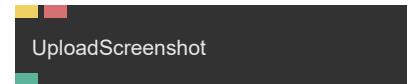
< Output

- **Result** (String)
- **Error** (booleanNumber)
- **Finished** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Cables.UploadAsset>

18.13 UploadScreenshot



Full Name: Ops.Cables.UploadScreenshot

Description: Upload an image as screenshot in cables

> Inputs

- **Trigger** (Trigger)
- **DataUrl** (String)

< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Cables.UploadScreenshot>

19 Ops.Color

19.1 ColorArraySort



Full Name: Ops.Color.ColorArraySort

Description: Sort an array of colors by saturation/lightness etc.

> Inputs

- Colors (Array)

< Output

- New Colors (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Color.ColorArraySort>

19.2 ColorPalettes



Full Name: Ops.Color.ColorPalettes

Description: Contains a collection of nice color palettes output to texture or array via index

> Inputs

- Index (Number: Integer)
- Smooth (Number: Boolean)

< Output

- Texture (Object)
- Color Array (Array)
- The color array containing 5 colors (15 values in total, 3 values per color – r, g and b)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Color.ColorPalettes>

19.3 ColorValue



Full Name: Ops.Color.ColorValue

Description: Use a color value on multiple places

> Inputs

- R (Number)
- G (Number)
- B (Number)
- A (Number)

< Output

- Outr (Number)
- Outg (Number)
- Outb (Number)
- Outa (Number)
- Hex (Number)
- Array (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Color.ColorValue>

19.4 EyeDropper



Full Name: Ops.Color.EyeDropper

Description: Native color picker

> Inputs

- Open (Trigger)

< Output

- Hex (String)
- R (Number)
- G (Number)
- B (Number)
- Supported (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Color.EyeDropper>

19.5 Gradient



Full Name: Ops.Color.Gradient

Description: gradient editor,outputs an objects with gradient information

> Inputs

- **Gradient** (Number)
- **Randomize Colors** (Trigger)

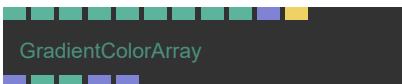
< Output

- **Gradient Object** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Color.Gradient>

19.6 GradientColorArray



Full Name: Ops.Color.GradientColorArray

Description: texture containing a colour gradient that can be altered with an editor

> Inputs

- **Gradient** (Number)
- **Direction Index** (Number: Integer)
- **Smoothstep** (Number: Boolean)
- **Step** (Number: Boolean)
- **Flip** (Number: Boolean)
- **SRGB** (Number: Boolean)
- **Oklab** (Number: Boolean)
- **Size** (Number: Integer)
- **Dither** (Number)
- **Gradient Array** (Array)
- **Randomize Colors** (Trigger)

< Output

- **Color Array** (Array)
- **Width** (Number)
- **Height** (Number)
- **Colors** (Array)

- **Colors Pos** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Color.GradientColorArray>

19.7 HexToRGB_v2



Full Name: Ops.Color.HexToRGB_v2

Description: Converts a hex color like #ff0000 to number values

> Inputs

- **Hex** (String)
- **Bytes** (Number: Boolean)

< Output

- **R** (Number)
- **G** (Number)
- **B** (Number)
- **RGB Array** (Array)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Color.HexToRGB_v2

19.8 HSLtoRGB



Full Name: Ops.Color.HSLtoRGB

Description: Convert HSL to RGB

> Inputs

- **Hue** (Number)
- **Saturation** (Number)
- **Lightness** (Number)

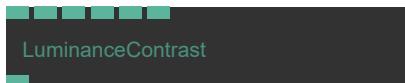
< Output

- **R** (Number)
- **G** (Number)
- **B** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Color.HSLtoRGB>

19.9 LuminanceContrast



Full Name: Ops.Color.LuminanceContrast

Description: Calculate the luminance contrast between two colors

> Inputs

- R 1 (Number)
- G 1 (Number)
- B 1 (Number)
- R 2 (Number)
- G 2 (Number)
- B 2 (Number)

< Output

- Contrast (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Color.LuminanceContrast>

19.10 RGBLuminance



Full Name: Ops.Color.RGBLuminance

Description: Calculate the luminance of a RGB color

> Inputs

- R (Number)
- G (Number)
- B (Number)

< Output

- Luminance (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Color.RGBLuminance>

19.11 RGBToCMYK



Full Name: Ops.Color.RGBToCMYK

Description: Output the CMYK value of a RGB color

> Inputs

- R (Number)
- G (Number)
- B (Number)

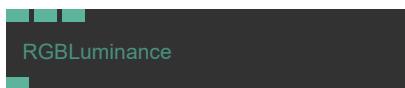
< Output

- C (Number)
- M (Number)
- Y (Number)
- K (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Color.RGBToCMYK>

19.12 RgbToHex



Full Name: Ops.Color.RgbToHex

Description: convert RGB float values to HEX color String

> Inputs

- R (Number)
- G (Number)
- B (Number)

< Output

- Result (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Color.RgbToHex>

19.13 RGBtoHSB



Full Name: Ops.Color.RGBtoHSB

Description: convert RGB color to HSB Hue, Saturation, Brightness

> Inputs

- **R** (Number)
- **G** (Number)
- **B** (Number)

< Output

- **Hue** (Number)
- **Saturation** (Number)
- **Brightness** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Color.RGBtoHSB>

19.14 RGBtoHSL



Full Name: Ops.Color.RGBtoHSL

Description: Convert RGB color to HSL values

> Inputs

- **R** (Number)
- **G** (Number)
- **B** (Number)

< Output

- **Hue** (Number)
- **Saturation** (Number)
- **Lightness** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Color.RGBtoHSL>

20 Ops.Data

20.1 SpreadSheetArray



Full Name: Ops.Data.SpreadSheetArray

Description: Enter data in a spreadsheet table

> Inputs

• Visit [Ops.Data.SpreadSheetArray documentation](#) for input port details

< Output

- **Array** (Array)
- **Width** (Number)
- **Height** (Number)
- **Column Names** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Data.SpreadSheetArray>

21 Ops.Data.Compose.Array

21.1 CompArray



Full Name: Ops.Data.Compose.Array.CompArray

Description: Compose an Array

> Inputs

- **Update** (Trigger)
- **Active** (Number: Boolean)
- **Clear** (Number: Boolean)
- **Reset** (Trigger)

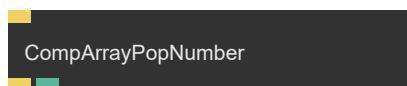
< Output

- **Next** (Trigger)
- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Data.Compose.Array.CompArray>

21.2 CompArrayPopNumber



Full Name: Ops.Data.Compose.Array.CompArrayPopNumber

Description: pop/remove the last number from an array

> Inputs

- **Update** (Trigger)

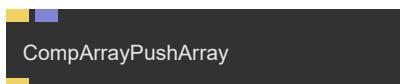
< Output

- **Next** (Trigger)
- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Data.Compose.Array.CompArrayPopNumber>

21.3 CompArrayPushArray



Full Name: Ops.Data.Compose.Array.CompArrayPushArray

Description: push/append an array to an array

> Inputs

- **Update** (Trigger)
- **Array** (Array)

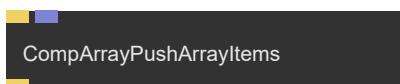
< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Data.Compose.Array.CompArrayPushArray>

21.4 CompArrayPushArrayItems



Full Name: Ops.Data.Compose.Array.CompArrayPushArrayItems

Description: push/append an array to an array

> Inputs

- **Update** (Trigger)
- **Array** (Array)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Data.Compose.Array.CompArrayPushArrayItems>

21.5 CompArrayPushNumber



Full Name: Ops.Data.Compose.Array.CompArrayPushNumber

Description: push/append a number to an array

> Inputs

- **Update** (Trigger)
- **Number** (Number)

< Output

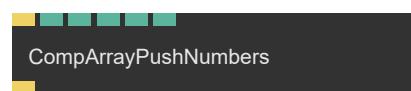
- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Data.Compose.Array.CompArrayPushNumbers>

↑

21.6 CompArrayPushNumbers



Full Name: Ops.Data.Compose.Array.CompArrayPushNumbers

Description: push/append multiple numbers to an array

> Inputs

- **Update** (Trigger)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **W** (Number)

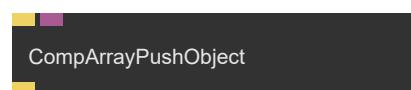
< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Data.Compose.Array.CompArrayPushNumbers>

21.7 CompArrayPushObject



Full Name: Ops.Data.Compose.Array.CompArrayPushObject

Description: push/append an object to an array

> Inputs

- **Update** (Trigger)
- **Object** (Object)

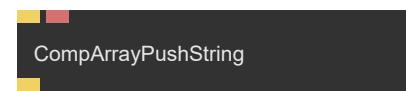
< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Data.Compose.Array.CompArrayPushObject>

21.8 CompArrayPushString



Full Name: Ops.Data.Compose.Array.CompArrayPushString

Description: push/append a string to an array

> Inputs

- **Update** (Trigger)
- **String** (String)

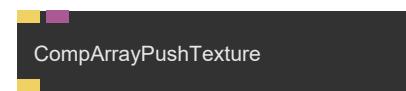
< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Data.Compose.Array.CompArrayPushString>

21.9 CompArrayPushTexture



Full Name: Ops.Data.Compose.Array.CompArrayPushTexture

Description: push/append a texture to an array

> Inputs

- **Update** (Trigger)
- **Object** (Object)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Data.Compose.Array.CompArrayPushTexture>

21.10 CompArraySetNumber



Full Name: Ops.Data.Compose.Array.CompArraySetNumber

Description: set a number to an array at index

> Inputs

- **Update** (Trigger)
- **Index** (Number)
- **Number** (Number)

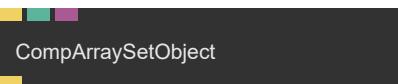
< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Data.Compose.Array.CompArraySetNumber>

21.11 CompArraySetObject



Full Name: Ops.Data.Compose.Array.CompArraySetObject

Description: push/append a number to an array

> Inputs

- **Update** (Trigger)
- **Index** (Number)
- **Object** (Object)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Data.Compose.Array.CompArraySetObject>

21.12 CompArrayShiftNumber



Full Name: Ops.Data.Compose.Array.CompArrayShiftNumber

Description: shift/remove the first number from an array

> Inputs

- **Update** (Trigger)

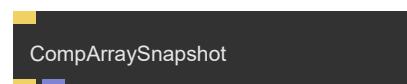
< Output

- **Next** (Trigger)
- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Data.Compose.Array.CompArrayShiftNumber>

21.13 CompArraySnapshot



Full Name: Ops.Data.Compose.Array.CompArraySnapshot

Description: get a copy of the current state of an array

> Inputs

- **Update** (Trigger)

< Output

- **Next** (Trigger)
- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Data.Compose.Array.CompArraySnapshot>

22 Ops.Data.Compose.Object

22.1 CompObject



Full Name: Ops.Data.Compose.Object.CompObject

Description: Compose an Object

> Inputs

- **Update** (Trigger)
- **Clear** (Number: Boolean)
- **Reset** (Trigger)

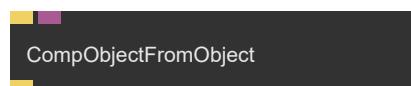
< Output

- **Next** (Trigger)
- **Result** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Data.Compose.Object.CompObject>

22.2 CompObjectFromObject



Full Name: Ops.Data.Compose.Object.CompObjectFromObject

Description: Set key/values to the current ObjectCompose from an existing object

> Inputs

- **Update** (Trigger)
- **Object** (Object)

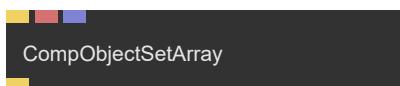
< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Data.Compose.Object.CompObjectFromObject>

22.3 CompObjectSetArray



Full Name: Ops.Data.Compose.Object.CompObjectSetArray

Description: set array as object property

> Inputs

- **Update** (Trigger)
- **Key** (String)
- **Array** (Array)

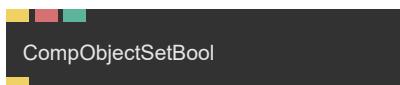
< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Data.Compose.Object.CompObjectSetArray>

22.4 CompObjectSetBool



Full Name: Ops.Data.Compose.Object.CompObjectSetBool

Description: set a boolean as object property

> Inputs

- **Update** (Trigger)
- **Key** (String)
- **Boolean** (Number: Boolean)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Data.Compose.Object.CompObjectSetBool>

22.5 CompObjectSetNumber



Full Name: Ops.Data.Compose.Object.CompObjectSetNumber

Description: set number as object property

> Inputs

- **Update** (Trigger)
- **Key** (String)
- **Number** (Number)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

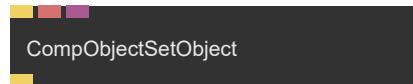
Docs: <https://cables.gl/op/Ops.Data.Compose.Object.CompObjectSetNumber>

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Data.Compose.Object.CompObjectSetString>

22.6 CompObjectSetObject



Full Name: Ops.Data.Compose.Object.CompObjectSetObject

Description: set object as object property

> Inputs

- **Update** (Trigger)
- **Key** (String)
- **Object** (Object)

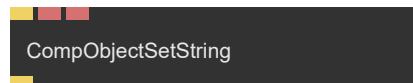
< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Data.Compose.Object.CompObjectSetObject>

22.7 CompObjectSetString



Full Name: Ops.Data.Compose.Object.CompObjectSetString

Description: set string as object property

> Inputs

- **Update** (Trigger)
- **Key** (String)
- **String** (String)

< Output

23 Ops.Data.Compose.String

23.3 CompStringShorten

23.1 CompString



Full Name: Ops.Data.Compose.String.CompString

Description: Compose a string

> Inputs

- **Update** (Trigger)
- **Clear** (Number: Boolean)
- **Reset** (Trigger)

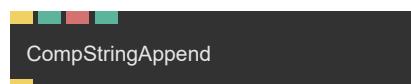
< Output

- **Next** (Trigger)
- **Result** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Data.Compose.String.CompString>

23.2 CompStringAppend



Full Name: Ops.Data.Compose.String.CompStringAppend

Description: Append a string to a string

> Inputs

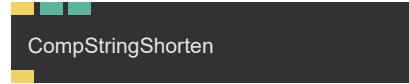
- **Update** (Trigger)
- **String** (String)
- **Add Break** (Number: Boolean)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Data.Compose.String.CompStringAppend>



Full Name: Ops.Data.Compose.String.CompStringShorten

Description: Remove characters from the beginning or end of a string

> Inputs

- **Update** (Trigger)
- **Direction Index** (Number: Integer)
- **Num Chars** (Number: Integer)

< Output

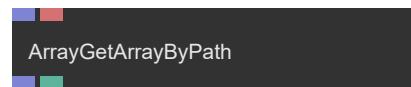
- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Data.Compose.String.CompStringShorten>

24 Ops.Data.JsonPath

24.1 ArrayGetArrayByPath



Full Name: Ops.Data.JsonPath.ArrayGetArrayByPath

Description: returns the array at the position defined by a path

> Inputs

- **Array** (Array)
- **Path** (String)
- **path to array** (i.e. data.numbers)

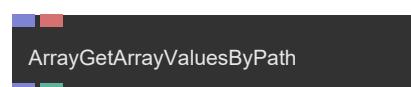
< Output

- **Found** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Data.JsonPath.ArrayGetArrayByPath>

24.2 ArrayGetArrayValuesByPath



Full Name: Ops.Data.JsonPath.ArrayGetArrayValuesByPath

Description: Outputs all the values of the properties of an array of objects given a path

> Inputs

- **Array** (Array)
- **Path** (String)
- **path to first array field** (i.e. "data.0.firstName")

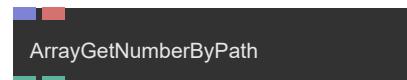
< Output

- **Found** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Data.JsonPath.ArrayGetArrayValuesByPath>

24.3 ArrayGetNumberByPath



Full Name: Ops.Data.JsonPath.ArrayGetNumberByPath

Description: finds a number at a position in an array defined by path

> Inputs

- **Array** (Array)
- **Path** (String)
- **the past** (i.e. person.age)

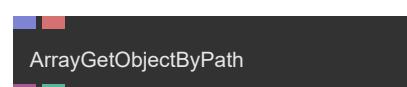
< Output

- **Found** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Data.JsonPath.ArrayGetNumberByPath>

24.4 ArrayGetObjectByPath



Full Name: Ops.Data.JsonPath.ArrayGetObjectByPath

Description: Returns the object at the position defined by a path

> Inputs

- **Array** (Array)
- **Path** (String)

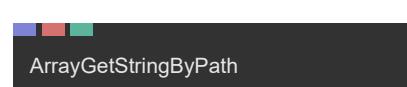
< Output

- **Found** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Data.JsonPath.ArrayGetObjectByPath>

24.5 ArrayGetStringByPath_v2



Full Name: Ops.Data.JsonPath.ArrayGetStringByPath_v2

Description: Finds a string at a position in an array defined by path

> Inputs

- **Array** (Array)
- **Path** (String)
- **the path** (i.e. data.names)
- **Return Path If Missing** (Number: Boolean)

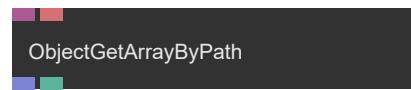
< Output

- **Found** (booleanNumber)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Data.JsonPath.ArrayGetStringByPath_v2

24.6 ObjectGetArrayByPath



Full Name: Ops.Data.JsonPath.ObjectGetArrayByPath

Description: returns the array at the position defined by a path

> Inputs

- **Object** (Object)
- **Path** (String)
- **path to array** (i.e. data.numbers)

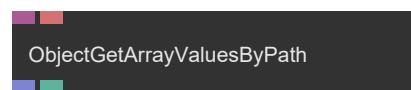
< Output

- **Found** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Data.JsonPath.ObjectGetArrayByPath>

24.7 ObjectGetArrayValuesByPath



Full Name: Ops.Data.JsonPath.ObjectGetArrayValuesByPath

Description: Outputs all the values of the properties of an array of objects given a path

> Inputs

- **Object** (Object)
- **Path** (String)
- **path to first array field** (i.e. "data.0.firstName")

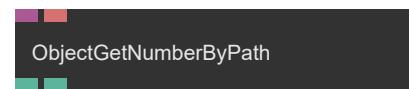
< Output

- **Found** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Data.JsonPath.ObjectGetArrayValuesByPath>

24.8 ObjectGetNumberByPath



Full Name: Ops.Data.JsonPath.ObjectGetNumberByPath

Description: finds a number at a position in an object defined by path

> Inputs

- **Object** (Object)
- **Path** (String)
- **the past** (i.e. person.age)

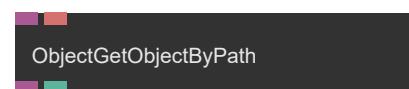
< Output

- **Found** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Data.JsonPath.ObjectGetNumberByPath>

24.9 ObjectGetObjectByPath



Full Name: Ops.Data.JsonPath.ObjectGetObjectByPath

Description: Returns the object at the position defined by a path

> Inputs

- **Object** (Object)
- **Path** (String)

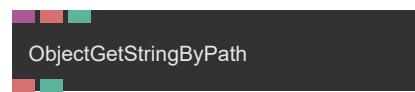
< Output

- **Found** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Data.JsonPath.ObjectGetObjectByPath>

24.10 ObjectGetStringByPath_v2



Full Name: Ops.Data.JsonPath.ObjectGetStringByPath_v2

Description: Finds a string at a position in an object defined by path

> Inputs

- **Object** (Object)
- **Path** (String)
- **the path** (i.e. data.names)
- **Output Path If Missing** (Number: Boolean)

< Output

- **Found** (booleanNumber)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Data.JsonPath.ObjectGetStringByPath_v2

25 Ops.Data.StackValues

25.1 StackGetArray



Full Name: Ops.Data.StackValues.StackGetArray

Description: read a value from the stack to use it later in the trigger branch

> Inputs

- **Trigger** (Trigger)
- **Name** (String)

< Output

- **Next** (Trigger)
- **Array** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Data.StackValues.StackGetArray>

25.2 StackGetNumber



Full Name: Ops.Data.StackValues.StackGetNumber

Description: read a value from the stack to use it later in the trigger branch

> Inputs

- **Exec** (Trigger)
- **Name** (String)

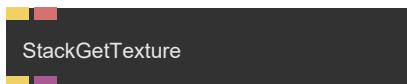
< Output

- **Next** (Trigger)
- **Value** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Data.StackValues.StackGetNumber>

25.3 StackGetTexture



Full Name: Ops.Data.StackValues.StackGetTexture

Description: read a value from the stack to use it later in the trigger branch

> Inputs

- **Exec** (Trigger)
- **Name** (String)

< Output

- **Next** (Trigger)
- **Texture** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Data.StackValues.StackGetTexture>

> Inputs

- **Exec** (Trigger)
- **Name** (String)
- **Value** (Number)

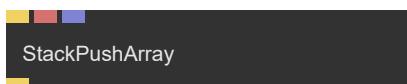
< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Data.StackPushNumber>

25.4 StackPushArray



Full Name: Ops.Data.StackValues.StackPushArray

Description: push a value on to the stack to use it later in the trigger branch

> Inputs

- **Trigger** (Trigger)
- **Name** (String)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Data.StackValues.StackPushArray>

25.5 StackPushNumber



Full Name: Ops.Data.StackValues.StackPushNumber

Description: push a value on to the stack to use it later in the trigger branch

Full Name: Ops.Data.StackValues.StackPushTexture

Description: push a value on to the stack to use it later in the trigger branch

> Inputs

- **Trigger** (Trigger)
- **Name** (String)
- **Texture** (Object:Texture)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Data.StackPushTexture>

26 Ops.Date

26.1 DateAndTime



Full Name: Ops.Date.DateAndTime

Description: Returns current date and time and timestamp

> Inputs

- **Update Rate** (Number)
- **How often the op should update the output** (in milliseconds)

< Output

- **Year** (Number)
- **Month** (Number)
- **Day** (Number)
- **Hours** (Number)
- **Minutes** (Number)
- **Seconds** (Number)
- **Timestamp** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Date.DateAndTime>

26.2 DateCalc



Full Name: Ops.Date.DateCalc

Description: Perform date calculations

> Inputs

- **Timestamp** (Number)
- **Difference** (Number: Integer)
- **Type Index** (Number: Integer)
- **Update** (Trigger)
- **Update time value** (not needed if an timestamp input is used)

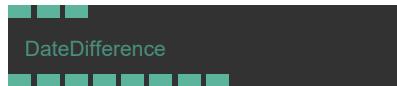
< Output

- **Date** (Object)
- **Timestamp** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Date.DateCalc>

26.3 DateDifference



Full Name: Ops.Date.DateDifference

Description: Calculates the difference between two timestamps

> Inputs

- **Timestamp 1** (Number)
- **Timestamp 2** (Number)
- **Stop At 0** (Number: Boolean)

< Output

- **Year** (Number)
- **Month** (Number)
- **Day** (Number)
- **Hours** (Number)
- **Minutes** (Number)
- **Seconds** (Number)
- **Milliseconds** (Number)
- **Diff** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Date.DateDifference>

26.4 DateFormatter



Full Name: Ops.Date.DateFormatter

Description: String representation of a date

> Inputs

- **Timestamp** (Number)
- **Date** (Object)
- **Format** (String)

< Output

- **StringDate** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Date.DateFormatter>

26.7 Milliseconds



Full Name: Ops.Date.DateIsoToTimestamp

Description: parses a date and time in iso format and outputs a millisecond timestamp

> Inputs

- **Datetime** (String)

< Output

- **Timestamp** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Date.DatelsoToTimestamp>



Full Name: Ops.Date.Milliseconds

Description: Value since the time origin in milliseconds (performance.now())

> Inputs

- **Update** (Trigger)

< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Date.Milliseconds>

26.6 DateTimestamp



Full Name: Ops.Date.DateTimestamp

Description: Calculates the timestamp of a date by year / month / day / hour / minute

> Inputs

- **Year** (Number: Integer)
- **Month** (Number: Integer)
- **Day** (Number: Integer)
- **Hour** (Number: Integer)
- **Minute** (Number: Integer)

< Output

- **Timestamp** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Date.DateTimestamp>

26.8 TimestampToIsoDate



Full Name: Ops.Date.TimestampToIsoDate

Description: convert a timestamp to an ISO date string

> Inputs

- **Timestamp** (Number)

< Output

- **ISO Date** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Date.TimestampToIsoDate>

27 Ops.Debug

27.1 Console



Full Name: Ops.Debug.Console

Description: Shows console log output on the screen

> Inputs

- **Visible** (Number: Boolean)
- **Clear** (Trigger)

< Output

- **Element** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Debug.Console>

27.2 ConsoleLog



Full Name: Ops.Debug.ConsoleLog

Description: Log incoming values to the console/dev tools

> Inputs

- **Number** (Number)
- **String** (String)

< Output

- Visit *Ops.Debug.ConsoleLog documentation for output port details*

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Debug.ConsoleLog>

27.3 CrashOp



Full Name: Ops.Debug.CrashOp

Description: Crash the editor in many ways

> Inputs

- **Async Crash** (Trigger)
- **Undefined Crash** (Trigger)
- **Throw Exception** (Trigger)
- **Float** (Number)
- **Array Exception** (Trigger)
- **Promise Fail** (Trigger)
- **Shader Error** (Trigger)

< Output

- **Nan** (Number)
- **Infinity** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Debug.CrashOp>

27.4 GlLogErrors



Full Name: Ops.Debug.GlLogErrors

Description: execute glGetError after every gl command and log to browser console

> Inputs

- **Exec** (Trigger)
- **Limit Error Logs Num** (Number: Integer)
- **Stop Trigger After Limit** (Number: Boolean)
- **Show Gl History** (Trigger)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Debug.GlLogErrors>

27.5 GLStates



Full Name: Ops.Debug.GLStates

Description: see current gl states and error message

> Inputs

- **Update** (Trigger)

< Output

- **Next** (Trigger)
- **GlGetError** (Number)
- **Depthtest** (Number)
- **Stack Depthtest** (Number)
- **Depth Writing** (Number)
- **Stack Depth Writing** (Number)
- **DepthFunc** (Number)
- **Stack DepthFunc** (Number)
- **Blend** (Number)
- **Blend Stack** (Number)
- **Cull Mode** (Number)
- **Face Culling** (Number)
- **Is Shadowpass** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Debug.GLStates>

27.6 ProfileGL



Full Name: Ops.Debug.ProfileGL

Description: dump all gl commands of one frame to console

> Inputs

- **Exec** (Trigger)
- **Debug One Frame** (Trigger)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Debug.ProfileGL>

27.7 StopWatch



Full Name: Ops.Debug.StopWatch

Description: Measure the time used to render all child nodes in milliseconds

> Inputs

- **Exec** (Trigger)

< Output

- **Next** (Trigger)
- **Time Used** (Number)
- **Times** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Debug.StopWatch>

28 Ops.Devices

28.1 TouchGesture



Full Name: Ops.Devices.TouchGesture

Description: detect touch gestures like swipe and pan

> Inputs

- **Active** (Number: Boolean)
- **Vertical Swipe** (Number: Boolean)
- **Vertical Pan** (Number: Boolean)

< Output

- **Press** (Trigger)
- **Press Up** (Trigger)
- **Pan Left** (Trigger)
- **Pan Right** (Trigger)
- **Swipe Left** (Trigger)
- **Swipe Right** (Trigger)
- **Swipe Up** (Trigger)
- **Swipe Down** (Trigger)
- **Event** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Devices.TouchGesture>

28.2 TouchScreen



Full Name: Ops.Devices.TouchScreen

Description: touch screen input: e.g. position of fingers

> Inputs

- **Disable Scaling** (Number: Boolean)
- **Disable Scroll** (Number: Boolean)
- **HDPI Coordinates** (Number: Boolean)

- **Active** (Number: Boolean)
- **Normalize Coordinates** (Number: Boolean)
- **Flip Y** (Number: Boolean)

< Output

- **Touched** (Number)
- **Fingers** (Number)
- **Finger 1 X** (Number)
- **Finger 1 Y** (Number)
- **Finger 1 Force** (Number)
- **Finger 2 X** (Number)
- **Finger 2 Y** (Number)
- **Finger 2 Force** (Number)
- **Events** (Array)
- **Touch Start** (Trigger)
- **Touch End** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Devices.TouchScreen>

29 Ops.Devices.Browser

29.1 BrowserInfo_v3



Full Name: Ops.Devices.Browser.BrowserInfo_v3

Description: Reports the browser being used

> Inputs

- Visit *Ops.Devices.Browser.BrowserInfo_v3 documentation for input port details*

< Output

- **Is Mobile** (booleanNumber)
- **Is Touchscreen** (booleanNumber)
- **Is IE** (booleanNumber)
- **Is Edge** (booleanNumber)
- **Is Chrome** (booleanNumber)
- **Is Firefox** (booleanNumber)
- **Is Opera** (booleanNumber)
- **Is Safari** (booleanNumber)
- **True if the browser is Safari** (iOS & macOS & OS X)
- **Is Windows** (booleanNumber)
- **Is Linux** (booleanNumber)
- **Is Mac** (booleanNumber)
- **Is IOS** (booleanNumber)
- **Is Android** (booleanNumber)
- **Is Electron** (booleanNumber)
- **Operating System** (String)
- **Browser Name** (String)
- **Browser Version** (String)
- **OS Version** (String)
- **Language** (String)
- **User Agent** (String)
- **Platform Object** (Object)

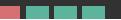
Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Devices.Browser.BrowserInfo_v3

29.2 ColorScheme



ColorScheme



Full Name: Ops.Devices.Browser.ColorScheme

Description: Get light/dark color scheme preference of the browser

> Inputs

- Visit *Ops.Devices.Browser.ColorScheme documentation for input port details*

< Output

- **Color Scheme** (String)
- **Dark Mode** (booleanNumber)
- **Light Mode** (booleanNumber)
- **Supported** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Devices.Browser.ColorScheme>

29.3 History



History

Full Name: Ops.Devices.Browser.History

Description: Move back or forward in the browser navigation history

> Inputs

- **Back** (Trigger)
- **Forward** (Trigger)

< Output

- Visit *Ops.Devices.Browser.History documentation for output port details*

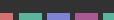
Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Devices.Browser.History>

29.4 JsExpression



JsExpression



Full Name: Ops.Devices.Browser.JsExpression

Description: evaluate a javascript expression

> Inputs

- **JS Expression** (String)

< Output

- **Result String** (String)
- **Result Number** (Number)
- **Result Array** (Array)
- **Result Object** (Object)
- **Error** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Devices.Browser.JsExpression>

29.5 JsMemory



Full Name: Ops.Devices.Browser.JsMemory

Description: browser js memory consumption

> Inputs

- **Update** (Trigger)

< Output

- **Used Heap Size** (Number)
- **Total Heap Size** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Devices.Browser.JsMemory>

29.6 UserActivation



Full Name: Ops.Devices.Browser.UserActivation

Description: detect if the user interacted with or activated the page

> Inputs

- **Update** (Trigger)

< Output

- **Next** (Trigger)

- **User Is Or Was Active** (booleanNumber)

- **User Has Been Active** (booleanNumber)

- **User Is Active** (booleanNumber)

- **Supported** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Devices.Browser.UserActivation>

29.7 WebShare



Full Name: Ops.Devices.Browser.WebShare

Description: Opens a sharing dialog to share text and images

> Inputs

- **Text** (String)
- **URL** (String)
- **Base64 File** (String)
- **Data URL** (String)
- **Filetype** (String)
- **Filename** (String)
- **Share** (Trigger)

< Output

- **Status** (String)
- **Supported** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Devices.Browser.WebShare>

30 Ops.Devices.GamePad

30.1 GamePad



Full Name: Ops.Devices.GamePad.GamePad

Description: Outputs the button states of a gamepad

> Inputs

- **GamePad Data** (Object)
- **Analog To Digital** (Number: Boolean)

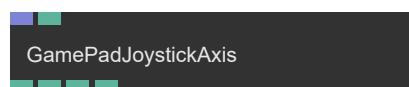
< Output

- **ID** (String)
- **Axes** (Array)
- **Pad Left** (booleanNumber)
- **Pad Right** (booleanNumber)
- **Pad Up** (booleanNumber)
- **Pad Down** (booleanNumber)
- **Button 1** (booleanNumber)
- **Button 2** (booleanNumber)
- **Button 3** (booleanNumber)
- **Button 4** (booleanNumber)
- **Left Shoulder** (Number)
- **Left Shoulder Bottom** (Number)
- **Right Shoulder** (Number)
- **Right Shoulder Bottom** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Devices.GamePad.GamePad>

30.2 GamePadJoystickAxis



Full Name: Ops.Devices.GamePad.GamePadJoystickAxis

Description: get axis and angle of a joystick/thumbstick

> Inputs

- **Axis** (Array)
- **Index** (Number: Integer)

< Output

- **X** (Number)
- **Y** (Number)
- **DeadZone** (Number)
- **Angle** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Devices.GamePad.GamePadJoystickAxis>

30.3 GamePads



Full Name: Ops.Devices.GamePad.GamePads

Description: list connected gamepads - press a button to connect

> Inputs

- **Exe** (Trigger)

< Output

- **Num Gamepads** (Number)
- **Pad 0** (Object)
- **Pad 1** (Object)
- **Pad 2** (Object)
- **Pad 3** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Devices.GamePad.GamePads>

31 Ops.Devices.Keyboard

31.1 CursorKeys



Full Name: Ops.Devices.Keyboard.CursorKeys

Description: get the state of your keyboards arrow keys

> Inputs

- **Canvas Only** (Number: Boolean)
- **Cursor Keys** (Number: Boolean)
- **WASD** (Number: Boolean)
- **Active** (Number: Boolean)

< Output

- **Degree** (Number)
- **Up** (booleanNumber)
- **Up Pressed** (Trigger)
- **Down** (booleanNumber)
- **Down Pressed** (Trigger)
- **Left** (booleanNumber)
- **Left Pressed** (Trigger)
- **Right** (booleanNumber)
- **Right Pressed** (Trigger)
- **Any Button Pressed** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Devices.Keyboard.CursorKeys>

31.2 KeyPress_v2



Full Name: Ops.Devices.Keyboard.KeyPress_v2

Description: Triggers when a key is pressed

> Inputs

- **Area Index** (Number: Integer)

- **Prevent Default** (Number: Boolean)

- **Enabled** (Number: Boolean)

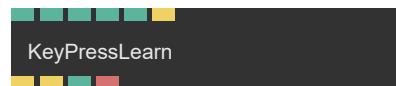
< Output

- **On Press** (Trigger)
- **Key Code** (Number)
- **Key** (String)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Devices.Keyboard.KeyPress_v2

31.3 KeyPressLearn



Full Name: Ops.Devices.Keyboard.KeyPressLearn

Description: Triggers when certain key is pressed or released

> Inputs

- **Key Code** (Number: Integer)
- **Canvas Only** (Number: Boolean)
- **Mod Key Index** (Number: Integer)
- **Enabled** (Number: Boolean)
- **Prevent Default** (Number: Boolean)
- **Learn** (Trigger)

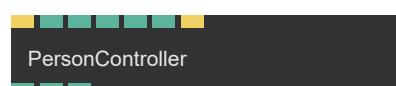
< Output

- **On Press** (Trigger)
- **On Release** (Trigger)
- **Pressed** (booleanNumber)
- **Key** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Devices.Keyboard.KeyPressLearn>

31.4 PersonController



Full Name: Ops.Devices.Keyboard.PersonController

Description: simple controller example op for game characters

> Inputs

- **Exe** (Trigger)
- **Speed** (Number)
- **North** (Number: Boolean)
- **East** (Number: Boolean)
- **South** (Number: Boolean)
- **West** (Number: Boolean)
- **Reset** (Trigger)

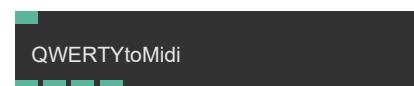
< Output

- **X** (Number)
- **Y** (Number)
- **Dir** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Devices.Keyboard.PersonController>

31.5 QWERTYtoMidi



Full Name: Ops.Devices.Keyboard.QWERTYtoMidi

Description: Emulates a MIDI keyboard using your regular keyboard

> Inputs

- **Canvas Only** (Number: Boolean)

< Output

- **Note Number** (Number)
- **Velocity** (Number)
- **Channel** (Number)
- **Command** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Devices.Keyboard.QWERTYtoMidi>

32 Ops.Devices.Midi

32.1 DeviceList



Full Name: Ops.Devices.Midi.DeviceList

Description: list of midi devices

> Inputs

- Visit *Ops.Devices.Midi.DeviceList documentation for input port details*

< Output

- **Num Devices** (Number)
- **Midi Support** (booleanNumber)
- **Device Names** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Devices.Midi.DeviceList>

32.2 MidiCC_v3



Full Name: Ops.Devices.Midi.MidiCC_v3

Description: read CC value from Midi controller

> Inputs

- **MIDI Event In** (Object)
- **MIDI Channel Index** (Number: Integer)
- **CC Index** (Number: Integer)
- **Speed** (Number)
- **Learn** (Trigger)
- **Clear** (Trigger)

< Output

- **CC Value Out** (Number)
- **Event** (Object)
- **Trigger Out** (Trigger)
- **CC Index Out** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Devices.Midi.MidiCC_v3

32.3 MidiCCOut_v2



Full Name: Ops.Devices.Midi.MidiCCOut_v2

Description: send MIDI CC data to a midi output

> Inputs

- **Send** (Trigger)
- **MIDI Channel Index** (Number: Integer)
- **CC Index** (Number: Integer)
- **CC Value** (Number: Integer)
- **Auto Send Value Change** (Number: Boolean)

< Output

- **MIDI Event Out** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Devices.Midi.MidiCCOut_v2

32.4 MidiChord3



Full Name: Ops.Devices.Midi.MidiChord3

Description: Map 3 midi notes to values

> Inputs

- **MIDI Event In** (Object)
- **MIDI Channel Index** (Number: Integer)
- **Note 1 Index** (Number: Integer)
- **Note 2 Index** (Number: Integer)
- **Note 3 Index** (Number: Integer)
- **Normalize Velocity Index** (Number: Integer)
- **Learn** (Trigger)
- **Reset** (Trigger)

< Output

- **MIDI Event Out** (Object)

- **Trigger Out** (Trigger)
- **Note Out 1** (Number)
- **Velocity 1** (Number)
- **Gate 1** (booleanNumber)
- **Note Out 2** (Number)
- **Velocity 2** (Number)
- **Gate 2** (booleanNumber)
- **Note Out 3** (Number)
- **Velocity 3** (Number)
- **Gate 3** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Devices.Midi.MidiChord3>

32.5 MidiClock



Full Name: Ops.Devices.Midi.MidiClock

Description: sends out midi clock signals as triggers

> Inputs

- **MIDI Event In** (Object)
- **Timing Index** (Number: Integer)

< Output

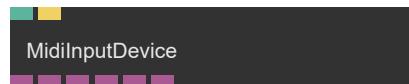
- **MIDI Event Out** (Object)
- **Tick Out** (Trigger)
- **Clock Start** (Trigger)
- **Clock Stop** (Trigger)
- **Clock Continue** (Trigger)
- **BPM** (Number)
- **Tick Duration** (Number)
- **Sub Tick** (Number)
- **current subtick** (value between 0 - 24)
- **outputs a trigger every bar** (dotted: 1.5 bars, triplet: full-note triplet)
- **outputs a trigger every half note** (dotted: trigger every 3/4, triplet: half-note triplet)
- **outputs a trigger every quarter note** (dotted: trigger every 3/8, triplet: quarter-note triplet)
- **outputs a trigger every eighth note** (dotted: trigger every 3/16, triplet: eighth-note triplet)

- **outputs a trigger every sixteenth note** (dotted: trigger every 3/32, triplet: sixteenth-note triplet)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Devices.Midi.MidiClock>

32.6 MidiInputDevice_v2



Full Name: Ops.Devices.Midi.MidiInputDevice_v2

Description: connect to MIDI device output port

> Inputs

- **Device Index** (Number: Integer)
- **Learn** (Trigger)

< Output

- **Event** (Object)
- **Note** (Object)
- **CC** (Object)
- **NRPN** (Object)
- **Program Change** (Object)
- **Clock** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Devices.Midi.MidiInputDevice_v2

32.7 MidiMonitor



Full Name: Ops.Devices.Midi.MidiMonitor

Description: detailed information about Midi events being sent

> Inputs

- **Event** (Object)

< Output

- **MIDI Event Out** (Object)
- **Trigger Out** (Trigger)
- **Device** (Number)
- **MIDI Channel** (Number)

- **Message Type** (Number)
- **the type of the message** (CC, Note, NRPN, Clock, ...)
- **Note** (Number)
- **Note Velocity** (Number)
- **CC Number** (Number)
- **CC Value** (Number)
- **Pitch Bend Value** (Number)
- **NRPN Number** (Number)
- **NRPN Value** (Number)
- **Program Change Value** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Devices.Midi.MidiMonitor>

32.8 MidiNote



Full Name: Ops.Devices.Midi.MidiNote

Description: Read a single midi note

> Inputs

- **MIDI Event In** (Object)
- **MIDI Channel Index** (Number: Integer)
- **Note Index** (Number: Integer)
- **Normalize Velocity Index** (Number: Integer)
- **Toggle Gate** (Number: Boolean)
- **Learn** (Trigger)
- **Clear** (Trigger)

< Output

- **MIDI Event Out** (Object)
- **Trigger Out** (Trigger)
- **Current Note** (Number)
- **Velocity** (Number)
- **Gate** (booleanNumber)
- **Velocity Array** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Devices.Midi.MidiNote>

32.9 MidiNoteFilter



Full Name: Ops.Devices.Midi.MidiNoteFilter

Description: Only read a range of notes (e.g. C1 to C2)

> Inputs

- **MIDI Event** (Object)
- **MIDI Channel Index** (Number: Integer)
- **Note Start Index** (Number: Integer)
- **Note End Index** (Number: Integer)
- **Normalize Velocity Index** (Number: Integer)
- **Learn** (Trigger)
- **Reset** (Trigger)

< Output

- **Event** (Object)
- **Trigger Out** (Trigger)
- **Current Note** (Number)
- **Velocity** (Number)
- **Gate** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Devices.Midi.MidiNoteFilter>

32.10 MidiNoteOut



Full Name: Ops.Devices.Midi.MidiNoteOut

Description: send midi note data to a midi output

> Inputs

- **MIDI Channel Index** (Number: Integer)
- **Note Index** (Number: Integer)
- **Note Number** (Number: Integer)
- **Velocity** (Number: Integer)
- **Min In Velocity** (Number)
- **Max In Velocity** (Number)
- **Velocity Array In** (Array)

< Output

- **MIDI Event Out** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Devices.Midi.MidiNoteOut>

32.11 MidiNRPN



Full Name: Ops.Devices.Midi.MidiNRPN

Description: read NRPN value from controller

> Inputs

- **MIDI Event In** (Object)
- **MIDI Channel Index** (Number: Integer)
- **NRPN Index** (Number: Integer)
- **Normalize Index** (Number: Integer)
- **Learn** (Trigger)
- **Clear** (Trigger)

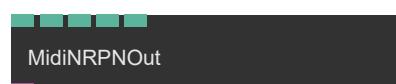
< Output

- **MIDI Event Out** (Object)
- **Trigger Out** (Trigger)
- **NRPN Index Out** (Number)
- **NRPN Value** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Devices.Midi.MidiNRPN>

32.12 MidiNRPNOut



Full Name: Ops.Devices.Midi.MidiNRPNOut

Description: send midi NRPN data to a midi output

> Inputs

- **MIDI Channel Index** (Number: Integer)
- **NRPN Index** (Number: Integer)
- **NRPN Value** (Number: Integer)
- **Min In Value** (Number)
- **Max In Value** (Number)

< Output

- **MIDI Event Out** (Object)

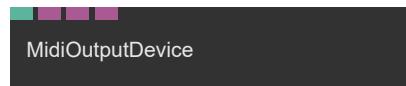
Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Devices.Midi.MidiNRPNOut>

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Devices.Midi.MidiTranspose>

32.13 MidiOutputDevice



Full Name: Ops.Devices.Midi.MidiOutputDevice

Description: Connect to MIDI device input port

> Inputs

- **Device Index** (Number: Integer)
- **Note** (Object)
- **CC** (Object)
- **NRPN** (Object)

< Output

- Visit *Ops.Devices.Midi.MidiOutputDevice documentation for output port details*

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Devices.Midi.MidiOutputDevice>

32.14 MidiTranspose



Full Name: Ops.Devices.Midi.MidiTranspose

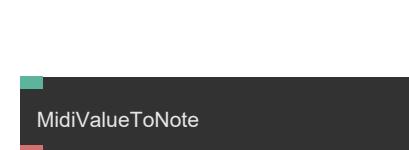
Description: transpose incoming midi notes

> Inputs

- **MIDI Event In** (Object)
- **MIDI Channel Index** (Number: Integer)
- **Transpose Amount** (Number: Integer)
- **Learn** (Trigger)

< Output

- **MIDI Event Out** (Object)
- **Trigger Out** (Trigger)



Full Name: Ops.Devices.Midi.MidiValueToNote_v2

Description: Converts a MIDI value to a note string

> Inputs

- **Midi Value** (Number)

< Output

- **Note** (String)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Devices.Midi.MidiValueToNote_v2

33 Ops.Devices.Mobile

33.1 DeviceVibrate



Full Name: Ops.Devices.Mobile.DeviceVibrate

Description: vibrating a mobile device

> Inputs

- **Vibrate** (Trigger)

< Output

- **Supported** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Devices.Mobile.DeviceVibrate>

33.2 GeoLocation



Full Name: Ops.Devices.Mobile.GeoLocation

Description: tries to get the geo coordinates from the mobile device/browser

> Inputs

- Visit *Ops.Devices.Mobile.GeoLocation documentation for input port details*

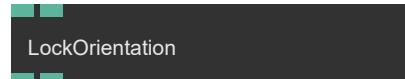
< Output

- **Browser Support** (booleanNumber)
- **Latitude** (Number)
- **Longitude** (Number)
- **Data** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Devices.Mobile.GeoLocation>

33.3 LockOrientation



Full Name: Ops.Devices.Mobile.LockOrientation

Description: locks orientation to landscape or portrait mode

> Inputs

- **Portrait** (Number: Boolean)
- **Landscape** (Number: Boolean)

< Output

- **Supported** (Number)
- **Locked** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Devices.Mobile.LockOrientation>

33.4 MotionSensor_v2



Full Name: Ops.Devices.Mobile.MotionSensor_v2

Description: get values from the device motion sensor mobile

> Inputs

- **Mul Orientation** (Number)
- **Request Permissions** (Trigger)

< Output

- **Orientation Alpha** (Number)
- **Orientation Beta** (Number)
- **Orientation Gamma** (Number)
- **Acceleration X** (Number)
- **Acceleration Y** (Number)
- **Acceleration Z** (Number)
- **Acceleration X No Gravity** (Number)
- **Acceleration Y No Gravity** (Number)
- **Acceleration Z No Gravity** (Number)
- **Rotation Rate Alpha** (Number)
- **Rotation Rate Beta** (Number)
- **Rotation Rate Gamma** (Number)
- **Permissions** (String)

- **Object** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Devices.Mobile.MotionSensor_v2

Docs: https://cables.gl/op/Ops.Devices.Mobile.ScreenOrientation_v2

33.5 Pinch



Full Name: Ops.Devices.Mobile.Pinch

Description: detect two finger pinch gestures on touchscreens

> Inputs

- **Enabled** (Number: Boolean)
- **Min Scale** (Number)
- **Max Scale** (Number)
- **Reset Scale** (Trigger)
- **Limit** (Number: Boolean)

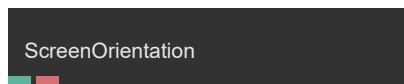
< Output

- **Scale** (Number)
- **Event Details** (Object)
- **Delta** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Devices.Mobile.Pinch>

33.6 ScreenOrientation_v2



Full Name: Ops.Devices.Mobile.ScreenOrientation_v2

Description: get orientation of the physical screen

> Inputs

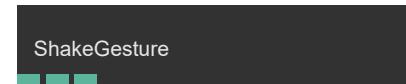
- Visit *Ops.Devices.Mobile.ScreenOrientation_v2 documentation* for input port details

< Output

- **Angle** (Number)
- **Type** (String)

Example Patch: Open in Editor

33.7 ShakeGesture



Full Name: Ops.Devices.Mobile.ShakeGesture

Description: Reads the accelerometer data from a mobile device

> Inputs

- Visit *Ops.Devices.Mobile.ShakeGesture documentation* for input port details

< Output

- **Acceleration X** (Number)
- **Acceleration Y** (Number)
- **Acceleration Z** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Devices.Mobile.ShakeGesture>

34 Ops.Devices.Mouse

34.1 Mouse_v4



Full Name: Ops.Devices.Mouse.Mouse_v4

Description: Get mouse/touchscreen/pointer coordinates and events

> Inputs

- **Area Index** (Number: Integer)
- **Flip Y** (Number: Boolean)
- **Right Click Prevent Default** (Number: Boolean)
- **Passive Events** (Number: Boolean)
- **Element** (Object)
- **Active** (Number: Boolean)

< Output

- **X** (Number)
- **Y** (Number)
- **Click** (Trigger)
- **Click Right** (Trigger)
- **Button Is Down** (booleanNumber)
- **Mouse Is Hovering** (booleanNumber)
- **Movement X** (Number)
- **Movement Y** (Number)
- **Event** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Devices.Mouse.Mouse_v4

34.2 MouseButtons



Full Name: Ops.Devices.Mouse.MouseButtons

Description: Get the state of mouse buttons

> Inputs

- **Area Index** (Number: Integer)
- **Active** (Number: Boolean)

< Output

- **Click Left** (Trigger)
- **Click Right** (Trigger)
- **Double Click** (Trigger)
- **Button Pressed Left** (Number)
- **Button Pressed Middle** (Number)
- **Button Pressed Right** (Number)
- **Mouse Down Left** (Trigger)
- **Mouse Down Middle** (Trigger)
- **Mouse Down Right** (Trigger)
- **Mouse Up Left** (Trigger)
- **Mouse Up Middle** (Trigger)
- **Mouse Up Right** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Devices.Mouse.MouseButtons>

34.3 MouseDrag



Full Name: Ops.Devices.Mouse.MouseDrag

Description: get delta of mouse position while dragging

> Inputs

- **Active** (Number: Boolean)
- **Speed** (Number)
- **Input Type Index** (Number: Integer)
- **Area Index** (Number: Integer)

< Output

- **Delta X** (Number)
- **Delta Y** (Number)
- **Is Dragging** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Devices.Mouse.MouseDrag>

34.4 MouseWheel_v2



Full Name: Ops.Devices.Mouse.MouseWheel_v2

Description: outputs delta values controlled by the mousewheel (scroll, zoom)

> Inputs

- **Speed** (Number)
- **Prevent Scroll** (Number: Boolean)
- **Flip Direction** (Number: Boolean)
- **Simple Delta** (Number: Boolean)
- **Active** (Number: Boolean)

< Output

- **Delta** (Number)
- **Delta X** (Number)
- **Browser Event Delta** (Number)
- **Wheel Action** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Devices.Mouse.MouseWheel_v2

34.5 PointerLock



Full Name: Ops.Devices.Mouse.PointerLock

Description: locks the pointer to the canvas and hides the cursor

> Inputs

- **Render** (Trigger)
- **Start** (Trigger)

< Output

- **Next** (Trigger)
- **Supported** (booleanNumber)
- **Is Locked** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Devices.Mouse.PointerLock>

35 Ops.Devices.WebXr.Vr



Full Name: Ops.Devices.WebXr.Vr.Vr

Description: rendering on webxr virtual reality immersive devices

> Inputs

- **Mainloop** (Trigger)
- **Stop** (Trigger)
- **Show Button** (Number: Boolean)
- **Button Style** (String)
- **Render To Texture** (Number: Boolean)
- **Shader** (Object:Shader)

< Output

- **Next** (Trigger)
- **Render After Eyes** (Trigger)
- **Viewer Pose** (Object)
- **Eye Index** (Number)
- **VR Support** (booleanNumber)
- **Matrix** (Array)
- **DOM Overlay Ele** (Object)
- **In Session** (booleanNumber)
- **Ms Per Eye** (Array)
- **Texture** (Object)
- **Texture Depth** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Devices.WebXr.Vr.Vr>

35.2 VrController



Full Name: Ops.Devices.WebXr.Vr.VrController

Description: tracking of vr hand controller

> Inputs

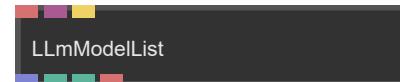
- **Update** (Trigger)
 - **Handedness Index** (Number: Integer)
- < Output
- **Next** (Trigger)
 - **Axis 1** (Number)
 - **Axis 2** (Number)
 - **Axis 3** (Number)
 - **Axis 4** (Number)
 - **Button 1 Pressed** (Number)
 - **Button 2 Pressed** (Number)
 - **Button 3 Pressed** (Number)
 - **Button 4 Pressed** (Number)
 - **Button 5 Pressed** (Number)
 - **Button 6 Pressed** (Number)
 - **Button 7 Pressed** (Number)
 - **Button 1 Touched** (Number)
 - **Button 2 Touched** (Number)
 - **Button 3 Touched** (Number)
 - **Button 4 Touched** (Number)
 - **Button 5 Touched** (Number)
 - **Button 6 Touched** (Number)
 - **Button 7 Touched** (Number)
 - **Position X** (Number)
 - **Position Y** (Number)
 - **Position Z** (Number)
 - **Gamepad Values** (Object)
 - **Transformed Position** (Trigger)
 - **Found** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Devices.WebXr.VrController>

36 Ops.Extension.Ai

36.1 LLmModelList



Full Name: Ops.Extension.Ai.LLmModelList

Description: Visit documentation for details

> Inputs

- **String1** (String)
- **Headers** (Object)
- **Reload** (Trigger)

< Output

- **Z2gttag4y7** (Array)
- **Jcju8npa2** (booleanNumber)
- **Ozg9pnd1z** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.Ai.LLmModelList>

36.2 LlmPrompt



Full Name: Ops.Extension.Ai.LlmPrompt

Description: Visit documentation for details

> Inputs

- **Prompt** (String)
- **Value** (String)
- **API URL** (String)
- **Authentication** (String)
- **Run** (Trigger)
- **Auto Request** (Number: Boolean)

< Output

- **I4feefw9n** (Object)
- **Klu6r35ga** (booleanNumber)

- **Xs18z73z0** (booleanNumber)
- **Aosval1gx** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.Ai.LlmPrompt>

37 Ops.Extension.AmmoPhysics

37.1 AmmoBody



Full Name: Ops.Extension.AmmoPhysics.AmmoBody

Description: Create a physics body/collision shape using a any geometry or select a shape

> Inputs

- **Update** (Trigger)
- **Name** (String)
- **Mass** (Number)
- **Friction** (Number)
- **Rolling Friction** (Number)
- **Restitution** (Number)
- **Shape Index** (Number: Integer)
- **Geometry** (Object:Geometry)
- **Simplify Max Triangles** (Number: Integer)
- **Radius** (Number)
- **Size X** (Number)
- **Size Y** (Number)
- **Size Z** (Number)
- **Positions** (Array)
- **Append Index To Name** (Number: Boolean)
- **Never Deactivate** (Number: Boolean)
- **Ghost Object** (Number: Boolean)
- **Active** (Number: Boolean)
- **Reset** (Trigger)
- **Activate** (Trigger)

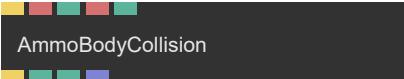
< Output

- **Next** (Trigger)
- **Ray Hit** (booleanNumber)
- **Transformed** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.AmmoPhysics.AmmoBody>

37.2 AmmoBodyCollision



AmmoBodyCollision

Full Name: Ops.Extension.AmmoPhysics.AmmoBodyCollision

Description: Check if physics bodies are colliding

> Inputs

- **Update** (Trigger)
- **Name 1** (String)
- **Match Name 1 Index** (Number: Integer)
- **Name 2** (String)
- **name of physics object** (optional)
- **Match Name 2 Index** (Number: Integer)
- **match name 2** (if set)

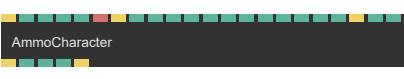
< Output

- **Next** (Trigger)
- **Colliding** (Number)
- **collision detected** (Boolean)
- **Num Collisions** (Number)
- **Collisions** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.AmmoPhysics.AmmoBodyCollision>

37.3 AmmoCharacter



AmmoCharacter

Full Name: Ops.Extension.AmmoPhysics.AmmoCharacter

Description: Control and move a character in a physics environment

> Inputs

- **Update** (Trigger)
- **Radius** (Number)
- **View Index** (Number: Integer)
- **Height** (Number)
- **Mass** (Number)
- **Name** (String)
- **Activate** (Trigger)
- **Move X-** (Number: Boolean)
- **Move Y-** (Number: Boolean)

- **Move Z-** (Number: Boolean)
- **Dir X** (Number)
- **X axis rotation value** (from AmmoCharacterFpsCamera for example)
- **Dir Y** (Number)
- **Y axis rotation value** (from AmmoCharacterFpsCamera for example)
- **Dir Z** (Number)
- **Z axis rotation value** (from AmmoCharacterFpsCamera for example)
- **Set Pos X** (Number)
- **Set Pos Y** (Number)
- **Set Pos Z** (Number)
- **Reset** (Trigger)
- **Speed** (Number)
- **Add Velocity Y** (Number)

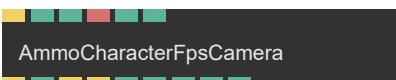
< Output

- **Next** (Trigger)
- **Position X** (Number)
- **Position Y** (Number)
- **Position Z** (Number)
- **Transformed** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.AmmoPhysics.AmmoCharacter>

37.4 AmmoCharacterFpsCamera



AmmoCharacterFpsCamera

Full Name: Ops.Extension.AmmoPhysics.AmmoCharacterFpsCamera

Description: First person camera to use with AmmoCharacter

> Inputs

- **Render** (Trigger)
- **Enable Pointer Lock** (Number: Boolean)
- **Height** (Number)
- **Character Name** (String)
- **Mouse Speed** (Number)
- **Active** (Number: Boolean)

< Output

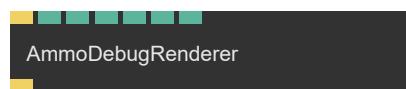
- **Trigger** (Trigger)
- **IsLocked** (Number)
- **has the mouse cursor been locked** (Boolean)

- **Mouse Left** (Trigger)
- **Mouse Right** (Trigger)
- **Dir X** (Number)
- **Dir Y** (Number)
- **Dir Z** (Number)
- **Rot X** (Number)
- **Rot Y** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.AmmoPhysics.AmmoCharacterFpsCamera>

37.5 AmmoDebugRenderer



Full Name: Ops.Extension.AmmoPhysics.AmmoDebugRenderer

Description: Visualize the physical bodies as lines and points

> Inputs

- **Render** (Trigger)
- **Draw Wireframe** (Number: Boolean)
- **Draw AABB** (Number: Boolean)
- **Draw Contact Points** (Number: Boolean)
- **Draw Constraints** (Number: Boolean)
- **Depth** (Number: Boolean)
- **Active** (Number: Boolean)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.AmmoPhysics.AmmoDebugRenderer>

37.6 AmmoEmitter



Full Name: Ops.Extension.AmmoPhysics.AmmoEmitter

Description: Emit Ammo physics bodies by triggering

> Inputs

- **Exec** (Trigger)
- **Limit Bodies** (Number: Integer)
- **Radius** (Number)
- **Mass** (Number)
- **Add Index To Name** (Number: Boolean)
- **Name** (String)
- **Friction** (Number)
- **Rolling Friction** (Number)
- **Restitution** (Number)
- **Dir X** (Number)
- **Dir Y** (Number)
- **Dir Z** (Number)
- **Speed** (Number)
- **Spawn One** (Trigger)
- **Remove All** (Trigger)
- **Activate All** (Trigger)

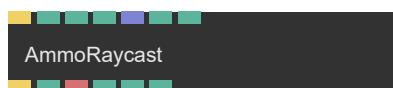
< Output

- **Next** (Trigger)
- **Total Bodies** (Number)
- **Positions** (Array)
- **Rotations Quats** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.AmmoPhysics.AmmoEmitter>

37.7 AmmoRaycast



Full Name: Ops.Extension.AmmoPhysics.AmmoRaycast

Description: Cast a ray and detect colliding bodies

> Inputs

- **Update** (Trigger)
- **Screen X** (Number)
- **Normalize screencoordinates on X Axis** (0-1)
- **Screen Y** (Number)
- **Normalize screencoordinates on Y Axis** (0-1)
- **Ray Points** (Array)
- **Active** (Number: Boolean)
- **Change Cursor** (Number: Boolean)

< Output

- **Next** (Trigger)
- **Has Hit** (booleanNumber)
- **Hit Body Name** (String)
- **Hit X** (Number)
- **Hit Y** (Number)
- **Hit Z** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.AmmoPhysics.AmmoRaycast>

37.8 AmmoWorld



Full Name: Ops.Extension.AmmoPhysics.AmmoWorld

Description: Simulate physical world

> Inputs

- **Update** (Trigger)
- **Simulate** (Number: Boolean)
- **Auto Remove Inactive** (Number: Boolean)
- **Gravity X** (Number)
- **Gravity Y** (Number)
- **Gravity Z** (Number)
- **Activate All** (Trigger)
- **Reset** (Trigger)

< Output

- **Next** (Trigger)
- **Total Bodies** (Number)
- **Debug Points** (Array)
- **Bodies Meta** (Array)
- **Collisions** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.AmmoPhysics.AmmoWorld>

37.9 GltfAmmoBodies



Full Name: Ops.Extension.AmmoPhysics.GltfAmmoBodies

Description: Create physics bodies from a GLTF File

> Inputs

- **Exec** (Trigger)
- **Shape Index** (Number: Integer)
- **Filter Meshes** (String)
- **Mass Kg** (Number)
- **Active** (Number: Boolean)

< Output

- **Meshes** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.AmmoPhysics.GltfAmmoBodies>

38 Ops.Extension.DetectGpu

38.1 DetectGPU



Full Name: Ops.Extension.DetectGpu.DetectGPU

Description: Use the detect-gpu library to assess performance of the client running the patch

> Inputs

- **Run** (Trigger)

< Output

- **Finished** (Trigger)
- **Tier** (Number)
- **Is Mobile** (booleanNumber)
- **GPU Name** (String)
- **FPS** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.DetectGpu.DetectGPU>

39 Ops.Extension.ECharts

39.1 ECharts



Full Name: Ops.Extension.ECharts.ECharts

Description: wrapper for echarts-library

> Inputs

- **Create** (Trigger)
- **Parent DOM Element** (Object)
- **Id** (String)
- **Width** (Number: Integer)
- **Height** (Number: Integer)
- **Chart Object** (Object)
- **Merge Options** (Object)
- **Renderer Index** (Number: Integer)
- **Renderer** (String)
- **Theme Index** (Number: Integer)
- **Theme** (String)
- **Custom Theme Obj** (Object)
- **Init Extra Options** (Object)
- **Style** (Number: String)
- **Visible** (Number: Boolean)

< Output

- **DOM Element** (Object)
- **ECharts Instance** (Object)
- **Chart Updated** (Trigger)
- **Theme Changed** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.ECharts.ECharts>

39.2 EChartsEvent



Full Name: Ops.Extension.ECharts.EChartsEvent

Description: capture echart-library-events

> Inputs

- **ECharts Instance** (Object)
- **Event Name** (String)
- **Query String** (String)
- **Query Object** (Object)
- **Refresh Event Binding** (Trigger)

< Output

- **Out Chart** (Object)
- **Trigger** (Trigger)
- **Event Params** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.ECharts.EChartsEvent>

40 Ops.Extension.FxHash

40.1 FxHash



Full Name: Ops.Extension.FxHash.FxHash

Description: FxHash simulator / generator of seeded random numbers

> Inputs

- **Hash** (String)
- **Randomize Hash** (Trigger)

< Output

- **Fxhash** (String)
- **Fxrnd 1** (Number)
- **Fxrnd 2** (Number)
- **Fxrnd 3** (Number)
- **Fxrnd 4** (Number)
- **Random Numbers** (Array)
- **Fxhash Environment** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.FxHash.FxHash>

41.1 VelocityBoundaries



Full Name: Ops.Extension.GlParticles.VelocityBoundaries

Description: Visit documentation for details

► Inputs

- **Render** (Trigger)
- **Area Index** (Number: Integer)
- **Method Index** (Number: Integer)
- **Invert Area** (Number: Boolean)
- **Strength** (Number)
- **Size** (Number)
- **Falloff** (Number)
- **Bounciness** (Number)
- **Collision Fade** (Number)
- **Dir Randomness** (Number)
- **InForceOutwards** (Number)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **Velocity Dir X** (Number)
- **Velocity Dir Y** (Number)
- **Velocity Dir Z** (Number)
- **Size X** (Number)
- **Size Y** (Number)
- **Size Z** (Number)
- **Multiply** (Object:Texture)
- **Age Start** (Number)
- **Age End** (Number)
- **Age Fade** (Number)

◀ Output

- **Trigger** (Trigger)
- **Velocity** (Object)
- **Collision** (Object)

Example Patch: Open in Editor

42 Ops.Extension.HtmlElementArray

42.1 DivElements



Full Name: Ops.Extension.HtmlElementArray.DivElements

Description: create an array of div elements

> Inputs

- **Class** (String)
- **Parent** (Object:Element)
- **Num** (Number: Integer)
- **Active** (Number: Boolean)
- **Text** (Array)
- **Reset Hover** (Trigger)

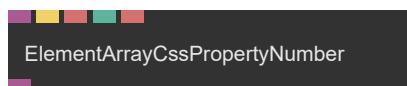
< Output

- **Elements** (Array)
- **Index Clicked** (Number)
- **Element Clicked** (Trigger)
- **Pointer Up** (Trigger)
- **Index Hovered** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.HtmlElementArray.DivElements>

42.2 ElementArrayCssPropertyNumber



Full Name: Ops.Extension.HtmlElementArray.ElementArrayCssPropertyNumber

Description: Set css style properties of a html element

> Inputs

- **Element** (Object)
- **Update** (Trigger)
- **Property** (String)
- **Value** (Number)

- **Value Suffix** (String)

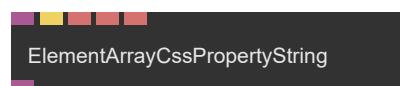
< Output

- **HTML Element** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.HtmlElementArray.ElementArrayCssPropertyNumber>

42.3 ElementArrayCssPropertyString



Full Name: Ops.Extension.HtmlElementArray.ElementArrayCssPropertyString

Description: set css properties

> Inputs

- **Element** (Object)
- **Update** (Trigger)
- **Property** (String)
- **Value** (String)
- **Value Suffix** (String)

< Output

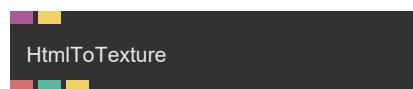
- **HTML Element** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.HtmlElementArray.ElementArrayCssPropertyString>

43 Ops.Extension.HtmlToTexture

43.1 HtmlToTexture



Full Name: Ops.Extension.HtmlToTexture.HtmlToTexture

Description: Visit documentation for details

> Inputs

- **Element** (Object:Element)
- **Update** (Trigger)

< Output

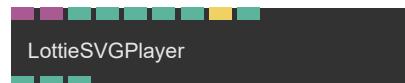
- **Image DataUrl** (String)
- **Progress** (Number)
- **Finished** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.HtmlToTexture.HtmlToTexture>

44 Ops.Extension.Lottie

44.1 LottieSVGPlayer



Full Name: Ops.Extension.Lottie.LottieSVGPlayer

Description: Play Bodymovin/Lottie animations as SVG in a HTML element

> Inputs

- **HTML Element** (Object:Element)
- **JSON Data** (Object)
- **Render Frame** (Number)
- **Loop** (Number: Boolean)
- **Play** (Number: Boolean)
- **Play Backward** (Number: Boolean)
- **Rewind** (Trigger)
- **Active** (Number: Boolean)

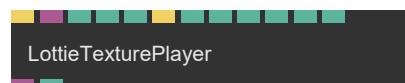
< Output

- **Completed** (booleanNumber)
- **Progress** (Number)
- **Total Frames** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.Lottie.LottieSVGPlayer>

44.2 LottieTexturePlayer_v2



Full Name: Ops.Extension.Lottie.LottieTexturePlayer_v2

Description: Play a Lottie animation in a texture

> Inputs

- **Exe** (Trigger)
- **JSON Data** (Object)
- **Play Mode Index** (Number: Integer)
- **Frame** (Number)

- **Play** (Number: Boolean)
 - **Rewind** (Trigger)
 - **Speed** (Number)
 - **Texture Width** (Number: Integer)
 - **Texture Height** (Number: Integer)
 - **Filter Index** (Number: Integer)
 - **Wrap Index** (Number: Integer)
 - **Scale Index** (Number: Integer)

< Output

- **Texture** (Object)
 - **Total Frames** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Extension.Lottie.LottieTexturePlayer_v2

45 Ops.Extension.LSystem

45.1 Lsystem_v2



Full Name: Ops.Extension.LSystem.Lsystem_v2

Description: Lsystem generator

> Inputs

- **Trigger** (Trigger)
 - **Iterations** (Number: Integer)
 - **Step Length** (Number)
 - **Step Scale Multiplier** (Number)
 - **Default Angle** (Number)
 - **Rotation Multiplier** (Number)
 - **Random Seed** (Number)
 - **Random Strength** (Number)

< Output

- **Out Trigger Geometry** (Trigger)
 - **Points Out** (Array)
 - **Max Size** (Number)
 - **Final Generated String** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.LSystem.Lsystem> v2

46 Ops.Extension.Mediapipe

46.1 FaceMesh



Full Name: Ops.Extension.Mediapipe.FaceMesh

Description: Generate an animated geometry from MpFaceTracking Point Coordinates

> Inputs

- **Geom** (Object)
- **Points** (Array)

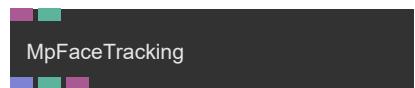
< Output

- **Result Geom** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.Mediapipe.FaceMesh>

46.2 MpFaceTracking



Full Name: Ops.Extension.Mediapipe.MpFaceTracking

Description: Get face mesh from webcam/video using mediapipe library

> Inputs

- **Element** (Object)
- **Refine LandMarks** (Number: Boolean)

< Output

- **Points** (Array)
- **Found** (Number)
- **Result** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.Mediapipe.MpFaceTracking>

46.3 MpHand



Full Name: Ops.Extension.Mediapipe.MpHand

Description: Get points and lines for left/right hand from mediapipe

> Inputs

- **Hands Result** (Object)
- **Hand Index** (Number: Integer)
- **Min Score** (Number)

< Output

- **Points** (Array)
- **Lines** (Array)
- **Data** (Object)
- **Found Hand** (Number)
- **Score** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.Mediapipe.MpHand>

46.4 MpHandCoordinate



Full Name: Ops.Extension.Mediapipe.MpHandCoordinate

Description: Get individual coordinates of fingers or wrist from an array of mediapipe data

> Inputs

- **Hand Points** (Array)
- **Joint Index** (Number: Integer)

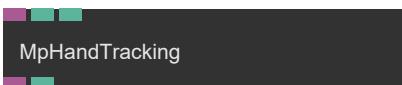
< Output

- **X** (Number)
- **Y** (Number)
- **Z** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.Mediapipe.MpHandCoordinate>

46.5 MpHandTracking



Full Name: Ops.Extension.Mediapipe.MpHandTracking

Description: Get hand data from mediapipe library, use with MpHand

> Inputs

- **Element** (Object:Element)
- **Min Confidence Detect** (Number)
- **Min Confidence Tracking** (Number)

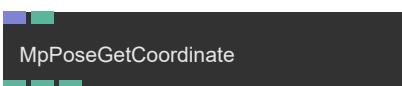
< Output

- **Result** (Object)
- **Found Hands** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.Mediapipe.MpHandTracking>

46.6 MpPoseGetCoordinate



Full Name: Ops.Extension.Mediapipe.MpPoseGetCoordinate

Description: Get coordinates of specific body parts from mediapipe data

> Inputs

- **Landmarks** (Array)
- **Landmark Index** (Number: Integer)

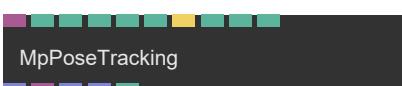
< Output

- **X** (Number)
- **Y** (Number)
- **Z** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.Mediapipe.MpPoseGetCoordinate>

46.7 MpPoseTracking



Full Name: Ops.Extension.Mediapipe.MpPoseTracking

Description: Get pose-data (points/landmarks/lines) from webcam using mediapipe library

> Inputs

- **Element** (Object:Element)
- **Smooth Landmarks** (Number: Boolean)
- **Min Detection Confidence** (Number)
- **Min Tracking Confidence** (Number)
- **Enable Segmentation** (Number: Boolean)
- **Update Texture** (Trigger)
- **Smooth Segmentation** (Number: Boolean)
- **Flip X** (Number: Boolean)
- **Flip Y** (Number: Boolean)

< Output

- **Points** (Array)
- **Segmentation Mask** (Object)
- **Landmarks** (Array)
- **Lines** (Array)
- **Found** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.Mediapipe.MpPoseTracking>

47 Ops.Extension.OpenType

47.1 OpentypeFont



Full Name: Ops.Extension.OpenType.OpentypeFont

Description: Load OTF & TTF fonts via OpenType library

> Inputs

- **Font File** (String)

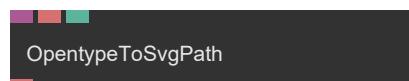
< Output

- **Opentype Font** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.OpenType.OpentypeFont>

47.2 OpentypeToSvgPath



Full Name: Ops.Extension.OpenType.OpentypeToSvgPath

Description: get svg path from (OTF) OpentypeFont using the opentype library

> Inputs

- **Opentype Font** (Object)
- **Text** (String)
- **Letter Spacing** (Number)

< Output

- **Path String** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.OpenType.OpentypeToSvgPath>

48 Ops.Extension.Osc2Ws

48.1 Osc2WsArray



Full Name: Ops.Extension.Osc2Ws.Osc2WsArray

Description: Outputs an array of data from a user defined OSC address

> Inputs

- **Message** (Object)
- **Address** (String)
- **Learn** (Trigger)

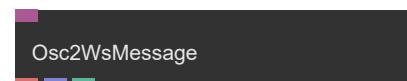
< Output

- **Result Message** (Object)
- **Array Out** (Array)
- **Array Length** (Number)
- **Received** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.Osc2Ws.Osc2WsArray>

48.2 Osc2WsMessage



Full Name: Ops.Extension.Osc2Ws.Osc2WsMessage

Description: Shows the current active address of an incoming OSC message

> Inputs

- **Message** (Object)

< Output

- **Address** (String)
- **Arguments** (Array)
- **Total Arguments** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.Osc2Ws.Osc2WsMessage>

48.3 Osc2WsNumber



Full Name: Ops.Extension.Osc2Ws.Osc2WsNumber

Description: Outputs a single number from a user defined OSC address

> Inputs

- **Message** (Object)
- **Address** (String)
- **Learn** (Trigger)

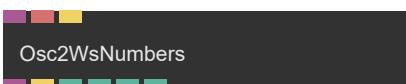
< Output

- **Result Message** (Object)
- **Value** (Number)
- **Received** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.Osc2Ws.Osc2WsNumber>

48.4 Osc2WsNumbers



Full Name: Ops.Extension.Osc2Ws.Osc2WsNumbers

Description: Outputs up to 4 numbers from a user defined OSC address

> Inputs

- **Message In** (Object)
- **Osc Address** (String)
- **Learn** (Trigger)

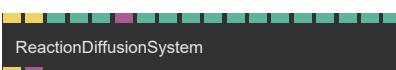
< Output

- **Message Through** (Object)
- **Received** (Trigger)
- **Number 0** (Number)
- **Number 1** (Number)
- **Number 2** (Number)
- **Number 3** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.Osc2Ws.Osc2WsNumbers>

49 Ops.Extension.ReactionDiffusion



ReactionDiffusionSystem

Full Name: Ops.Extension.ReactionDiffusion.ReactionDiffusionSystem_v2

Description: Cellular automata system as feedback loop texture.

> Inputs

- **Render** (Trigger)
- **Reset** (Trigger)
- **Use Viewport Size** (Number: Boolean)
- **Width** (Number: Integer)
- **Height** (Number: Integer)
- **Texture In** (Object:Texture)
- **Speed** (Number: Integer)
- **Seed** (Number)
- **Presets Index** (Number: Integer)
- **Feed** (Number)
- **Feed Variation** (Number)
- **Kill** (Number)
- **Kill Variation** (Number)
- **Diffusion Scale** (Number)
- **Diffusion Scale Variation** (Number)
- **Anisotropy** (Number)
- **Noise Scale** (Number)
- **Separate Fields** (Number: Boolean)

< Output

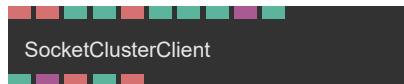
- **Trigger** (Trigger)
- **Texture Out** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Extension.ReactionDiffusion.ReactionDiffusionSystem_v2

50 Ops.Extension.SocketCluster

50.1 SocketClusterClient_v2



Full Name: Ops.Extension.SocketCluster.SocketClusterClient_v2

Description: connect to a socketcluster server and manage the connection

> Inputs

- **Channel** (String)
- **Server Hostname** (String)
- **Server Port** (Number)
- **Use SSL** (Number: Boolean)
- **enable encryption** (needs to be supported by server)
- **Server Path** (String)
- **Allow Send** (Number: Boolean)
- **Allow Multiple Senders** (Number: Boolean)
- **Additional Serverdata** (Object)
- **additional data send with every message** (can be used for auth-token)
- **Active** (Number: Boolean)

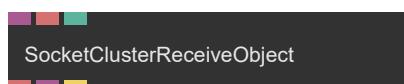
< Output

- **Ready** (booleanNumber)
- **Socket** (Object)
- **Own Client Id** (String)
- **Can Send** (booleanNumber)
- **Error** (String)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Extension.SocketCluster.SocketClusterClient_v2

50.2 SocketClusterReceiveObject



Full Name: Ops.Extension.SocketCluster.SocketClusterReceiveObject

Description: Receives object from the socketcluster socket/topic

> Inputs

- **Socket** (Object:Socketcluster)
- **Topic** (String)
- **Receive Own Data** (Number: Boolean)

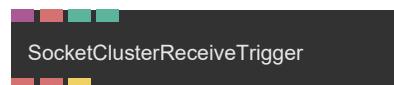
< Output

- **Client Id** (String)
- **Data** (Object)
- **Received** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.SocketCluster.SocketClusterReceiveObject>

50.3 SocketClusterReceiveTrigger



Full Name: Ops.Extension.SocketCluster.SocketClusterReceiveTrigger

Description: Receives trigger from the socketcluster socket/topic

> Inputs

- **Socket** (Object:Socketcluster)
- **Topic** (String)
- **Receive Own Data** (Number: Boolean)
- **Use Named Trigger** (Number: Boolean)

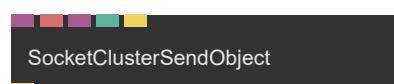
< Output

- **Client Id** (String)
- **Trigger Name** (String)
- **Received** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.SocketCluster.SocketClusterReceiveTrigger>

50.4 SocketClusterSendObject



Full Name: Ops.Extension.SocketCluster.SocketClusterSendObject

Description: sends an object via socketcluster/websocket

> Inputs

- **Socket** (Object:Socketcluster)
- **Topic** (String)
- **Data** (Object)
- **Send** (Trigger)

< Output

- **Sent Data** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.SocketCluster.SocketClusterSendObject>

50.5 SocketClusterSendTrigger

SocketClusterSendTrigger

Full Name: Ops.Extension.SocketCluster.SocketClusterSendTrigger

Description: sends a trigger via socketcluster/websocket

> Inputs

- **Data** (Trigger)
- **Socket** (Object:Socketcluster)
- **Topic** (String)
- **Trigger Name** (String)
- **the name of the trigger** (created with TriggerSend)

< Output

- Visit *Ops.Extension.SocketCluster.SocketClusterSendTrigger documentation for output port details*

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.SocketCluster.SocketClusterSendTrigger>

50.6 SocketClusterTopicInfo_v2

SocketClusterTopicInfo

Full Name: Ops.Extension.SocketCluster.SocketClusterTopicInfo_v2

Description: get info for clients listening on a socketcluster topic

> Inputs

- **Socket** (Object:Socketcluster)
- **Topic** (String)
- **Timeout Seconds** (Number: Integer)
- **Soft Timeout Seconds** (Number: Integer)
- **Retain Messages** (Number: Integer)
- **Update** (Trigger)
- **Receive My Data** (Number: Boolean)

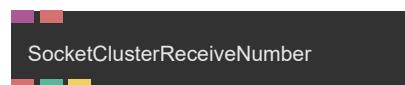
< Output

- **Active Clients** (Array)
- **Will Time Out** (Object)
- **Timed Out Clients** (Array)
- **Messages** (Object)
- **Updated** (Trigger)

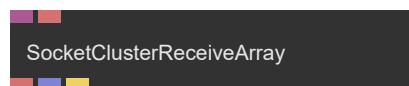
Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Extension.SocketCluster.SocketClusterTopicInfo_v2

51 Ops.Extension.SocketCluster.Deprecated 51.3 SocketClusterReceiveNumber



51.1 SocketClusterReceiveArray



Full Name: Ops.Extension.SocketCluster.Deprecated.SocketClusterReceiveArray

Description: receive an array from the socketcluster topic

> Inputs

- **Socket** (Object)
- **Topic** (String)

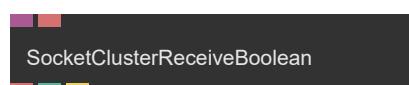
< Output

- **Client Id** (String)
- **Data** (Array)
- **Received** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.SocketCluster.Deprecated.SocketClusterReceiveArray>

51.2 SocketClusterReceiveBoolean



Full Name: Ops.Extension.SocketCluster.Deprecated.SocketClusterReceiveBoolean

Description: Receive boolean value from the socketcluster socket/topic

> Inputs

- **Socket** (Object)
- **Topic** (String)

< Output

- **Client Id** (String)
- **Data** (booleanNumber)
- **Received** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.SocketCluster.Deprecated.SocketClusterReceiveBoolean>

Full Name: Ops.Extension.SocketCluster.Deprecated.SocketClusterReceiveNumber

Description: receive number from the socketcluster socket/topic

> Inputs

- **Socket** (Object)
- **Topic** (String)

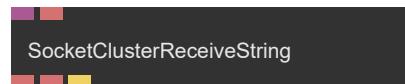
< Output

- **Client Id** (String)
- **Data** (Number)
- **Received** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.SocketCluster.Deprecated.SocketClusterReceiveNumber>

51.4 SocketClusterReceiveString



Full Name: Ops.Extension.SocketCluster.Deprecated.SocketClusterReceiveString

Description: receives string from the socketcluster socket/topic

> Inputs

- **Socket** (Object:Socketcluster)
- **Topic** (String)

< Output

- **Data** (String)
- **Client Id** (String)
- **Received** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.SocketCluster.Deprecated.SocketClusterReceiveString>

51.5 SocketClusterSendArray

SocketClusterSendArray

Full Name: Ops.Extension.SocketCluster.Deprecated.SocketClusterSendArray

Description: sends an array via socketcluster/websocket

> Inputs

- **Send** (Trigger)
- **Socket** (Object:Socketcluster)
- **Topic** (String)
- **Data** (Array)
- **Public** (2): MOUSE MOVEMENT SEND

< Output

- Visit *Ops.Extension.SocketCluster.Deprecated.SocketClusterSendArray documentation for output port details*

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.SocketCluster.Deprecated.SocketClusterSendArray>

51.6 SocketClusterSendBoolean

SocketClusterSendBoolean

Full Name: Ops.Extension.SocketCluster.Deprecated.SocketClusterSendBoolean

Description: Sends boolean value via socketcluster/websocket

> Inputs

- **Send** (Trigger)
- **Socket** (Object)
- **Topic** (String)
- **Data** (Number: Boolean)

< Output

- Visit *Ops.Extension.SocketCluster.Deprecated.SocketClusterSendBoolean documentation for output port details*

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.SocketCluster.Deprecated.SocketClusterSendBoolean>

51.7 SocketClusterSendNumber

SocketClusterSendNumber

Full Name: Ops.Extension.SocketCluster.Deprecated.SocketClusterSendNumber

Description: sends a number via socketcluster/websocket

> Inputs

- **Send** (Trigger)
- **Socket** (Object)
- **Topic** (String)
- **Data** (Number)

< Output

- Visit *Ops.Extension.SocketCluster.Deprecated.SocketClusterSendNumber documentation for output port details*

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.SocketCluster.Deprecated.SocketClusterSendNumber>

51.8 SocketClusterSendString

SocketClusterSendString

Full Name: Ops.Extension.SocketCluster.Deprecated.SocketClusterSendString

Description: sends a string via socketcluster/websocket

> Inputs

- **Send** (Trigger)
- **Socket** (Object:Socketcluster)
- **Topic** (String)
- **Data** (String)

< Output

- Visit *Ops.Extension.SocketCluster.Deprecated.SocketClusterSendString documentation for output port details*

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.SocketCluster.Deprecated.SocketClusterSendString>

52 Ops.Extension.Standalone

52.1 Ffmpeg



Full Name: Ops.Extension.Standalone.Ffmpeg
Description: FFmpeg video converter toolbox op

> Inputs

- **Source Video** (String)
- **Destination File** (String)
- **Set Bitrate** (Number: Boolean)
- **Bitrate** (String)
- **Constant** (Number: Boolean)
- **Set Codec** (Number: Boolean)
- **Codec** (String)
- **Set Size** (Number: Boolean)
- **Size** (String)
- **Crop Time** (Number: Boolean)
- **Start Time** (String)
- **Duration** (String)
- **Process** (Trigger)

< Output

- **Processing** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.Standalone.Ffmpeg>

53 Ops.Extension.Standalone.Files

53.1 CreateFile



Full Name: Ops.Extension.Standalone.Files.CreateFile

Description: Create a new empty file on your local harddrive

> Inputs

- **Default Path** (String)
- **Create File** (Trigger)

< Output

- **Path** (String)
- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.Standalone.Files.CreateFile>

53.2 Exist



Full Name: Ops.Extension.Standalone.Files.Exist

Description: Check if a file exists on the local file system

> Inputs

- **Path** (String)
- **Execute** (Trigger)

< Output

- **Exists** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.Standalone.Files.Exist>

53.3 FileUrlToPath



Full Name: Ops.Extension.Standalone.Files.FileUrlToPath

Description: convert file-url to path

> Inputs

- **FileUrl** (String)

< Output

- **Path** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.Standalone.Files.FileUrlToPath>

53.4 Makedir



Full Name: Ops.Extension.Standalone.Files.Makedir

Description: Create a directory on the local file system

> Inputs

- **Path** (String)
- **Create** (Trigger)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.Standalone.Files.Makedir>

53.5 OpenFileManager



Full Name: Ops.Extension.Standalone.Files.OpenFileManager

Description: Open the native file manager application using that path

> Inputs

- **Path** (String)

- **Open File Manager** (Trigger)

< Output

- Visit *Ops.Extension.Standalone.Files.OpenFileManager documentation for output port details*

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.Standalone.Files.OpenFileManager>

53.6 PathToFileUrl



Full Name: Ops.Extension.Standalone.Files.PathToFileUrl

Description: convert local path to file-url

> Inputs

- **Path** (String)

< Output

- **FileUrl** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.Standalone.Files.PathToFileUrl>

53.7 ReadDir



Full Name: Ops.Extension.Standalone.Files.ReadDir

Description: Read all entries in a directory

> Inputs

- **Path** (String)
- **Reload** (Trigger)

< Output

- **Entries** (Array)
- **Has Error** (booleanNumber)
- **Error** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.Standalone.Files.ReadDir>

53.8 ResolvePath



Full Name: Ops.Extension.Standalone.Files.ResolvePath

Description: Resolves a paths into an absolute path

> Inputs

- **Path** (String)

< Output

- **Result** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.Standalone.Files.ResolvePath>

53.9 SelectDir



Full Name: Ops.Extension.Standalone.Files.SelectDir

Description: Choose a directory on your hard drive

> Inputs

- **Default Path** (String)
- **Select Directory** (Trigger)

< Output

- **Path** (String)
- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.Standalone.Files.SelectDir>

53.10 SelectFile



Full Name: Ops.Extension.Standalone.Files.SelectFile

Description: Choose a file on your hard drive

> Inputs

- **Default Path** (String)
- **Select File** (Trigger)

< Output

- **Path** (String)
- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.Standalone.Files.SelectFile>

53.11 Stat



Full Name: Ops.Extension.Standalone.Files.Stat

Description: Get statistics about a file on the local file system

> Inputs

- **Path** (String)

< Output

- **Stats** (Object)
- **Is Directory** (booleanNumber)
- **Is File** (booleanNumber)
- **Has Error** (booleanNumber)
- **Error** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.Standalone.Files.Stat>

53.12 SystemDirs



Full Name: Ops.Extension.Standalone.Files.SystemDirs

Description: Get Default System Directories Paths

> Inputs

- Visit *Ops.Extension.Standalone.Files.SystemDirs* documentation for input port details

< Output

- **Home** (String)
- **Downloads** (String)

- **Documents** (String)
- **Desktop** (String)
- **Exe** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.Standalone.Files.SystemDirs>

53.13 Watch



Full Name: Ops.Extension.Standalone.Files.Watch

Description: Watch a directory, get a trigger when a file changes

> Inputs

- **Path** (String)
- **Read** (Trigger)

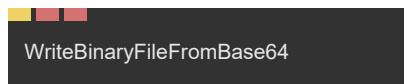
< Output

- **Event Type** (String)
- **Event Filename** (String)
- **Event Happened** (Trigger)
- **Content** (String)
- **Has Error** (booleanNumber)
- **Error** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.Standalone.Files.Watch>

53.14 WriteBinaryFileFromBase64



Full Name: Ops.Extension.Standalone.Files.WriteBinaryFileFromBase64

Description: Create a binary file on the local file system from a base64 string

> Inputs

- **Trigger** (Trigger)
- **Base64** (String)
- **Filename** (String)

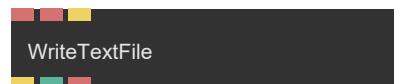
< Output

- Visit [Ops.Extension.Standalone.Files.WriteBinaryFileFromBase64 documentation](#) for output port details

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.Standalone.Files.WriteBinaryFileFromBase64>

53.15 WriteTextFile



Full Name: Ops.Extension.Standalone.Files.WriteTextFile

Description: Write a string to a text file on the local file system

> Inputs

- **Filename** (String)
- **Content** (String)
- **Write** (Trigger)

< Output

- **Next** (Trigger)
- **Has Error** (booleanNumber)
- **Error** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.Standalone.Files.WriteTextFile>

54 Ops.Extension.Standalone.Net

54.1 HttpServer



Full Name: Ops.Extension.Standalone.Net.HttpServer

Description: Create a Web/Http server locally

> Inputs

- **Hostname** (String)
- **Port** (Number: Integer)

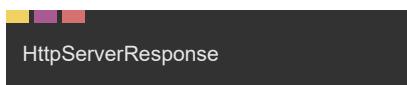
< Output

- **Trigger Request** (Trigger)
- **Response** (Object)
- **Request URL** (String)
- **Request** (Object)
- **Running** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.Standalone.Net.HttpServer>

54.2 HttpServerResponse



Full Name: Ops.Extension.Standalone.Net.HttpServerResponse

Description: Answer http requests by sending string to the browser/client

> Inputs

- **Trigger** (Trigger)
- **Response** (Object)
- **Body** (String)

< Output

- Visit *Ops.Extension.Standalone.Net.HttpServerResponse documentation for output port details*

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.Standalone.Net.HttpServerResponse>

54.3 IpAddress



Full Name: Ops.Extension.Standalone.Net.IpAddress

Description: Outputs your local IP Adress

> Inputs

- Visit *Ops.Extension.Standalone.Net.IpAddress documentation for input port details*

< Output

- **Local IP** (String)
- **Interface** (String)
- **Data** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.Standalone.Net.IpAddress>

54.4 Osc_v2



Full Name: Ops.Extension.Standalone.Net.Osc_v2

Description: Visit documentation for details

> Inputs

- **Port** (Number: Integer)

< Output

- **Message Received** (Trigger)
- **Message** (Object)
- **Connection** (Object)
- **Status** (String)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Extension.Standalone.Net.Osc_v2

54.5 OscSend



Full Name: Ops.Extension.Standalone.Net.OscSend

Description: send data to a OSC device

> Inputs

- **Connection** (Object)
- **Net Address** (String)
- **Port** (Number: Integer)
- **OSC Address** (String)
- **Number** (Number)
- **Send** (Trigger)
- **Public** (1): OSC: READ / SEND

< Output

- Visit *Ops.Extension.Standalone.Net.OscSend documentation* for output port details

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.Standalone.Net.OscSend>

54.6 ReadTextFile



Full Name: Ops.Extension.Standalone.Net.ReadTextFile

Description: Read a text file as string from the local file system

> Inputs

- **Filename** (String)
- **Read** (Trigger)

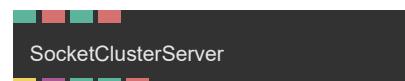
< Output

- **Next** (Trigger)
- **Content** (String)
- **Has Error** (booleanNumber)
- **Error** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.Standalone.Net.ReadTextFile>

54.7 SocketClusterServer



Full Name: Ops.Extension.Standalone.Net.SocketClusterServer

Description: start a socketcluster server

> Inputs

- **Active** (Number: Boolean)
- **Hostname** (String)
- **Port** (Number: Integer)
- **Path** (String)

< Output

- **Receiving** (Trigger)
- **Data** (Object)
- **Listening** (booleanNumber)
- **Clients** (Number)
- **Error** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.Standalone.Net.SocketClusterServer>

55.1 SuperShapesCpu



Full Name: Ops.Extension.SuperShapes.SuperShapesCpu

Description: Visit documentation for details

> Inputs

- **Update** (Trigger)
- **Shape Index** (Number: Integer)
- **Tesselation** (Number: Integer)
- **Param 0** (Number)
- **Param 1** (Number)
- **Param 2** (Number)
- **Param 3** (Number)
- **Param 4** (Number)
- **Param 5** (Number)
- **Param 6** (Number)
- **Param 7** (Number)
- **Param 8** (Number)
- **Param 9** (Number)
- **Param 10** (Number)
- **Param 11** (Number)
- **Param 12** (Number)
- **Param 13** (Number)
- **Param 14** (Number)
- **Param 15** (Number)

< Output

- **Next** (Trigger)
- **Coords** (Array)
- **Faces** (Array)
- **TexCoords** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.SuperShapes.SuperShapesCpu>



Full Name: Ops.Extension.SuperShapes.SuperShapesGpu

Description: Visit documentation for details

> Inputs

- **Update** (Trigger)
- **Render** (Number: Boolean)
- **Shape Index** (Number: Integer)
- **Tesselation** (Number: Integer)
- **Param 0** (Number)
- **Param 1** (Number)
- **Param 2** (Number)
- **Param 3** (Number)
- **Param 4** (Number)
- **Param 5** (Number)
- **Param 6** (Number)
- **Param 7** (Number)
- **Param 8** (Number)
- **Param 9** (Number)
- **Param 10** (Number)
- **Param 11** (Number)
- **Param 12** (Number)
- **Param 13** (Number)
- **Param 14** (Number)
- **Param 15** (Number)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.SuperShapes.SuperShapesGpu>

56 Ops.Extension.TeachableMachines

56.1 AudioClassifier



Full Name: Ops.Extension.TeachableMachines.AudioClassifier

Description: Use the Teachable Machines audio classifier for your microphone. Insert the uploaded model URL.

> Inputs

- **Trigger In** (Trigger)
- **Initialize** (Trigger)
- **Model URL** (String)

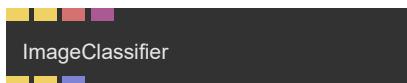
< Output

- **Trigger** (Trigger)
- **Initialized** (Trigger)
- **Classifier** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.TeachableMachines.AudioClassifier>

56.2 ImageClassifier_v2



Full Name: Ops.Extension.TeachableMachines.ImageClassifier_v2

Description: Use the Teachable Machines image classifier. Insert the uploaded model URL.

> Inputs

- **Trigger In** (Trigger)
- **Initialize** (Trigger)
- **Model URL** (String)
- **Webcam Element** (Object)

< Output

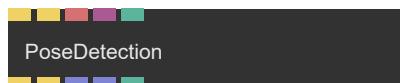
- **Trigger** (Trigger)

- **Initialized** (Trigger)
- **Classifier** (Array)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Extension.TeachableMachines.ImageClassifier_v2

56.3 PoseDetection_v2



Full Name: Ops.Extension.TeachableMachines.PoseDetection_v2

Description: Use the Teachable Machines pose detection with your webcam. Insert the uploaded model URL.

> Inputs

- **Render** (Trigger)
- **Initialize** (Trigger)
- **Model URL** (String)
- **Webcam Element** (Object)
- **Flip Image** (Number: Boolean)

< Output

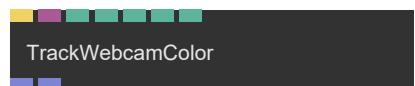
- **Trigger** (Trigger)
- **Initialized** (Trigger)
- **Classifier** (Array)
- **Pose Positions** (Array)
- **Image Flipped** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Extension.TeachableMachines.PoseDetection_v2

57 Ops.Extension.Trackingjs

57.1 TrackWebcamColor



Full Name: Ops.Extension.Trackingjs.TrackWebcamColor

Description: Track a position of a specific color in the current webcam stream

> Inputs

- **Update** (Trigger)
- **Video Element** (Object)
- **Threshold** (Number)
- **Resize Video** (Number)
- **R** (Number)
- **G** (Number)
- **B** (Number)

< Output

- **Positions** (Array)
- **Sizes** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.Trackingjs.TrackWebcamColor>

58 Ops.Extension.Voice

58.1 MeSpeak



Full Name: Ops.Extension.Voice.MeSpeak

Description: uses mespeak.js to convert text-to-speech

> Inputs

- **Text** (String)
- **Say** (Trigger)
- **Amplitude** (Number)
- **Pitch** (Number)
- **Voice Index** (Number: Integer)
- **Word Gap** (Number: Integer)
- **Variants Index** (Number: Integer)
- **Line-Break Length** (Number: Integer)
- **Capitals** (Number: Integer)
- **Punctuation** (String)
- **No Stop** (Number: Boolean)
- **UTF16** (Number: Boolean)
- **SSML** (Number: Boolean)
- **Log Console** (Number: Boolean)
- **Pan** (Number)

< Output

- **Audio Out** (Object)
- **Speaking** (booleanNumber)
- **Voice Loaded** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.Voice.MeSpeak>

58.2 Say_v2



Full Name: Ops.Extension.Voice.Say_v2

Description: Text-to-Speech, speaks different languages (speech synthesis)

> Inputs

- **Update State** (Trigger)
- **Text** (String)
- **Say** (Trigger)
- **Voice** (Number: Select Box)
- **Pitch** (Number)
- **Rate** (Number)
- **Volume** (Number)
- **Say On Text Change** (Number: Boolean)
- **Pause** (Trigger)
- **Resume** (Trigger)
- **Cancel** (Trigger)

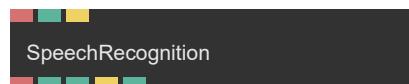
< Output

- **Next** (Trigger)
- **Speaking** (Number)
- **Pending** (Number)
- **Paused** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Extension.Voice.Say_v2

58.3 SpeechRecognition



Full Name: Ops.Extension.Voice.SpeechRecognition

Description: speech to text recognition

> Inputs

- **Language** (String)
- **Active** (Number: Boolean)
- **Start** (Trigger)

< Output

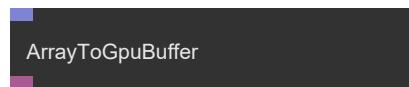
- **Result** (String)
- **Confidence** (Number)
- **Supported** (booleanNumber)
- **New Result** (Trigger)
- **Started** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.Voice.SpeechRecognition>

59 Ops.Extension.WebGpu

59.1 ArrayToGpuBuffer



Full Name: Ops.Extension.WebGpu.ArrayToGpuBuffer

Description: Upload an array to the GPU as a GpuBuffer

> Inputs

- **Arr** (Array)

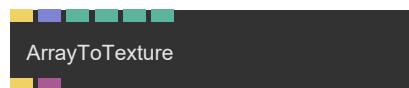
< Output

- **GPUBuffer** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.WebGpu.ArrayToGpuBuffer>

59.2 ArrayToTexture



Full Name: Ops.Extension.WebGpu.ArrayToTexture

Description: Convert an array of numbers to a webgpu texture

> Inputs

- **Update** (Trigger)
- **Array** (Array)
- **Wrap Index** (Number: Integer)
- **Width** (Number: Integer)
- **Height** (Number: Integer)

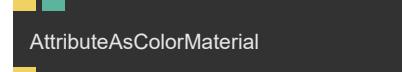
< Output

- **Next** (Trigger)
- **Texture** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.WebGpu.ArrayToTexture>

59.3 AttributeAsColorMaterial



AttributeAsColorMaterial

Full Name: Ops.Extension.WebGpu.AttributeAsColorMaterial

Description: Render mesh attribultes as color

> Inputs

- **Render** (Trigger)

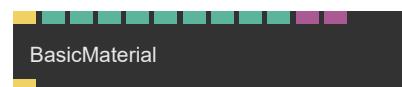
< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.WebGpu.AttributeAsColorMaterial>

59.4 BasicMaterial



Full Name: Ops.Extension.WebGpu.BasicMaterial

Description: A simple material without shading

> Inputs

- **Render** (Trigger)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)
- **Colorize Texture** (Number: Boolean)
- **DiffuseRepeatX** (Number)
- **DiffuseRepeatY** (Number)
- **Tex Offset X** (Number)
- **Tex Offset Y** (Number)
- **Texture** (Object:Texture)
- **Mask** (Object:Texture)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.WebGpu.BasicMaterial>

59.5 ColorTexture



Full Name: Ops.Extension.WebGpu.ColorTexture

Description: A texture containing only one color

> Inputs

- **Render** (Trigger)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)

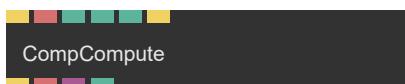
< Output

- **Next** (Trigger)
- **Texture_out** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.WebGpu.ColorTexture>

59.6 CompCompute



Full Name: Ops.Extension.WebGpu.CompCompute

Description: Compose a compute shader

> Inputs

- **Compute** (Trigger)
- **Source** (String)
- **Workgroups 1** (Number: Integer)
- **Workgroups 2** (Number: Integer)
- **Workgroups 3** (Number: Integer)
- **Force Update** (Trigger)

< Output

- **Next** (Trigger)
- **Code** (String)
- **Buffer** (Object)
- **Length** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.WebGpu.CompCompute>

59.7 ComputeStorageInput



Full Name: Ops.Extension.WebGpu.ComputeStorageInput

Description: Compute shader GPU buffer storage input

> Inputs

- **Trigger** (Trigger)
- **Name** (String)
- **Buffer** (Object)

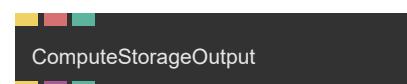
< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.WebGpu.ComputeStorageInput>

59.8 ComputeStorageOutput



Full Name: Ops.Extension.WebGpu.ComputeStorageOutput

Description: Compute shader GPU buffer storage output

> Inputs

- **Trigger** (Trigger)
- **Name** (String)
- **Length** (Number: Integer)

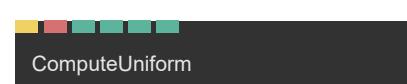
< Output

- **Next** (Trigger)
- **Buffer** (Object)
- **Buffer Length** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.WebGpu.ComputeStorageOutput>

59.9 ComputeUniform



Full Name: Ops.Extension.WebGpu.ComputeUniform

Description: Add a uniform input to a compute shader composition

> Inputs

- **Trigger** (Trigger)
- **Name** (String)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **W** (Number)

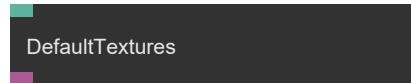
< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.WebGpu.ComputeUniform>

59.10 DefaultTextures



Full Name: Ops.Extension.WebGpu.DefaultTextures

Description: Outputs textures

> Inputs

- Visit *Ops.Extension.WebGpu.DefaultTextures documentation for input port details*

< Output

- **Result** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.WebGpu.DefaultTextures>

59.11 FaceCulling



Full Name: Ops.Extension.WebGpu.FaceCulling

Description: cull (do not draw) back or front facing faces/triangles

> Inputs

- **Render** (Trigger)

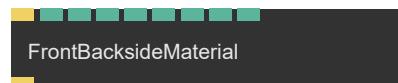
< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.WebGpu.FaceCulling>

59.12 FrontBacksideMaterial



Full Name: Ops.Extension.WebGpu.FrontBacksideMaterial

Description: Show direction of faces as color

> Inputs

- **Render** (Trigger)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)
- **R 2** (Number)
- **G 2** (Number)
- **B 2** (Number)
- **A 2** (Number)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.WebGpu.FrontBacksideMaterial>

59.13 FullScreenRect



Full Name: Ops.Extension.WebGpu.FullScreenRect

Description: Render a rectangle that fills the whole canvas

> Inputs

- **Render** (Trigger)
- **Flip Y** (Number: Boolean)
- **Flip X** (Number: Boolean)
- **Texture** (Object:Texture)

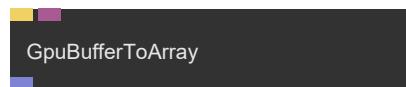
< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.WebGpu.FullScreenRect>

59.14 GpuBufferToArray



Full Name: Ops.Extension.WebGpu.GpuBufferToArray

Description: Convert a GpuBuffer to a CPU Array

> Inputs

- **Trigger** (Trigger)
- **Pos Buffer** (Object)

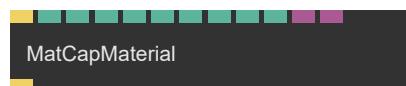
< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.WebGpu.GpuBufferToArray>

59.15 MatCapMaterial



Full Name: Ops.Extension.WebGpu.MatCapMaterial

Description: Image based material that uses a matcap environment texture

> Inputs

- **Render** (Trigger)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)
- **Colorize Texture** (Number: Boolean)
- **DiffuseRepeatX** (Number)
- **DiffuseRepeatY** (Number)
- **Tex Offset X** (Number)
- **Tex Offset Y** (Number)
- **Matcap** (Object:Texture)

- **Diffuse** (Object:Texture)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.WebGpu.MatCapMaterial>

59.16 MeshInstancer



Full Name: Ops.Extension.WebGpu.MeshInstancer

Description: Draw the same mesh many times very fast

> Inputs

- **Render** (Trigger)
- **Geometry** (Object:Geometry)
- **Pos Buffer** (Object)
- **Scale Buffer** (Object)
- **Num Instances** (Number: Integer)
- **Reset** (Trigger)
- **Test** (Trigger)

< Output

- **Next** (Trigger)
- **Total Instances** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.WebGpu.MeshInstancer>

59.17 Pipeline



Full Name: Ops.Extension.WebGpu.Pipeline

Description: show content of last used pipeline for debugging

> Inputs

- **Trigger** (Trigger)
- **Force Rebuild** (Trigger)

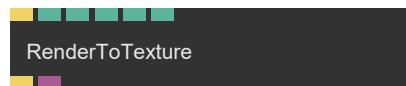
< Output

- **Next** (Trigger)
- **Pipeline** (Object)
- **Shader Info** (Object)
- **Shader Source** (String)
- **Compile Count** (Number)
- **Shader Id** (String)
- **Defines** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.WebGpu.Pipeline>

59.18 RenderToTexture



Full Name: Ops.Extension.WebGpu.RenderToTexture

Description: render into a texture

> Inputs

- **Trigger** (Trigger)
- **Texture Width** (Number: Integer)
- **Texture Height** (Number: Integer)
- **Clear** (Number: Boolean)

< Output

- **Next** (Trigger)
- **Texture** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.WebGpu.RenderToTexture>

59.19 SaselHund



Full Name: Ops.Extension.WebGpu.SaselHund

Description: Visit documentation for details

> Inputs

- Visit *Ops.Extension.WebGpu.SaselHund* documentation for input port details

< Output

- Visit *Ops.Extension.WebGpu.SaselHund* documentation for output port details

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.WebGpu.SaselHund>

59.20 Texture



Full Name: Ops.Extension.WebGpu.Texture

Description: Load an image file as a texture

> Inputs

- **File** (String)
- **Wrap Index** (Number: Integer)

< Output

- **Texture** (Object)
- **Width** (Number)
- **Height** (Number)
- **PixelFormat** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.WebGpu.Texture>

59.21 VizTexture



Full Name: Ops.Extension.WebGpu.VizTexture

Description: Vizualize a webgpu texture on the patchfield

> Inputs

- **Texture In** (Object:Texture)

< Output

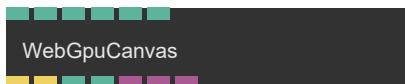
- Visit *Ops.Extension.WebGpu.VizTexture* documentation for output port details

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.WebGpu.VizTexture>

59.22 WebGpuCanvas

Docs: <https://cables.gl/op/Ops.Extension.WebGpu.WebGpuCanvas>



Full Name: Ops.Extension.WebGpu.WebGpuCanvas

Description: Create a canvas for WebGPU

> Inputs

- **Active** (Number: Boolean)
- **Catch Errors** (Number: Boolean)
- **Stop On Errors** (Number: Boolean)
- **Profile** (Number: Boolean)

< Output

- **Next** (Trigger)
- **Next2** (Trigger)
- **Supported** (booleanNumber)
- **MS Frame** (Number)
- **Canvas** (Object)
- **Canvas Prev** (Object)
- **Profiler Data** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Extension.WebGpu.WebGpuCanvas>

59.23 WebGpuInfo



Full Name: Ops.Extension.WebGpu.WebGpuInfo

Description: Output information about WebGPU adapter and implementation

> Inputs

- **Trigger** (Trigger)

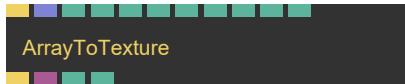
< Output

- **Next** (Trigger)
- **Limits** (Object)
- **Vendor** (String)
- **Architecture** (String)
- **Presentation Format** (String)

Example Patch: Open in Editor

60 Ops.Gl

60.1 ArrayToTexture_v2



Full Name: Ops.Gl.ArrayToTexture_v2

Description: create a texture from an array of number values

> Inputs

- **Update** (Trigger)
- **Array** (Array)
- **Width** (Number: Integer)
- **Height** (Number: Integer)
- **Fill Up** (Number: Boolean)
- **Flip** (Number: Boolean)
- **Pixel Format Index** (Number: Integer)
- **Wrap Index** (Number: Integer)

< Output

- **Next** (Trigger)
- **Texture Out** (Object)
- **Tex Width** (Number)
- **Tex Height** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ArrayToTexture_v2

60.2 BlendMode



Full Name: Ops.Gl.BlendMode

Description: change how colors are mixed (blending/mixing modes)

> Inputs

- **Render** (Trigger)
- **Blendmode Index** (Number: Integer)
- **Premultiplied** (Number: Boolean)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.BlendMode>

60.3 CanvasFocus



Full Name: Ops.Gl.CanvasFocus

Description: is canvas focussed ?

> Inputs

- **Focus** (Trigger)

< Output

- **Has Focus** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.CanvasFocus>

60.4 CanvasInfo_v3



Full Name: Ops.Gl.CanvasInfo_v3

Description: the size of the canvas in pixels, aspect ratio and pixel density

> Inputs

- Visit *Ops.Gl.CanvasInfo_v3 documentation for input port details*

< Output

- **CSS Width** (Number)
- **CSS Height** (Number)
- **Pixel Ratio** (Number)
- **Pixel Width** (Number)
- **Pixel Height** (Number)
- **Aspect Ratio** (Number)
- **Landscape** (booleanNumber)
- **Canvas** (Object)
- **Canvas Parent** (Object)
- **Resized** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.CanvasInfo_v3

60.5 CanvasToTexture



Full Name: Ops.Gl.CanvasToTexture

Description: convert a canvas to texture

> Inputs

- **Canvas** (Object)
- **Filter Index** (Number: Integer)
- **Wrap Index** (Number: Integer)
- **Force Update** (Trigger)

< Output

- **Texture** (Object)
- **Width** (Number)
- **Height** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.CanvasToTexture>

60.6 ClearColor



Full Name: Ops.Gl.ClearColor

Description: sets all cleared pixels to one colour. Use to change the background colour.

> Inputs

- **Render** (Trigger)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ClearColor>

60.7 ClearDepth



Full Name: Ops.Gl.ClearDepth

Description: Clears the depth buffer (zbuffer, z buffer)

> Inputs

- **Render** (Trigger)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ClearDepth>

60.8 ColorMask



Full Name: Ops.Gl.ColorMask

Description: enable/disable RGBA color channels of your entire scene

> Inputs

- **Execute** (Trigger)
- **Red** (Number: Boolean)
- **Green** (Number: Boolean)
- **Blue** (Number: Boolean)
- **Alpha** (Number: Boolean)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ColorMask>

60.9 ColorPick



Full Name: Ops.Gl.ColorPick

Description: pick a color at x,y coordinates of canvas

> Inputs

- **Render** (Trigger)
- **X** (Number)
- **Y** (Number)

< Output

- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ColorPick>

60.10 DirectionalTranslate



Full Name: Ops.Gl.DirectionallyTranslate

Description: translate away from a point in space

> Inputs

- **Exec** (Trigger)
- **Center Model Matrix** (Array)
- **Amount** (Number)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.DirectionallyTranslate>

60.11 DownloadTexture_v3



Full Name: Ops.Gl.DownloadTexture_v3

Description: Download a texture as an image file

> Inputs

- **Texture** (Object:Texture)
- **Quality** (Number)
- **Filename** (String)
- **Download** (Trigger)

< Output

- **Jcrmz8mnz** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.DownloadTexture_v3

60.12 DrawTextureMapping



Full Name: Ops.Gl.DrawTextureMapping

Description: draw texture mapping coordinates

> Inputs

- **Render** (Trigger)
- **Geometry** (Object:Geometry)
- **Num Points** (Number)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.DrawTextureMapping>

60.13 ElementInBrowserViewport



Full Name: Ops.Gl.ElementInBrowserViewport

Description: check if webgl canvas element is in the current browser viewport

> Inputs

- **Update** (Trigger)
- **Element** (Object:Element)

< Output

- **Next** (Trigger)
- **Fully Visible** (booleanNumber)
- **Partly Visible** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ElementInBrowserViewport>

60.14 ExternalCanvas



Full Name: Ops.Gl.ExternalCanvas

Description: Open a new window that shows a copy of the patch canvas

> Inputs

- **Update** (Trigger)
- **Pos X** (Number: Integer)
- **Pos Y** (Number: Integer)
- **Width** (Number: Integer)
- **Height** (Number: Integer)
- **Smoothing** (Number: Boolean)
- **Stretch** (Number: Boolean)
- **Title** (String)
- **Open Window** (Trigger)
- **Fullscreen** (Trigger)
- **Close** (Trigger)

< Output

- **Next** (Trigger)
- **Element** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ExternalCanvas>

60.15 FaceCulling_v2



Full Name: Ops.Gl.FaceCulling_v2

Description: Disable the rendering of front or back facing triangles with culling

> Inputs

- **Render** (Trigger)
- **Active** (Number: Boolean)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.FaceCulling_v2

60.16 FontMSDF_v2



Full Name: Ops.Gl.FontMSDF_v2

Description: Load MSDF Font data and texture to use

> Inputs

- **Font Name** (String)
- **Font Data** (String)
- **Font Image** (String)
- **Font Image 1** (String)
- **Font Image 2** (String)
- **Font Image 3** (String)

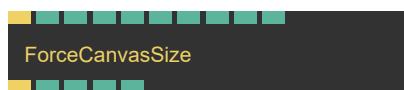
< Output

- **Loaded** (booleanNumber)
- **Total Chars** (Number)
- **Chars** (String)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.FontMSDF_v2

60.17 ForceCanvasSize



Full Name: Ops.Gl.ForceCanvasSize

Description: Resize canvas element to a specific pixel size or aspect ratio

> Inputs

- **Trigger** (Trigger)
- **Active** (Number: Boolean)
- **Center In Parent** (Number: Boolean)
- **Scale To Fit Parent** (Number: Boolean)
- **Set Width** (Number: Integer)
- **Set Height** (Number: Integer)
- **Aspect Ratio Index** (Number: Integer)
- **Ratio** (Number)
- **Fill Parent Index** (Number: Integer)

< Output

- **Next** (Trigger)
- **Width** (Number)
- **Height** (Number)
- **Margin Left** (Number)
- **Margin Top** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ForceCanvasSize>

60.18 GateTexture



Full Name: Ops.Gl.GateTexture

Description: Will only allow an Object to be output if the pass through parameter evaluates to true

> Inputs

- **Object In** (Object:Texture)
- **Pass Through** (Number: Boolean)
- **Only Valid Textures** (Number: Boolean)

< Output

- **Object Out** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.GateTexture>

60.19 GBlendFunc



Full Name: Ops.Gl.GBlendFunc

Description: set gl blendmodes directly

> Inputs

- **Exec** (Trigger)
- **Src RGB Index** (Number: Integer)
- **Dst RGB Index** (Number: Integer)
- **Src Alpha Index** (Number: Integer)
- **Dst Alpha Index** (Number: Integer)
- **Blend Equation Index** (Number: Integer)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.GBlendFunc>

60.20 GLInfo_v2



Full Name: Ops.Gl.GLInfo_v2

Description: information about the webgl context

> Inputs

• Visit [Ops.Gl.GLInfo_v2 documentation](#) for input port details

< Output

- **WebGL Version Short** (Number)
- **WebGL Version** (String)
- **GLSL Version** (String)
- **Max Frag Uniforms** (Number)
- **Max Vert Uniforms** (Number)
- **Max Texture Size** (Number)
- **Max Texture Units** (Number)

- **Max Varying Vectors** (Number)
- **Max MSAA Samples** (Number)
- **Extensions** (Array)
- **Vendor** (String)
- **Renderer** (String)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.GlInfo_v2

60.21 GlPrimitive



Full Name: Ops.Gl.GlPrimitive

Description: force rendering of meshes using points,lines or triangles

> Inputs

- **Execute** (Trigger)
- **Primitive Index** (Number: Integer)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.GlPrimitive>

60.22 GradientTexture



Full Name: Ops.Gl.GradientTexture

Description: texture containing a colour gradient that can be altered with an editor

> Inputs

- **Gradient** (Number)
- **Direction Index** (Number: Integer)
- **Smoothstep** (Number: Boolean)
- **Step** (Number: Boolean)
- **Flip** (Number: Boolean)
- **SRGB** (Number: Boolean)
- **Oklab** (Number: Boolean)

- **Size** (Number: Integer)
- **Wrap Index** (Number: Integer)
- **Dither** (Number)
- **Gradient Array** (Array)
- **Randomize Colors** (Trigger)

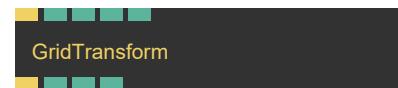
< Output

- **Texture** (Object)
- **Alpha Mask** (Object)
- **Colors** (Array)
- **Colors Pos** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.GradientTexture>

60.23 GridTransform



Full Name: Ops.Gl.GridTransform

Description: transform and arrange elements into a grid

> Inputs

- **Render** (Trigger)
- **Num X** (Number: Integer)
- **Num Y** (Number: Integer)
- **Space X** (Number)
- **Space Y** (Number)

< Output

- **Next** (Trigger)
- **Index** (Number)
- **X Index** (Number)
- **Y Index** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.GridTransform>

60.24 Identity



Full Name: Ops.Gl.Identity
Description: reset all transforms (modelmatrix)
> Inputs

- **Exe** (Trigger)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor
Docs: <https://cables.gl/op/Ops.Gl.Identity>

60.25 IdentityViewMatrix



Full Name: Ops.Gl.IdentityViewMatrix
Description: reset the view matrix (cameras etc.)
> Inputs

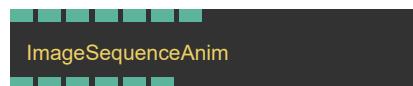
- **Exe** (Trigger)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor
Docs: <https://cables.gl/op/Ops.Gl.IdentityViewMatrix>

60.26 ImageSequenceAnim_v2



Full Name: Ops.Gl.ImageSequenceAnim_v2
Description: play a image sprite animation
> Inputs

- **Time** (Number)
- **FPS** (Number)
- **Num X** (Number)
- **Num Y** (Number)
- **Max Frames** (Number: Integer)
- **Flip Y** (Number: Boolean)

< Output

- **Repeat X** (Number)
- **Repeat Y** (Number)
- **Offset X** (Number)
- **Offset Y** (Number)
- **Frame** (Number)
- **Progress** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageSequenceAnim_v2

60.27 InteractiveRectangle_v2



Full Name: Ops.Gl.InteractiveRectangle_v2
Description: An area which is interactive
> Inputs

- **Trigger In** (Trigger)
- **Width** (Number)
- **Height** (Number)
- **ID** (String)
- **Class** (String)
- **Pivot X Index** (Number: Integer)
- **Pivot Y Index** (Number: Integer)
- **Axis Index** (Number: Integer)
- **Is Interactive** (Number: Boolean)
- **Render Rectangle** (Number: Boolean)
- **Show Boundings** (Number: Boolean)
- **Cursor Index** (Number: Integer)
- **Active** (Number: Boolean)

< Output

- **Trigger Out** (Trigger)
- **Geometry** (Object)
- **Pointer Hover** (booleanNumber)
- **Pointer Down** (booleanNumber)
- **Pointer X** (Number)
- **Pointer Y** (Number)
- **Top** (Number)
- **Left** (Number)
- **Right** (Number)

- **Bottom** (Number)
- **Left Click** (Trigger)
- **Dom Element** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.InteractiveRectangle_v2

60.28 LayerSequence



Full Name: Ops.Gl.LayerSequence

Description: Render Multiple Layers in a specific order

> Inputs

- **Exe** (Trigger)

< Output

- **Trigger 0** (Trigger)
- **Trigger 1** (Trigger)
- **Trigger 2** (Trigger)
- **Trigger 3** (Trigger)
- **Trigger 4** (Trigger)
- **Trigger 5** (Trigger)
- **Trigger 6** (Trigger)
- **Trigger 7** (Trigger)
- **Trigger 8** (Trigger)
- **Trigger 9** (Trigger)
- **Trigger 10** (Trigger)
- **Trigger 11** (Trigger)
- **Trigger 12** (Trigger)
- **Trigger 13** (Trigger)
- **Trigger 14** (Trigger)
- **Trigger 15** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.LayerSequence>

60.29 LineFont_v2



Full Name: Ops.Gl.LineFont_v2

Description: A Simple way to write text on the screen.

> Inputs

- **Render** (Trigger)
- **Text** (String)
- **Letter Spacing** (Number)

< Output

- **Lines** (Array)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.LineFont_v2

60.30 MainLoop_v2



Full Name: Ops.Gl.MainLoop_v2

Description: Trigger other ops once every frame to create smooth animations

> Inputs

- **FPS Limit** (Number)
- **Reduce FPS Unfocussed** (Number: Boolean)
- **Transparent** (Number: Boolean)
- **Active** (Number: Boolean)
- **Focus Canvas** (Number: Boolean)

< Output

- **Trigger** (Trigger)
- **Width** (Number)
- **Height** (Number)
- **Pixel Density** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.MainLoop_v2

60.31 MediaRecorder_v2



Full Name: Ops.Gl.MediaRecorder_v2

Description: Record the renderer-output to video

> Inputs

- **Recording** (Number: Boolean)
- **Filename** (String)
- **Download Video** (Number: Boolean)
- **Mimetype Index** (Number: Integer)
- **MBit** (Number)
- **Max FPS** (Number)
- **Force FPS** (Number)
- **Audio In** (Object:AudioNode)
- **Video Canvas Id** (String)

< Output

- **State** (String)
- **Error** (String)
- **Final Mimetype** (String)
- **Valid Mimetypes** (Array)
- **Duration** (Number)
- **Finished Recording** (Trigger)
- **Video DataUrl** (String)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.MediaRecorder_v2

60.32 MeshInstancer_v4



Full Name: Ops.Gl.MeshInstancer_v4

Description: Draw the same mesh multiple times on the GPU

> Inputs

- **Exe** (Trigger)
- **Geom** (Object:Geometry)
- **Scale** (Number)
- **Limit Instances** (Number: Boolean)
- **Limit** (Number: Integer)
- **Positions** (Array)
- **Scale Array** (Array)
- **Rotations** (Array)
- **Colors** (Array)

- **TexCoords** (Array)

< Output

- **Trigger Out** (Trigger)
- **Num** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.MeshInstancer_v4

60.33 MeshMorph



Full Name: Ops.Gl.MeshMorph

Description: morph from one geometry to another

> Inputs

- **Render** (Trigger)
- **Geometry** (Number: Integer)
- **Duration** (Number)
- **Index** (Number)
- **Index 2** (Number)
- **Fade** (Number)
- **Easing Index** (Number: Integer)
- **Geometry 0** (Object)
- **Geometry 1** (Object)
- **Geometry 2** (Object)
- **Geometry 3** (Object)
- **Geometry 4** (Object)
- **Geometry 5** (Object)
- **Geometry 6** (Object)
- **Geometry 7** (Object)
- **Geometry 8** (Object)
- **Geometry 9** (Object)
- **Geometry 10** (Object)
- **Geometry 11** (Object)
- **Geometry 12** (Object)
- **Geometry 13** (Object)
- **Geometry 14** (Object)
- **Geometry 15** (Object)

< Output

- **Finished** (booleanNumber)
- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.MeshMorph>

60.34 NormalizeScreenCoordinates



Full Name: Ops.Gl.NormalizeScreenCoordinates

Description: convert screen pixel coordinates to range 0-1

> Inputs

- **X** (Number)
- **Y** (Number)

< Output

- **Result X** (Number)
- **Result Y** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.NormalizeScreenCoordinates>

60.35 OrTexture



Full Name: Ops.Gl.OrTexture

Description: outputs the first valid texture of the

> Inputs

- **Texture 1** (Object:Texture)
- **Texture 2** (Object:Texture)
- **Texture 3** (Object:Texture)
- **Texture 4** (Object:Texture)
- **Texture 5** (Object:Texture)
- **Texture 6** (Object:Texture)
- **Texture 7** (Object:Texture)
- **Texture 8** (Object:Texture)

< Output

- **Result** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.OrTexture>

60.36 Orthogonal_v2



Full Name: Ops.Gl.Orthogonal_v2

Description: Orthogonal projection / objects in distance don't appear smaller (isometric)

> Inputs

- **Render** (Trigger)
- **Bounds** (Number)
- **Axis Index** (Number: Integer)
- **Frustum Near** (Number)
- **Frustum Far** (Number)

< Output

- **Trigger** (Trigger)
- **Ratio** (Number)
- **Width** (Number)
- **Height** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Orthogonal_v2

60.37 OverwriteViewportSize



Full Name: Ops.Gl.OverwriteViewportSize

Description: Force a manually set viewport size for connected ops

> Inputs

- **Exec** (Trigger)
- **Width** (Number: Integer)
- **Height** (Number: Integer)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.OverwriteViewportSize>

60.38 Performance



Full Name: Ops.Gl.Performance

Description: Show WebGL Performance Statistics

> Inputs

- **Exe** (Trigger)
- **Active** (Number: Boolean)
- **Visible** (Number: Boolean)
- **Measure GPU** (Number: Boolean)
- **Open** (Number: Boolean)
- **Smooth Graph** (Number: Boolean)
- **Scale** (Number)
- **Size** (Number)

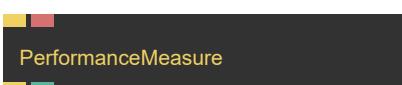
< Output

- **Childs** (Trigger)
- **Canvas** (Object)
- **FPS** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Performance>

60.39 PerformanceMeasure



Full Name: Ops.Gl.PerformanceMeasure

Description: Measure the time used to execute all child ops

> Inputs

- **Execute** (Trigger)
- **Name** (String)

< Output

- **Childs** (Trigger)
- **Time Used** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.PerformanceMeasure>

60.40 Perspective



Full Name: Ops.Gl.Perspective

Description: Adjust FOV, field of view, and frustum clipping

> Inputs

- **Render** (Trigger)
- **FOV Degrees** (Number)
- **Frustum Near** (Number)
- **Frustum Far** (Number)
- **Auto Aspect Ratio** (Number: Boolean)
- **Aspect Ratio** (Number)

< Output

- **Trigger** (Trigger)
- **Aspect** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Perspective>

60.41 PixelProjection_v3



Full Name: Ops.Gl.PixelProjection_v3

Description: Remaps world co-ordinates to a pixel co-ordinate system

> Inputs

- **Render** (Trigger)
- **Width** (Number)
- **Height** (Number)
- **Frustum Near** (Number)
- **Frustum Far** (Number)
- **Flip X** (Number: Boolean)
- **Flip Y** (Number: Boolean)
- **Zero Y** (Number: Boolean)

< Output

- **Trigger** (Trigger)
- **Size Width** (Number)
- **Size Height** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.PixelProjection_v3

60.42 PointCollector



Full Name: Ops.Gl.PointCollector

Description: save points/coordinates in an array

> Inputs

- **Render** (Trigger)
- **Absolute** (Number: Boolean)

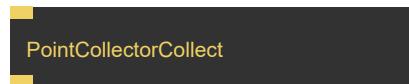
< Output

- **Trigger** (Trigger)
- **Points** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.PointCollector>

60.43 PointCollectorCollect



Full Name: Ops.Gl.PointCollectorCollect

Description: collect world space coordinates into an array

> Inputs

- **Render** (Trigger)

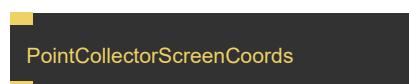
< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.PointCollectorCollect>

60.44 PointCollectorScreenCoords



Full Name: Ops.Gl.PointCollectorScreenCoords

Description: collect screen pixel coordinates into an array

> Inputs

- **Render** (Trigger)

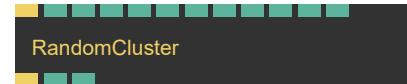
< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.PointCollectorScreenCoords>

60.45 RandomCluster



Full Name: Ops.Gl.RandomCluster

Description: Transforms objects randomly in space

> Inputs

- **Exe** (Trigger)
- **Num** (Number: Integer)
- **Random Seed** (Number)
- **Round** (Number: Boolean)
- **Size** (Number)
- **ScaleX** (Number)
- **ScaleY** (Number)
- **ScaleZ** (Number)
- **Rotate X** (Number)
- **Rotate Y** (Number)
- **Rotate Z** (Number)
- **Scroll X** (Number)

< Output

- **Trigger** (Trigger)
- **Index** (Number)
- **Rnd** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.RandomCluster>

60.46 RenderAnim_v2



Full Name: Ops.Gl.RenderAnim_v2

Description: record, render an animation and save as webm video file or png image sequence

> Inputs

- **Render** (Trigger)
- **File Type Index** (Number: Integer)
- **ZIP Multiple Files** (Number: Boolean)
- **Download Files** (Number: Boolean)
- **Filename** (String)
- **Quality** (Number)
- **Duration** (Number: Integer)
- **FPS** (Number: Integer)
- **Transparency** (Number: Boolean)
- **Use Canvas Size** (Number: Boolean)
- **Texture Width** (Number: Integer)
- **Texture Height** (Number: Integer)
- **Start** (Trigger)

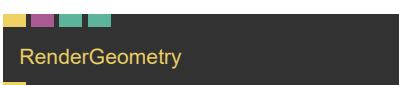
< Output

- **Next** (Trigger)
- **Progress** (Number)
- **Frame** (Number)
- **Status** (String)
- **Started** (booleanNumber)
- **Data URL** (String)
- **Finished** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.RenderAnim_v2

60.47 RenderGeometry_v2



Full Name: Ops.Gl.RenderGeometry_v2

Description: Render a geometry as mesh

> Inputs

- **Render** (Trigger)
- **Geometry** (Object:Geometry)
- **Add Vertex Numbers** (Number: Boolean)
- **Render Mesh** (Number: Boolean)

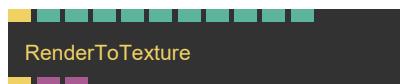
< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.RenderGeometry_v2

60.48 RenderToTexture_v3



Full Name: Ops.Gl.RenderToTexture_v3

Description: Render into an Image

> Inputs

- **Render** (Trigger)
- **Texture Width** (Number: Integer)
- **Texture Height** (Number: Integer)
- **Auto Aspect** (Number: Boolean)
- **PixelFormat Index** (Number: Integer)
- **Depth** (Number: Boolean)
- **Clear** (Number: Boolean)

< Output

- **Trigger** (Trigger)
- **Texture** (Object)
- **TextureDepth** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.RenderToTexture_v3

60.49 RenderToTextures_v3



Full Name: Ops.Gl.RenderToTextures_v3

Description: render to multiple textures at the same time

> Inputs

- **Render** (Trigger)
- **Texture Width** (Number: Integer)
- **Texture Height** (Number: Integer)
- **Auto Aspect** (Number: Boolean)
- **Pixel Format Index** (Number: Integer)
- **Wrap Index** (Number: Integer)
- **Clear** (Number: Boolean)
- **Texture 0 Index** (Number: Integer)
- **Texture 1 Index** (Number: Integer)
- **Texture 2 Index** (Number: Integer)
- **Texture 3 Index** (Number: Integer)
- **Texture 4 Index** (Number: Integer)
- **Texture 5 Index** (Number: Integer)
- **Texture 6 Index** (Number: Integer)
- **Texture 7 Index** (Number: Integer)

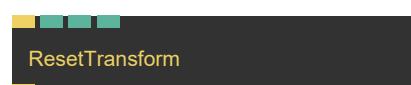
< Output

- **Next** (Trigger)
- **Result Texture 0** (Object)
- **Result Texture 1** (Object)
- **Result Texture 2** (Object)
- **Result Texture 3** (Object)
- **Result Texture 4** (Object)
- **Result Texture 5** (Object)
- **Result Texture 6** (Object)
- **Result Texture 7** (Object)
- **TextureDepth** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.RenderToTextures_v3

60.50 ResetTransform



Full Name: Ops.Gl.ResetTransform

Description: reset current transforms to initial value (identity)

> Inputs

- **Exe** (Trigger)
- **Reset Model Transform** (Number: Boolean)

- **Reset View Transform** (Number: Boolean)

- **Default View** (Number: Boolean)

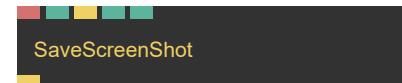
< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ResetTransform>

60.51 SaveScreenShot_v3



Full Name: Ops.Gl.SaveScreenShot_v3

Description: Download the current screen content as png file

> Inputs

- **Filename** (String)
- **Use Canvas Size** (Number: Boolean)
- **Screenshot** (Trigger)
- **Width** (Number: Integer)
- **Height** (Number: Integer)

< Output

- **Finished** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.SaveScreenShot_v3

60.52 ShowNormals_v2



Full Name: Ops.Gl.ShowNormals_v2

Description: visualize normals, tangents or bitangents

> Inputs

- **Render** (Trigger)
- **Draw** (Number: Boolean)
- **Geometry** (Object:Geometry)
- **Length** (Number)
- **Colorize** (Number: Boolean)
- **R** (Number)

- **G** (Number)
- **B** (Number)
- **A** (Number)

< Output

- **Trigger** (Trigger)
- **Line Geom** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ShowNormals_v2

60.53 SurfaceScatter_v2



Full Name: Ops.Gl.SurfaceScatter_v2

Description: Scatter an object on the surface of a mesh with different distribution methods

> Inputs

- **Render** (Trigger)
- **Draw** (Number: Boolean)
- **Num** (Number: Integer)
- **Geom Surface** (Object)
- **Distribution Index** (Number: Integer)
- **Selection Index** (Number: Integer)
- **Random Seed** (Number)
- **Size Min** (Number)
- **Size Max** (Number)
- **Limit** (Number: Boolean)
- **Limit Num** (Number: Integer)
- **Random Rotate** (Number: Boolean)

< Output

- **Next** (Trigger)
- **Positions** (Array)
- **Scale** (Array)
- **Quaternions** (Array)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.SurfaceScatter_v2

60.54 TextMeshMSDF_v2



Full Name: Ops.Gl.TextMeshMSDF_v2

Description: draw text using the FontMSDF operator

> Inputs

- **Render** (Trigger)
- **Text** (String)
- **Scale** (Number)
- **Letter Spacing** (Number)
- **Line Height** (Number)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)
- **SDF** (Number: Boolean)
- **Smoothing** (Number)
- **Border** (Number: Boolean)
- **Border Width** (Number)
- **Smoothness** (Number)
- **Border R** (Number)
- **Border G** (Number)
- **Border B** (Number)
- **Shadow** (Number: Boolean)
- **Texture Color** (Object:Texture)
- **Texture Mask** (Object:Texture)
- **Positions** (Array)
- **Scalings** (Array)
- **Rotations** (Array)
- **Colors** (Array)
- **Premultiply** (Number: Boolean)

< Output

- **Next** (Trigger)
- **Positions Original** (Array)
- **Scales** (Array)
- **Num Lines** (Number)
- **Width** (Number)
- **Height** (Number)
- **Start Y** (Number)
- **Num Chars** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.TextMeshMSDF_v2

60.55 Texture_v2



Full Name: Ops.Gl.Texture_v2

Description: Load an image as a texture

> Inputs

- **File** (String)
- **Wrap Index** (Number: Integer)
- **Flip** (Number: Boolean)
- **Active** (Number: Boolean)
- **Save Memory** (Number: Boolean)
- **Add Cachebuster** (Number: Boolean)
- **Reload** (Trigger)

< Output

- **Texture** (Object)
- **Width** (Number)
- **Height** (Number)
- **Aspect Ratio** (Number)
- **Loaded** (booleanNumber)
- **Loading** (booleanNumber)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Texture_v2

60.56 TextureArray



Full Name: Ops.Gl.TextureArray

Description: create an array of textures

> Inputs

- **Texture 0** (Object:Texture)
- **Texture 1** (Object:Texture)
- **Texture 2** (Object:Texture)

- **Texture 3** (Object:Texture)
- **Texture 4** (Object:Texture)
- **Texture 5** (Object:Texture)
- **Texture 6** (Object:Texture)
- **Texture 7** (Object:Texture)
- **Texture 8** (Object:Texture)
- **Texture 9** (Object:Texture)
- **Texture 10** (Object:Texture)
- **Texture 11** (Object:Texture)
- **Texture 12** (Object:Texture)
- **Texture 13** (Object:Texture)
- **Texture 14** (Object:Texture)

< Output

- **Array** (Array)
- **Count** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.TextureArray>

60.57 TextureArrayLoader_v2



Full Name: Ops.Gl.TextureArrayLoader_v2

Description: load multiple images into an array

> Inputs

- **Url** (String)
- **Left Pad** (Number: Boolean)
- **Index Start** (Number: Integer)
- **Index End** (Number: Integer)
- **Filter Index** (Number: Integer)
- **Wrap Index** (Number: Integer)
- **Flip** (Number: Boolean)
- **UnpackPreMultipliedAlpha** (Number: Boolean)

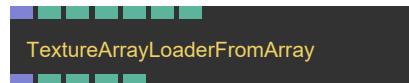
< Output

- **TextureArray** (Array)
- **Width** (Number)
- **Height** (Number)
- **Loading** (booleanNumber)
- **AspectRatio** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.TextureArrayLoader_v2

60.58 TextureArrayLoaderFromArray_v3



Full Name: Ops.Gl.TextureArrayLoaderFromArray_v3

Description: load multiple texture from filenames given as an array

> Inputs

- **Urls** (Array)
- **Filter Index** (Number: Integer)
- **Wrap Index** (Number: Integer)
- **Flip** (Number: Boolean)
- **UnpackPreMultipliedAlpha** (Number: Boolean)
- **Caching** (Number: Boolean)
- **Asset In Patch** (Number: Boolean)

< Output

- **TextureArray** (Array)
- **Width** (Number)
- **Height** (Number)
- **Loading** (booleanNumber)
- **Aspect Ratio** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.TextureArrayLoaderFromArray_v3

60.59 TextureColorPick



Full Name: Ops.Gl.TextureColorPick

Description: get the color of a pixel in a texture

> Inputs

- **Update** (Trigger)
- **X** (Number: Integer)
- **Y** (Number: Integer)
- **Texture** (Object:Texture)

- **Active** (Number: Boolean)

< Output

- **Trigger** (Trigger)
- **Red** (Number)
- **Green** (Number)
- **Blue** (Number)
- **Alpha** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.TextureColorPick>

60.60 TextureToArray_v4



Full Name: Ops.Gl.TextureToArray_v4

Description: extract colors from a texture

> Inputs

- **Update** (Trigger)
- **Texture** (Object)

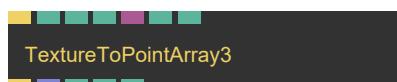
< Output

- **Trigger** (Trigger)
- **Colors** (Array)
- **Floating Point** (booleanNumber)
- **Num Pixel** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.TextureToArray_v4

60.61 TextureToPointArray3



Full Name: Ops.Gl.TextureToPointArray3

Description: generate an array3 of grid positions from a texture

> Inputs

- **Update** (Trigger)
- **Center** (Number: Boolean)
- **Threshold Remove** (Number)

- **Z Multiply** (Number)
- **Texture** (Object)
- **Width** (Number)
- **Height** (Number)

< Output

- **Trigger** (Trigger)
- **Points** (Array)
- **Total Points** (Number)
- **Min Z** (Number)
- **Max Z** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.TextureToPointArray3>

60.62 TextureToRandomPoints



Full Name: Ops.Gl.TextureToRandomPoints

Description: Create points by sampling texture

> Inputs

- **Update** (Trigger)
- **Num Points** (Number: Integer)
- **Seed** (Number)
- **Z Position Index** (Number: Integer)
- **Z Multiply** (Number)
- **Texture** (Object)

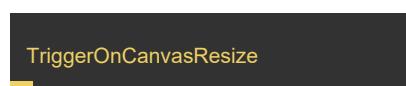
< Output

- **Trigger** (Trigger)
- **Points** (Array)
- **NumPoints** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.TextureToRandomPoints>

60.63 TriggerOnCanvasResize



Full Name: Ops.Gl.TriggerOnCanvasResize

Description: will trigger when canvas was resized

> Inputs

- Visit *Ops.Gl.TriggerOnCanvasResize documentation for input port details*

< Output

- **Resized** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.TriggerOnCanvasResize>

60.64 ValidTexture



Full Name: Ops.Gl.ValidTexture

Description: output current input texture or a default texture

> Inputs

- **Texture** (Object:Texture)

< Output

- **Result** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ValidTexture>

60.65 ViewPortSize



Full Name: Ops.Gl.ViewPortSize

Description: Outputs current viewport size

> Inputs

- **Exec** (Trigger)

< Output

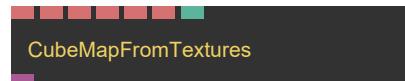
- **Next** (Trigger)
- **X** (Number)
- **Y** (Number)
- **Width** (Number)
- **Height** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ViewPortSize>

61 Ops.Gl.CubeMap

61.1 CubeMapFromTextures_v2



Full Name: Ops.Gl.CubeMap.CubeMapFromTextures_v2

Description: generate a cubemap from 6 textures

> Inputs

- **Posx** (String)
- **Negx** (String)
- **Posy** (String)
- **Negy** (String)
- **Posz** (String)
- **Negz** (String)
- **Flip Y** (Number: Boolean)

< Output

- **Cubemap** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.CubeMap.CubeMapFromTextures_v2

61.2 CubeMapMaterial_v2



Full Name: Ops.Gl.CubeMap.CubeMapMaterial_v2

Description: use a cubemap or equirectangular texture as a material

> Inputs

- **Render** (Trigger)
- **Cubemap** (Object)
- **Use Reflection** (Number: Boolean)
- **Blur** (Number)
- **Rotation** (Number)
- **Flip X** (Number: Boolean)
- **Flip Y** (Number: Boolean)

- **Flip Z** (Number: Boolean)
- **Colorize** (Number: Boolean)
- **R** (Number)
- **G** (Number)
- **B** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.CubeMap.CubeMapMaterial_v2

61.3 CubemapToEquirectangularTexture_v2



Full Name: Ops.Gl.CubeMap.CubemapToEquirectangularTexture_v2

Description: visualize cubemap as folded texture or equirectangular texture

> Inputs

- **In Trigger** (Trigger)
- **Cubemap** (Object)
- **Projection Index** (Number: Integer)
- **Format Index** (Number: Integer)
- **Filter Index** (Number: Integer)
- **Width** (Number: Integer)
- **Height** (Number: Integer)

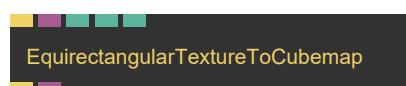
< Output

- **Out Trigger** (Trigger)
- **Result** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.CubeMap.CubemapToEquirectangularTexture_v2

61.4 EquirectangularTextureToCubemap



Full Name: Ops.Gl.CubeMap.EquirectangularTextureToCubemap

Description: convert an equirectangular map to a cubemap

> Inputs

- **Trigger In** (Trigger)
- **Equirectangular Map** (Object:Texture)
- **Cubemap Size Index** (Number: Integer)
- **Advanced** (Number: Boolean)
- **Filter Index** (Number: Integer)

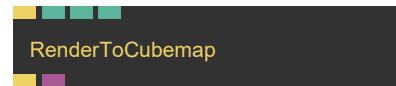
< Output

- **Trigger Out** (Trigger)
- **Cubemap Projection** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.CubeMap.EquirectangularTextureToCubemap>

61.5 RenderToCubemap_v3



Full Name: Ops.Gl.CubeMap.RenderToCubemap_v3

Description: render a scene into a cubemap

> Inputs

- **Render** (Trigger)
- **Size Index** (Number: Integer)
- **Pixel Format Index** (Number: Integer)
- **MSAA Index** (Number: Integer)

< Output

- **Next** (Trigger)
- **Cubemap** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.CubeMap.RenderToCubemap_v3

61.6 Skybox



Full Name: Ops.Gl.CubeMap.Skybox

Description: render an equirectangular map or a cubemap as scene background

> Inputs

- **Trigger In** (Trigger)
- **Render** (Number: Boolean)
- **Skybox** (Object:Texture)
- **Rotate** (Number)
- **RGBE Format** (Number: Boolean)
- **Exposure** (Number)
- **Gamma** (Number)

< Output

- **Trigger Out** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.CubeMap.Skybox>

62 Ops.Gl.Geometry

62.1 BoundingBoxVisible



Full Name: Ops.Gl.Geometry.BoundingBoxVisible

Description: Test if a boundingbox could be visible in the current viewport

> Inputs

- **Exec** (Trigger)
- **Bindings** (Object)
- **Active** (Number: Boolean)
- **Draw** (Number: Boolean)
- **Width** (Number)
- **Height** (Number)
- **Length** (Number)

< Output

- **Next** (Trigger)
- **Visible** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Geometry.BoundingBoxVisible>

62.2 GeometryBoundingBox



Full Name: Ops.Gl.Geometry.GeometryBoundingBox

Description: Calculate a bounding box from a geometry

> Inputs

- **Geometry** (Object)

< Output

- **Bindings** (Object)
- **Min X** (Number)
- **Min Y** (Number)
- **Min Z** (Number)

- **Max X** (Number)
- **Max Y** (Number)
- **Max Z** (Number)
- **MaxMin Points** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Geometry.GeometryBoundingBox>

63 Ops.Gl.GLTF

63.1 GltfAnimationArray



Full Name: Ops.Gl.GLTF.GltfAnimationArray

Description: Convert an animation into an array of coordinates

> Inputs

- **Render** (Trigger)
- **Node Name** (String)
- **Steps** (Number: Integer)
- **Full Animation** (Number: Boolean)
- **Start** (Number)
- **Length** (Number)

< Output

- **Next** (Trigger)
- **Found** (booleanNumber)
- **Positions** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.GLTF.GltfAnimationArray>

63.2 GltfCameraViewMatrix



Full Name: Ops.Gl.GLTF.GltfCameraViewMatrix

Description: get view matrix from a gltf camera

> Inputs

- **Update** (Trigger)
- **Node Name** (String)

< Output

- **Matrix** (Array)
- **Found** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.GLTF.GltfCameraViewMatrix>

63.3 GltfDracoCompression

GltfDracoCompression

Full Name: Ops.Gl.GLTF.GltfDracoCompression

Description: gltf draco compression library

> Inputs

- Visit *Ops.Gl.GLTF.GltfDracoCompression documentation* for input port details

< Output

- Visit *Ops.Gl.GLTF.GltfDracoCompression documentation* for output port details

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.GLTF.GltfDracoCompression>

63.4 GltfGeometry

GltfGeometry

Full Name: Ops.Gl.GLTF.GltfGeometry

Description: expose geometry from gltf meshes, also possible to expose sub-material geometries

> Inputs

- **Update** (Trigger)
- **Name** (String)
- **Submesh** (Number: Integer)

< Output

- **Next** (Trigger)
- **Geometry** (Object)
- **Found** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.GLTF.GltfGeometry>

63.5 GltfHierarchy

GltfHierarchy

Full Name: Ops.Gl.GLTF.GltfHierarchy

Description: export array of positions from a hierarchy of a branch structure in a gltf, e.g. a skeleton bones

> Inputs

- **Trigger** (Trigger)
- **Node Name** (String)

< Output

- **Next** (Trigger)
- **Bones Lines** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.GLTF.GltfHierarchy>

63.6 GltfInfo

GltfInfo

Full Name: Ops.Gl.GLTF.GltfInfo

Description: output some infos about the current parent GLTF scene

> Inputs

- **Exec** (Trigger)

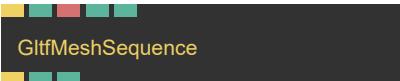
< Output

- **Num Nodes** (Number)
- **Num Cams** (Number)
- **FileUrl** (String)
- **FileName** (String)
- **Camera Names** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.GLTF.GltfInfo>

63.7 GltfMeshSequence_v2



Full Name: Ops.Gl.GLTF.GltfMeshSequence_v2

Description: switch between meshes e.g. like a stop motion animation

> Inputs

- **Render** (Trigger)
- **Index** (Number: Integer)
- **Node Name** (String)
- **Transformation** (Number: Boolean)
- **Ignore Material** (Number: Boolean)

< Output

- **Next** (Trigger)
- **Found** (Number)
- **Current Index** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.GLTF.GltfMeshSequence_v2

63.8 GltfMorphTargets



Full Name: Ops.Gl.GLTF.GltfMorphTargets

Description: render weighted morph targets/shape keys from a gltf file

> Inputs

- **Render** (Trigger)
- **Node Name** (String)
- **Scene Time** (Number: Boolean)
- **Time** (Number)
- **Submesh** (Number: Integer)
- **Target Weights** (Array)

< Output

- **Found Node** (booleanNumber)
- **Found Skin** (booleanNumber)
- **Target Names** (Array)
- **MorphTargets Tex** (Object)
- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.GLTF.GltfMorphTargets>

63.9 GltfNode_v2



Full Name: Ops.Gl.GLTF.GltfNode_v2

Description: Control a single node from the GLTFscene op

> Inputs

- **Render** (Trigger)
- **Node Name** (String)
- **Transformation** (Number: Boolean)
- **Draw Mesh** (Number: Boolean)
- **Draw Childs** (Number: Boolean)
- **Ignore Material** (Number: Boolean)
- **Use Scene Time** (Number: Boolean)
- **Time** (Number)

< Output

- **Next** (Trigger)
- **Geometry** (Object)
- **Found** (booleanNumber)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.GLTF.GltfNode_v2

63.10 GltfNodeSineAnim



Full Name: Ops.Gl.GLTF.GltfNodeSineAnim

Description: sine animate gltf nodes by a filter

> Inputs

- **Update** (Trigger)
- **Filter** (String)
- **Time** (Number)
- **Offset** (Number)
- **Amplitude** (Number)

- **Axis X** (Number)
- **Axis Y** (Number)
- **Axis Z** (Number)

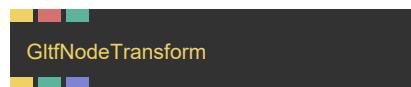
< Output

- **Next** (Trigger)
- **Found** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.GLTF.GltfNodeSineAnim>

63.11 GltfNodeTransform_v2



Full Name: Ops.Gl.GLTF.GltfNodeTransform_v2

Description: Get the transform from the GLTFScene op

> Inputs

- **Render** (Trigger)
- **Node Name** (String)
- **Set Matrix** (Number: Boolean)

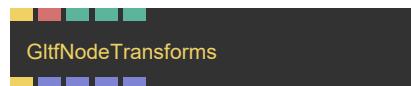
< Output

- **Next** (Trigger)
- **Found** (booleanNumber)
- **Matrix** (Array)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.GLTF.GltfNodeTransform_v2

63.12 GltfNodeTransforms_v3



Full Name: Ops.Gl.GLTF.GltfNodeTransforms_v3

Description: output all transformations of nodes starting with [search]

> Inputs

- **Render** (Trigger)
- **Search** (String)
- **Order Index** (Number: Integer)
- **Space Index** (Number: Integer)

- **Time** (Number)

< Output

- **Next** (Trigger)
- **Positions** (Array)
- **Scale** (Array)
- **Rotation** (Array)
- **Names** (Array)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.GLTF.GltfNodeTransforms_v3

63.13 GltfScene_v4



Full Name: Ops.Gl.GLTF.GltfScene_v4

Description: Load GLTF/GLB 3d files

> Inputs

- **Render** (Trigger)
- **Glb File** (String)
- **Draw** (Number: Boolean)
- **Camera Index** (Number: Integer)
- **Animation** (String)
- **Show Structure** (Trigger)
- **Rescale** (Number: Boolean)
- **Rescale Size** (Number)
- **Time** (Number)
- **Sync To Timeline** (Number: Boolean)
- **Loop** (Number: Boolean)
- **Materials** (Object)
- **Hide Nodes** (Array)
- **Use Material Properties** (Number: Boolean)
- **Active** (Number: Boolean)

< Output

- **Render Before** (Trigger)
- **Next** (Trigger)
- **Generator** (String)
- **GLTF Version** (Number)
- **GLTF Extensions Used** (Array)
- **Anim Length** (Number)
- **Anim Time** (Number)

- **Json** (Object)
- **Anims** (Array)
- **BoundingPoints** (Array)
- **Bounds** (Object)
- **Finished** (Trigger)
- **Loading** (booleanNumber)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.GLTF.GltfScene_v4

63.14 GltfSetMaterial



Full Name: Ops.Gl.GLTF.GltfSetMaterial

Description: Assigns a material to a node inside of the gltfScene op

➢ **Inputs**

- **Shader** (Object:Shader)
- **Material Name** (String)

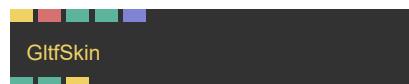
◀ **Output**

- **Material** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.GLTF.GltfSetMaterial>

63.15 GltfSkin



Full Name: Ops.Gl.GLTF.GltfSkin

Description: render a skinned mesh (bone/rigging/rigged animation)

➢ **Inputs**

- **Render** (Trigger)
- **Node Name** (String)
- **Scene Time** (Number: Boolean)
- **Time** (Number)
- **Blend Anims** (Array)

◀ **Output**

- **Found Node** (booleanNumber)

- **Found Skin** (booleanNumber)
- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.GLTF.GltfSkin>

63.16 GltfTexture



Full Name: Ops.Gl.GLTF.GltfTexture

Description: Load textures from inside a .glb file

➢ **Inputs**

- **Render** (Trigger)
- **Name** (String)
- **Filter Index** (Number: Integer)
- **Wrap Index** (Number: Integer)
- **Anisotropic Index** (Number: Integer)
- **Flip** (Number: Boolean)
- **Pre Multiplied Alpha** (Number: Boolean)

◀ **Output**

- **Texture** (Object)
- **Width** (Number)
- **Height** (Number)
- **Type** (String)
- **Found** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.GLTF.GltfTexture>

63.17 GltfTransformNode



Full Name: Ops.Gl.GLTF.GltfTransformNode

Description: set transformation of a gltf node

➢ **Inputs**

- **Render** (Trigger)
- **Node Name** (String)

- **Translate X** (Number)
- **Translate Y** (Number)
- **Translate Z** (Number)
- **Rotation X** (Number)
- **Rotation Y** (Number)
- **Rotation Z** (Number)

< Output

- **Next** (Trigger)
- **Found** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.GLTF.GltfTransformNode>

63.18 GltfVertexAnim



Full Name: Ops.Gl.GLTF.GltfVertexAnim

Description: play gltf vertex anim directly with its own timing

> Inputs

- **Render** (Trigger)
- **Node Name** (String)
- **Scene Time** (Number: Boolean)
- **Time** (Number)

< Output

- **Found Node** (Number)
- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.GLTF.GltfVertexAnim>

64 Ops.Gl.ImageCompose

64.1 Alpha



Full Name: Ops.Gl.ImageCompose.Alpha

Description: Modify current alpha-opacity

> Inputs

- **Render** (Trigger)
- **Amount** (Number)
- **Clamp** (Number: Boolean)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ImageCompose.Alpha>

64.2 AlphaMask_v2



Full Name: Ops.Gl.ImageCompose.AlphaMask_v2

Description: Set alphachannel of current imagecompose via a texture mask

> Inputs

- **Render** (Trigger)
- **Amount** (Number)
- **Invert** (Number: Boolean)
- **Image** (Object:Texture)
- **Method Index** (Number: Integer)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.AlphaMask_v2

64.3 BarrelDistortion_v3



Full Name: Ops.Gl.ImageCompose.BarrelDistortion_v3

Description: Simulate fisheye effect

> Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Intensity** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.BarrelDistortion_v3

64.4 Blur



Full Name: Ops.Gl.ImageCompose.Blur

Description: Blur the pixels of an image

> Inputs

- **Render** (Trigger)
- **Amount** (Number)
- **Direction Index** (Number: Integer)
- **Direction** (String)
- **Fast** (Number: Boolean)
- **Mask** (Object:Texture)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ImageCompose.Blur>

64.5 Border_v2



Full Name: Ops.Gl.ImageCompose.Border_v2

Description: Draws a Border (rectangular frame) around the current Image-Compose

> Inputs

- **Render** (Trigger)
- **Width** (Number)
- **Blend Mode Index** (Number: Integer)
- **Alpha Mask Index** (Number: Integer)
- **Amount** (Number)
- **Smooth** (Number: Boolean)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **Side A** (Number)
- **Side B** (Number)
- **Side C** (Number)
- **Side D** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.Border_v2

64.6 BrightnessContrast



Full Name: Ops.Gl.ImageCompose.BrightnessContrast

Description: adjust image brightness and contrast

> Inputs

- **Render** (Trigger)
- **Contrast** (Number)
- **Brightness** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ImageCompose.BrightnessContrast>

64.7 BulgePinch



Full Name: Ops.Gl.ImageCompose.BulgePinch

Description: bulge and pinch an image (deform,stretch,distort)

> Inputs

- **Render** (Trigger)
- **Radius** (Number)
- **Strength** (Number)
- **Center X** (Number)
- **Center Y** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ImageCompose.BulgePinch>

64.8 CheckerBoard_v2



Full Name: Ops.Gl.ImageCompose.CheckerBoard_v2

Description: Draw a checkerboard pattern

> Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Alpha Mask Index** (Number: Integer)
- **Amount** (Number)
- **Square** (Number: Boolean)
- **Num X** (Number)
- **Num Y** (Number)
- **Rotate** (Number)
- **Centered** (Number: Boolean)

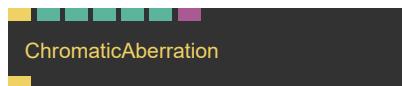
< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.CheckerBoard_v2

64.9 ChromaticAberration_v2



Full Name: Ops.Gl.ImageCompose.CromaticAberration_v2

Description: simulating lens effect by shifting rgb channels

> Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Pixel** (Number)
- **Lens Distort** (Number)
- **Smooth** (Number: Boolean)
- **Mask** (Object:Texture)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.CromaticAberration_v2

64.10 CircleTexture_v4



Full Name: Ops.Gl.ImageCompose.CircleTexture_v4

Description: Draw 2d circle into texture

> Inputs

- **Render** (Trigger)
- **Amount** (Number)
- **Blend Mode Index** (Number: Integer)
- **Alpha Mask Index** (Number: Integer)
- **Size** (Number)
- **Inner** (Number)
- **Stretch X** (Number)

- **Stretch Y** (Number)
- **Pos X** (Number)
- **Pos Y** (Number)
- **Falloff Index** (Number: Integer)
- **Fade Out** (Number)
- **Warn Overflow** (Number: Boolean)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.CircleTexture_v4

64.11 ClampTexture_v2



Full Name: Ops.Gl.ImageCompose.ClampTexture_v2

Description: Clamps a texture to min and max values - Also has remap modes

> Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Mode Index** (Number: Integer)
- **R** (Number: Boolean)
- **R Min** (Number)
- **R Max** (Number)
- **G** (Number: Boolean)
- **G Min** (Number)
- **G Max** (Number)
- **B** (Number: Boolean)
- **B Min** (Number)
- **B Max** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.ClampTexture_v2

64.12 Clarity



Full Name: Ops.Gl.ImageCompose.Clarity

Description: Increase contrast in midtones

> Inputs

- **Render** (Trigger)
- **Amount** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ImageCompose.Clarity>

64.13 Color_v2



Full Name: Ops.Gl.ImageCompose.Color_v2

Description: fill image using a color (overlay)

> Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Alpha Mask Index** (Number: Integer)
- **Mask** (Object:Texture)
- **Mask Invert** (Number: Boolean)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.Color_v2

64.14 ColorBalance_v2



Full Name: Ops.Gl.ImageCompose.ColorBalance_v2

Description: change intensity of r,g,b channels

> Inputs

- **Render** (Trigger)
- **Tone Index** (Number: Integer)
- **R** (Number)
- **G** (Number)
- **B** (Number)

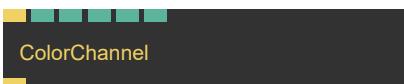
< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.ColorBalance_v2

64.15 ColorChannel_v2



Full Name: Ops.Gl.ImageCompose.ColorChannel_v2

Description: enable disable RGB color channels

> Inputs

- **Render** (Trigger)
- **ChannelR** (Number: Boolean)
- **ChannelG** (Number: Boolean)
- **ChannelB** (Number: Boolean)
- **ChannelA** (Number: Boolean)
- **Mono** (Number: Boolean)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.ColorChannel_v2

64.16 ColorMap_v2



Full Name: Ops.Gl.ImageCompose.ColorMap_v2

Description: colorize a black and white image using a gradient texture

> Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Gradient** (Object:Texture)
- **Method Index** (Number: Integer)
- **Min** (Number)
- **Max** (Number)
- **Position** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.ColorMap_v2

64.17 Denoise



Full Name: Ops.Gl.ImageCompose.Denoise

Description: Denoise texture effect - used to smooth out noisy images

> Inputs

- **Render** (Trigger)
- **Exponent** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ImageCompose.Denoise>

64.18 DepthTexture_v2



Full Name: Ops.Gl.ImageCompose.DepthTexture_v2

Description: draw the content of a depth texture

> Inputs

- **Render** (Trigger)
- **Image** (Object:Texture)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Farplane** (Number)
- **Nearplane** (Number)
- **Invert** (Number: Boolean)

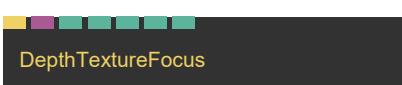
< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.DepthTexture_v2

64.19 DepthTextureFocus_v2



Full Name: Ops.Gl.ImageCompose.DepthTextureFocus_v2

Description: draws a gradient from white to black back to white over distance of the scene

> Inputs

- **Render** (Trigger)
- **Depth Texture** (Object)
- **Focus** (Number)
- **focus distance** (in world space)
- **Width** (Number)
- **width of the focus** (in world space)
- **Invert** (Number: Boolean)
- **Nearplane** (Number)
- **Farplane** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.DepthTextureFocus_v2

64.20 Desaturate



Full Name: Ops.Gl.ImageCompose.Desaturate

Description: Remove colors from image / greyscale

> Inputs

- **Render** (Trigger)
- **Amount** (Number)
- **Mask** (Object)
- **Invert Mask** (Number: Boolean)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ImageCompose.Desaturate>

64.21 Dither_v2



Full Name: Ops.Gl.ImageCompose.Dither_v2

Description: convert color to black and white patterns

> Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Threshold** (Number)
- **Strength** (Number)
- **Mask** (Object:Texture)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.Dither_v2

64.22 DrawImage_v3



Full Name: Ops.Gl.ImageCompose.DrawImage_v3

Description: Draws an image into a composition

> Inputs

- **Render** (Trigger)
- **BlendMode Index** (Number: Integer)
- **Amount** (Number)
- **Image** (Object:Texture)
- **Premultiplied** (Number: Boolean)
- **Alpha Mask** (Number: Boolean)
- **RemoveAlphaSrc** (Number: Boolean)
- **Mask** (Object:Texture)
- **Mask Src Index** (Number: Integer)
- **Invert Alpha Channel** (Number: Boolean)
- **Aspect Ratio** (Number: Boolean)
- **Stretch Axis Index** (Number: Integer)
- **Position** (Number)
- **Crop** (Number: Boolean)
- **Flip X** (Number: Boolean)
- **Flip Y** (Number: Boolean)
- **Transform** (Number: Boolean)
- **Scale X** (Number)
- **Scale Y** (Number)
- **Position X** (Number)
- **Position Y** (Number)
- **Rotation** (Number)
- **Clip Repeat** (Number: Boolean)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.DrawImage_v3

64.23 EdgeDetection_v4



Full Name: Ops.Gl.ImageCompose.EdgeDetection_v4

Description: Draw only the edges of an image

> Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Strength** (Number)
- **Width** (Number)
- **Mul Color** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.EdgeDetection_v4

64.24 Emboss



Full Name: Ops.Gl.ImageCompose.Emboss

Description: Emboss / bevel effect

> Inputs

- **Render** (Trigger)
- **Strength** (Number)
- **Clear** (Number: Boolean)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ImageCompose.Emboss>

64.25 FastBlur_v2



Full Name: Ops.Gl.ImageCompose.FastBlur_v2

Description: Blurs a texture - simple and fast

> Inputs

- **Render** (Trigger)
- **Passes** (Number: Integer)
- **Clamp** (Number: Boolean)
- **Direction Index** (Number: Integer)
- **Mask** (Object:Texture)
- **Mask Invert** (Number: Boolean)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.FastBlur_v2

64.26 Flip



Full Name: Ops.Gl.ImageCompose.Flip

Description: flip the image on x or y axis

> Inputs

- **Render** (Trigger)
- **X** (Number: Boolean)
- **Y** (Number: Boolean)

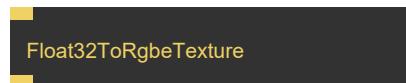
< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ImageCompose.Flip>

64.27 Float32ToRgbeTexture



Full Name: Ops.Gl.ImageCompose.Float32ToRgbeTexture

Description: Convert a Float32 bit/HDR texture to RGBE format (only positive numbers)

> Inputs

- **Render** (Trigger)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ImageCompose.Float32ToRgbeTexture>

64.28 Fog_v4



Full Name: Ops.Gl.ImageCompose.Fog_v4

Description: add post processing fog (nebula) to a scene

> Inputs

- **Render** (Trigger)
- **BlendMode Index** (Number: Integer)
- **Amount** (Number)
- **Depth Texture** (Object:Texture)
- **Gradient Texture** (Object:Texture)
- **Background Texture** (Object:Texture)
- **Fog Start** (Number)
- **Fog End** (Number)
- **Fog Density** (Number)
- **Ignore Infinity** (Number: Boolean)
- **Nearplane** (Number)
- **Farplane** (Number)
- **Fog R** (Number)
- **Fog G** (Number)
- **Fog B** (Number)
- **Fog A** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.Fog_v4

64.29 FXAA



Full Name: Ops.Gl.ImageCompose.FXAA
Description: post processing antialiasing

> Inputs

- **Render** (Trigger)
- **Span Index** (Number: Integer)
- **ReduceMin** (Number)
- **ReduceMul** (Number)
- **Use Viewport Size** (Number: Boolean)
- **Width** (Number: Integer)
- **Height** (Number: Integer)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ImageCompose.FXAA>

64.30 GammaCorrection_v2



Full Name: Ops.Gl.ImageCompose.GammaCorrection_v2

Description: Allows for Gamma correction of a texture

> Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Multiply Texture** (Number)
- **Gamma Correction** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.GammaCorrection_v2

64.31 Gradient_v2



Full Name: Ops.Gl.ImageCompose.Gradient_v2

Description: Draws a simple gradient between three colors

> Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Alpha Mask Index** (Number: Integer)
- **Amount** (Number)
- **Width** (Number)
- **Type Index** (Number: Integer)
- **Pos** (Number)
- **Smoothstep** (Number: Boolean)
- **SRGB** (Number: Boolean)
- **Color Space Index** (Number: Integer)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **R2** (Number)
- **G2** (Number)
- **B2** (Number)
- **R3** (Number)
- **G3** (Number)
- **B3** (Number)
- **Randomize** (Trigger)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.Gradient_v2

64.32 GridTexture_v2



Full Name: Ops.Gl.ImageCompose.GridTexture_v2

Description: Creates a grid texture

> Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Alpha Mask Index** (Number: Integer)
- **Amount** (Number)

- **Line Thickness X** (Number)
- **Line Thickness Y** (Number)
- **Cells X** (Number)
- **Cells Y** (Number)
- **Rotate** (Number)
- **Offset X** (Number)
- **Offset Y** (Number)
- **Invert Color** (Number: Boolean)
- **Line Red** (Number)
- **Line Green** (Number)
- **Line Blue** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.GridTexture_v2

64.33 GrowPixels_v2



Full Name: Ops.Gl.ImageCompose.GrowPixels_v2

Description: Make one pixel lines thicker via postprocessing

> Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Strength** (Number)
- **Iterations** (Number: Integer)
- **R** (Number)
- **G** (Number)
- **B** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.GrowPixels_v2

64.34 Hue



Full Name: Ops.Gl.ImageCompose.Hue

Description: Adjust Hue of current ImageCompose

> Inputs

- **Render** (Trigger)
- **Hue** (Number)
- **Mask** (Object:Texture)
- **Offset** (Object:Texture)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ImageCompose.Hue>

64.33 GrowPixels_v2



Full Name: Ops.Gl.ImageCompose.ImageCompose_v4

Description: Compose Images and effects as layers to generate new Images

> Inputs

- **Render** (Trigger)
- **Base Texture** (Object:Texture)
- **UV Texture** (Object:Texture)
- **Width** (Number: Integer)
- **Height** (Number: Integer)
- **Wrap Index** (Number: Integer)
- **PixelFormat Index** (Number: Integer)
- **Clear** (Number: Boolean)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)

< Output

- **Next** (Trigger)
- **Texture_out** (Object)

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.Invert_v2

64.40 Kaleidoscope_v2



Full Name: Ops.Gl.ImageCompose.Kaleidoscope_v2

Description: Kaleidoscope effect

> Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Sides** (Number)
- **Angle** (Number)
- **Slide X** (Number)
- **Slide Y** (Number)
- **Center X** (Number)
- **Center Y** (Number)
- **Aspect Ratio** (Number: Boolean)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.Kaleidoscope_v2

64.41 LensDirt_v2



Full Name: Ops.Gl.ImageCompose.LensDirt_v2

Description: Creates a lens dirt like texture

> Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Alpha Mask Index** (Number: Integer)
- **Offset X** (Number)
- **Offset Y** (Number)

- **Zoom** (Number)
- **Iterations** (Number: Integer)
- **Seed** (Number: Integer)
- **Spot Edge** (Number)
- **Gamma** (Number)

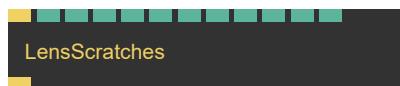
< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.LensDirt_v2

64.42 LensScratches_v2



Full Name: Ops.Gl.ImageCompose.LensScratches_v2

Description: Creates a procedural texture simulating scratches on a lens

> Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Alpha Mask Index** (Number: Integer)
- **Offset X** (Number)
- **Offset Y** (Number)
- **Wavyness** (Number)
- **Scale** (Number)
- **Layers** (Number: Integer)
- **AA Iterations** (Number)
- **Frequency** (Number)
- **Frequency Step Size** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.LensScratches_v2

64.43 Levels_v2



Full Name: Ops.Gl.ImageCompose.Levels_v2

Description: adjust levels to correct the tonal range of an image

> Inputs

- **Render** (Trigger)
- **In Min** (Number)
- **Midpoint** (Number)
- **In Max** (Number)
- **Out Min** (Number)
- **Out Max** (Number)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.Levels_v2

64.44 LumaKey_v3



Full Name: Ops.Gl.ImageCompose.LumaKey_v3

Description: Remove darkest or brightest parts of the image

> Inputs

- **Render** (Trigger)
- **Invert** (Number: Boolean)
- **Black White** (Number: Boolean)
- **Remove Alpha** (Number: Boolean)
- **Remap** (Number: Boolean)
- **Threshold Low** (Number)
- **Threshold High** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.LumaKey_v3

64.45 LUTMap



Full Name: Ops.Gl.ImageCompose.LUTMap

Description: apply color filter/effects by using a lookup texture

> Inputs

- **Render** (Trigger)
- **LUT Image** (Object:Texture)
- **Amount** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ImageCompose.LUTMap>

64.46 Mirror



Full Name: Ops.Gl.ImageCompose.Mirror

Description: mirroring image effect

> Inputs

- **Render** (Trigger)
- **Axis Index** (Number: Integer)
- **Width** (Number)
- **Offset** (Number)
- **Flip** (Number: Boolean)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ImageCompose.Mirror>

64.47 Mix



Full Name: Ops.Gl.ImageCompose.Mix

Description: simple mix/fade of two input images

> Inputs

- **Render** (Trigger)

- **Texture 1** (Object:Texture)
- **Fade** (Number)
- **Texture 2** (Object:Texture)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ImageCompose.Mix>

64.48 MultiDrawImage



Full Name: Ops.Gl.ImageCompose.MultiDrawImage

Description: draw multiple images at once

> Inputs

- **Render** (Trigger)
- **Mask Invert** (Number: Boolean)
- **Texture 1** (Object:Texture)
- **Blendmode 1 Index** (Number: Integer)
- **Mask 1** (Object:Texture)
- **Mask Source 1 Index** (Number: Integer)
- **Opacity 1 Index** (Number: Integer)
- **Amount 1** (Number)
- **Texture 2** (Object:Texture)
- **Blendmode 2 Index** (Number: Integer)
- **Mask 2** (Object:Texture)
- **Mask Source 2 Index** (Number: Integer)
- **Opacity 2 Index** (Number: Integer)
- **Amount 2** (Number)
- **Texture 3** (Object:Texture)
- **Blendmode 3 Index** (Number: Integer)
- **Mask 3** (Object:Texture)
- **Mask Source 3 Index** (Number: Integer)
- **Opacity 3 Index** (Number: Integer)
- **Amount 3** (Number)
- **Texture 4** (Object:Texture)
- **Blendmode 4 Index** (Number: Integer)
- **Mask 4** (Object:Texture)
- **Mask Source 4 Index** (Number: Integer)
- **Opacity 4 Index** (Number: Integer)
- **Amount 4** (Number)

- **Texture 5** (Object:Texture)
- **Blendmode 5 Index** (Number: Integer)
- **Mask 5** (Object:Texture)
- **Mask Source 5 Index** (Number: Integer)
- **Opacity 5 Index** (Number: Integer)
- **Amount 5** (Number)
- **Texture 6** (Object:Texture)
- **Blendmode 6 Index** (Number: Integer)
- **Mask 6** (Object:Texture)
- **Mask Source 6 Index** (Number: Integer)
- **Opacity 6 Index** (Number: Integer)
- **Amount 6** (Number)
- **Texture 7** (Object:Texture)
- **Blendmode 7 Index** (Number: Integer)
- **Mask 7** (Object:Texture)
- **Mask Source 7 Index** (Number: Integer)
- **Opacity 7 Index** (Number: Integer)
- **Amount 7** (Number)
- **Texture 8** (Object:Texture)
- **Blendmode 8 Index** (Number: Integer)
- **Mask 8** (Object:Texture)
- **Mask Source 8 Index** (Number: Integer)
- **Opacity 8 Index** (Number: Integer)
- **Amount 8** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ImageCompose.MultiDrawImage>

64.49 OnePassBlur



Full Name: Ops.Gl.ImageCompose.OnePassBlur

Description: Visit documentation for details

> Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)

- **Radius** (Number)
- **Mask** (Object:Texture)
- **Mask Invert** (Number: Boolean)

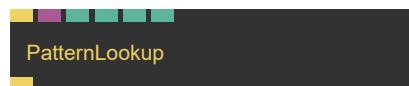
< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ImageCompose.OnePassBlur>

64.50 PatternLookup



Full Name: Ops.Gl.ImageCompose.PatternLookup

Description: map a pattern to value levels of your texture

> Inputs

- **Render** (Trigger)
- **Multiplier** (Object)
- **Blend Mode** (Number: String)
- **Amount** (Number)
- **Width** (Number)
- **Height** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ImageCompose.PatternLookup>

64.51 Pixelate_v2



Full Name: Ops.Gl.ImageCompose.Pixelate_v2

Description: Pixelate an image

> Inputs

- **Render** (Trigger)
- **Multiplier** (Object:Texture)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)

- **Width** (Number)
- **Height** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.Pixelate_v2

64.52 PixelColor



Full Name: Ops.Gl.ImageCompose.PixelColor

Description: fill image with one color picked at a position

> Inputs

- **Render** (Trigger)
- **Source Texture** (Object:Texture)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Pos X** (Number)
- **Pos Y** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ImageCompose.PixelColor>

64.53 PixelDifference



Full Name: Ops.Gl.ImageCompose.PixelDifference

Description: visualize the difference of neighbouring pixels (slope)

> Inputs

- **Render** (Trigger)
- **Strength** (Number)
- **Step** (Number)
- **Red Index** (Number: Integer)
- **Red Flip** (Number: Boolean)

- **Green Index** (Number: Integer)
- **Green Flip** (Number: Boolean)
- **Blue Index** (Number: Integer)
- **Blue Flip** (Number: Boolean)

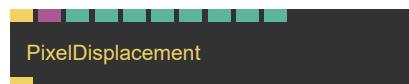
< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ImageCompose.PixelDifference>

64.54 PixelDisplacement_v4



Full Name: Ops.Gl.ImageCompose.PixelDisplacement_v4

Description: Changes color lookup for every pixel using a displacement map

> Inputs

- **Render** (Trigger)
- **DisplaceTex** (Object:Texture)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Amount X** (Number)
- **Amount Y** (Number)
- **Input Index** (Number: Integer)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.PixelDisplacement_v4

64.55 Plasma_v2



Full Name: Ops.Gl.ImageCompose.Plasma_v2

Description: Renders a plasma effect

> Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)

- **Alpha Mask Index** (Number: Integer)
- **Amount** (Number)
- **Width** (Number)
- **Height** (Number)
- **Aspect** (Number: Boolean)
- **Mul** (Number)
- **X** (Number)
- **Y** (Number)
- **Time** (Number)
- **Greyscale** (Number: Boolean)
- **Offset** (Object:Texture)
- **Offset Multiply** (Number)
- **Offset X Index** (Number: Integer)
- **Offset Y Index** (Number: Integer)
- **Offset Time Index** (Number: Integer)
- **Mask** (Object:Texture)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.Plasma_v2

64.56 PolarCoords



Full Name: Ops.Gl.ImageCompose.PolarCoords

Description: display texture using polar/radial coordinate system

> Inputs

- **Render** (Trigger)
- **Radius Inner** (Number)
- **Radius Outer** (Number)
- **Crop** (Number: Boolean)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ImageCompose.PolarCoords>

64.57 Posterize_v2



Full Name: Ops.Gl.ImageCompose.Posterize_v2

Description: reduce number of colors

> Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Levels** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.Posterize_v2

64.58 PseudoLensFlares



Full Name: Ops.Gl.ImageCompose.PseudoLensFlares

Description: simulate lens flare effect

> Inputs

- **Render** (Trigger)
- **Ghosts** (Number)
- **Num Ghosts** (Number: Integer)
- **Dispersal** (Number)
- **Halo** (Number)
- **Halo Width** (Number)
- **Color Lookup** (Object)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ImageCompose.PseudoLensFlares>

64.59 RandomNumberTexture



Full Name: Ops.Gl.ImageCompose.RandomNumberTexture

Description: Set random numbers into an imagecompose

> Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Seed** (Number)
- **Min R** (Number)
- **Max R** (Number)
- **Min G** (Number)
- **Max G** (Number)
- **Min B** (Number)
- **Max B** (Number)
- **Min A** (Number)
- **Max A** (Number)
- **Multiply** (Object:Texture)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ImageCompose.RandomNumberTexture>

64.60 RectangleTexture_v5



Full Name: Ops.Gl.ImageCompose.RectangleTexture_v5

Description: draws a 2d rectangle into a texture.

> Inputs

- **Render** (Trigger)
- **Amount** (Number)
- **Blend Mode Index** (Number: Integer)
- **Center** (Number: Boolean)
- **X** (Number)
- **Y** (Number)
- **Inner** (Number)

- **Width** (Number)
- **Height** (Number)
- **Rotate** (Number)
- **Roundness** (Number)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)
- **Map Texture** (Object:Texture)
- **Start X** (Number)
- **Start Y** (Number)
- **Map Width** (Number)
- **Map Height** (Number)
- **Mask** (Object:Texture)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.RectangleTexture_v5

64.61 RemoveAlpha



Full Name: Ops.Gl.ImageCompose.RemoveAlpha

Description: Remove alpha information from image

> Inputs

- **Render** (Trigger)

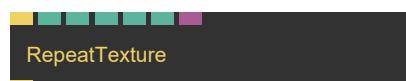
< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ImageCompose.RemoveAlpha>

64.62 RepeatTexture_v2



Full Name: Ops.Gl.ImageCompose.RepeatTexture_v2

Description: Visit documentation for details

> Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **X** (Number)
- **Y** (Number)
- **Clear** (Number: Boolean)
- **Multiply** (Object:Texture)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.RepeatTexture_v2

64.63 RgbMultiply



Full Name: Ops.Gl.ImageCompose.RgbMultiply

Description: multiply image colors by color channel

> Inputs

- **Render** (Trigger)
- **R** (Number)
- **G** (Number)
- **B** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ImageCompose.RgbMultiply>

64.64 RGBOffset_v2



Full Name: Ops.Gl.ImageCompose.RGBOffset_v2

Description: Offsets the xy components of an RGB texture

> Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Red Offset X** (Number)
- **Red Offset Y** (Number)
- **Red Amount** (Number)
- **amount of red** (fade, hide, show)
- **Green Offset X** (Number)
- **Green Offset Y** (Number)
- **Green Amount** (Number)
- **amount of green** (fade, hide, show)
- **Blue Offset X** (Number)
- **Blue Offset Y** (Number)
- **Blue Amount** (Number)
- **amount of blue** (fade, hide, show)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.RGBOffset_v2

64.65 RgbToHsvTexture



Full Name: Ops.Gl.ImageCompose.RgbToHsvTexture

Description: Convert a RGB Texture to Hue/Saturation/Lightness values as RGB colors

> Inputs

- **Render** (Trigger)
- **Output RGB Index** (Number: Integer)

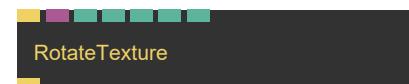
< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ImageCompose.RgbToHsvTexture>

64.66 RotateTexture_v2



Full Name: Ops.Gl.ImageCompose.RotateTexture_v2

Description: Rotates a texture

> Inputs

- **Render** (Trigger)
- **Multiplier** (Object:Texture)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Rotate** (Number)
- **Crop** (Number: Boolean)
- **Clear** (Number: Boolean)

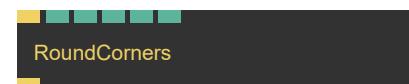
< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.RotateTexture_v2

64.67 RoundCorners



Full Name: Ops.Gl.ImageCompose.RoundCorners

Description: Draw round corners around image (border)

> Inputs

- **Render** (Trigger)
- **Radius** (Number)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ImageCompose.RoundCorners>

64.68 ScaleTexture_v3



Full Name: Ops.Gl.ImageCompose.ScaleTexture_v3

Description: Scales a texture

> Inputs

- **Render** (Trigger)
- **Multiplier** (Object:Texture)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Scale X** (Number)
- **Scale Y** (Number)
- **Offset X** (Number)
- **Offset Y** (Number)
- **Center X** (Number)
- **Center Y** (Number)
- **Clear** (Number: Boolean)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.ScaleTexture_v3

64.69 ScrollTexture



Full Name: Ops.Gl.ImageCompose.ScrollTexture

Description: Visit documentation for details

> Inputs

- **Render** (Trigger)
- **AmountX** (Number)
- **AmountY** (Number)
- **Mask** (Object:Texture)
- **Repeat** (Number: Boolean)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ImageCompose.ScrollTexture>

64.70 Shapes2d_v2



Full Name: Ops.Gl.ImageCompose.Shapes2d_v2

Description: Generates different 2d shapes to use as a texture

> Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Alpha Mask Index** (Number: Integer)
- **Amount** (Number)
- **Shape Index** (Number: Integer)
- **Mirror X** (Number: Boolean)
- **Mirror Y** (Number: Boolean)
- **Offset X** (Number)
- **Offset Y** (Number)
- **FillShape** (Number: Boolean)
- **Line Thickness** (Number)
- **Invert Color** (Number: Boolean)
- **Width** (Number)
- **Height** (Number)
- **Rotate** (Number)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.Shapes2d_v2

64.71 Sharpen



Full Name: Ops.Gl.ImageCompose.Sharpen

Description: Adjust image sharpness

> Inputs

- **Render** (Trigger)
- **Amount** (Number)

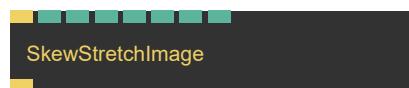
< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ImageCompose.Sharpen>

64.72 SkewStretchImage_v2



Full Name: Ops.Gl.ImageCompose.SkewStretchImage_v2

Description: skew / stretch an image by rendering scaled sides

> Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Clamp** (Number: Boolean)
- **Stretch Top** (Number)
- **Stretch Bottom** (Number)
- **Stretch Left** (Number)
- **Stretch Right** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.SkewStretchImage_v2

64.73 Stripes_v4



Full Name: Ops.Gl.ImageCompose.Stripes_v4

Description: Create a texture of stripes /lines

> Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Alpha Mask Index** (Number: Integer)
- **Num** (Number)
- **Width** (Number)
- **Rotate** (Number)
- **Offset** (Number)
- **Gradients** (Number: Boolean)
- **Circular** (Number: Boolean)
- **Invert** (Number: Boolean)
- **R** (Number)
- **G** (Number)
- **B** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.Stripes_v4

64.74 TexMathModulo



Full Name: Ops.Gl.ImageCompose.TexMathModulo

Description: modulo pixel color values

> Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Mask Invert** (Number: Boolean)
- **Mask** (Object:Texture)
- **Amount** (Number)
- **Modulo** (Number)

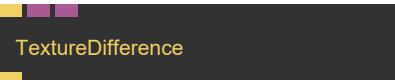
< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ImageCompose.TexMathModulo>

64.75 TextureDifference



Full Name: Ops.Gl.ImageCompose.TextureDifference

Description: render the difference of two textures

> Inputs

- **Render** (Trigger)
- **Texture 1** (Object:Texture)
- **Texture 2** (Object:Texture)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ImageCompose.TextureDifference>

64.76 ToNormalMap_v2



Full Name: Ops.Gl.ImageCompose.ToNormalMap_v2

Description: Convert a black and white map to a normal map

> Inputs

- **Render** (Trigger)
- **Strength** (Number)
- **Step Multiplier** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.ToNormalMap_v2

64.77 Twirl_v4



Full Name: Ops.Gl.ImageCompose.Twirl_v4

Description: Creates a twirl/swirl/spiral effect in a texture

> Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Twist Amount** (Number)
- **Radius** (Number)
- **Center X** (Number)
- **Center Y** (Number)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.Twirl_v4

64.78 Vibrance



Full Name: Ops.Gl.ImageCompose.Vibrance

Description: adjust vibrance/saturation

> Inputs

- **Render** (Trigger)
- **Amount** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ImageCompose.Vibrance>

64.79 Vignette_v3



Full Name: Ops.Gl.ImageCompose.Vignette_v3

Description: Simulating an old camera effect of fading away the edges of the image

> Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)

- **Alpha Mask Index** (Number: Integer)
- **Amount** (Number)
- **Strength** (Number)
- **Radius** (Number)
- **Sharp** (Number)
- **Aspect** (Number)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **Alpha** (Number: Boolean)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.Vignette_v3

64.80 Waveform_v3



Full Name: Ops.Gl.ImageCompose.Waveform_v3

Description: Generates 4 different waveform textures. Sine, sawtooth, Triangle, Square.

> Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Alpha Mask Index** (Number: Integer)
- **Waveform Index** (Number: Integer)
- **Amplitude** (Number)
- **Frequency** (Number)
- **Line Width** (Number)
- **Line Glow** (Number)
- **Invert Color** (Number: Boolean)
- **Solid Fill** (Number: Boolean)
- **Offset X** (Number)
- **Offset Y** (Number)
- **Rotate** (Number)
- **R** (Number)
- **G** (Number)

- **B** (Number)

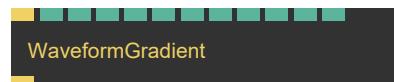
< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.Waveform_v3

64.81 WaveformGradient_v4



Full Name: Ops.Gl.ImageCompose.WaveformGradient_v4

Description: Generate different texture waveforms. Sine, sawtooth and triangle.

> Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Alpha Mask Index** (Number: Integer)
- **Amount** (Number)
- **Mode Index** (Number: Integer)
- **Frequency** (Number)
- **Pow Factor** (Number)
- **Offset** (Number)
- **Rotate** (Number)
- **R** (Number)
- **G** (Number)
- **B** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.WaveformGradient_v4

64.82 Wobble_v2



Full Name: Ops.Gl.ImageCompose.Wobble_v2

Description: waving wobble motion effect

> Inputs

- **Render** (Trigger)
- **Time** (Number)
- **SpeedX** (Number)
- **SpeedY** (Number)
- **RepeatX** (Number)
- **RepeatY** (Number)
- **Multiply** (Number)
- **Amount Map** (Object:Texture)
- **Source Amount Map Index** (Number: Integer)
- **Invert Amount Map** (Number: Boolean)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.Wobble_v2

64.83 ZoomBlur_v2



Full Name: Ops.Gl.ImageCompose.ZoomBlur_v2

Description: Directional blur effect

> Inputs

- **Render** (Trigger)
- **Strength** (Number)
- **Samples** (Number: Integer)
- **X** (Number)
- **Y** (Number)
- **Strength Map** (Object:Texture)
- **Source Strength Map Index** (Number: Integer)
- **Invert Strength Map** (Number: Boolean)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.ZoomBlur_v2

65 Ops.Gl.ImageCompose.Math

65.1 ColorMapRange



Full Name: Ops.Gl.ImageCompose.Math.ColorMapRange

Description: Map the range of color number values to another

> Inputs

- **Render** (Trigger)
- **Old Min** (Number)
- **Old Max** (Number)
- **New Min** (Number)
- **New Max** (Number)
- **Clamp** (Number: Boolean)
- **R** (Number: Boolean)
- **G** (Number: Boolean)
- **B** (Number: Boolean)
- **A** (Number: Boolean)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ImageCompose.Math.ColorMapRange>

65.2 Normalize



Full Name: Ops.Gl.ImageCompose.Math.Normalize

Description: normalize texture rgb values

> Inputs

- **Render** (Trigger)
- **Fade** (Number)
- **Size** (Number)

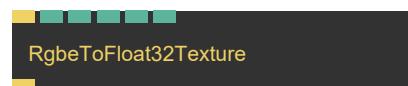
< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ImageCompose.Math.Normalize>

65.3 RgbeToFloat32Texture



Full Name: Ops.Gl.ImageCompose.Math.RgbeToFloat32Texture

Description: Convert a RGBE texture to HDR/floating point texture

► Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Mode Index** (Number: Integer)
- **Min** (Number)
- **Max** (Number)

◀ Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ImageCompose.Math.RgbeToFloat32Texture>

65.4 RgbMath



Full Name: Ops.Gl.ImageCompose.Math.RgbMath

Description: This OP enables you to use precise values to modify the pixels in your texture. For example adjusting texture values that are modifying your geometry or array values, or even your post processing compositions.

► Inputs

- **Render** (Trigger)
- **Operation Index** (Number: Integer)
- **R Active** (Number: Boolean)
- **G Active** (Number: Boolean)
- **B Active** (Number: Boolean)

- **A Active** (Number: Boolean)
- **Texture** (Object:Texture)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)
- **Multiply Texture** (Number)
- **Mask** (Object:Texture)

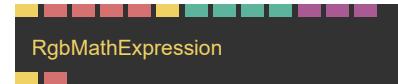
◀ Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ImageCompose.Math.RgbMath>

65.5 RgbMathExpression



Full Name: Ops.Gl.ImageCompose.Math.RgbMathExpression

Description: Execute a glsl code math expression in a image compose

► Inputs

- **Render** (Trigger)
- **Update Shader** (Trigger)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **W** (Number)
- **TexA** (Object:Texture)
- **TexB** (Object:Texture)
- **TexC** (Object:Texture)

◀ Output

- **Trigger** (Trigger)
- **Code** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ImageCompose.Math.RgbMathExpression>

65.6 RgbTransform



Full Name: Ops.Gl.ImageCompose.Math.RgbTransform

Description: transform RGB values interpreted as XYZ coordinates

> Inputs

- **Render** (Trigger)
- **Translate** (Number: Boolean)
- **Pos X** (Number)
- **Pos Y** (Number)
- **Pos Z** (Number)
- **Scale** (Number: Boolean)
- **Scale X** (Number)
- **Scale Y** (Number)
- **Scale Z** (Number)
- **Rotate** (Number: Boolean)
- **Rotation X** (Number)
- **Rotation Y** (Number)
- **Rotation Z** (Number)
- **Mask** (Object:Texture)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ImageCompose.Math.RgbTransform>

65.7 Round



Full Name: Ops.Gl.ImageCompose.Math.Round

Description: Round number values of texture color channels

> Inputs

- **Render** (Trigger)
- **Amount** (Number)
- **Multiplier** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ImageCompose.Math.Round>

65.8 TexMathCompare



Full Name: Ops.Gl.ImageCompose.Math.TexMathCompare

Description: compare and pass through of color channel values

> Inputs

- **Render** (Trigger)
- **Comparison Index** (Number: Integer)
- **Result Index** (Number: Integer)
- **Number** (Number)
- **R Active** (Number: Boolean)
- **G Active** (Number: Boolean)
- **B Active** (Number: Boolean)
- **A Active** (Number: Boolean)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ImageCompose.Math.TexMathCompare>

66 Ops.Gl.ImageCompose.Noise

66.1 CellularNoise_v2



Full Name: Ops.Gl.ImageCompose.Noise.CellularNoise_v2

Description: Visit documentation for details

> Inputs

- **Render** (Trigger)
- **Mask** (Object:Texture)
- **Blend Mode Index** (Number: Integer)
- **Alpha Mask Index** (Number: Integer)
- **Amount** (Number)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **Scale** (Number)
- **Harmonics Index** (Number: Integer)
- **Tileable** (Number: Boolean)
- **Offset** (Object:Texture)
- **Offset Multiply** (Number)
- **Offset X Index** (Number: Integer)
- **Offset Y Index** (Number: Integer)
- **Offset Z Index** (Number: Integer)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.Noise.CellularNoise_v2

66.2 FBMNoise_v2



Full Name: Ops.Gl.ImageCompose.Noise.FBMNoise_v2

Description: fractional brownian motion noise

> Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Alpha Mask Index** (Number: Integer)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **Scale** (Number)
- **Anim** (Number)
- **ScrollX** (Number)
- **ScrollY** (Number)
- **Repeat** (Number)
- **Aspect** (Number)
- **Layer 1** (Number: Boolean)
- **Layer 2** (Number: Boolean)
- **Layer 3** (Number: Boolean)
- **Layer 4** (Number: Boolean)
- **Tileable** (Number: Boolean)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.Noise.FBMNoise_v2

66.3 GaborNoise



Full Name: Ops.Gl.ImageCompose.Noise.GaborNoise

Description: Render "gabor noise" into a texture

> Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Phase** (Number)
- **Scale** (Number)
- **X** (Number)
- **Y** (Number)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ImageCompose.Noise.GaborNoise>

66.4 GlitchNoise_v2



Full Name: Ops.Gl.ImageCompose.Noise.GlitchNoise_v2

Description: Creates a black and white glitched texture to use for displacement

> Inputs

- **Render** (Trigger)
- **Amount** (Number)
- **Blend Mode Index** (Number: Integer)
- **Alpha Mask Index** (Number: Integer)
- **Seed** (Number)
- **Frequency** (Number)
- **Strength** (Number)
- **Block Size Small X** (Number)
- **Block Size Small Y** (Number)
- **Block Size Large X** (Number)
- **Block Size Large Y** (Number)
- **Scroll X** (Number)
- **Scroll Y** (Number)

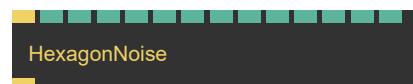
< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.Noise.GlitchNoise_v2

66.5 HexagonNoise_v2



Full Name: Ops.Gl.ImageCompose.Noise.HexagonNoise_v2

Description: Creates a hexagonal noise

> Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Alpha Mask Index** (Number: Integer)
- **Loop** (Number: Boolean)
- **RGB** (Number: Boolean)
- **Minimum Value** (Number)
- **Maximum Value** (Number)
- **Scale** (Number)
- **Orientation** (Number: Boolean)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **Seed** (Number)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.Noise.HexagonNoise_v2

66.6 LayerNoise_v3



Full Name: Ops.Gl.ImageCompose.Noise.LayerNoise_v3

Description: Multilayer perlin noise variation

> Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Alpha Mask Index** (Number: Integer)
- **Mode Index** (Number: Integer)
- **RGBA** (Number: Boolean)
- **Scale** (Number)
- **Layers** (Number: Integer)
- **Factor** (Number)
- **Exponent** (Number)
- **ScrollX** (Number)
- **ScrollY** (Number)
- **ScrollZ** (Number)

- **Tileable** (Number: Boolean)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.Noise.LayerNoise_v3

66.7 Noise_v2



Full Name: Ops.Gl.ImageCompose.Noise.Noise_v2

Description: White noise pixel effect

> Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Threshold** (Number)
- **Animated** (Number: Boolean)
- **RGB** (Number: Boolean)
- **Normalize** (Number: Boolean)
- **Multiply** (Object:Texture)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.Noise.Noise_v2

66.8 PerlinNoise_v2



Full Name: Ops.Gl.ImageCompose.Noise.PerlinNoise_v2

Description: Draw perlin noise into an image

> Inputs

- **Render** (Trigger)
- **Mask** (Object:Texture)
- **Blend Mode Index** (Number: Integer)
- **Alpha Mask Index** (Number: Integer)

- **Amount** (Number)
- **Color Index** (Number: Integer)
- **Scale** (Number)
- **Multiply** (Number)
- **Harmonics Index** (Number: Integer)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **Offset** (Object:Texture)
- **Offset Multiply** (Number)
- **Offset X Index** (Number: Integer)
- **Offset Y Index** (Number: Integer)
- **Offset Z Index** (Number: Integer)

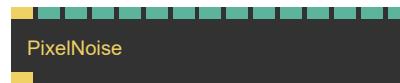
< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.Noise.PerlinNoise_v2

66.9 PixelNoise_v3



Full Name: Ops.Gl.ImageCompose.Noise.PixelNoise_v3

Description: Amount of blend mode to apply

> Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Alpha Mask Index** (Number: Integer)
- **Amount** (Number)
- **Loop** (Number: Boolean)
- **RGB** (Number: Boolean)
- **Minimum Value** (Number)
- **Maximum Value** (Number)
- **Num X** (Number)
- **Num Y** (Number)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **Seed** (Number)

- **Centered** (Number: Boolean)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.Noise.PixelNoise_v3

66.10 PolkaDotNoise_v2



Full Name: Ops.Gl.ImageCompose.Noise.PolkaDotNoise_v2

Description: Visit documentation for details

> Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Alpha Mask Index** (Number: Integer)
- **Square Look** (Number: Boolean)
- **Threshold** (Number)
- **Radius Low** (Number)
- **Radius High** (Number)
- **Scale** (Number)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.Noise.PolkaDotNoise_v2

66.11 Shardnoise



Full Name: Ops.Gl.ImageCompose.Noise.Shardnoise

Description: Render “shard noise” into a texture

> Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Sharpness** (Number)
- **Scale** (Number)
- **Round** (Number: Boolean)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ImageCompose.Noise.Shardnoise>

66.12 SimplexNoise_v2



Full Name: Ops.Gl.ImageCompose.Noise.SimplexNoise_v2

Description: simplex noise generator

> Inputs

- **Render** (Trigger)
- **Mask** (Object:Texture)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Alpha Mask Index** (Number: Integer)
- **Smoothness** (Number)
- **Harmonics Index** (Number: Integer)
- **Scale** (Number)
- **X** (Number)
- **Y** (Number)
- **Time** (Number)
- **Offset** (Object:Texture)
- **Offset Multiply** (Number)
- **Offset X Index** (Number: Integer)
- **Offset Y Index** (Number: Integer)
- **Offset Z Index** (Number: Integer)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.Noise.SimplexNoise_v2

66.13 TriangleNoise_v2



Full Name: Ops.Gl.ImageCompose.Noise.TriangleNoise_v2

Description: noise made from triangles

> Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Alpha Mask Index** (Number: Integer)
- **Scale** (Number)
- **Angle** (Number)
- **Add** (Number)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.Noise.TriangleNoise_v2

66.14 ValueNoise_v2



Full Name: Ops.Gl.ImageCompose.Noise.ValueNoise_v2

Description: Visit documentation for details

> Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Scale** (Number)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.Noise.ValueNoise_v2

66.15 Voronoise_v2



Full Name: Ops.Gl.ImageCompose.Noise.Voronoise_v2

Description: Voronoi Noise function

> Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Alpha Mask Index** (Number: Integer)
- **Time** (Number)
- **Movement** (Number)
- **Num** (Number)
- **Seed** (Number)
- **Fill Index** (Number: Integer)
- **Draw Isolines** (Number: Boolean)
- **Draw Distance** (Number: Boolean)
- **Draw Center** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.Noise.Voronoise_v2

66.16 WorleyNoise_v2



Full Name: Ops.Gl.ImageCompose.Noise.WorleyNoise_v2

Description: Visit documentation for details

> Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Alpha Mask Index** (Number: Integer)

- **Amount** (Number)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **Scale** (Number)
- **Harmonics Index** (Number: Integer)
- **Invert** (Number: Boolean)
- **RangeA** (Number)
- **RangeB** (Number)
- **Tileable** (Number: Boolean)
- **Amount Map** (Object:Texture)
- **Source Strength Map Index** (Number: Integer)
- **Invert Strength Map** (Number: Boolean)
- **Offset** (Object:Texture)
- **Offset Multiply** (Number)
- **Offset X Index** (Number: Integer)
- **Offset Y Index** (Number: Integer)
- **Offset Z Index** (Number: Integer)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ImageCompose.Noise.WorleyNoise_v2

67 Ops.Gl.Matrix

67.1 AnimMatrix



Full Name: Ops.Gl.Matrix.AnimMatrix

Description: animate values in a matrix to a new matrix

> Inputs

- **Update** (Trigger)
- **Next Matrix** (Array)
- **Duration** (Number)
- **Easing Index** (Number: Integer)

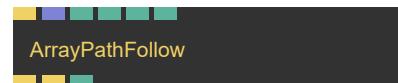
< Output

- **Next** (Trigger)
- **Matrix** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Matrix.AnimMatrix>

67.2 ArrayPathFollow



Full Name: Ops.Gl.Matrix.ArrayPathFollow

Description: interpolate position on a spline/array3x

> Inputs

- **Exe** (Trigger)
- **Array** (Array)
- **Time** (Number)
- **Duration** (Number)
- **Offset** (Number)
- **Look Ahead** (Number)

< Output

- **Trigger** (Trigger)
- **Transform Lookat** (Trigger)

- **Index** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Matrix.ArrayPathFollow>

67.3 ArrayPathFollowParticles_v2



Full Name: Ops.Gl.Matrix.ArrayPathFollowParticles_v2

Description: render lots of particles following a path/spline/array3x

> Inputs

- **Exec** (Trigger)
- **Points** (Array)
- **Num Particles** (Number)
- **Length** (Number)
- **Spread** (Number)
- **Offset** (Number)
- **Max Distance** (Number)
- **RandomSpeed** (Number: Boolean)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Matrix.ArrayPathFollowParticles_v2

67.4 Billboard



Full Name: Ops.Gl.Matrix.Billboard

Description: rotate an object to always face the camera

> Inputs

- **Exec** (Trigger)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Matrix.Billboard>

67.5 Camera_v2



Full Name: Ops.Gl.Matrix.Camera_v2

Description: Transforms and projects the scene from the point of view of the camera.

> Inputs

- **Render** (Trigger)
- **Identity** (Number: Boolean)
- **Projection Mode Index** (Number: Integer)
- **Frustum Near** (Number)
- **Frustum Far** (Number)
- **Fov** (Number)
- **Auto Aspect Ratio** (Number: Boolean)
- **Aspect Ratio** (Number)
- **Eye X** (Number)
- **Eye Y** (Number)
- **Eye Z** (Number)
- **Center X** (Number)
- **Center Y** (Number)
- **Center Z** (Number)
- **Truck** (Number)
- **Move sideways** (in local x axis)
- **Boom** (Number)
- **Dolly** (Number)
- **Tilt** (Number)
- **Pan** (Number)
- **Roll** (Number)

< Output

- **Trigger** (Trigger)
- **Aspect** (Number)
- **Look At Array** (Array)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Matrix.Camera_v2

67.6 CameraInfo



Full Name: Ops.Gl.Matrix.CameraInfo

Description: get camera attributes from current camera/orbit controls

> Inputs

- **Render** (Trigger)
- **Camera Type Index** (Number: Integer)

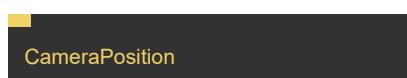
< Output

- **Trigger** (Trigger)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **Right X** (Number)
- **Right Y** (Number)
- **Right Z** (Number)
- **Up X** (Number)
- **Up Y** (Number)
- **Up Z** (Number)
- **Forward X** (Number)
- **Forward Y** (Number)
- **Forward Z** (Number)
- **Near Frustum** (Number)
- **Far Frustum** (Number)
- **Bottom Frustum** (Number)
- **Top Frustum** (Number)
- **Left Frustum** (Number)
- **Right Frustum** (Number)
- **FOV** (Number)
- **Aspect Ratio** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Matrix.CameraInfo>

67.7 CameraPosition



Full Name: Ops.Gl.Matrix.CameraPosition

Description: get the current position of viewmatrix/camera eye

Inputs

- **Render** (Trigger)

< Output

- **Trigger** (Trigger)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Matrix.CameraPosition>

67.8 Coordinates



Full Name: Ops.Gl.Matrix.Coordinates

Description: current xyz coordinates (modelmatrix)

> Inputs

- **Render** (Trigger)

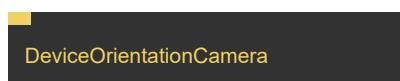
< Output

- **Trigger** (Trigger)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Matrix.Coordinates>

67.9 DeviceOrientationCamera



Full Name: Ops.Gl.Matrix.DeviceOrientationCamera

Description: gyroscope motionsensor camera

> Inputs

- **Render** (Trigger)

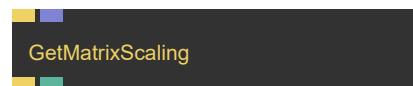
< Output

- **Next** (Trigger)
- **Window Orientation** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Matrix.DeviceOrientationCamera>

67.10 GetMatrixScaling



Full Name: Ops.Gl.Matrix.GetMatrixScaling

Description: Get the scalar scaling of a matrix

> Inputs

- **Render** (Trigger)
- **Matrix** (Array)

< Output

- **Trigger** (Trigger)
- **Scaling** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Matrix.GetMatrixScaling>

67.11 GetModelMatrix



Full Name: Ops.Gl.Matrix.GetModelMatrix

Description: Get current modelmatrix

> Inputs

- **Render** (Trigger)

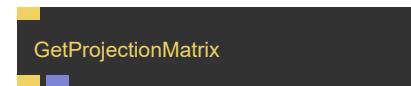
< Output

- **Trigger** (Trigger)
- **Matrix** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Matrix.GetModelMatrix>

67.12 GetProjectionMatrix



Full Name: Ops.Gl.Matrix.GetProjectionMatrix

Description: get current projectionmatrix

> Inputs

- **Render** (Trigger)

< Output

- **Trigger** (Trigger)
- **Matrix** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Matrix.GetProjectionMatrix>

67.13 GetViewMatrix



Full Name: Ops.Gl.Matrix.GetViewMatrix

Description: get current viewmatrix

> Inputs

- **Render** (Trigger)

< Output

- **Trigger** (Trigger)
- **Matrix** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Matrix.GetViewMatrix>

67.14 InterpolateMatrix



Full Name: Ops.Gl.Matrix.InterpolateMatrix

Description: interpolate between two matrices

> Inputs

- **Exe** (Trigger)
- **Array 1** (Array)
- **Array 2** (Array)
- **Perc** (Number)

< Output

- **Next** (Trigger)
- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Matrix.InterpolateMatrix>

67.15 InvertMatrix



Full Name: Ops.Gl.Matrix.InvertMatrix

Description: outputs an inverted matrix

> Inputs

- **Matrix** (Array)

< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Matrix.InvertMatrix>

67.16 LookatCamera



Full Name: Ops.Gl.Matrix.LookatCamera

Description: transforms view to look from eye to center

> Inputs

- **Render** (Trigger)
- **EyeX** (Number)
- **EyeY** (Number)
- **EyeZ** (Number)
- **CenterX** (Number)
- **CenterY** (Number)
- **CenterZ** (Number)

- **UpX** (Number)
- **UpY** (Number)
- **UpZ** (Number)

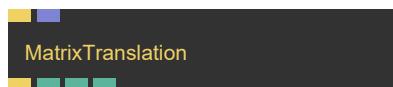
< Output

- **Trigger** (Trigger)
- **Array** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Matrix.LookatCamera>

67.17 MatrixTranslation



Full Name: Ops.Gl.Matrix.MatrixTranslation

Description: get translation of a matrix

> Inputs

- **Render** (Trigger)
- **Matrix** (Array)

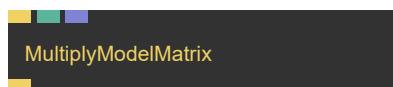
< Output

- **Trigger** (Trigger)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Matrix.MatrixTranslation>

67.18 MultiplyModelMatrix



Full Name: Ops.Gl.Matrix.MultiplyModelMatrix

Description: multiply model matrix

> Inputs

- **Render** (Trigger)
- **Identity** (Number: Boolean)
- **Matrix** (Array)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Matrix.MultiplyModelMatrix>

67.19 MulViewMatrix



Full Name: Ops.Gl.Matrix.MulViewMatrix

Description: multiply view matrix

> Inputs

- **Render** (Trigger)
- **Matrix** (Array)
- **Identity** (Number: Boolean)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Matrix.MulViewMatrix>

67.20 Quaternion



Full Name: Ops.Gl.Matrix.Quaternion

Description: multiplies current modelmatrix with a quaternion

> Inputs

- **Render** (Trigger)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **W** (Number)

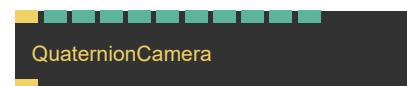
< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Matrix.Quaternion>

67.21 QuaternionCamera



Full Name: Ops.Gl.Matrix.QuaternionCamera

Description: Set up a camera, rotated by a quaternion

> Inputs

- **Render** (Trigger)
- **EyeX** (Number)
- **EyeY** (Number)
- **EyeZ** (Number)
- **QuatX** (Number)
- **QuatY** (Number)
- **QuatZ** (Number)
- **QuatW** (Number)
- **UpX** (Number)
- **UpY** (Number)
- **UpZ** (Number)

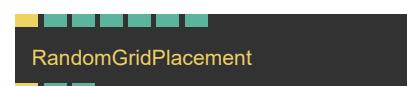
< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Matrix.QuaternionCamera>

67.22 RandomGridPlacement



Full Name: Ops.Gl.Matrix.RandomGridPlacement

Description: place random objects on a grid

> Inputs

- **Exe** (Trigger)
- **Max Depth** (Number)
- **Possibility** (Number)
- **Seed** (Number)
- **Scale** (Number)
- **Width** (Number)
- **Height** (Number)

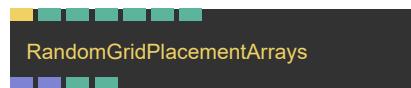
< Output

- **Next** (Trigger)
- **Index** (Number)
- **Depth** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Matrix.RandomGridPlacement>

67.23 RandomGridPlacementArrays



Full Name: Ops.Gl.Matrix.RandomGridPlacementArrays

Description: Place random objects on a grid

► **Inputs**

- **Exe** (Trigger)
- **Max Depth** (Number)
- **Possibility** (Number)
- **Seed** (Number)
- **Scale** (Number)
- **Width** (Number)
- **Height** (Number)

◀ **Output**

- **Positions** (Array)
- **Scalings** (Array)
- **Array Length** (Number)
- **Total Points** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Matrix.RandomGridPlacementArrays>

67.24 Scale



Full Name: Ops.Gl.Matrix.Scale

Description: Scale all child objects (scaleXYZ)

► **Inputs**

- **Render** (Trigger)
- **Scale** (Number)

- **X** (Number)
- **Y** (Number)
- **Z** (Number)

◀ **Output**

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Matrix.Scale>

67.25 ScaleXYZViewMatrix



Full Name: Ops.Gl.Matrix.ScaleXYZViewMatrix

Description: scale xyz of viewmatrix

► **Inputs**

- **Render** (Trigger)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)

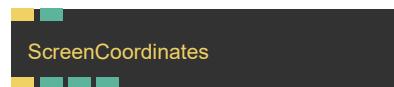
◀ **Output**

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Matrix.ScaleXYZViewMatrix>

67.26 ScreenCoordinates_v2



Full Name: Ops.Gl.Matrix.ScreenCoordinates_v2

Description: screen/pixel coordinates of the current transform

► **Inputs**

- **Execute** (Trigger)
- **Pixel Unit Index** (Number: Integer)

◀ **Output**

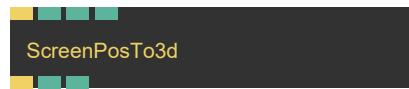
- **Trigger** (Trigger)
- **X** (Number)

- **Y** (Number)
- **Visible** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Matrix.ScreenCoordinates_v2

67.27 ScreenPosTo3d_v3



Full Name: Ops.Gl.Matrix.ScreenPosTo3d_v3

Description: convert screen coordinates to a 3d position

> Inputs

- **Exec** (Trigger)
- **X** (Number)
- **Y** (Number)
- **Input Type Index** (Number: Integer)

< Output

- **Trigger Out** (Trigger)
- **Result X** (Number)
- **Result Y** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Matrix.ScreenPosTo3d_v3

67.28 SetProjectionMatrix



Full Name: Ops.Gl.Matrix.SetProjectionMatrix

Description: set a projection matrix

> Inputs

- **Exe** (Trigger)
- **Matrix** (Array)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Matrix.SetProjectionMatrix>

67.29 Shear



Full Name: Ops.Gl.Matrix.Shear

Description: displaces each point of a mesh in fixed direction

> Inputs

- **Render** (Trigger)
- **ShearX** (Number)
- **ShearY** (Number)

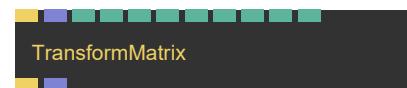
< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Matrix.Shear>

67.30 TransformMatrix



Full Name: Ops.Gl.Matrix.TransformMatrix

Description: transform a matrix (mat4)

> Inputs

- **Transform** (Trigger)
- **Matrix** (Array)
- **Translate X** (Number)
- **Translate Y** (Number)
- **Translate Z** (Number)
- **Scale X** (Number)
- **Scale Y** (Number)
- **Scale Z** (Number)
- **Rotation X** (Number)
- **Rotation Y** (Number)
- **Rotation Z** (Number)

< Output

- **Next** (Trigger)
- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Matrix.TransformMatrix>

67.31 TransformMul



Full Name: Ops.Gl.Matrix.TransformMul

Description: multiply current modelmatrix

> Inputs

- **Render** (Trigger)
- **Mul** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Matrix.TransformMul>

67.32 Translate



Full Name: Ops.Gl.Matrix.Translate

Description: Translate objects (move / position in 3D space)

> Inputs

- **Render** (Trigger)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Matrix.Translate>

67.33 TranslateView



Full Name: Ops.Gl.Matrix.TranslateView

Description: translate the view/camera matrix

> Inputs

- **Render** (Trigger)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Matrix.TranslateView>

67.34 VectorTranslate



Full Name: Ops.Gl.Matrix.VectorTranslate

Description: Translate any geometry underneath it using vectors and speed.

> Inputs

- **Exec** (Trigger)
- **Speed** (Number)
- **Vector X** (Number)
- **Vector Y** (Number)
- **Vector Z** (Number)
- **Reset Position X** (Number)
- **Reset Position Y** (Number)
- **Reset Position Z** (Number)
- **Reset** (Trigger)
- **Max** (Number)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Matrix.VectorTranslate>

67.35 WASDCamera_v2



Full Name: Ops.Gl.Matrix.WASDCamera_v2

Description: simple camera you control with W,A,S,D keys like in a FPS game

> Inputs

- **Render** (Trigger)
- **Enable Pointer Lock** (Number: Boolean)
- **Speed** (Number)
- **Mouse Speed** (Number)
- **Allow Flying** (Number: Boolean)
- **Active** (Number: Boolean)
- **Move X-** (Number: Boolean)
- **Move Y-** (Number: Boolean)
- **Reset** (Trigger)

< Output

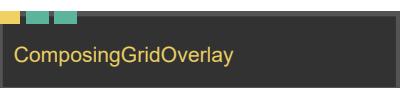
- **Trigger** (Trigger)
- **IsLocked** (booleanNumber)
- **PosX** (Number)
- **PosY** (Number)
- **PosZ** (Number)
- **Mouse Left** (Trigger)
- **Mouse Right** (Trigger)
- **Dir X** (Number)
- **Dir Y** (Number)
- **Dir Z** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Matrix.WASDCamera_v2

68 Ops.Gl.Meshes

68.1 ComposingGridOverlay



Full Name: Ops.Gl.Meshes.ComposingGridOverlay

Description: Rule of thirds image composition helper

> Inputs

- **Render** (Trigger)
- **Scale** (Number)
- **Show Center** (Number: Boolean)

< Output

- Visit *Ops.Gl.Meshes.ComposingGridOverlay documentation* for output port details

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Meshes.ComposingGridOverlay>

68.2 Cone



Full Name: Ops.Gl.Meshes.Cone

Description: number of horizontal segments

> Inputs

- **Render** (Trigger)
- **Slices** (Number)
- **Stacks** (Number)
- **Radius** (Number)
- **Height** (Number)
- **Active** (Number: Boolean)

< Output

- **Trigger** (Trigger)
- **Geometry** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Meshes.Cone>

68.3 Corner



Full Name: Ops.Gl.Meshes.Corner

Description: render a rectangular corner

> Inputs

- **Render** (Trigger)
- **Width** (Number)
- **Height** (Number)
- **Thickness** (Number)
- **Draw** (Number: Boolean)
- **Pivot X Index** (Number: Integer)
- **Pivot Y Index** (Number: Integer)

< Output

- **Trigger** (Trigger)
- **Geometry** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Meshes.Corner>

68.4 Cylinder_v2



Full Name: Ops.Gl.Meshes.Cylinder_v2

Description: draw parameterizable cylinder (aka tube,pipe,round,circle)

> Inputs

- **Render** (Trigger)
- **Render Mesh** (Number: Boolean)
- **Segments** (Number: Integer)
- **Stacks** (Number: Integer)
- **Length** (Number)
- **Outer Radius** (Number)
- **Inner Radius** (Number)
- **Flip Mapping** (Number: Boolean)

- **Caps** (Number: Boolean)
- **Flat Normals** (Number: Boolean)

< Output

- **Next** (Trigger)
- **Geometry** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Meshes.Cylinder_v2

68.5 FloorGrid



Full Name: Ops.Gl.Meshes.FloorGrid

Description: draw a grid on the floor

> Inputs

- **Render** (Trigger)
- **Active** (Number: Boolean)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Meshes.FloorGrid>

68.6 FreeFormPlane



Full Name: Ops.Gl.Meshes.FreeFormPlane

Description: A freely deformable plane, rectangle, polygon

> Inputs

- **Render** (Trigger)
- **X 1** (Number)
- **Y 1** (Number)
- **Z 1** (Number)
- **X 2** (Number)
- **Y 2** (Number)
- **Z 2** (Number)
- **X 3** (Number)

- **Y 3** (Number)
- **Z 3** (Number)
- **X 4** (Number)
- **Y 4** (Number)
- **Z 4** (Number)
- **Tc X 1** (Number)
- **Tc Y 1** (Number)
- **Tc X 2** (Number)
- **Tc Y 2** (Number)
- **Tc X 3** (Number)
- **Tc Y 3** (Number)
- **Tc X 4** (Number)
- **Tc Y 4** (Number)

< Output

- **Trigger** (Trigger)
- **Geometry** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Meshes.FreeFormPlane>

68.7 FullscreenRectangle_v2



Full Name: Ops.Gl.Meshes.FullscreenRectangle_v2

Description: Draws a rectangle using the full WebGL canvas size

> Inputs

- **Render** (Trigger)
- **Flip Y** (Number: Boolean)
- **Flip X** (Number: Boolean)
- **Texture** (Object:Texture)

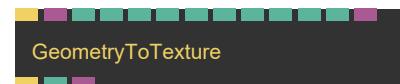
< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Meshes.FullscreenRectangle_v2

68.8 GeometryToTexture_v3



Full Name: Ops.Gl.Meshes.GeometryToTexture_v3

Description: Convert vertices of a geometry to a data texture

> Inputs

- **Render** (Trigger)
- **Geometry** (Object:Geometry)
- **Continuously Update** (Number: Boolean)
- **Order Index** (Number: Integer)
- **Content Index** (Number: Integer)
- **New Size** (Number)
- **Tex Width** (Number: Integer)
- **Filter Index** (Number: Integer)
- **Wrap Index** (Number: Integer)
- **Pixel Format Index** (Number: Integer)
- **Color Texture** (Object:Texture)

< Output

- **Next** (Trigger)
- **Total Vertices** (Number)
- **Texture** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Meshes.GeometryToTexture_v3

68.9 Grid



Full Name: Ops.Gl.Meshes.Grid

Description: Draw a simple grid of lines

> Inputs

- **Render** (Trigger)
- **Num** (Number: Integer)
- **Spacing** (Number)
- **Center** (Number: Boolean)
- **Axis Index** (Number: Integer)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Meshes.Grid>

68.10 HeightMap



Full Name: Ops.Gl.Meshes.HeightMap

Description: generate a rectangular mesh where the height is defined by the luminance of an image

> Inputs

- **Render** (Trigger)
- **File** (String)
- **Extrude** (Number)
- **Width** (Number)
- **Height** (Number)
- **Rows** (Number: Integer)
- **Columns** (Number: Integer)
- **TexCoords Slice** (Number: Boolean)
- **Flat** (Number: Boolean)

< Output

- **Trigger** (Trigger)
- **Geometry** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Meshes.HeightMap>

68.11 Helix



Full Name: Ops.Gl.Meshes.Helix

Description: generates a helix, spiral spline

> Inputs

- **Render** (Trigger)
- **Draw** (Number: Boolean)
- **Segments** (Number)

- **Frequency** (Number)

- **Radius** (Number)

- **Radius End** (Number)

- **Height** (Number)

< Output

- **Next** (Trigger)

- **Points** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Meshes.Helix>

68.12 Icosahedron_v2



Full Name: Ops.Gl.Meshes.Icosahedron_v2

Description: Renders a icosahedron (polyhedron with 20 faces)

> Inputs

- **Render** (Trigger)
- **Smooth** (Number: Boolean)
- **Render Mesh** (Number: Boolean)

< Output

- **Trigger** (Trigger)
- **Geometry** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Meshes.Icosahedron_v2

68.13 Line



Full Name: Ops.Gl.Meshes.Line

Description: Draw a line between two points

> Inputs

- **Render** (Trigger)
- **X 1** (Number)
- **Y 1** (Number)
- **Z 1** (Number)

- **X 2** (Number)
- **Y 2** (Number)
- **Z 2** (Number)

< Output

- **Next** (Trigger)
- **Array** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Meshes.Line>

68.14 LinesArray



Full Name: Ops.Gl.Meshes.LinesArray

Description: an array of lines

> Inputs

- **Render** (Trigger)
- **Width** (Number)
- **Height** (Number)
- **Logarithmic** (Number: Boolean)
- **Pivot X Index** (Number: Integer)
- **Pivot Y Index** (Number: Integer)
- **Num Columns** (Number: Integer)
- **Num Rows** (Number: Integer)
- **Axis Index** (Number: Integer)

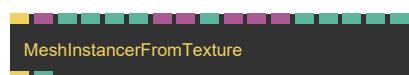
< Output

- **Trigger** (Trigger)
- **Point Arrays** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Meshes.LinesArray>

68.15 MeshInstancerFromTexture_v3



Full Name: Ops.Gl.Meshes.MeshInstancerFromTexture_v3

Description: Draw the same mesh multiple times on the GPU

> Inputs

- **Exe** (Trigger)
- **Geometry** (Object:Geometry)
- **Scale** (Number)
- **Limit Instances** (Number: Boolean)
- **Num Instances** (Number: Integer)
- **Position Texture** (Object:Texture)
- **Rotation Texture** (Object:Texture)
- **Scale Texture** (Object:Texture)
- **Color Texture** (Object:Texture)
- **TexCoord Texture** (Object:Texture)
- **Ignore Alpha Less Than** (Number)
- **Multiply Pos X** (Number)
- **Multiply Pos Y** (Number)
- **Multiply Pos Z** (Number)

< Output

- **Trigger Out** (Trigger)
- **Num** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Meshes.MeshInstancerFromTexture_v3

68.16 ParametricSurface



Full Name: Ops.Gl.Meshes.ParametricSurface

Description: Creates a 3d mesh from a 2d area expressions

> Inputs

- **Shapes Index** (Number: Integer)
- **Render** (Trigger)
- **U Segments** (Number: Integer)
- **V Segments** (Number: Integer)
- **Multiple Of PI - U** (Number: Boolean)
- **UMin** (Number)
- **UMax** (Number)
- **Displace U** (Number)
- **Multiple Of PI - V** (Number: Boolean)
- **VMin** (Number)
- **VMax** (Number)
- **Displace V** (Number)

- **X Function** (String)
- **Y Function** (String)
- **Z Function** (String)
- **Scale X** (Number)
- **Scale Y** (Number)
- **Scale Z** (Number)
- **Draw** (Number: Boolean)

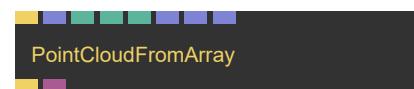
< Output

- **Trigger** (Trigger)
- **Geometry** (Object)
- **Position** (Array)
- **outputs the vertices of the surface** (as an xyz-Array)
- **Position Amount** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Meshes.ParametricSurface>

68.17 PointCloudFromArray_v2



Full Name: Ops.Gl.Meshes.PointCloudFromArray_v2

Description: visualize an array of coordinates as points

> Inputs

- **Exe** (Trigger)
- **Positions** (Array)
- **Num Points** (Number: Integer)
- **Scramble Texcoords** (Number: Boolean)
- **Seed** (Number)
- **Texture Coordinates** (Array)
- **Point Sizes** (Array)
- **Vertex Colors** (Array)

< Output

- **Trigger Out** (Trigger)
- **Geometry** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Meshes.PointCloudFromArray_v2

68.18 PointCloudFromTexture



Full Name: Ops.Gl.Meshes.PointCloudFromTexture

Description: Visualize a RGB texture as XYZ coordinates as points

> Inputs

- **Render** (Trigger)
- **Num Points** (Number: Integer)
- **Texture** (Object:Texture)
- **Point Size** (Object:Texture)
- **Normalize** (Number: Boolean)
- **Remove Point At 0** (Number: Boolean)
- **Ignore Alpha 0** (Number: Boolean)

< Output

- **Trigger** (Trigger)
- **Total Points** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Meshes.PointCloudFromTexture>

68.19 Polyhedron_v2



Full Name: Ops.Gl.Meshes.Polyhedron_v2

Description: Generate polyhedron meshes

> Inputs

- **Receipt** (String)

< Output

- **Geometry** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Meshes.Polyhedron_v2

68.20 Pyramid_v2



Full Name: Ops.Gl.Meshes.Pyramid_v2

Description: render a pyramid mesh

> Inputs

- **Render** (Trigger)
- **Width** (Number)
- **Length** (Number)
- **Height** (Number)
- **Smooth** (Number: Boolean)
- **Draw** (Number: Boolean)

< Output

- **Trigger** (Trigger)
- **Geometry** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Meshes.Pyramid_v2

68.21 QuadWarpTexture



Full Name: Ops.Gl.Meshes.QuadWarpTexture

Description: Warp a texture mapped quad (projection mapping)

> Inputs

- **Render** (Trigger)
- **A X** (Number)
- **A Y** (Number)
- **B X** (Number)
- **B Y** (Number)
- **C X** (Number)
- **C Y** (Number)
- **D X** (Number)
- **D Y** (Number)
- **Flip Y** (Number: Boolean)
- **Flip X** (Number: Boolean)
- **Texture** (Object)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Meshes.QuadWarpTexture>

68.22 Rectangle9Slice



Full Name: Ops.Gl.Meshes.Rectangle9Slice

Description: nine slice image format texture mapped rectangle

> Inputs

- **Render** (Trigger)
- **Width** (Number)
- **Height** (Number)
- **Border Width** (Number)
- **Scale X** (Number)
- **Scale Y** (Number)
- **Draw** (Number: Boolean)
- **Pivot X Index** (Number: Integer)
- **Pivot Y Index** (Number: Integer)

< Output

- **Trigger** (Trigger)
- **Geometry** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Meshes.Rectangle9Slice>

68.23 RectangleFrame_v2



Full Name: Ops.Gl.Meshes.RectangleFrame_v2

Description: Draws a rectangle frame

> Inputs

- **Render** (Trigger)
- **Width** (Number)
- **Height** (Number)

- **Thickness** (Number)
- **Draw Top** (Number: Boolean)
- **Draw Bottom** (Number: Boolean)
- **Draw Left** (Number: Boolean)
- **Draw Right** (Number: Boolean)
- **Active** (Number: Boolean)

< Output

- **Trigger** (Trigger)
- **Geometry** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Meshes.RectangleFrame_v2

68.24 RectangleRounded_v2



Full Name: Ops.Gl.Meshes.RectangleRounded_v2

Description: Draws a rectangle with rounded corners

> Inputs

- **Render** (Trigger)
- **Segments** (Number: Integer)
- **Width** (Number)
- **Height** (Number)
- **Border Radius** (Number)
- **Top Left** (Number: Boolean)
- **Top Right** (Number: Boolean)
- **Bottom Left** (Number: Boolean)
- **Bottom Right** (Number: Boolean)
- **Draw** (Number: Boolean)

< Output

- **Trigger** (Trigger)
- **Geometry** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Meshes.RectangleRounded_v2

68.25 SimpleSpline_v2



Full Name: Ops.Gl.Meshes.SimpleSpline_v2

Description: Draws a simple spline only one pixel wide

> Inputs

- **Render** (Trigger)
- **Points** (Array)
- **Num Points** (Number: Integer)
- **Line Strip** (Number: Boolean)
- **TexCoords Array** (Array)
- **Vertex Colors** (Array)

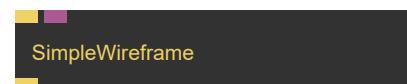
< Output

- **Geometry** (Object)
- **Next** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Meshes.SimpleSpline_v2

68.26 SimpleWireframe



Full Name: Ops.Gl.Meshes.SimpleWireframe

Description: Simple Wireframe Line Renderer

> Inputs

- **Render** (Trigger)
- **Geometry** (Object:Geometry)

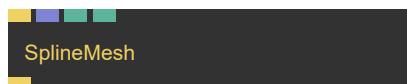
< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Meshes.SimpleWireframe>

68.27 SplineMesh_v2



Full Name: Ops.Gl.Meshes.SplineMesh_v2

Description: draw splines/lines

> Inputs

- **Render** (Trigger)
- **Points** (Array)
- **Tesselate Edges** (Number: Boolean)
- **Render Mesh** (Number: Boolean)

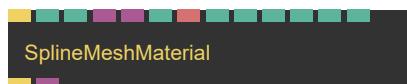
< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Meshes.SplineMesh_v2

68.28 SplineMeshMaterial_v2



Full Name: Ops.Gl.Meshes.SplineMeshMaterial_v2

Description: material for splinemesh

> Inputs

- **Render** (Trigger)
- **Width** (Number)
- **Width Perspective** (Number: Boolean)
- **Texture** (Object:Texture)
- **Texture Mask** (Object:Texture)
- **Mapping Index** (Number: Integer)
- **Mapping** (String)
- **Colorize Texture** (Number: Boolean)
- **Offset** (Number)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)

< Output

- **Trigger** (Trigger)

- **Shader** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Meshes.SplineMeshMaterial_v2

68.29 TextMesh_v2



Full Name: Ops.Gl.Meshes.TextMesh_v2

Description: Draws text in 3d space using one of the font ops

> Inputs

- **Render** (Trigger)
- **Text** (String)
- **Scale Text** (Number)
- **Line Scale** (Number)
- **Font** (String)
- **Align Index** (Number: Integer)
- **Vertical Align Index** (Number: Integer)
- **Line Height** (Number)
- **Letter Spacing** (Number)
- **Texture Color** (Object:Texture)
- **Texture Mask** (Object:Texture)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)

< Output

- **Next** (Trigger)
- **Total Lines** (Number)
- **Width** (Number)
- **Font Available** (booleanNumber)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Meshes.TextMesh_v2

68.30 Torus_v3



Full Name: Ops.Gl.Meshes.Torus_v3

Description: Draw a torus (doughnut, donut, ring mesh)

> Inputs

- **Render** (Trigger)
- **Sides** (Number)
- **Rings** (Number)
- **InnerRadius** (Number)
- **OuterRadius** (Number)
- **Render Mesh** (Number: Boolean)

< Output

- **Trigger** (Trigger)
- **Geometry** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Meshes.Torus_v3

68.31 TriangleSphere



TriangleSphere

Full Name: Ops.Gl.Meshes.TriangleSphere

Description: A sphere mesh with uniform distributed vertices

> Inputs

- **Render** (Trigger)
- **Iterations** (Number)
- **Flat** (Number: Boolean)
- **Draw** (Number: Boolean)

< Output

- **Next** (Trigger)
- **Geometry** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Meshes.TriangleSphere>

69 Ops.Gl.Pbr

69.1 PbrEnvironmentLight



Full Name: Ops.Gl.Pbr.PbrEnvironmentLight

Description: PBR image based lighting setup

> Inputs

- **Render** (Trigger)
- **Intensity** (Number)
- **RGBE Environment Map** (Object:Texture)
- **Size Irradiance Map Index** (Number: Integer)
- **Size Pre-Filtered Environment Index** (Number: Integer)
- **Size IBL LUT Index** (Number: Integer)
- **Force 8bit IBL** (Number: Boolean)
- **Rotation** (Number)
- **Use Parallax Correction** (Number: Boolean)
- **Center X** (Number)
- **Center Y** (Number)
- **Center Z** (Number)
- **Box Min X** (Number)
- **Box Min Y** (Number)
- **Box Min Z** (Number)
- **Box Max X** (Number)
- **Box Max Y** (Number)
- **Box Max Z** (Number)

< Output

- **Render** (Trigger)
- **Intensity** (Number)
- **RGBE Environment Map** (Object:Texture)
- **Size Irradiance Map Index** (Number: Integer)
- **Size Pre-Filtered Environment Index** (Number: Integer)
- **Size IBL LUT Index** (Number: Integer)
- **Force 8bit IBL** (Number: Boolean)
- **Rotation** (Number)
- **Use Parallax Correction** (Number: Boolean)
- **Center X** (Number)

- **Center Y** (Number)
- **Center Z** (Number)
- **Box Min X** (Number)
- **Box Min Y** (Number)
- **Box Min Z** (Number)
- **Box Max X** (Number)
- **Box Max Y** (Number)
- **Box Max Z** (Number)
- **Next** (Trigger)
- **IBL LUT** (Object)
- **for PBR Material** (not required)
- **Number Of Pre-Filtered Mip Levels** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Pbr.PbrEnvironmentLight>

69.2 PbrMaterial



Full Name: Ops.Gl.Pbr.PbrMaterial

Description: PBR/Physical Based Rendering Material for realistic materials

Inputs

- **Render** (Trigger)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)
- **Roughness** (Number)
- **Metalness** (Number)
- **Use Clear Coat** (Number: Boolean)
- **Clear Coat Intensity** (Number)
- **Clear Coat Roughness** (Number)
- **Use Normal Map For Clear Coat** (Number: Boolean)
- **Clear Coat Normal Map** (Object:Texture)
- **Use Thin Film** (Number: Boolean)
- **Thin Film Intensity** (Number)
- **Thin Film IOR** (Number)
- **Thickness Tex Min** (Number)
- **Thickness Tex Max** (Number)
- **Exposure** (Number)
- **Emission Intensity** (Number)

- **Disable Geometric Roughness** (Number: Boolean)
- **Use Roughness From Normal Map** (Number: Boolean)
- **Use Vertex Colours** (Number: Boolean)
- **Height Intensity** (Number)
- **Faster Heightmapping** (Number: Boolean)
- **Double Sided** (Number: Boolean)
- **IBL LUT** (Object:Texture)
- **Diffuse Irradiance** (Object:Texture)
- **Pre-Filtered Envmap** (Object:Texture)
- **Num Mip Levels** (Number: Integer)
- **Albedo** (Object:Texture)
- **AORM** (Object:Texture)
- **Normal Map** (Object:Texture)
- **Emission** (Object:Texture)
- **Height** (Object:Texture)
- **Lightmap** (Object:Texture)
- **Thin Film** (Object:Texture)
- **Diffuse Intensity** (Number)
- **Specular Intensity** (Number)
- **Lightmap Is RGBE** (Number: Boolean)
- **Lightmap Intensity** (Number)

Output

- **Next** (Trigger)
- **Shader** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Pbr.PbrMaterial>

70 Ops.Gl.Phong

70.1 AmbientLight_v4



Full Name: Ops.Gl.Phong.AmbientLight_v4

Description: ambient light for phong material shading

> Inputs

- **Trigger In** (Trigger)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **Intensity** (Number)

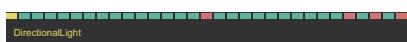
< Output

- **Trigger Out** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Phong.AmbientLight_v4

70.2 DirectionalLight_v5



Full Name: Ops.Gl.Phong.DirectionLight_v5

Description: Directional light for phong shading

> Inputs

- **Trigger In** (Trigger)
- **Cast Light** (Number: Boolean)
- **Intensity** (Number)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **Specular R** (Number)

- **Specular G** (Number)
- **Specular B** (Number)
- **Cast Shadow** (Number: Boolean)
- **Rendering Active** (Number: Boolean)
- **Map Size Index** (Number: Integer)
- **Map Size** (String)
- **Shadow Strength** (Number)
- **LR-BottomTop** (Number)
- **Near** (Number)
- **Far** (Number)
- **Bias** (Number)
- **Polygon Offset** (Number: Integer)
- **Normal Offset** (Number)
- **Blur Amount** (Number)
- **Enable Advanced** (Number: Boolean)
- **MSAA Index** (Number: Integer)
- **MSAA** (String)
- **Texture Filter Index** (Number: Integer)
- **Texture Filter** (String)
- **Anisotropic Index** (Number: Integer)
- **Anisotropic** (String)

< Output

- **Trigger Out** (Trigger)
- **Shadow Map** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Phong.DirectionLight_v5

70.3 LambertMaterial_v2



Full Name: Ops.Gl.Phong.LambertMaterial_v2

Description: a simple shaded material

> Inputs

- **Execute** (Trigger)
- **Diffuse R** (Number)
- **Diffuse G** (Number)
- **Diffuse B** (Number)
- **Diffuse A** (Number)

- **Diffuse Texture** (Object:Texture)
- **Colorize Texture** (Number: Boolean)

< Output

- **Next** (Trigger)
- **Shader** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Phong.LambertMaterial_v2

70.4 PhongMaterial_v6



Full Name: Ops.Gl.Phong.PhongMaterial_v6

Description: A shaded material for lighting objects

> Inputs

- **Trigger In** (Trigger)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)
- **Albedo** (Number)
- **Roughness** (Number)
- **Fresnel Intensity** (Number)
- **Fresnel Width** (Number)
- **Fresnel Exponent** (Number)
- **Fresnel R** (Number)
- **Fresnel G** (Number)
- **Fresnel B** (Number)
- **Emissive Active** (Number: Boolean)
- **Color Intensity** (Number)
- **Emissive R** (Number)
- **Emissive G** (Number)
- **Emissive B** (Number)
- **Shininess** (Number)
- **Specular Amount** (Number)
- **Diffuse Texture** (Object:Texture)
- **Specular Texture** (Object:Texture)
- **Normal Map** (Object:Texture)
- **AO Texture** (Object:Texture)
- **Emissive Texture** (Object:Texture)
- **Emissive Mask** (Object:Texture)

- **Opacity Texture** (Object:Texture)
- **Environment Map** (Object:Texture)
- **Env Map Mask** (Object:Texture)
- **Diffuse Repeat X** (Number)
- **Diffuse Repeat Y** (Number)
- **Texture Offset X** (Number)
- **texture pixel offset on the C axis** (applied to all textures)
- **Texture Offset Y** (Number)
- **texture pixel offset on the Y axis** (applied to all textures)
- **Specular Intensity** (Number)
- **Normal Map Intensity** (Number)
- **AO Intensity** (Number)
- **Emissive Intensity** (Number)
- **Emissive Mask Intensity** (Number)
- **Env Map Intensity** (Number)
- **Env Mask Intensity** (Number)

< Output

- **Trigger Out** (Trigger)
- **Shader** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Phong.PhongMaterial_v6

70.5 PointLight_v5



Full Name: Ops.Gl.Phong.PointLight_v5

Description: Point light for phong shading

> Inputs

- **Trigger In** (Trigger)
- **Cast Light** (Number: Boolean)
- **Intensity** (Number)
- **Radius** (Number)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **Specular R** (Number)

- **Specular G** (Number)
- **Specular B** (Number)
- **Falloff** (Number)
- **Cast Shadow** (Number: Boolean)
- **Rendering Active** (Number: Boolean)
- **Shadow Strength** (Number)
- **Near** (Number)
- **Far** (Number)
- **Bias** (Number)
- **Polygon Offset** (Number: Integer)

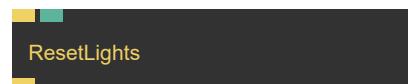
< Output

- **Trigger Out** (Trigger)
- **Cubemap** (Object)
- **World Position X** (Number)
- **World Position Y** (Number)
- **World Position Z** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Phong.PointLight_v5

70.6 ResetLights



Full Name: Ops.Gl.Phong.ResetLights

Description: reset lights for everything triggered after

> Inputs

- **Trigger In** (Trigger)
- **Reset Lights** (Number: Boolean)

< Output

- **Trigger Out** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Phong.ResetLights>

70.7 SpotLight_v5



Full Name: Ops.Gl.Phong.SpotLight_v5

Description: spot light that emits a cone of light

> Inputs

- **Trigger In** (Trigger)
- **Cast Light** (Number: Boolean)
- **Intensity** (Number)
- **Radius** (Number)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **Point At X** (Number)
- **Point At Y** (Number)
- **Point At Z** (Number)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **Specular R** (Number)
- **Specular G** (Number)
- **Specular B** (Number)
- **Cone Angle** (Number)
- **Inner Cone Angle** (Number)
- **Spot Exponent** (Number)
- **Falloff** (Number)
- **Cast Shadow** (Number: Boolean)
- **Rendering Active** (Number: Boolean)
- **Shadow Strength** (Number)

< Output

- **Trigger Out** (Trigger)
- **Shadow Map** (Object)
- **World Position X** (Number)
- **World Position Y** (Number)
- **World Position Z** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Phong.SpotLight_v5

71 Ops.Gl.Shader

71.1 AttributeAsColorMaterial



Full Name: Ops.Gl.Shader.AttributeAsColorMaterial

Description: render mesh normals as colors

> Inputs

- **Render** (Trigger)
 - **Absolute** (Number: Boolean)
 - **World Space** (Number: Boolean)

< Output

- **Trigger** (Trigger)
 - **Shader** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.GlShader.AttributeAsColorMaterial>

71.2 BasicMaterial v3



Full Name: Ops.Gl.Shader.BasicMaterial v3

Description: A material without shading

> Inputs

- **Render** (Trigger)
 - **R** (Number)
 - **G** (Number)
 - **B** (Number)
 - **A** (Number)
 - **Texture** (Object:Texture)
 - **ColorizeTexture** (Number: Boolean)
 - **Vertex Colors** (Number: Boolean)
 - **TextureOpacity** (Object:Texture)
 - **Opacity TexCoords Transform** (Number: Boolean)

- **Discard Transparent Pixels** (Number: Boolean)
 - **DiffuseRepeatX** (Number)
 - **DiffuseRepeatY** (Number)
 - **Tex Offset X** (Number)
 - **Tex Offset Y** (Number)
 - **Crop TexCoords** (Number: Boolean)
 - **Billboard** (Number: Boolean)

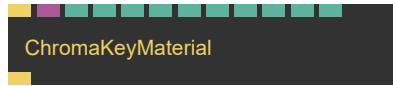
< Output

- **Trigger** (Trigger)
 - **Shader** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.GlShader.BasicMaterial_v3

71.3 ChromaKeyMaterial



Full Name: Ops.Gl.Shader.ChromaKeyMaterial

Description: display texture and replace a color with transparency

> Inputs

- **Render** (Trigger)
 - **Texture** (Object)
 - **Mode Index** (Number: Integer)
 - **WeightMul** (Number)
 - **R** (Number)
 - **G** (Number)
 - **B** (Number)
 - **White** (Number)
 - **DiffuseRepeatX** (Number)
 - **DiffuseRepeatY** (Number)
 - **Tex Offset X** (Number)
 - **Tex Offset Y** (Number)

< Output

- Trigger (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Shader.ChromaKeyMaterial>

71.4 CustomShader_v2



Full Name: Ops.Gl.Shader.CustomShader_v2

Description: Write your own custom shader

> Inputs

- **Render** (Trigger)
- **Fragment Code** (String)
- **Vertex Code** (String)
- **Use As Material** (Number: Boolean)
- **W** (Number)
- **H** (Number)
- **GPosition** (Object)
- **GNormal** (Object)
- **TexNoise** (Object)
- **Samples** (Array)
- **Projection** (Array)

< Output

- **Trigger** (Trigger)
- **Shader** (Object)
- **Has Errors** (booleanNumber)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Shader.CustomShader_v2

71.5 ErrorMaterial



Full Name: Ops.Gl.Shader.ErrorMaterial

Description: draw meshes using the cables error material shader

> Inputs

- **Render** (Trigger)

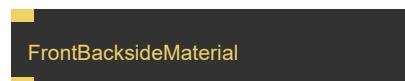
< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Shader.ErrorMaterial>

71.6 FrontBacksideMaterial



Full Name: Ops.Gl.Shader.FrontBacksideMaterial

Description: visualize which faces are facing the camera

> Inputs

- **Render** (Trigger)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Shader.FrontBacksideMaterial>

71.7 GetShader



Full Name: Ops.Gl.Shader.GetShader

Description: get current set shader

> Inputs

- **Update** (Trigger)

< Output

- **Next** (Trigger)
- **Shader** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Shader.GetShader>

71.8 MatCapMaterial_v3



Full Name: Ops.Gl.Shader.MatCapMaterial_v3

Description: Easy to use image based lighting Material

> Inputs

- **Render** (Trigger)
- **MatCap** (Object:Texture)

- **Diffuse** (Object:Texture)
- **Normal** (Object:Texture)
- **Specular Mask** (Object:Texture)
- **Specular MatCap** (Object:Texture)
- **AO Texture** (Object:Texture)
- **Opacity Texture** (Object:Texture)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **Opacity** (Number)
- **AO Intensity** (Number)
- **Normal Map Intensity** (Number)
- **Repeat X** (Number)
- **Repeat Y** (Number)
- **Offset X** (Number)
- **Offset Y** (Number)
- **Double Sided** (Number: Boolean)
- **Screen Space Normals** (Number: Boolean)
- **check to use screen space normals** (flat shading)
- **Calc Normal Tangents** (Number: Boolean)
- **Opacity TexCoords Transform** (Number: Boolean)
- **Discard Transparent Pixels** (Number: Boolean)

< Output

- **Next** (Trigger)
- **Shader** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Shader.MatCapMaterial_v3

71.9 MinifyGlsl



Full Name: Ops.Gl.Shader.MinifyGlsl

Description: Minify GLSL shader source code

> Inputs

- **Shader Source** (String)

< Output

- **Minified Shader Source** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Shader.MinifyGlsl>

71.10 PointMaterial_v6



Full Name: Ops.Gl.Shader.PointMaterial_v6

Description: Draw all vertices as points / circles

> Inputs

- **Render** (Trigger)
- **PointSize** (Number)
- **Size In Pixels** (Number: Boolean)
- **Random Size** (Number)
- **Round** (Number: Boolean)
- **Round Antialias** (Number: Boolean)
- **Scale By Distance** (Number: Boolean)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)
- **Vertex Colors** (Number: Boolean)
- **Texture** (Object:Texture)
- **Colorize Texture** (Number: Boolean)
- **Texture Mask** (Object:Texture)
- **Texture Colorize** (Object:Texture)
- **Colorize Randomize** (Number: Boolean)
- **Texture Opacity** (Object:Texture)
- **Texture Point Size** (Object:Texture)
- **Texture Point Size Mul** (Number)
- **Flip Texture** (Number: Boolean)
- **Atlas Cross Fade** (Number: Boolean)
- **Atlas Repeat X** (Number)
- **Atlas Lookup** (Object:Texture)
- **Rotate Texture** (Object:Texture)
- **Min Point Size** (Number)

< Output

- **Trigger** (Trigger)
- **Shader** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Shader.PointMaterial_v6

71.11 PositionAsColorMaterial



PositionAsColorMaterial

Full Name: Ops.Gl.Shader.PositionAsColorMaterial

Description: draw meshes using XYZ position coordinates as RGB color

> Inputs

- **Render** (Trigger)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Shader.PositionAsColorMaterial>

71.12 SetShader



SetShader

Full Name: Ops.Gl.Shader.SetShader

Description: Reuse another shader at different points in the patch.

> Inputs

- **Render** (Trigger)
- **Shader** (Object)

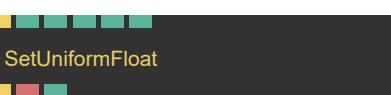
< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Shader.SetShader>

71.13 SetUniformFloat_v2



SetUniformFloat

Full Name: Ops.Gl.Shader.SetUniformFloat_v2

Description: set a uniform value of the current shader

> Inputs

- **Render** (Trigger)

- **Uniform Index** (Number: Integer)

- **X** (Number)

- **Y** (Number)

- **Z** (Number)

- **W** (Number)

< Output

- **Next** (Trigger)

- **Type** (String)

- **Found** (booleanNumber)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Shader.SetUniformFloat_v2

71.14 SetUniformTexture_v2



SetUniformTexture

Full Name: Ops.Gl.Shader.SetUniformTexture_v2

Description: set a uniform value of the current shader

> Inputs

- **Render** (Trigger)
- **Uniform Index** (Number: Integer)
- **Texture** (Object:Texture)

< Output

- **Next** (Trigger)
- **Found** (booleanNumber)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Shader.SetUniformTexture_v2

71.15 ShaderDefine



ShaderDefine

Full Name: Ops.Gl.Shader.ShaderDefine

Description: Set shader defines

> Inputs

- **Shader** (Object)
- **Name** (String)

- **Value** (String)
- **Active** (Number: Boolean)
- **Public** (4): 1

< Output

- Visit `Ops.Gl.Shader.ShaderDefine` documentation for output port details

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Shader.ShaderDefine>

71.16 ShaderInfo



Full Name: Ops.Gl.Shader.ShaderInfo

Description: view current shader source code

> Inputs

- **Exec** (Trigger)
- **Show Fragment** (Trigger)
- **Show Vertex** (Trigger)
- **Show Modules** (Trigger)
- **Show Uniforms** (Trigger)
- **State Info** (Trigger)

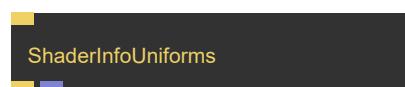
< Output

- **Next** (Trigger)
- **Source Frag** (String)
- **Source Vert** (String)
- **Name** (String)
- **Id** (String)
- **NeedsBarycentric** (booleanNumber)
- **Num Uniforms** (Number)
- **Num Attributes** (Number)
- **Attributes Names** (Array)
- **Num Defines** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Shader.ShaderInfo>

71.17 ShaderInfoUniforms_v2



Full Name: Ops.Gl.Shader.ShaderInfoUniforms_v2

Description: read back all uniforms values of the current bound shader

> Inputs

- **Exec** (Trigger)

< Output

- **Next** (Trigger)
- **Uniforms** (Array)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Shader.ShaderInfoUniforms_v2

71.18 ShaderToTexture_v2



Full Name: Ops.Gl.Shader.ShaderToTexture_v2

Description: render a shader into a texture

> Inputs

- **Render** (Trigger)
- **Shader** (Object:Shader)
- **Width** (Number: Integer)
- **Height** (Number: Integer)
- **Filter Index** (Number: Integer)
- **Wrap Index** (Number: Integer)
- **PixelFormat Index** (Number: Integer)

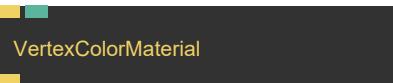
< Output

- **Next** (Trigger)
- **Texture** (Object)
- **Texture 2** (Object)
- **Texture 3** (Object)
- **Texture 4** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Shader.ShaderToTexture_v2

71.19 VertexColorMaterial



Full Name: Ops.Gl.Shader.VertexColorMaterial

Description: Draw a mesh, showing only its vertex colors

> Inputs

- **Render** (Trigger)
- **Opacity** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Shader.VertexColorMaterial>

• **Enable Depth Testing** (Number: Boolean)

- **Width** (Number)
- **AntiAlias** (Number)
- **Diffuse R** (Number)
- **Diffuse G** (Number)
- **Diffuse B** (Number)
- **Diffuse A** (Number)
- **Fill** (Number: Boolean)
- **Fill R** (Number)
- **Fill G** (Number)
- **Fill B** (Number)
- **Fill A** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Shader.WireframeMaterial_v2

71.20 VertexNumberMaterial



Full Name: Ops.Gl.Shader.VertexNumberMaterial

Description: visually debug vertices of your 3D geometry

> Inputs

- **Render** (Trigger)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Shader.VertexNumberMaterial>

71.21 WireframeMaterial_v2



Full Name: Ops.Gl.Shader.WireframeMaterial_v2

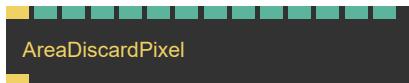
Description: Renders following meshes as wireframes

> Inputs

- **Render** (Trigger)

72 Ops.Gl.ShaderEffects

72.1 AreaDiscardPixel_v2



Full Name: Ops.Gl.ShaderEffects.AreaDiscardPixel_v2

Description: do not draw pixels inside a defined 3d area

> Inputs

- **Render** (Trigger)
- **Invert** (Number: Boolean)
- **Area Index** (Number: Integer)
- **Area** (Number: String)
- **Size** (Number)
- **Size X** (Number)
- **Size Y** (Number)
- **Size Z** (Number)
- **Repeat** (Number: Boolean)
- **Repeat Distance** (Number)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **WorldSpace** (Number: Boolean)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ShaderEffects.AreaDiscardPixel_v2

72.2 AreaRotate_v2



Full Name: Ops.Gl.ShaderEffects.AreaRotate_v2

Description: rotate vertices in an area around a center point

> Inputs

- **Render** (Trigger)
- **Size** (Number)
- **Strength** (Number)
- **Smooth** (Number: Boolean)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ShaderEffects.AreaRotate_v2

72.3 AreaScaler_v3



Full Name: Ops.Gl.ShaderEffects.AreaScaler_v3

Description: Scales the size of meshes within the area of influence

> Inputs

- **Render** (Trigger)
- **Area Size** (Number)
- **Source Index** (Number: Integer)
- **Strength** (Number)
- **Smoothstep** (Number: Boolean)
- **Min Size Original** (Number: Boolean)
- **Clamp Size** (Number: Boolean)
- **Clamp Min** (Number)
- **Clamp Max** (Number)
- **Pos X** (Number)
- **Pos Y** (Number)
- **Pos Z** (Number)

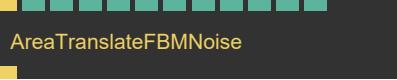
< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ShaderEffects.AreaScaler_v3

72.4 AreaTranslateFBMNoise



AreaTranslateFBMNoise

Full Name: Ops.Gl.ShaderEffects.AreaTranslateFBMNoise

Description: Area size of noise

> Inputs

- **Render** (Trigger)
- **Mode Index** (Number: Integer)
- **Size** (Number)
- **Strength** (Number)
- **Smooth** (Number: Boolean)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **Noise Scale** (Number)
- **Noise X** (Number)
- **Noise Y** (Number)
- **Noise Z** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ShaderEffects.AreaTranslateFBMNoise>

72.5 AreaTranslateMeshes_v3



AreaTranslateMeshes

Full Name: Ops.Gl.ShaderEffects.AreaTranslateMeshes_v3

Description: Change the position of all meshes inside of the area of influence

> Inputs

- **Render** (Trigger)
- **Size** (Number)
- **Strength** (Number)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **Multiply X** (Number)

- **Multiply Y** (Number)
- **Multiply Z** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ShaderEffects.AreaTranslateMeshes_v3

72.6 Bend_v2



Bend

Full Name: Ops.Gl.ShaderEffects.Bend_v2

Description: bend objects along an axis

> Inputs

- **Render** (Trigger)
- **Amount** (Number)
- **RotX** (Number)
- **RotY** (Number)
- **RotZ** (Number)
- **Scale** (Number)
- **Offset** (Number)
- **Limited** (Number: Boolean)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ShaderEffects.Bend_v2

72.7 ClampVertexPosition_v2



ClampVertexPosition

Full Name: Ops.Gl.ShaderEffects.ClampVertexPosition_v2

Description: clamp/restrict the vertex position to min/max values per axis

> Inputs

- **Render** (Trigger)
- **Axis Index** (Number: Integer)
- **Min** (Number)

- **Max** (Number)
- **Update Normals** (Number: Boolean)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ShaderEffects.ClampVertexPosition_v2

72.8 ColorArea_v5



Full Name: Ops.Gl.ShaderEffects.ColorArea_v5

Description: Colorize all meshes around current position

> Inputs

- **Render** (Trigger)
- **Area Index** (Number: Integer)
- **Size** (Number)
- **Roundness** (Number)
- **Amount** (Number)
- **Falloff** (Number)
- **Invert** (Number: Boolean)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **Change Size** (Number: Boolean)
- **Size X** (Number)
- **Size Y** (Number)
- **Size Z** (Number)
- **Texture** (Object:Texture)
- **Priority** (Number: Boolean)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ShaderEffects.ColorArea_v5

72.9 DeformArea



Full Name: Ops.Gl.ShaderEffects.DeformArea

Description: deform a spherical area of a mesh

> Inputs

- **Render** (Trigger)
- **Size** (Number)
- **Strength** (Number)
- **Smooth** (Number: Boolean)
- **WorldSpace** (Number: Boolean)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)

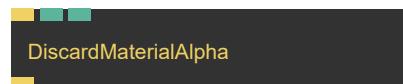
< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ShaderEffects.DeformArea>

72.10 DiscardMaterialAlpha



Full Name: Ops.Gl.ShaderEffects.DiscardMaterialAlpha

Description: discard transparent pixels in material textures

> Inputs

- **Render** (Trigger)
- **Method Index** (Number: Integer)
- **Threshold** (Number)

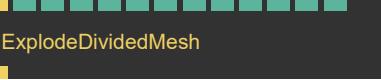
< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ShaderEffects.DiscardMaterialAlpha>

72.11 ExplodeDividedMesh_v2



ExplodeDividedMesh

Full Name: Ops.Gl.ShaderEffects.ExplodeDividedMesh_v2

Description: explode a (divided) mesh in the direction of faces normals

> **Inputs**

- **Render** (Trigger)
- **Distance** (Number)
- **Size** (Number)
- **Absolute** (Number: Boolean)
- **Add X** (Number)
- **Add Y** (Number)
- **Add Z** (Number)
- **Mul X** (Number)
- **Mul Y** (Number)
- **Mul Z** (Number)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)

< **Output**

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ShaderEffects.ExplodeDividedMesh_v2

72.12 FogEffect



FogEffect

Full Name: Ops.Gl.ShaderEffects.FogEffect

Description: Fog as a shadereffect applied to a material

> **Inputs**

- **Render** (Trigger)
- **Mode Index** (Number: Integer)
- **Start** (Number)
- **End** (Number)
- **Amount** (Number)
- **R** (Number)

- **G** (Number)
- **B** (Number)

< **Output**

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ShaderEffects.FogEffect>

72.13 FresnelGlow



FresnelGlow

Full Name: Ops.Gl.ShaderEffects.FresnelGlow

Description: add fresnel glow to any material

> **Inputs**

- **Trigger In** (Trigger)
- **Active** (Number: Boolean)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **Fresnel Intensity** (Number)
- **Fresnel Exponent** (Number)

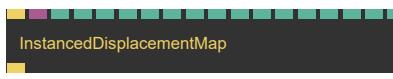
< **Output**

- **Trigger Out** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ShaderEffects.FresnelGlow>

72.14 InstancedDisplacementMap_v2



InstancedDisplacementMap

Full Name: Ops.Gl.ShaderEffects.InstancedDisplacementMap_v2

Description: displace positions of instanced meshes using a texture

> **Inputs**

- **Trigger** (Trigger)
- **Texture** (Object:Texture)
- **Source Index** (Number: Integer)
- **Mode Index** (Number: Integer)

- **Strength** (Number)
- **Min** (Number)
- **Scale** (Number)
- **Clamp** (Number: Boolean)
- **Colorize** (Number: Boolean)
- **Debug Bounds** (Number: Boolean)
- **Normalize** (Number: Boolean)
- **Offset X** (Number)
- **Offset Y** (Number)
- **Abs** (Number: Boolean)
- **Channel Index** (Number: Integer)
- **X** (Number: Boolean)
- **Y** (Number: Boolean)
- **Z** (Number: Boolean)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ShaderEffects.InstancedDisplacementMap_v2

72.15 InstancedPerlinPosition_v2



Full Name: Ops.Gl.ShaderEffects.InstancedPerlinPosition_v2

Description: displace position of instanced object by perlin noise value

> Inputs

- **Render** (Trigger)
- **Strength** (Number)
- **Scroll X** (Number)
- **Scroll Y** (Number)
- **Scroll Z** (Number)
- **Scale** (Number)
- **Method Index** (Number: Integer)
- **Method** (String)
- **Mul X** (Number)
- **Mul Y** (Number)
- **Mul Z** (Number)
- **Min Scale** (Number)

- **WorldSpace** (Number: Boolean)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ShaderEffects.InstancedPerlinPosition_v2

72.16 InstancedTextureColorize



Full Name: Ops.Gl.ShaderEffects.InstancedTextureColorize

Description: colorize instanced meshes using a texture

> Inputs

- **Trigger** (Trigger)
- **Texture** (Object:Texture)
- **Strength** (Number)
- **Scale** (Number)
- **Clamp** (Number: Boolean)
- **Debug Bounds** (Number: Boolean)
- **Offset X** (Number)
- **Offset Y** (Number)
- **Method Index** (Number: Integer)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ShaderEffects.InstancedTextureColorize>

72.17 LimitMeshByTexCoord



Full Name: Ops.Gl.ShaderEffects.LimitMeshByTexCoord

Description: discard pixel if texture coordinate is below threshold

> Inputs

- **Render** (Trigger)
- **Axis Index** (Number: Integer)
- **Threshold** (Number)

- **Sine Animation** (Number: Boolean)
- **Time** (Number)
- **Sine Source Index** (Number: Integer)
- **Frequency** (Number)
- **Amplitude** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ShaderEffects.LimitMeshByTexCoord>

72.18 MeshPixelNoise_v2



Full Name: Ops.Gl.ShaderEffects.MeshPixelNoise_v2

Description: 3d space noise for mesh materials

> Inputs

- **Render** (Trigger)
- **Scale** (Number)
- **Amount** (Number)
- **Blendmode Index** (Number: Integer)
- **Blendmode** (String)
- **WorldSpace** (Number: Boolean)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ShaderEffects.MeshPixelNoise_v2

72.19 ModuloVertexPosition



ModuloVertexPosition

Full Name: Ops.Gl.ShaderEffects.ModuloVertexPosition

Description: vertex shader modulo operation on vertex position

> Inputs

- **Render** (Trigger)
- **Axis Index** (Number: Integer)
- **Modulo** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ShaderEffects.ModuloVertexPosition>

72.20 PerlinAreaDeform_v4



Full Name: Ops.Gl.ShaderEffects.PerlinAreaDeform_v4

Description: Displace vertices using perlin noise animation

> Inputs

- **Render** (Trigger)
- **Scale** (Number)
- **Size** (Number)
- **Strength** (Number)
- **Calc Normals** (Number: Boolean)
- **Flip Normals** (Number: Boolean)
- **Falloff** (Number)
- **Output Index** (Number: Integer)
- **Source Index** (Number: Integer)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **Scroll X** (Number)
- **Scroll Y** (Number)
- **Scroll Z** (Number)
- **WorldSpace** (Number: Boolean)

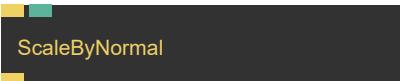
< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ShaderEffects.PerlinAreaDeform_v4

72.21 ScaleByNormal_v2



Full Name: Ops.Gl.ShaderEffects.ScaleByNormal_v2

Description: Scale vertices of an object in the direction of face normals

> Inputs

- **Render** (Trigger)
- **Strength** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ShaderEffects.ScaleByNormal_v2

72.22 Shadow_v3



Full Name: Ops.Gl.ShaderEffects.Shadow_v3

Description: add shadow capabilities to any material

> Inputs

- **Trigger In** (Trigger)
- **Cast Shadow** (Number: Boolean)
- **Receive Shadow** (Number: Boolean)
- **Sample Distribution** (Number: Integer)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **Discard Transparent** (Number: Boolean)
- **Opacity Threshold** (Number)
- **Opacity Texture** (Object:Texture)
- **Cull Backfacing** (Number: Boolean)

< Output

- **Trigger Out** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ShaderEffects.Shadow_v3

72.23 SplineDeform_v2



Full Name: Ops.Gl.ShaderEffects.SplineDeform_v2

Description: Deform a mesh along a spline

> Inputs

- **Render** (Trigger)
- **Size** (Number)
- **Offset** (Number)
- **Points** (Array)

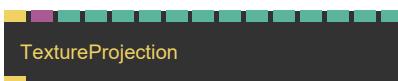
< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ShaderEffects.SplineDeform_v2

72.24 TextureProjection_v2



Full Name: Ops.Gl.ShaderEffects.TextureProjection_v2

Description: texture projection on meshes

> Inputs

- **Render** (Trigger)
- **Texture** (Object:Texture)
- **BlendMode Index** (Number: Integer)
- **Amount** (Number)
- **Scale** (Number)
- **Use Texture Alpha** (Number: Boolean)
- **Pos X** (Number)
- **Pos Y** (Number)
- **Rot X** (Number)
- **Rot Y** (Number)
- **Rot Z** (Number)
- **Mapping Index** (Number: Integer)
- **Discard** (Number: Boolean)
- **WorldSpace** (Number: Boolean)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ShaderEffects.TextureProjection_v2

72.25 TransformTextureCoordinates



Full Name: Ops.Gl.ShaderEffects.TransformTextureCoordinates

Description: Transform and repeat texture coordinates of a mesh via vertex shader

> Inputs

- **Render** (Trigger)
- **Translate X** (Number)
- **Translate Y** (Number)
- **Repeat X** (Number)
- **Repeat Y** (Number)
- **Flip X** (Number: Boolean)
- **Flip Y** (Number: Boolean)
- **Rotation** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ShaderEffects.TransformTextureCoordinates>

72.26 TransformVertex



Full Name: Ops.Gl.ShaderEffects.TransformVertex

Description: transform vertices of a mesh via vertex shader

> Inputs

- **Render** (Trigger)
- **Translate X** (Number)
- **Translate Y** (Number)
- **Translate Z** (Number)

- **Scale X** (Number)
- **Scale Y** (Number)
- **Scale Z** (Number)
- **Rotation X** (Number)
- **Rotation Y** (Number)
- **Rotation Z** (Number)
- **Transform Normals** (Number: Boolean)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ShaderEffects.TransformVertex>

72.27 Twist_v3



Full Name: Ops.Gl.ShaderEffects.Twist_v3

Description: twist a mesh around an axis

> Inputs

- **Render** (Trigger)
- **Degree** (Number)
- **Height** (Number)
- **Axis Index** (Number: Integer)
- **Axis** (Number: String)

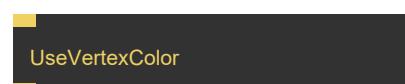
< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ShaderEffects.Twist_v3

72.28 UseVertexColor



Full Name: Ops.Gl.ShaderEffects.UseVertexColor

Description: Use vertex color as basecolor/diffuse color

> Inputs

- **Render** (Trigger)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ShaderEffects.UseVertexColor>

72.29 VertexArea



Full Name: Ops.Gl.ShaderEffects.VertexArea

Description: transform an area of a mesh

> Inputs

- **Render** (Trigger)
- **Area Index** (Number: Integer)
- **Visualize Area** (Number: Boolean)
- **WorldSpace** (Number: Boolean)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **Radius** (Number)
- **Area Size X** (Number)
- **Area Size Y** (Number)
- **Area Size Z** (Number)
- **Translate X** (Number)
- **Translate Y** (Number)
- **Translate Z** (Number)
- **Scale X** (Number)
- **Scale Y** (Number)
- **Scale Z** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ShaderEffects.VertexArea>

72.30 VertexColorAsAlpha



Full Name: Ops.Gl.ShaderEffects.VertexColorAsAlpha

Description: Use mesh vertexcolor as Alpha/Opacity

> Inputs

- **Render** (Trigger)
- **Input Index** (Number: Integer)
- **Invert** (Number: Boolean)

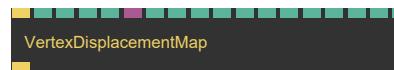
< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.ShaderEffects.VertexColorAsAlpha>

72.31 VertexDisplacementMap_v5



Full Name: Ops.Gl.ShaderEffects.VertexDisplacementMap_v5

Description: Displace the vertices of a mesh with the pixels brightness values from a texture

> Inputs

- **Render** (Trigger)
- **Extrude** (Number)
- **Texture** (Object:Texture)
- **Offset X** (Number)
- **Offset Y** (Number)
- **Scale** (Number)
- **Calc Normals** (Number: Boolean)
- **Discard Zero Values** (Number: Boolean)
- **Colorize** (Number: Boolean)
- **Colorize Min** (Number)
- **Colorize Max** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ShaderEffects.VertexDisplacementMap_v5

72.32 VertexNumberLimit_v2



Full Name: Ops.Gl.ShaderEffects.VertexNumberLimit_v2

Description: only draw the first X vertices of a mesh

> **Inputs**

- **Render** (Trigger)
- **Min** (Number: Integer)
- **Max** (Number: Integer)
- **Invert** (Number: Boolean)

< **Output**

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ShaderEffects.VertexNumberLimit_v2

72.33 VertexPositionFromTexture_v2



Full Name: Ops.Gl.ShaderEffects.VertexPositionFromTexture_v2

Description: set vertex positions of a mesh from a texture

> **Inputs**

- **Render** (Trigger)
- **Texture** (Object:Texture)
- **Mode Index** (Number: Integer)

< **Output**

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ShaderEffects.VertexPositionFromTexture_v2

72.34 VertexWobble_v2



Full Name: Ops.Gl.ShaderEffects.VertexWobble_v2

Description: sine wave vertex displacement

> **Inputs**

- **Render** (Trigger)
- **Source Index** (Number: Integer)
- **Amount** (Number)
- **Time** (Number)
- **Scale** (Number)
- **AxisX** (Number: Boolean)
- **AxisY** (Number: Boolean)
- **AxisZ** (Number: Boolean)
- **Area Index** (Number: Integer)
- **Size** (Number)
- **Falloff** (Number)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **WorldSpace** (Number: Boolean)
- **Invert** (Number: Boolean)

< **Output**

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.ShaderEffects.VertexWobble_v2

73 Ops.Gl.Textures

73.1 Base64ToTexture



Full Name: Ops.Gl.Textures.Base64ToTexture

Description: Converts a base-64 image string into a texture

> Inputs

- **Wrap Index** (Number: Integer)
- **Pre Multiplied Alpha** (Number: Boolean)

< Output

- **Texture** (Object)
- **Has Error** (booleanNumber)
- **Loading** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Textures.Base64ToTexture>

73.2 ColorTexture



Full Name: Ops.Gl.Textures.ColorTexture

Description: Simple texture filled with one color

> Inputs

- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)

< Output

- **Texture_out** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Textures.ColorTexture>

73.3 CombineTextures



Full Name: Ops.Gl.Textures.CombineTextures

Description: combine multiple textures into one by copying colorchannels

> Inputs

- **Execute** (Trigger)
- **Filter Index** (Number: Integer)
- **Wrap Index** (Number: Integer)
- **PixelFormat Index** (Number: Integer)
- **Size Index** (Number: Integer)
- **R** (Object:Texture)
- **R Source Index** (Number: Integer)
- **R Value Index** (Number: Integer)
- **R Default** (Number)
- **G** (Object:Texture)
- **G Source Index** (Number: Integer)
- **G Value Index** (Number: Integer)
- **G Default** (Number)
- **B** (Object:Texture)
- **B Source Index** (Number: Integer)
- **B Value Index** (Number: Integer)
- **B Default** (Number)
- **A** (Object:Texture)
- **A Source Index** (Number: Integer)
- **A Value Index** (Number: Integer)
- **A Default** (Number)

< Output

- **Next** (Trigger)
- **Texture** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Textures.CombineTextures>

73.4 CopyTexture_v3



Full Name: Ops.Gl.Textures.CopyTexture_v3

Description: copy a texture and optionally resize it

> Inputs

- **Render** (Trigger)
- **Texture** (Object:Texture)
- **Alpha Mask** (Object:Texture)
- **Use Original Size** (Number: Boolean)
- **Width** (Number: Integer)
- **Height** (Number: Integer)
- **Pixel Format Index** (Number: Integer)
- **Wrap Index** (Number: Integer)
- **Invert A** (Number: Boolean)
- **Flip X** (Number: Boolean)
- **Flip Y** (Number: Boolean)

< Output

- **Trigger** (Trigger)
- **Texture_out** (Object)
- **Aspect Ratio** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Textures.CopyTexture_v3

73.5 EmptyTexture



Full Name: Ops.Gl.Textures.EmptyTexture

Description: A very simple empty transparent texture with an opacity of 0

> Inputs

- **Width** (Number)
- **Height** (Number)

< Output

- **Texture** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Textures.EmptyTexture>

73.6 ExrTexture



Full Name: Ops.Gl.Textures.ExrTexture

Description: load .exr floating point texture files

> Inputs

- **EXR File** (String)
- **Remove Alpha** (Number: Boolean)
- **Flip** (Number: Boolean)

< Output

- **Texture** (Object)
- **Width** (Number)
- **Height** (Number)
- **Channels** (String)
- **Loading** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Textures.ExrTexture>

73.7 GraphTexture



Full Name: Ops.Gl.Textures.GraphTexture

Description: draw a graph of a value into a texture

> Inputs

- **Trigger** (Trigger)
- **Value** (Number)
- **Index** (Number: Integer)
- **Reset** (Trigger)
- **Color Random Seed** (Number)
- **Texture Width** (Number: Integer)
- **Texture Height** (Number: Integer)

< Output

- **Texture** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Textures.GraphTexture>

73.8 Histogram



Full Name: Ops.Gl.Textures.Histogram

Description: graphical representation of distribution of color in a texture

> Inputs

- **Trigger** (Trigger)
- **Texture** (Object:Texture)

< Output

- **Histogram Texture** (Object)
- **Histogram Data** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Textures.Histogram>

73.9 MontageTextures_v2



Full Name: Ops.Gl.Textures.MontageTextures_v2

Description: combine multiple textures into one by copying colorchannels

> Inputs

- **Execute** (Trigger)
- **Flip Order** (Number: Boolean)
- **Width** (Number: Integer)
- **Height** (Number: Integer)
- **Wrap Index** (Number: Integer)
- **PixelFormat Index** (Number: Integer)
- **Texture 0** (Object:Texture)
- **Texture 1** (Object:Texture)
- **Texture 2** (Object:Texture)
- **Texture 3** (Object:Texture)
- **Texture 4** (Object:Texture)
- **Texture 5** (Object:Texture)
- **Texture 6** (Object:Texture)
- **Texture 7** (Object:Texture)
- **Texture 8** (Object:Texture)
- **Texture 9** (Object:Texture)
- **Texture 10** (Object:Texture)

- **Texture 11** (Object:Texture)
- **Texture 12** (Object:Texture)
- **Texture 13** (Object:Texture)
- **Texture 14** (Object:Texture)
- **Texture 15** (Object:Texture)

< Output

- **Next** (Trigger)
- **Texture** (Object)
- **Columns** (Number)
- **Rows** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Textures.MontageTextures_v2

73.10 NoiseTexture



Full Name: Ops.Gl.Textures.NoiseTexture

Description: Simple noisetexture

> Inputs

- **Width** (Number: Integer)
- **Height** (Number: Integer)
- **Wrap Index** (Number: Integer)
- **Color** (Number: Boolean)
- **PixelFormat Index** (Number: Integer)
- **Integer** (Number: Boolean)
- **Seed** (Number)
- **Channel R** (Number: Boolean)
- **Min R** (Number)
- **Max R** (Number)
- **Channel G** (Number: Boolean)
- **Min G** (Number)
- **Max G** (Number)
- **Channel B** (Number: Boolean)
- **Min B** (Number)
- **Max B** (Number)
- **Channel A** (Number: Boolean)
- **Min A** (Number)
- **Max A** (Number)

< Output

- **Texture** (Object)
- **Total Pixel** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Textures.NoiseTexture>

73.11 PaletteTexture



Full Name: Ops.Gl.Textures.PaletteTexture

Description: Create a RGB color palette using an array

> Inputs

- **Palette Array** (Array)
- **Smooth** (Number: Boolean)

< Output

- **Color Array** (Array)
- **Texture** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Textures.PaletteTexture>

73.12 SequenceTextures



Full Name: Ops.Gl.Textures.SequenceTextures

Description: control order and flow of objects

> Inputs

- **Texture 0** (Object:Texture)
- **Texture 1** (Object:Texture)
- **Texture 2** (Object:Texture)
- **Texture 3** (Object:Texture)
- **Texture 4** (Object:Texture)
- **Texture 5** (Object:Texture)
- **Texture 6** (Object:Texture)
- **Texture 7** (Object:Texture)
- **Texture 8** (Object:Texture)
- **Texture 9** (Object:Texture)

- **Texture 10** (Object:Texture)
- **Texture 11** (Object:Texture)
- **Texture 12** (Object:Texture)
- **Texture 13** (Object:Texture)
- **Texture 14** (Object:Texture)
- **Texture 15** (Object:Texture)

< Output

- **Output 0** (Object)
- **Output 1** (Object)
- **Output 2** (Object)
- **Output 3** (Object)
- **Output 4** (Object)
- **Output 5** (Object)
- **Output 6** (Object)
- **Output 7** (Object)
- **Output 8** (Object)
- **Output 9** (Object)
- **Output 10** (Object)
- **Output 11** (Object)
- **Output 12** (Object)
- **Output 13** (Object)
- **Output 14** (Object)
- **Output 15** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Textures.SequenceTextures>

73.13 SSAO



Full Name: Ops.Gl.Textures.SSAO

Description: screen space ambient occlusion from depth texture

> Inputs

- **Execute** (Trigger)
- **Depth Texture** (Object:Texture)
- **Radius** (Number)
- **Max Dist** (Number)
- **Begin** (Number)
- **End** (Number)

- **Strength** (Number)
- **Base** (Number)
- **Filter Index** (Number: Integer)

◀ Output

- **Next** (Trigger)
- **SSAO** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Textures.SSAO>

73.14 SwitchTextureMultiPort_v2



Full Name: Ops.Gl.Textures.SwitchTextureMultiPort_v2

Description: Switch between multiple textures

➢ Inputs

- **Index** (Number: Integer)
- **Textures_0** (Object)
- **Add Port** (Object)

◀ Output

- **Texture** (Object)
- **Num Textures** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Textures.SwitchTextureMultiPort_v2

73.15 SwitchTextures_v2



Full Name: Ops.Gl.Textures.SwitchTextures_v2

Description: Switch between different textures

➢ Inputs

- **Exec** (Trigger)
- **Num** (Number: Integer)
- **Default Texture Transparent** (Number: Boolean)
- **Texture0** (Object:Texture)
- **Texture1** (Object:Texture)

- **Texture2** (Object:Texture)
- **Texture3** (Object:Texture)
- **Texture4** (Object:Texture)
- **Texture5** (Object:Texture)
- **Texture6** (Object:Texture)
- **Texture7** (Object:Texture)
- **Texture8** (Object:Texture)
- **Texture9** (Object:Texture)
- **Texture10** (Object:Texture)
- **Texture11** (Object:Texture)
- **Texture12** (Object:Texture)
- **Texture13** (Object:Texture)
- **Texture14** (Object:Texture)
- **Texture15** (Object:Texture)

◀ Output

- **Next** (Trigger)
- **Texture** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Textures.SwitchTextures_v2

73.16 TextTexture_v6



Full Name: Ops.Gl.Textures.TextTexture_v6

Description: Generates a texture of Text using one of the font ops

➢ Inputs

- **Render** (Trigger)
- **Text** (String)
- **Draw Mesh** (Number: Boolean)
- **Scale Mesh** (Number)
- **Width** (Number: Integer)
- **Height** (Number: Integer)
- **Auto Height** (Number: Boolean)
- **Auto Line Breaks** (Number: Boolean)
- **Font** (String)
- **Weight** (String)
- **FontSize** (Number)
- **Letter Spacing** (Number)
- **Line Height Add** (Number)
- **Padding Y Top** (Number: Integer)

- **Padding Y Bottom** (Number: Integer)
- **Padding X** (Number: Integer)
- **Wrap Index** (Number: Integer)
- **Reuse Texture** (Number: Boolean)
- **Show Debug** (Number: Boolean)
- **Redraw On Font Load** (Number: Boolean)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **Opacity** (Number)
- **Background R** (Number)
- **Background G** (Number)
- **Background B** (Number)
- **Background A** (Number)
- **Force Redraw** (Trigger)

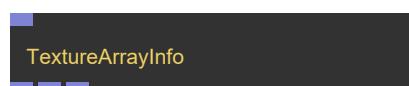
< Output

- **Next** (Trigger)
- **Ratio** (Number)
- **Texture** (Object)
- **Canvas** (Object)
- **Aspect** (Number)
- **Num Lines** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Textures.TextTexture_v6

73.17 TextureArrayInfo



Full Name: Ops.Gl.Textures.TextureArrayInfo

Description: Information about Textures in an array

> Inputs

- **Texture Array** (Array)

< Output

- **Names** (Array)
- **Widths** (Array)
- **Heights** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Textures.TextureArrayInfo>

73.18 TextureInfo_v2



Full Name: Ops.Gl.Textures.TextureInfo_v2

Description: Outputs information about the connected texture

> Inputs

- **Texture** (Object:Texture)

< Output

- **Name** (String)
- **PixelFormat** (String)
- **Width** (Number)
- **Height** (Number)
- **Ratio** (Number)
- **Filter** (Number)
- **Wrap** (Number)
- **Flipped** (booleanNumber)
- **HDR** (booleanNumber)
- **Is Empty Default Texture** (booleanNumber)
- **Is Default Texture** (booleanNumber)
- **Is Cubemap** (booleanNumber)
- **Id** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Textures.TextureInfo_v2

73.19 TextureSVG_v2



Full Name: Ops.Gl.Textures.TextureSVG_v2

Description: Load a SVG image and convert to a texture of pixels

> Inputs

- **File** (String)
- **Texture Width** (Number: Integer)
- **Texture Height** (Number: Integer)
- **Wrap Index** (Number: Integer)
- **Filter Index** (Number: Integer)

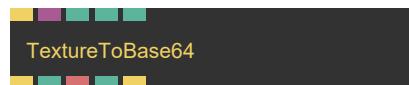
< Output

- **Texture** (Object)
- **Loaded** (booleanNumber)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Textures.TextureSVG_v2

73.20 TextureToBase64_v5



Full Name: Ops.Gl.Textures.TextureToBase64_v5

Description: Converts a texture into a base-64 image string

> Inputs

- **Trigger** (Trigger)
- **Texture** (Object:Texture)
- **Quality** (Number)
- **Output DataUrl** (Number: Boolean)

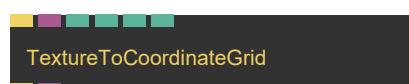
< Output

- **Next** (Trigger)
- **Binary Size** (Number)
- **Base64 String** (String)
- **Loading** (booleanNumber)
- **Finished** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Textures.TextureToBase64_v5

73.21 TextureToCoordinateGrid



Full Name: Ops.Gl.Textures.TextureToCoordinateGrid

Description: convert a texture to a 3d coordinate grid storing coordinates in texture RGB channels

> Inputs

- **Execute** (Trigger)
- **Texture** (Object:Texture)
- **Aspect** (Number)
- **Threshold** (Number)

- **Repeats** (Number: Integer)
- **Repeats Spacing** (Number)

< Output

- **Next** (Trigger)
- **HDR Texture** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Gl.Textures.TextureToCoordinateGrid>

73.22 VideoTexture_v3



Full Name: Ops.Gl.Textures.VideoTexture_v3

Description: Play a video file and use it as a texture

> Inputs

- **Update** (Trigger)
- **File** (String)
- **Play** (Number: Boolean)
- **Loop** (Number: Boolean)
- **Volume** (Number)
- **Mute** (Number: Boolean)
- **Update FPS** (Number)
- **Wrap Index** (Number: Integer)
- **Flip** (Number: Boolean)
- **Speed** (Number)
- **Set Time** (Number)
- **Rewind** (Trigger)
- **Preload** (Number: Boolean)
- **Show Interaction Needed Button** (Number: Boolean)

< Output

- **Next** (Trigger)
- **Texture** (Object)
- **Duration** (Number)
- **Progress** (Number)
- **Interaction Needed** (booleanNumber)
- **CurrentTime** (Number)
- **Loading** (booleanNumber)
- **Playing** (booleanNumber)
- **Can Play Through** (booleanNumber)

- **Width** (Number)
- **Height** (Number)
- **Aspect Ratio** (Number)
- **Has Error** (booleanNumber)
- **Auto FPS** (booleanNumber)
- **Error Message** (String)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Textures.VideoTexture_v3

- **Texture Updated** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Gl.Textures.WebcamTexture_v3

73.23 WebcamTexture_v3



Full Name: Ops.Gl.Textures.WebcamTexture_v3

Description: Use your webcam camera as a texture

> Inputs

- **Render** (Trigger)
- **Active** (Number: Boolean)
- **Generate Texture** (Number: Boolean)
- **Webcam Input Index** (Number: Integer)
- **Requested Width** (Number: Integer)
- **Requested Height** (Number: Integer)
- **Flip X** (Number: Boolean)
- **Flip Y** (Number: Boolean)
- **Show HTML Element** (Number: Boolean)
- **CSS** (String)
- **Element Flip X** (Number: Boolean)
- **Element Flip Y** (Number: Boolean)

< Output

- **Next** (Trigger)
- **Texture** (Object)
- **Ratio** (Number)
- **Available** (booleanNumber)
- **Size Width** (Number)
- **Size Height** (Number)
- **Error** (String)
- **HTML Element** (Object)
- **Available Devices** (Array)
- **Active Device** (String)

74 Ops.Graphics

Docs: <https://cables.gl/op/Ops.Graphics.DepthTest>

74.1 ArrayToExr



Full Name: Ops.Graphics.ArrayToExr

Description: convert and download an array of numbers as an .exr image file

> Inputs

- **Array** (Array)
- **Width** (Number: Integer)
- **Height** (Number: Integer)
- **ZIP Compression** (Number: Boolean)
- **Filename** (String)
- **Download** (Trigger)

< Output

- Visit *Ops.Graphics.ArrayToExr documentation* for output port details

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Graphics.ArrayToExr>

74.2 DepthTest



Full Name: Ops.Graphics.DepthTest

Description: change depth testing method (depth-
Mask,depthWrite,depthFunc)

> Inputs

- **Render** (Trigger)
- **Enable Depth Testing** (Number: Boolean)
- **Depth Test Method Index** (Number: Integer)
- **Write To Depth Buffer** (Number: Boolean)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

74.3 GeometryMergeSimple



Full Name: Ops.Graphics.GeometryMergeSimple

Description: merge two geometries into one

> Inputs

- **Geometry** (Object)
- **Geometry 2** (Object)

< Output

- **Geometry Result** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Graphics.GeometryMergeSimple>

74.4 GetMaterialId



Full Name: Ops.Graphics.GetMaterialId

Description: get the id/index of the current set material

> Inputs

- **Update** (Trigger)

< Output

- **Next** (Trigger)
- **Material Id** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Graphics.GetMaterialId>

74.5 GetObjectId



Full Name: Ops.Graphics.GetObjectId

Description: get the id/index of the current object/mesh

> Inputs

- **Update** (Trigger)

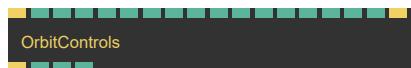
< Output

- **Next** (Trigger)
- **Material Id** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Graphics.GetObjectId>

74.6 OrbitControls_v3



Full Name: Ops.Graphics.OrbitControls_v3

Description: rotate your object by clicking and dragging the mouse

> Inputs

- **Render** (Trigger)
- **Min Distance** (Number)
- **Max Distance** (Number)
- **Min Rot Y** (Number)
- **Max Rot Y** (Number)
- **Initial Radius** (Number)
- **Initial Axis Y** (Number)
- **Initial Axis X** (Number)
- **Smoothness** (Number)
- **Speed X** (Number)
- **Speed Y** (Number)
- **Active** (Number: Boolean)
- **Allow Panning** (Number: Boolean)
- **Allow Zooming** (Number: Boolean)
- **Allow Rotation** (Number: Boolean)
- **Restricted** (Number: Boolean)
- **Identity** (Number: Boolean)
- **Reset** (Trigger)

< Output

- **Trigger** (Trigger)
- **Radius** (Number)
- **Rot X** (Number)
- **Rot Y** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Graphics.OrbitControls_v3

74.7 Transform



Full Name: Ops.Graphics.Transform

Description: Transform objects in 3d space (rotate, translate, scale)

> Inputs

- **Render** (Trigger)
- **PosX** (Number)
- **PosY** (Number)
- **PosZ** (Number)
- **Scale** (Number)
- **RotX** (Number)
- **RotY** (Number)
- **RotZ** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Graphics.Transform>

74.8 TransformView



Full Name: Ops.Graphics.TransformView

Description: the most simple camera op / transform the viewmatrix

> Inputs

- **Render** (Trigger)
- **PosX** (Number)
- **PosY** (Number)
- **PosZ** (Number)
- **Scale** (Number)
- **RotX** (Number)
- **RotY** (Number)

- **RotZ** (Number)

◀ Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Graphics.TransformView>

75 Ops.Graphics.Geometry

75.1 AlignGeometry



Full Name: Ops.Graphics.Geometry.AlignGeometry

Description: align a geometry / change its pivot / center / origin point

➢ Inputs

- **Geometry** (Object)
- **X Index** (Number: Integer)
- **Y Index** (Number: Integer)
- **Z Index** (Number: Integer)

◀ Output

- **Result** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Graphics.Geometry.AlignGeometry>

75.2 BoundingBox



Full Name: Ops.Graphics.Geometry.BoundingBox

Description: create a simple bounding box from width,height,depth

➢ Inputs

- **Width** (Number)
- **Height** (Number)
- **Depth** (Number)

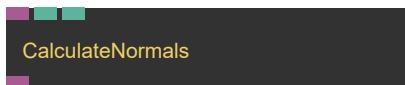
◀ Output

- **Result** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Graphics.Geometry.BoundingBox>

75.3 CalculateNormals



Full Name: Ops.Graphics.Geometry.CalculateNormals

Description: calculate normals of a geometry

> Inputs

- **Geometry** (Object)
- **Smooth** (Number: Boolean)
- **Force Z Up** (Number: Boolean)

< Output

- **Geometry Out** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Graphics.Geometry.CalculateNormals>

75.4 DivideGeometry



Full Name: Ops.Graphics.Geometry.DivideGeometry

Description: disconnect faces/polygons of a mesh

> Inputs

- **Geometry** (Object)

< Output

- **Result** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Graphics.Geometry.DivideGeometry>

75.5 FlipNormals



Full Name: Ops.Graphics.Geometry.FlipNormals

Description: flip all normals of a geometry

> Inputs

- **Geometry** (Object)
- **Flip** (Number: Boolean)
- **Normalize** (Number: Boolean)

< Output

- **Result** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Graphics.Geometry.FlipNormals>

75.6 FreezeMeshes



Full Name: Ops.Graphics.Geometry.FreezeMeshes

Description: capture all following meshes into one geometry

> Inputs

- **Capture** (Trigger)

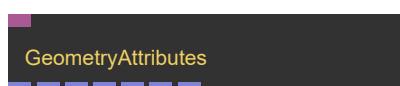
< Output

- **Geometry** (Object)
- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Graphics.Geometry.FreezeMeshes>

75.7 GeometryAttributes



Full Name: Ops.Graphics.Geometry.GeometryAttributes

Description: Get vertices of a geometry as array3x (vertex vertices)

> Inputs

- **Geometry** (Object)

< Output

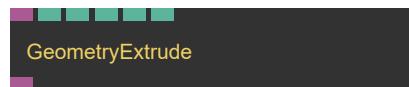
- **Faces** (Array)
- **Vertices** (Array)
- **Normals** (Array)
- **TexCoords** (Array)
- **Vertex Colors** (Array)

- **Tangents** (Array)
- **BiTangents** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Graphics.Geometry.GeometryAttributes>

75.8 GeometryExtrude



Full Name: Ops.Graphics.Geometry.GeometryExtrude

Description: basic extrusion of flat geometry

> Inputs

- **Geometry** (Object:Geometry)
- **Height** (Number)
- **Smooth** (Number: Boolean)
- **Walls** (Number: Boolean)
- **Top** (Number: Boolean)
- **Bottom** (Number: Boolean)

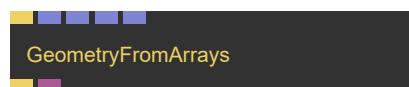
< Output

- **Result Geometry** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Graphics.Geometry.GeometryExtrude>

75.9 GeometryFromArrays



Full Name: Ops.Graphics.Geometry.GeometryFromArrays

Description: Create a geometry from array data

> Inputs

- **Render** (Trigger)
- **Vertices** (Array)
- **Faces** (Array)
- **Texture Coords** (Array)
- **Normals** (Array)

< Output

- **Next** (Trigger)

- **Geometry** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Graphics.Geometry.GeometryFromArrays>

75.10 GeometryInfo



Full Name: Ops.Graphics.Geometry.GeometryInfo

Description: information about a geometry

> Inputs

- **Geometry** (Object:Geometry)

< Output

- **Indexed** (Number)
- **Faces** (Number)
- **Indices** (Number)
- **Vertices** (Number)
- **Normals** (Number)
- **TexCoords** (Number)
- **Tangents** (Number)
- **BiTangents** (Number)
- **VertexColors** (Number)
- **Other Attributes** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Graphics.Geometry.GeometryInfo>

75.11 GeometryMerge



Full Name: Ops.Graphics.Geometry.GeometryMerge

Description: merge two geometries to one

> Inputs

- **Geometry** (Object)
- **Geometry 2** (Object)
- **Merge** (Trigger)
- **Reset** (Trigger)

< Output

- **Geometry Result** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Graphics.Geometry.GeometryMerge>

75.12 GeometryToObj



GeometryToObj

Full Name: Ops.Graphics.Geometry.GeometryToObj

Description: Generate an .obj file as string from a geometry

> Inputs

- **Geometry** (Object:Geometry)

< Output

- **Obj** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Graphics.Geometry.GeometryToObj>

75.13 GeometryToWireframeArray3



GeometryToWireframeArray3

Full Name: Ops.Graphics.Geometry.GeometryToWireframeArray3

Description: generate an array of lines from a mesh to render a wireframe

> Inputs

- **Geometry** (Object)

< Output

- **Array** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Graphics.Geometry.GeometryToWireframeArray3>

75.14 GeometryUnIndex



GeometryUnIndex

Full Name: Ops.Graphics.Geometry.GeometryUnIndex

Description: convert geometry to only flat triangles without reusing vertices positions

> Inputs

- **Geometry** (Object:Geometry)

< Output

- **Result** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Graphics.Geometry.GeometryUnIndex>

75.15 ObjGeometry



ObjGeometry

Full Name: Ops.Graphics.Geometry.ObjGeometry

Description: parse an obj string to a geometry object

> Inputs

- **Obj** (String)

< Output

- **Geometry** (Object)
- **Status** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Graphics.Geometry.ObjGeometry>

75.16 RandomizeTriangles



RandomizeTriangles

Full Name: Ops.Graphics.Geometry.RandomizeTriangles

Description: randomize order of triangles in a geometry

> Inputs

- **Geometry** (Object)
- **Seed** (Number)

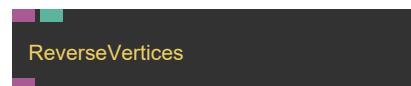
< Output

- **Result** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Graphics.Geometry.RandomizeTriangles>

75.17 ReverseVertices



Full Name: Ops.Graphics.Geometry.ReverseVertices

Description: Reverses the order of vertices in a geometry, back facing triangles become front facing ones

> Inputs

- **Geometry** (Object)
- **Flip** (Number: Boolean)

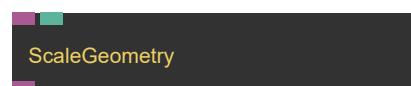
< Output

- **Result** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Graphics.Geometry.ReverseVertices>

75.18 ScaleGeometry



Full Name: Ops.Graphics.Geometry.ScaleGeometry

Description: uniform scaling of geometry vertices

> Inputs

- **Geometry** (Object)
- **Scale** (Number)

< Output

- **Result** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Graphics.Geometry.ScaleGeometry>

75.19 SortGeometryAxis



Full Name: Ops.Graphics.Geometry.SortGeometryAxis

Description: sort geometry triangles by position

> Inputs

- **Geometry** (Object)
- **Sort Index** (Number: Integer)
- **Reverse** (Number: Boolean)

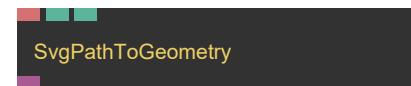
< Output

- **Result** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Graphics.Geometry.SortGeometryAxis>

75.20 SvgPathToGeometry_v2



Full Name: Ops.Graphics.Geometry.SvgPathToGeometry_v2

Description: Generate a SVG path string of a string using an opentype font

> Inputs

- **SVG Path** (String)
- **Bezier Stepsize** (Number)
- **Rescale** (Number)

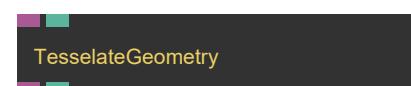
< Output

- **Geometry** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Graphics.Geometry.SvgPathToGeometry_v2

75.21 TesselateGeometry



Full Name: Ops.Graphics.Geometry.TesselateGeometry

Description: create new triangles in a mesh (subdivide)

> Inputs

- **Geometry** (Object)
- **Iterations** (Number: Integer)

< Output

- **Result** (Object)
- **Num Vertices** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Graphics.Geometry.TesselateGeometry>

75.22 TransformGeometry



Full Name: Ops.Graphics.Geometry.TransformGeometry

Description: transform vertices of geometry

> Inputs

- **Geometry** (Object)
- **Translate X** (Number)
- **Translate Y** (Number)
- **Translate Z** (Number)
- **Scale X** (Number)
- **Scale Y** (Number)
- **Scale Z** (Number)
- **Rotation X** (Number)
- **Rotation Y** (Number)
- **Rotation Z** (Number)

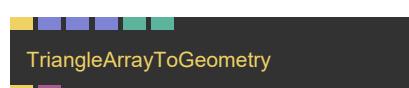
< Output

- **Result** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Graphics.Geometry.TransformGeometry>

75.23 TriangleArrayToGeometry_v2



Full Name: Ops.Graphics.Geometry.TriangleArrayToGeometry_v2

Description: Draws multiple triangles using coordinates from an array

> Inputs

- **Render** (Trigger)
- **Points** (Array)
- **Vertex Colors** (Array)
- **TexCoords** (Array)
- **Flat** (Number: Boolean)
- **Render Mesh** (Number: Boolean)

< Output

- **Next** (Trigger)
- **Geometry** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Graphics.Geometry.TriangleArrayToGeometry_v2

75.24 Triangulate2dPath



Full Name: Ops.Graphics.Geometry.Triangulate2dPath

Description: Triangulate a 2d path to a flat and filled 3d geometry

> Inputs

- **Update** (Trigger)
- **Combine Index** (Number: Integer)
- **Path 2** (Array)
- **Path 3** (Array)

< Output

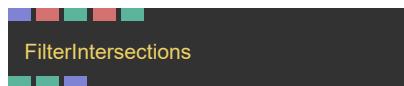
- **Next** (Trigger)
- **Geometry** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Graphics.Geometry.Triangulate2dPath>

76 Ops.Graphics.Intersection

76.1 FilterIntersections



Full Name: Ops.Graphics.Intersection.FilterIntersections

Description: Define filters to get colliding and intersecting bodies

> Inputs

- **Collisions** (Array)
- **Name 1** (String)
- **Match Name 1 Index** (Number: Integer)
- **Name 2** (String)
- **Match Name 2 Index** (Number: Integer)

< Output

- **Colliding** (booleanNumber)
- **Num Collisions** (Number)
- **Result Collisions** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Graphics.Intersection.FilterIntersections>

76.2 IntersectBody



Full Name: Ops.Graphics.Intersection.IntersectBody

Description: Add Bodies and check if they intersect/collide with each other

> Inputs

- **Trigger** (Trigger)
- **Name** (String)
- **Radius** (Number)
- **Size X** (Number)
- **Size Y** (Number)
- **Size Z** (Number)
- **Positions** (Array)

- **Append Index To Name** (Number: Boolean)

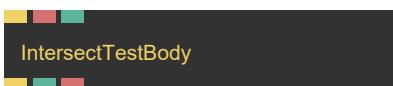
< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Graphics.Intersection.IntersectBody>

76.3 IntersectTestBody



Full Name: Ops.Graphics.Intersection.IntersectTestBody

Description: test one body against all bodies in the world

> Inputs

- **Trigger** (Trigger)
- **Name** (String)
- **Active** (Number: Boolean)

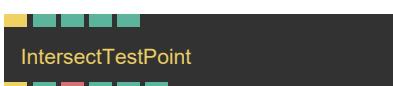
< Output

- **Next** (Trigger)
- **Has Hit** (booleanNumber)
- **Hit Body Name** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Graphics.Intersection.IntersectTestBody>

76.4 IntersectTestPoint



Full Name: Ops.Graphics.Intersection.IntersectTestPoint

Description: test intersect bodies collision against a point/coordinate

> Inputs

- **Trigger** (Trigger)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **Active** (Number: Boolean)

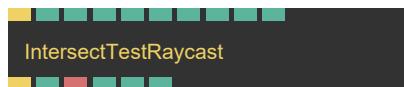
< Output

- **Next** (Trigger)
- **Has Hit** (booleanNumber)
- **Hit Body Name** (String)
- **Hit X** (Number)
- **Hit Y** (Number)
- **Hit Z** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Graphics.Intersection.IntersectTestPoint>

76.5 IntersectTestRaycast



Full Name: Ops.Graphics.Intersection.IntersectTestRaycast

Description: Cast a ray and check if it intersect/collide with bodies

➤ Inputs

- **Trigger** (Trigger)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **To X** (Number)
- **To Y** (Number)
- **To Z** (Number)
- **Active** (Number: Boolean)
- **Change Cursor** (Number: Boolean)

◀ Output

- **Next** (Trigger)
- **Has Hit** (booleanNumber)
- **Hit Body Name** (String)
- **Hit X** (Number)
- **Hit Y** (Number)
- **Hit Z** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Graphics.IntersectTestRaycast>

76.6 IntersectWorld



Full Name: Ops.Graphics.Intersection.IntersectWorld

Description: Define a world to check for intersections and collisions

➤ Inputs

- **Trigger** (Trigger)
- **Check Body Collisions** (Number: Boolean)

◀ Output

- **Next** (Trigger)
- **Total Bodies** (Number)
- **Collisions** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Graphics.IntersectWorld>

77 Ops.Graphics.Meshes

77.1 CablesLogo



Full Name: Ops.Graphics.Meshes.CablesLogo

Description: cables logo mesh/geometry

> Inputs

- **Render** (Trigger)
- **Scale** (Number)
- **Draw** (Number: Boolean)

< Output

- **Trigger** (Trigger)
- **Geometry** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Graphics.Meshes.CablesLogo>

77.2 Circle_v3



Full Name: Ops.Graphics.Meshes.Circle_v3

Description: Draws a circle to the canvas.

> Inputs

- **Render** (Trigger)
- **Radius** (Number)
- **InnerRadius** (Number)
- **Segments** (Number: Integer)
- **Percent** (Number)
- **Steps** (Number)
- **InvertSteps** (Number: Boolean)
- **Spline** (Number: Boolean)
- **Render Mesh** (Number: Boolean)

< Output

- **Trigger** (Trigger)
- **Geometry** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Graphics.Meshes.Circle_v3

77.3 Cross



Full Name: Ops.Graphics.Meshes.Cross

Description: Draws a cross with controllable thickness and length.

> Inputs

- **Render** (Trigger)
- **Size** (Number)
- **Thickness** (Number)
- **Crosshair** (Number: Boolean)
- **Left** (Number: Boolean)
- **Right** (Number: Boolean)
- **Top** (Number: Boolean)
- **Bottom** (Number: Boolean)
- **Active** (Number: Boolean)

< Output

- **Next** (Trigger)
- **Geometry** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Graphics.Meshes.Cross>

77.4 Cube_v2



Full Name: Ops.Graphics.Meshes.Cube_v2

Description: Draws a cube to the canvas. Please note that without doing a rotation you will only see a rectangle.

> Inputs

- **Render** (Trigger)
- **Render Mesh** (Number: Boolean)

- **Width** (Number)
- **Length** (Number)
- **Height** (Number)
- **Center** (Number: Boolean)
- **Bias** (Number)
- **Flip X** (Number: Boolean)
- **Top** (Number: Boolean)
- **Bottom** (Number: Boolean)
- **Left** (Number: Boolean)
- **Right** (Number: Boolean)
- **Front** (Number: Boolean)
- **Back** (Number: Boolean)

< Output

- **Next** (Trigger)
- **Geometry** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Graphics.Meshes.Cube_v2

77.5 Rectangle_v4



Full Name: Ops.Graphics.Meshes.Rectangle_v4

Description: draw a rectangle (plane, square)

> Inputs

- **Trigger** (Trigger)
- **Render** (Number: Boolean)
- **Width** (Number)
- **Height** (Number)
- **Flip TexCoord X** (Number: Boolean)
- **Flip TexCoord Y** (Number: Boolean)
- **Num Columns** (Number: Integer)
- **Num Rows** (Number: Integer)

< Output

- **Trigger** (Trigger)
- **Geometry** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Graphics.Meshes.Rectangle_v4

77.6 Sphere_v3



Full Name: Ops.Graphics.Meshes.Sphere_v3

Description: Draw parameterizable sphere

> Inputs

- **Render** (Trigger)
- **Radius** (Number)
- **Stacks** (Number)
- **Slices** (Number)
- **Filloffset** (Number)

< Output

- **Trigger** (Trigger)
- **Geometry** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Graphics.Meshes.Sphere_v3

77.7 Star_v2



Full Name: Ops.Graphics.Meshes.Star_v2

Description: draw a star mesh (saw,gear)

> Inputs

- **Render** (Trigger)
- **Segments** (Number)
- **Radius** (Number)
- **Shape Index** (Number: Integer)
- **Length** (Number)
- **Peak Z Pos** (Number)
- **Percent** (Number)
- **Fill** (Number: Boolean)
- **Render Mesh** (Number: Boolean)

< Output

- **Trigger** (Trigger)
- **Geometry** (Object)

Example Patch: Open in Editor

77.8 Triangle_v2



Full Name: Ops.Graphics.Meshes.Triangle_v2

Description: Renders a triangle to the canvas.

> Inputs

- **Render** (Trigger)
- **Width** (Number)
- **Height** (Number)
- **Draw** (Number: Boolean)

< Output

- **Trigger** (Trigger)
- **Geometry** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Graphics.Meshes.Triangle_v2

78 Ops.Html

78.1 ActiveElement



Full Name: Ops.Html.ActiveElement

Description: Outputs the currently active/focused element

> Inputs

- **Trigger** (Trigger)

< Output

- **Active Element** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.ActiveElement>

78.2 AlignElement



Full Name: Ops.Html.AlignElement

Description: Align a HTML element to another, keep positioning

> Inputs

- **Element** (Object:Element)
- **Align Element** (Object:Element)
- **Force Update** (Trigger)
- **Offset X** (Number)
- **Offset Y** (Number)

< Output

- **Element Passthrough** (Object)
- **Aligned Element** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.AlignElement>

78.3 AppendChild_v2



Full Name: Ops.Html.AppendChild_v2

Description: Appends a HTML DOM Element to another

> Inputs

- **Parent** (Object:Element)
- **Child** (Object:Element)

< Output

- **Parent Out** (Object)
- **Child Out** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Html.AppendChild_v2

78.4 BrowserSpecificFile_v2



Full Name: Ops.Html.BrowserSpecificFile_v2

Description: set file dependant on browser

> Inputs

- **Chrome File** (String)
- **Firefox File** (String)
- **Safari File** (String)
- **Edge File** (String)
- **Opera File** (String)
- **Default File** (String)

< Output

- **Browser Specific File** (String)
- **Detected Browser** (String)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Html.BrowserSpecificFile_v2

78.5 CanvasToBase64



Full Name: Ops.Html.CanvasToBase64

Description: Create an image file from a canvas

> Inputs

- **Trigger** (Trigger)
- **Texture** (Object)
- **Quality** (Number)
- **Output DataUrl** (Number: Boolean)

< Output

- **Next** (Trigger)
- **Binary Size** (Number)
- **Base64 String** (String)
- **Loading** (booleanNumber)
- **Finished** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.CanvasToBase64>

78.6 CompareImages_v2



Full Name: Ops.Html.CompareImages_v2

Description: compares two images and shows the difference as a pink color

> Inputs

- **Image 1** (String)
- **Image 2** (String)
- **Start** (Trigger)

< Output

- **Difference Image** (String)
- **Mismatch Percentage** (Number)
- **Same Dimensions** (booleanNumber)
- **Resemble Data** (Object)
- **Finished** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Html.CompareImages_v2

78.7 DocumentBody



DocumentBody

Full Name: Ops.Html.DocumentBody

Description: Outputs the current document body element

> Inputs

- Visit *Ops.Html.DocumentBody documentation for input port details*

< Output

- Body (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.DocumentBody>

78.8 DraggableElement



DraggableElement

Full Name: Ops.Html.DraggableElement

Description: Make a HTML element draggable to move it around with the mouse

> Inputs

- Element (Object:Element)

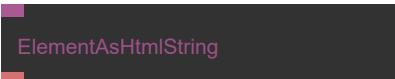
< Output

- Element Out (Object)
- X (Number)
- Y (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.DraggableElement>

78.9 ElementAsHtmlString



ElementAsHtmlString

Full Name: Ops.Html.ElementAsHtmlString

Description: Serialize HTML/SVG elements to a string

> Inputs

- Parent (Object:Element)

< Output

- HTML String (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.ElementAsHtmlString>

78.10 ElementChilds_v2



ElementChilds

Full Name: Ops.Html.ElementChilds_v2

Description: Set childs of a HTML Element

> Inputs

- Parent (Object:Element)
- Child 1 (Object:Element)
- Child 2 (Object:Element)
- Child 3 (Object:Element)
- Child 4 (Object:Element)
- Child 5 (Object:Element)
- Child 6 (Object:Element)
- Child 7 (Object:Element)
- Child 8 (Object:Element)
- Child 9 (Object:Element)
- Child 10 (Object:Element)

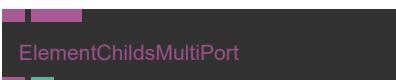
< Output

- Parent Out (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Html.ElementChilds_v2

78.11 ElementChildsMultiPort_v2



ElementChildsMultiPort

Full Name: Ops.Html.ElementChildsMultiPort_v2

Description: add child elements to another HTML Element

> Inputs

- **Parent** (Object:Element)
- **Childs_0** (Object)
- **Add Port** (Object)

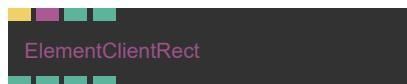
< Output

- **Parent Out** (Object)
- **Num Values** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Html.ElementChildsMultiPort_v2

78.12 ElementClientRect



Full Name: Ops.Html.ElementClientRect

Description: get html element absolute position and size in pixels on screen

> Inputs

- **Update** (Trigger)
- **Element** (Object:Element)

< Output

- **X** (Number)
- **Y** (Number)
- **Width** (Number)
- **Height** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.ElementClientRect>

78.13 ElementCssCursor_v3



Full Name: Ops.Html.ElementCssCursor_v3

Description: Set the mouse cursor

> Inputs

- **Element** (Object:Element)
- **CSS Cursors Index** (Number: Integer)
- **File** (String)
- **Offset X** (Number: Integer)

- **Offset Y** (Number: Integer)

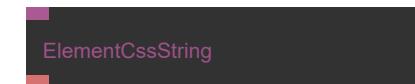
< Output

- **HTML Element** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Html.ElementCssCursor_v3

78.14 ElementCssString



Full Name: Ops.Html.ElementCssString

Description: Output css attributes of an element as a string

> Inputs

- **Element** (Object:Element)

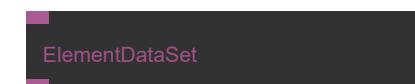
< Output

- **CSS** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.ElementCssString>

78.15 ElementDataSet



Full Name: Ops.Html.ElementDataSet

Description: Get the data-attributes and values of an HTML element

> Inputs

- **HTML Element** (Object:Element)

< Output

- **Dataset** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.ElementDataSet>

78.16 ElementEquals



Full Name: Ops.Html.ElementEquals

Description: Check if two HTML element objects are equal

> Inputs

- **HTML Element** (Object:Element)
- **HTML Element 2** (Object:Element)

< Output

- **Equal** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.ElementEquals>

78.17 ElementFadeInOut_v2



Full Name: Ops.Html.ElementFadeInOut_v2

Description: Fade html elements in or out

> Inputs

- **HTML Element** (Object)
- **Visible** (Number: Boolean)
- **Duration** (Number)
- **Opacity** (Number)

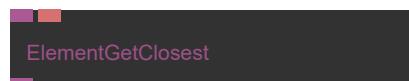
< Output

- **PassThrough** (Object)
- **Is Showing** (booleanNumber)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Html.ElementFadeInOut_v2

78.18 ElementGetClosest



Full Name: Ops.Html.ElementGetClosest

Full Name: Ops.Html.ElementGetClosest

Description: get the closest parent element matching the query selector

> Inputs

- **HTML Element** (Object:Element)
- **Query** (String)

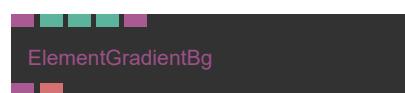
< Output

- **Element** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.ElementGetClosest>

78.19 ElementGradientBg



Full Name: Ops.Html.ElementGradientBg

Description: Use a cables gradient as HTML element background

> Inputs

- **Element** (Object:Element)
- **Rect Color Space Index** (Number: Integer)
- **Angle** (Number)
- **Gradient Object** (Object:Gradient)

< Output

- **HTML Element** (Object)
- **CSS String** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.ElementGradientBg>

78.20 ElementHasClass



Full Name: Ops.Html.ElementHasClass

Description: Does the element currently have a specific class set

> Inputs

- **Element** (Object:Element)
- **Classname** (String)

- **Update** (Trigger)

< Output

- **Has Class** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.ElementHasClass>

78.21 ElementInfo



Full Name: Ops.Html.ElementInfo

Description: Get information about an element

> Inputs

- **Element** (Object)

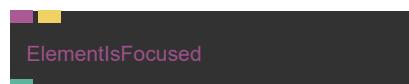
< Output

- **Tagname** (String)
- **Id** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.ElementInfo>

78.22 ElementIsFocused



Full Name: Ops.Html.ElementIsFocused

Description: Is the connected element currently focused

> Inputs

- **Element** (Object:Element)
- **Update** (Trigger)

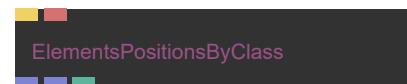
< Output

- **Has Focus** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.ElementIsFocused>

78.23 ElementsPositionsByClass



Full Name: Ops.Html.ElementsPositionsByClass

Description: get html element absolute positions and sizes by classname

> Inputs

- **Update** (Trigger)
- **Classname** (String)

< Output

- **Position** (Array)
- **Size** (Array)
- **Total Elements** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.ElementsPositionsByClass>

78.24 FontFile_v2



Full Name: Ops.Html.FontFile_v2

Description: Load a font file like .otf, .ttf, .woff via css

> Inputs

- **File** (String)
- **Family** (String)
- **Active** (Number: Boolean)

< Output

- **Loaded** (booleanNumber)
- **Loaded Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Html.FontFile_v2

78.25 FontsLoaded



Full Name: Ops.Html.FontsLoaded

Description: triggers when asynchronous requests finished loading

> Inputs

- Visit *Ops.Html.FontsLoaded* documentation for input port details

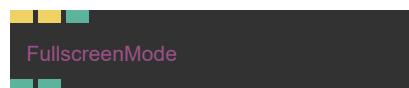
< Output

- **Font Loaded** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.FontsLoaded>

78.26 FullscreenMode



Full Name: Ops.Html.FullscreenMode

Description: Switch webgl to fullscreen

> Inputs

- **Request Fullscreen** (Trigger)
- **Exit Fullscreen** (Trigger)

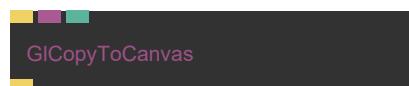
< Output

- **Is Fullscreen** (booleanNumber)
- **Supported** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.FullscreenMode>

78.27 GlCopyToCanvas



Full Name: Ops.Html.GlCopyToCanvas

Description: Copy GL canvas content to another canvas

> Inputs

- **Render** (Trigger)
- **Canvas** (Object:Element)
- **Smooth** (Number: Boolean)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.GlCopyToCanvas>

78.28 HyperLink_v3



Full Name: Ops.Html.HyperLink_v3

Description: Open another website

> Inputs

- **Open** (Trigger)
- **URL** (String)
- **Frame Name** (String)
- **Win Specs** (String)
- **Rel Attribute** (String)

< Output

- Visit *Ops.Html.HyperLink_v3* documentation for output port details

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Html.HyperLink_v3

78.29 InnerHTML



Full Name: Ops.Html.InnerHTML

Description: Set innerHTML or innerTEXT of an HTML element

> Inputs

- **Element** (Object)
- **Value** (String)
- **Active** (Number: Boolean)
- **Clear** (Trigger)

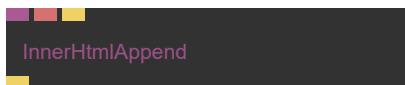
< Output

- **HTML Element** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.InnerHTML>

78.30 InnerHtmlAppend



Full Name: Ops.Html.InnerHtmlAppend

Description: Append string to the inner html or an element

> Inputs

- **Element** (Object:Element)
- **Html** (String)
- **Trigger** (Trigger)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.InnerHtmlAppend>

78.31 MailtoLink



Full Name: Ops.Html.MailtoLink

Description: creates a mailto: link to open the default email app

> Inputs

- **Email** (String)
- **Subject** (String)
- **Execute** (Trigger)

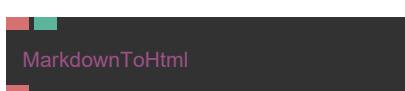
< Output

- Visit *Ops.Html.MailtoLink documentation* for output port details

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.MailtoLink>

78.32 MarkdownToHtml



Full Name: Ops.Html.MarkdownToHtml

Description: markdown markup language to html parser

> Inputs

- **Markdown** (String)
- **Active** (Number: Boolean)

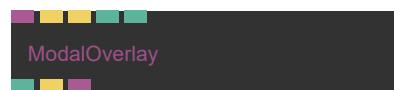
< Output

- **Html** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.MarkdownToHtml>

78.33 ModalOverlay



Full Name: Ops.Html.ModalOverlay

Description: create a modal HTML overlay with a darkened background

> Inputs

- **Content Element** (Object)
- **Show** (Trigger)
- **Close** (Trigger)
- **Show Closebutton** (Number: Boolean)
- **Opacity** (Number)

< Output

- **Visible** (booleanNumber)
- **Closed** (Trigger)
- **Element** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.ModalOverlay>

78.34 QuerySelector_v3



Full Name: Ops.Html.QuerySelector_v3

Description: Selects an element in the DOM

> Inputs

- **Update** (Trigger)
- **Query** (String)
- **Type Index** (Number: Integer)

- **Document** (String)
- **Input Element** (Object:Element)

< Output

- **Element** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Html.QuerySelector_v3

78.35 QuerySelectorAll_v2



Full Name: Ops.Html.QuerySelectorAll_v2

Description: Selects all matching elements in the DOM

> Inputs

- **Query** (String)
- **Mode Index** (Number: Integer)
- **Type Index** (Number: Integer)
- **Document** (String)
- **Element** (Object:Element)
- **Update** (Trigger)

< Output

- **Elements** (Array)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Html.QuerySelectorAll_v2

78.36 ReloadPage



Full Name: Ops.Html.ReloadPage

Description: reload the website

> Inputs

- **Exec** (Trigger)

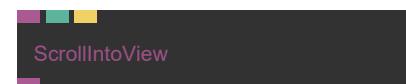
< Output

- Visit *Ops.Html.ReloadPage* documentation for output port details

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.ReloadPage>

78.37 ScrollIntoView



Full Name: Ops.Html.ScrollIntoView

Description: Scroll an area, so the html element is visible/in view

> Inputs

- **Element** (Object:Element)
- **Scroll Into View** (Trigger)

< Output

- **HTML Element** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.ScrollIntoView>

78.38 ScrollPosition_v2



Full Name: Ops.Html.ScrollPosition_v2

Description: the current x y top left scrolling position of html page or element

> Inputs

- **Update** (Trigger)
- **Element** (Object:Element)
- **Scroll To Top** (Trigger)

< Output

- **Next** (Trigger)
- **Left** (Number)
- **Top** (Number)
- **Percentage X** (Number)
- **Percentage Y** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Html.ScrollPosition_v2

78.39 ScrollTo



Full Name: Ops.Html.ScrollTo

Description: Trigger the browser to scroll to top or bottom of an element

> Inputs

- **Element** (Object:Element)
- **Scroll To Top** (Trigger)
- **Scroll To Bottom** (Trigger)

< Output

- Visit [Ops.Html.ScrollTo documentation for output port details](#)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.ScrollTo>

78.40 WindowClose



Full Name: Ops.Html.WindowClose

Description: close current window

> Inputs

- **Close** (Trigger)

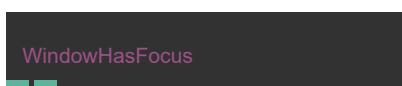
< Output

- Visit [Ops.Html.WindowClose documentation for output port details](#)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.WindowClose>

78.41 WindowHasFocus



Full Name: Ops.Html.WindowHasFocus

Description: detect if the browser window/tab has focus

> Inputs

- Visit [Ops.Html.WindowHasFocus documentation for input port details](#)

< Output

- **Has Focus** (booleanNumber)
- **Tab Visible** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.WindowHasFocus>

78.42 WindowInfo



Full Name: Ops.Html.WindowInfo

Description: size of browser window in pixels

> Inputs

- Visit [Ops.Html.WindowInfo documentation for input port details](#)

< Output

- **ClientWidth** (Number)
- **ClientHeight** (Number)
- **Body Scroll Height** (Number)
- **Device Pixel Ratio** (Number)
- **Iframe Parent** (booleanNumber)
- **Orientation Angle** (Number)
- **Orientation Type** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.WindowInfo>

78.43 WindowScroll



Full Name: Ops.Html.WindowScroll

Description: Get the current scroll position of the window

> Inputs

- **Update** (Trigger)

< Output

- **Scoll X** (Number)

- **Scroll Y** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.WindowScroll>

79 Ops.Html.Attributes

79.1 ElementAccessibility



Full Name: Ops.Html.Attributes.ElementAccessibility

Description: Element Accessibility properties for screen reader

> Inputs

- **Element** (Object)
- **Aria Label** (String)
- **Aria Labeled By** (String)
- **Aria Hidden** (Number: Boolean)

< Output

- **HTML Element** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.Attributes.ElementAccessibility>

79.2 ElementAttributes



Full Name: Ops.Html.Attributes.ElementAttributes

Description: Get all attributes from an element an object

> Inputs

- **Element** (Object)

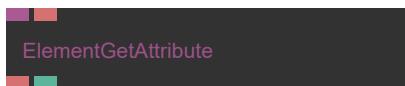
< Output

- **Attribs** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.Attributes.ElementAttributes>

79.3 ElementGetAttribute



Full Name: Ops.Html.Attributes.ElementGetAttribute

Description: Read or Get the value of an HTML element Attribute

> Inputs

- **Element** (Object)
- **Attribute Name** (String)

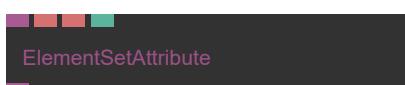
< Output

- **Value** (String)
- **Has Attribute** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.Attributes.ElementGetAttribute>

79.4 ElementSetAttribute



Full Name: Ops.Html.Attributes.ElementSetAttribute

Description: Write or Set the value of an HTML element Attribute

> Inputs

- **Element** (Object)
- **Attribute** (String)
- **Value** (String)
- **Active** (Number: Boolean)

< Output

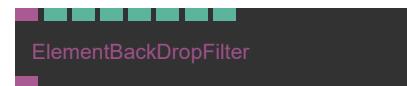
- **HTML Element** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.Attributes.ElementSetAttribute>

80 Ops.Html.Css

80.1 ElementBackDropFilter



Full Name: Ops.Html.Css.ElementBackDropFilter

Description: Set CSS backdrop filter like blur, contrast, brightness, saturation

> Inputs

- **Element** (Object)
- **Blur** (Number)
- **Contrast** (Number)
- **Brightness** (Number)
- **Hue** (Number)
- **Invert** (Number)
- **Saturate** (Number)
- **Sepia** (Number)

< Output

- **HTML Element** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.Css.ElementBackDropFilter>

80.2 ElementMargin



Full Name: Ops.Html.Css.ElementMargin

Description: Set CSS margins of a html element

> Inputs

- **Element** (Object:Element)
- **Margin** (Number)
- **Margin Top** (Number)
- **Margin Bottom** (Number)
- **Margin Left** (Number)
- **Margin Right** (Number)

< Output

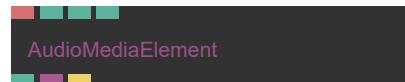
- **HTML Element** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.Css.ElementMargin>

81 Ops.Html.Elements

81.1 AudioMediaElement



Full Name: Ops.Html.Elements.AudioMediaElement

Description: Simple Audio Player, using HTML5 Audio, does not need WebAudio

> Inputs

- **File** (String)
- **Play** (Number: Boolean)
- **Volume** (Number)
- **Loop** (Number: Boolean)

< Output

- **Playing** (Number)
- **Element** (Object)
- **Has Ended** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.Elements.AudioMediaElement>

81.2 Element_v2



Full Name: Ops.Html.Elements.Element_v2

Description: A more convenient version of div element op, that can be used for creating html without writing much css code

> Inputs

- **Text** (String)
- **Set Size** (Number: Boolean)
- **Width** (Number)
- **Height** (Number)
- **Inline Style** (String)
- **CSS Class** (String)

- **Disable CSS Props** (String)
- **Display Index** (Number: Integer)
- **Tag Name** (String)
- **Opacity** (Number)
- **Propagate Click-Events** (Number: Boolean)
- **Add To DOM** (Number: Boolean)

< Output

- **DOM Element** (Object)
- **Hovering** (booleanNumber)
- **Clicked** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Html.Elements.Element_v2

81.3 IFrame_v3



Full Name: Ops.Html.Elements.IFrame_v3

Description: Show another website in an iframe element

> Inputs

- **URL** (String)
- **ID** (String)
- **Active** (Number: Boolean)
- **Style** (String)

< Output

- **Element** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Html.Elements.IFrame_v3

81.4 ImageElement_v3



Full Name: Ops.Html.Elements.ImageElement_v3

Description: create an image(img) html element

> Inputs

- **File** (String)

- **Class** (String)
- **Style** (String)
- **Alt Text** (String)

< Output

- **Image Element** (Object)
- **Width** (Number)
- **Height** (Number)
- **Loading** (booleanNumber)
- **Error** (booleanNumber)
- **Loaded** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Html.Elements.ImageElement_v3

81.5 InputElement



Full Name: Ops.Html.Elements.InputElement

Description: HTML input/textarea element to allow the user to enter text

> Inputs

- **Default Value** (String)
- **Placeholder** (String)
- **Id** (String)
- **Class** (String)
- **Style** (String)
- **Autocomplete** (Number: Boolean)
- **Max Length** (Number: Integer)
- **Enter Key Prevent Default** (Number: Boolean)
- **Visible** (Number: Boolean)
- **Focus** (Trigger)
- **Blur** (Trigger)
- **Clear** (Trigger)
- **Select** (Trigger)

< Output

- **DOM Element** (Object)
- **Value** (String)
- **Hover** (booleanNumber)
- **Enter Pressed** (Trigger)
- **Escape Pressed** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.Elements.InputElement>

81.6 VideoElement



Full Name: Ops.Html.Elements.VideoElement

Description: html video player element

> Inputs

- **File** (String)
- **ID** (String)
- **Play** (Number: Boolean)
- **Autoplay** (Number: Boolean)
- **Controls** (Number: Boolean)
- **Active** (Number: Boolean)
- **Loop** (Number: Boolean)
- **Muted** (Number: Boolean)
- **Style** (String)
- **Rewind** (Trigger)

< Output

- **Element** (Object)
- **Playing** (booleanNumber)
- **Can Play Through** (booleanNumber)
- **Time** (Number)
- **Ended** (Trigger)
- **Has Error** (booleanNumber)
- **Error Message** (String)
- **Video Width** (Number)
- **Video Height** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.Elements.VideoElement>

82 Ops.Html.Event

82.1 ElementEventListener_v2



Full Name: Ops.Html.Event.ElementEventListener_v2

Description: Add a custom event listener

> Inputs

- **Element** (Object)
- **Event Name** (String)
- **Use Capture** (Number: Boolean)
- **Prevent Default** (Number: Boolean)
- **Stop Propagation** (Number: Boolean)

< Output

- **Element Passthrough** (Object)
- **Event Trigger** (Trigger)
- **Event Object** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Html.Event.ElementEventListener_v2

82.2 ElementPointerEvents



Full Name: Ops.Html.Event.ElementPointerEvents

Description: Listen to events of an element

> Inputs

- **Dom Element** (Object)
- **Mouse Down Active** (Number: Boolean)
- **Mouse Up Active** (Number: Boolean)
- **Click Active** (Number: Boolean)
- **Mouse Move Active** (Number: Boolean)
- **Touch Start Active** (Number: Boolean)
- **Touch Move Active** (Number: Boolean)

- **Touch End Active** (Number: Boolean)
- **Touch Cancel Active** (Number: Boolean)

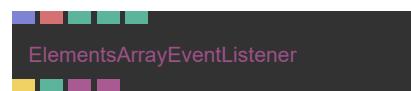
< Output

- **Event Object** (Object)
- **Mouse Down** (Trigger)
- **Mouse Up** (Trigger)
- **Click** (Trigger)
- **Mouse Move** (Trigger)
- **Touch Start** (Trigger)
- **Touch Move** (Trigger)
- **Touch End** (Trigger)
- **Touch Cancel** (Trigger)
- **Event Name** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.Event.ElementPointerEvents>

82.3 ElementsArrayEventListener



Full Name: Ops.Html.Event.ElementsArrayEventListener

Description: listen to events on multiple html elements

> Inputs

- **Elements** (Array)
- **Event Name** (String)
- **Use Capture** (Number: Boolean)
- **Prevent Default** (Number: Boolean)
- **Stop Propagation** (Number: Boolean)

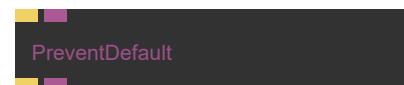
< Output

- **Event Trigger** (Trigger)
- **Index** (Number)
- **Event Object** (Object)
- **Event Element** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.Event.ElementsArrayEventListener>

82.4 PreventDefault



Full Name: Ops.Html.Event.PreventDefault

Description: Prevents the default on a JavaScript event

> Inputs

- **Execute** (Trigger)
- **Event In** (Object)

< Output

- **Next** (Trigger)
- **Event Out** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.Event.PreventDefault>

82.5 StopPropagation



Full Name: Ops.Html.Event.StopPropagation

Description: Stop a JavaScript event (bubbling / capturing)

> Inputs

- **Execute** (Trigger)
- **Event In** (Object)

< Output

- **Next** (Trigger)
- **Event Out** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.Event.StopPropagation>

83 Ops.Html_Utils

83.1 CablesLink



Full Name: Ops.Html_Utils.CablesLink

Description: create a cables logo which links to cables gl

> Inputs

- **Size** (Number)
- **Opacity** (Number)

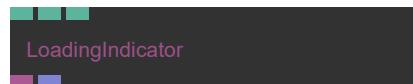
< Output

- Visit *Ops.Html_Utils.CablesLink documentation* for output port details

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Html_Utils.CablesLink

83.2 LoadingIndicator_v2



Full Name: Ops.Html_Utils.LoadingIndicator_v2

Description: show a typical web loading/progress indicator animation

> Inputs

- **Center Position** (Number: Boolean)

< Output

- **Elment** (Object)
- **Requests** (Array)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Html_Utils.LoadingIndicator_v2

83.3 Notification



Full Name: Ops.Html_Utils.Notification

Description: Trigger a simple pop up notification on the screen

> Inputs

- **Trigger Animation** (Trigger)
- **Text** (String)
- **Class** (String)
- **Style** (String)
- **Active** (Number: Boolean)
- **Convert Line Breaks** (Number: Boolean)
- **Fade In** (Number)
- **Hold** (Number)
- **Fade Out** (Number)
- **Mode Index** (Number: Integer)
- **Side Index** (Number: Integer)
- **Starting Position** (Number)
- **Ending Position** (Number)

< Output

- **Finished Trigger** (Trigger)
- **Finished** (booleanNumber)
- **DOM Element** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Html_Utils.Notification

83.4 PlayButton



Full Name: Ops.Html_Utils.PlayButton

Description: shows a playbutton for forcing a simple user interaction

> Inputs

- **Trigger** (Trigger)
- **Only If Audio Suspended** (Number: Boolean)
- **Reset** (Trigger)
- **Style Outer** (String)

- **Style Inner** (String)
- **Active** (Number: Boolean)

< Output

- **Next** (Trigger)
- **Not Clicked** (Trigger)
- **Audiocontext State** (String)
- **Element** (Object)
- **Clicked** (booleanNumber)
- **Clicked Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.Utils.PlayButton>

83.5 PlayerControlPanel_v2



Full Name: Ops.Html.Utils.PlayerControlPanel_v2

Description: simple html ui for timeline/mediaplayers (was: TimelineUI)

> Inputs

- **Length** (Number)
- **Current** (Number)
- **Clamp** (Number: Boolean)
- **Is Playing** (Number: Boolean)
- **Visible** (Number: Boolean)
- **Show Time** (Number: Boolean)
- **Show Skip Buttons** (Number: Boolean)

< Output

- **Play Clicked** (Trigger)
- **Pause Clicked** (Trigger)
- **Rewind Clicked** (Trigger)
- **Skip Back Clicked** (Trigger)
- **Skip Forward Clicked** (Trigger)
- **Dragged** (Trigger)
- **Current Value** (Number)
- **Dragging** (booleanNumber)
- **DOM Element** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Html.Utils.PlayerControlPanel_v2

83.6 QrCode



Full Name: Ops.Html.Utils.QrCode

Description: Generate a qr code as a texture

> Inputs

- **Text** (String)

< Output

- **Image DataUrl** (String)
- **Element** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.Utils.QrCode>

83.7 YoutubePlayer



Full Name: Ops.Html.Utils.YoutubePlayer

Description: play a youtube video in a HTML element

> Inputs

- **Video Id** (String)
- **Active** (Number: Boolean)
- **Style** (String)
- **ElementID** (String)
- **Autoplay** (Number: Boolean)
- **Display Captions** (Number: Boolean)
- **Loop** (Number: Boolean)
- **Allow Fullscreen** (Number: Boolean)
- **Hide Controls** (Number: Boolean)
- **Start At Second** (Number: Integer)

< Output

- **Element** (Object)
- **Direct Link** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Html.Utils.YoutubePlayer>

84 Ops.Json

84.1 ArrayOfObjectsMultiPort_v2



Full Name: Ops.Json.ArrayOfObjectsMultiPort_v2

Description: create an array with multiple objects

> Inputs

- **Objects_0** (Object)
- **Add Port** (Object)

< Output

- **Array** (Array)
- **Num Values** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Json.ArrayOfObjectsMultiPort_v2

84.2 CopyObject



Full Name: Ops.Json.CopyObject

Description: Creates a copy of a JSON object

> Inputs

- Visit *Ops.Json.CopyObject documentation for input port details*

< Output

- **Valid** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Json.CopyObject>

84.3 CsvArray



Full Name: Ops.Json.CsvArray

Description: parse CSV files as array

> Inputs

- **File** (String)

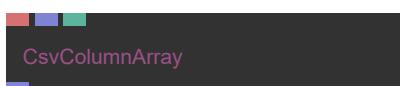
< Output

- **Result** (Array)
- **Num Items** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Json.CsvArray>

84.4 CsvColumnArray_v2



Full Name: Ops.Json.CsvColumnArray_v2

Description: get all values of a CSV column as array of strings

> Inputs

- **Column Name** (String)
- **CSV Array** (Array)
- **Numbers** (Number: Boolean)

< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Json.CsvColumnArray_v2

84.5 EmptyObject



Full Name: Ops.Json.EmptyObject

Description: Visit documentation for details

> Inputs

- Visit *Ops.Json.EmptyObject* documentation for input port details

< Output

- **Result** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Json.EmptyObject>

84.6 FilterValidObject



Full Name: Ops.Json.FilterValidObject

Description: Filter valid objects

> Inputs

- **Object** (Object)

< Output

- **Last Valid Object** (Object)
- **Is Valid** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Json.FilterValidObject>

84.7 GateObject



Full Name: Ops.Json.GateObject

Description: Will only allow an Object to be output if the pass through parameter evaluates to true

> Inputs

- **Object In** (Object)
- **Pass Through** (Number: Boolean)
- **Only Valid Objects** (Number: Boolean)

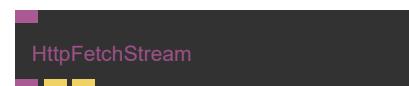
< Output

- **Object Out** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Json.GateObject>

84.8 HttpFetchStream



Full Name: Ops.Json.HttpFetchStream

Description: HttpRequest/Fetch Streaming

> Inputs

- **Fetch Response** (Object)

< Output

- **Result** (Object)
- **Received Result** (Trigger)
- **Started** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Json.HttpFetchStream>

84.9 HttpRequest_v4



Full Name: Ops.Json.HttpRequest_v4

Description: Request a json file and output an object (ajax, url, json,fetch)

> Inputs

- **URL** (String)
- **HTTP Method Index** (Number: Integer)
- **Request Body** (String)
- **Content-Type** (String)
- **the content type of the body sent** (if any)
- **Send Credentials** (Number: Boolean)
- **Headers** (Object)
- **Auto Request** (Number: Boolean)
- **trigger the request on any value change** (or on pagereload)
- **Empty Output On Change** (Number: Boolean)
- **Retry On Error** (Number: Boolean)
- **Reload** (Trigger)

< Output

- **Response Json Object** (Object)
- **Response String** (String)
- **Response Data Url** (String)

- **Status Code** (Number)
- **Is Loading** (booleanNumber)
- **Has Error** (booleanNumber)
- **Error** (String)
- **Duration MS** (Number)
- **Fetch Response** (Object)
- **Loaded** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Json.HttpRequest_v4

84.10 Object



Full Name: Ops.Json.Object

Description: Visit documentation for details

► **Inputs**

- **Object** (Object)

◀ **Output**

- **Result** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Json.Object>

84.11 ObjectDeleteKey



Full Name: Ops.Json.ObjectDeleteKey

Description: Remove a Property from an Object by Key

► **Inputs**

- **Object** (Object)
- **Key** (String)

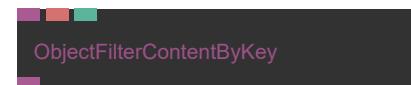
◀ **Output**

- **Object Result** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Json.ObjectDeleteKey>

84.12 ObjectFilterContentByKey



Full Name: Ops.Json.ObjectFilterContentByKey

Description: filter values from an object if key starts with input string

► **Inputs**

- **Object** (Object)
- **Name** (String)
- **Remove Null** (Number: Boolean)

◀ **Output**

- **Result** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Json.ObjectFilterContentByKey>

84.13 ObjectFunnel



Full Name: Ops.Json.ObjectFunnel

Description: outputs the last changed object

► **Inputs**

- **Object1** (Object)
- **Object2** (Object)
- **Object3** (Object)
- **Object4** (Object)
- **Object5** (Object)

◀ **Output**

- **Out Object** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Json.ObjectFunnel>

84.14 ObjectGetArray_v2



Full Name: Ops.Json.ObjectGetArray_v2

Description: Returns an array from a JSON-object

> Inputs

- **Data** (Object)
- **Key** (String)

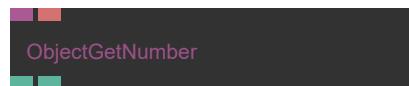
< Output

- **Result** (Array)
- **Length** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Json.ObjectGetArray_v2

84.15 ObjectGetNumber_v2



Full Name: Ops.Json.ObjectGetNumber_v2

Description: Get a number from an object

> Inputs

- **Data** (Object)
- **Key** (String)

< Output

- **Result** (Number)
- **Found** (booleanNumber)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Json.ObjectGetNumber_v2

84.16 ObjectGetObject_v2



Full Name: Ops.Json.ObjectGetObject_v2

Description: Get an object from an object

> Inputs

- **Object** (Object)
- **Key** (String)

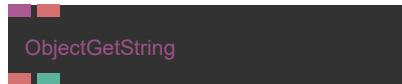
< Output

- **Result** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Json.ObjectGetObject_v2

84.17 ObjectGetString_v2



Full Name: Ops.Json.ObjectGetString_v2

Description: Get string from object by key

> Inputs

- **Data** (Object)
- **Key** (String)

< Output

- **Result** (String)
- **Found** (booleanNumber)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Json.ObjectGetString_v2

84.18 ObjectIsNull



Full Name: Ops.Json.ObjectIsNull

Description: check if object is null or a valid object

> Inputs

- **Object** (Object)

< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Json.ObjectIsNull>

84.19 ObjectKeys



Full Name: Ops.Json.ObjectKeys

Description: returns an array of strings, which contain the keys of the object

> Inputs

- **Object** (Object)

< Output

- **Keys** (Array)
- **Num Keys** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Json.ObjectKeys>

- **Object 1** (Object)
- **Object 2** (Object)
- **Object 3** (Object)
- **Object 4** (Object)
- **Object 5** (Object)
- **Object 6** (Object)
- **Object 7** (Object)
- **Object 8** (Object)

< Output

- **Result** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Json.ObjectOr>

84.20 ObjectMerge



Full Name: Ops.Json.ObjectMerge

Description: merge key+values of two objects

> Inputs

- **Object 1** (Object)
- **Object 2** (Object)

< Output

- **Object Result** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Json.ObjectMerge>

84.21 ObjectOr

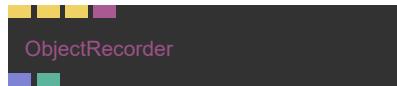


Full Name: Ops.Json.ObjectOr

Description: result is first connected valid object

> Inputs

84.22 ObjectRecorder



Full Name: Ops.Json.ObjectRecorder

Description: record objects and download as json file

> Inputs

- **Exec** (Trigger)
- **Reset** (Trigger)
- **Download** (Trigger)
- **Object** (Object)

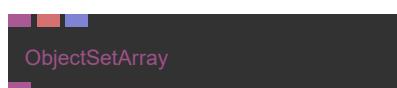
< Output

- **Result** (Array)
- **Num Objects** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Json.ObjectRecorder>

84.23 ObjectSetArray_v2



Full Name: Ops.Json.ObjectSetArray_v2

Description: Set array by key in an object

> Inputs

- **Object** (Object)
- **Key** (String)
- **Value** (Array)

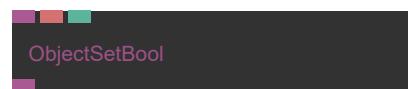
< Output

- **Result Object** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Json.ObjectSetArray_v2

84.24 ObjectSetBool



Full Name: Ops.Json.ObjectSetBool

Description: set number at key in an object

> Inputs

- **Object** (Object)
- **Key** (String)
- **Boolean** (Number: Boolean)

< Output

- **Result Object** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Json.ObjectSetBool>

84.25 ObjectSetColorArray



Full Name: Ops.Json.ObjectSetColorArray

Description: Set rgba array by key in an object

> Inputs

- **Object** (Object)
- **Key** (String)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)

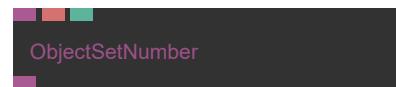
< Output

- **Result Object** (Object)
- **Out R** (Number)
- **Out G** (Number)
- **Out B** (Number)
- **Out A** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Json.ObjectSetColorArray>

84.26 ObjectSetNumber_v2



Full Name: Ops.Json.ObjectSetNumber_v2

Description: set number at key in an object

> Inputs

- **Object** (Object)
- **Key** (String)
- **Number** (Number)

< Output

- **Result Object** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Json.ObjectSetNumber_v2

84.27 ObjectSetObject_v2



Full Name: Ops.Json.ObjectSetObject_v2

Description: set object as value in an object

> Inputs

- **Object** (Object)
- **Key** (String)
- **Object Value** (Object)

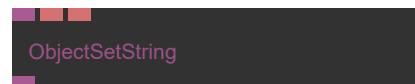
< Output

- **Result Object** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Json.ObjectSetObject_v2

84.28 ObjectSetString_v2



Full Name: Ops.Json.ObjectSetString_v2

Description: set a string value by key in an object

> Inputs

- **Object** (Object)
- **Key** (String)
- **Value** (String)

< Output

- **Result Object** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Json.ObjectSetString_v2

84.29 ObjectStringify_v2



Full Name: Ops.Json.ObjectStringify_v2

Description: Convert object to string

> Inputs

- **Object** (Object)
- **Beautify** (Number: Boolean)

< Output

- **Result** (String)
- **Error** (booleanNumber)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Json.ObjectStringify_v2

84.30 ObjectToArray



Full Name: Ops.Json.ObjectToArray

Description: cast an object port to an array port

> Inputs

- **Object** (Object)

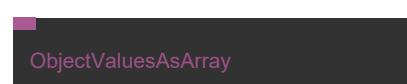
< Output

- **Array** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Json.ObjectToArray>

84.31 ObjectValuesAsArray



Full Name: Ops.Json.ObjectValuesAsArray

Description: extract all object values as an array

> Inputs

- **Object** (Object)

< Output

- **Values** (Array)
- **Num Values** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Json.ObjectValuesAsArray>

84.32 ParseObject_v2



Full Name: Ops.Json.ParseObject_v2

Description: Parses a string to a JSON object

> Inputs

- **JSON String** (String)

< Output

- **Result** (Object)
- **Valid** (booleanNumber)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Json.ParseObject_v2

84.33 RemoveDataUrlPrefix



Full Name: Ops.Json.RemoveDataUrlPrefix

Description: Removes data URL prefix from a string

> Inputs

- **String Input** (String)

< Output

- **String Output** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Json.RemoveDataUrlPrefix>

84.34 RouteObject



Full Name: Ops.Json.RouteObject

Description: Route an object to an output port

> Inputs

- **Index** (Number: Integer)
- **Object In** (Object)
- **Default Object** (Object)

< Output

- **Index 0 Object** (Object)
- **Index 1 Object** (Object)
- **Index 2 Object** (Object)
- **Index 3 Object** (Object)
- **Index 4 Object** (Object)
- **Index 5 Object** (Object)
- **Index 6 Object** (Object)

> Inputs

- **Index 7 Object** (Object)
- **Index 8 Object** (Object)
- **Index 9 Object** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Json.RouteObject>

84.35 SaveJsonFile



Full Name: Ops.Json.SaveJsonFile

Description: save/download an object as json file

> Inputs

- **Download** (Trigger)
- **Filename** (String)
- **Object** (Object)

< Output

• Visit *Ops.Json.SaveJsonFile documentation* for output port details

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Json.SaveJsonFile>

84.36 SequenceObjects_v2



Full Name: Ops.Json.SequenceObjects_v2

Description: control order and flow of objects

> Inputs

- **Number 0** (Object)
- **Number 1** (Object)
- **Number 2** (Object)
- **Number 3** (Object)
- **Number 4** (Object)
- **Number 5** (Object)
- **Number 6** (Object)
- **Number 7** (Object)
- **Number 8** (Object)

- **Number 9** (Object)
- **Number 10** (Object)
- **Number 11** (Object)
- **Number 12** (Object)
- **Number 13** (Object)
- **Number 14** (Object)
- **Number 15** (Object)

< Output

- **Output 0** (Object)
- **Output 1** (Object)
- **Output 2** (Object)
- **Output 3** (Object)
- **Output 4** (Object)
- **Output 5** (Object)
- **Output 6** (Object)
- **Output 7** (Object)
- **Output 8** (Object)
- **Output 9** (Object)
- **Output 10** (Object)
- **Output 11** (Object)
- **Output 12** (Object)
- **Output 13** (Object)
- **Output 14** (Object)
- **Output 15** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Json.SequenceObjects_v2

84.37 SwitchObject



Full Name: Ops.Json.SwitchObject

Description: Allows switching between objects

> Inputs

- **Object Index** (Number: Integer)
- **Object Port 0** (Object)
- **Object Port 1** (Object)
- **Object Port 2** (Object)
- **Object Port 3** (Object)

- **Object Port 4** (Object)
- **Object Port 5** (Object)
- **Object Port 6** (Object)
- **Object Port 7** (Object)

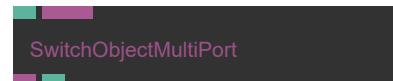
< Output

- **Object Out** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Json.SwitchObject>

84.38 SwitchObjectMultiPort_v2



Full Name: Ops.Json.SwitchObjectMultiPort_v2

Description: Switch between multiple object inputs

> Inputs

- **Index** (Number: Integer)
- **Objects_0** (Object)
- **Add Port** (Object)

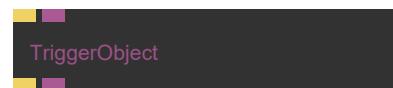
< Output

- **Object** (Object)
- **Num Values** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Json.SwitchObjectMultiPort_v2

84.39 TriggerObject



Full Name: Ops.Json.TriggerObject

Description: set output object when triggered

> Inputs

- **Trigger** (Trigger)
- **Object** (Object)

< Output

- **Next** (Trigger)

- **Result** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Json.TriggerObject>

Docs: <https://cables.gl/op/Ops.Json.TriggerObjectSetString>

84.40 TriggerObjectSetNumber



Full Name: Ops.Json.TriggerObjectSetNumber

Description: set a number value of an object using trigger

> Inputs

- **Trigger** (Trigger)
- **Object** (Object)
- **Key** (String)
- **Number** (Number)

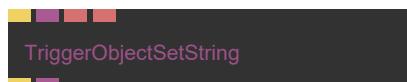
< Output

- **Next** (Trigger)
- **Result** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Json.TriggerObjectSetNumber>

84.41 TriggerObjectSetString



Full Name: Ops.Json.TriggerObjectSetString

Description: set a string value of an object using trigger

> Inputs

- **Trigger** (Trigger)
- **Object** (Object)
- **Key** (String)
- **String** (String)

< Output

- **Next** (Trigger)
- **Result** (Object)

Example Patch: Open in Editor

85 Ops.Math

85.1 Abs



Full Name: Ops.Math.Abs

Description: Returns the absolute, positive value

> Inputs

- **Number** (Number)

< Output

- **Result** (Number)
- **The absolute value of Number** (always positive)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Abs>

85.2 Accumulator



Full Name: Ops.Math.Accumulator

Description: Add to and multiply a number, set to current value

> Inputs

- **Trigger In** (Trigger)
- **Add To Number** (Number)
- **Multiplier To Add Number** (Number)
- **Default Value** (Number)
- **Set Default Value** (Trigger)

< Output

- **Current Value** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Accumulator>

85.3 AddUp



Full Name: Ops.Math.AddUp

Description: Visit documentation for details

> Inputs

- **Number** (Number)
- **Add** (Trigger)
- **Reset** (Trigger)

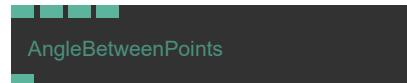
< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.AddUp>

85.4 AngleBetweenPoints



Full Name: Ops.Math.AngleBetweenPoints

Description: outputs the angle between two points (degree)

> Inputs

- **Point 1 X** (Number)
- **Point 1 Y** (Number)
- **Point 2 X** (Number)
- **Point 2 Y** (Number)

< Output

- **Angle** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.AngleBetweenPoints>

85.5 Array3MultiplyMatrix



Full Name: Ops.Math.Array3MultiplyMatrix

Description: multiply every XYZ coordinate with a matrix

> Inputs

- **Update** (Trigger)
- **Array** (Array)
- **Matrix** (Array)

< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Array3MultiplyMatrix>

85.6 Array3To2dProjection



Full Name: Ops.Math.Array3To2dProjection

Description: calculate 2d positions of an array3x

> Inputs

- **Exec** (Trigger)
- **Array3x** (Array)
- **Fov** (Number)
- **W** (Number)
- **H** (Number)
- **Pos X** (Number)
- **Pos Y** (Number)
- **Mul** (Number)

< Output

- **Next** (Trigger)
- **Array2x** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Array3To2dProjection>

85.7 Atan2



Full Name: Ops.Math.Atan2

Description: Calculates the angle from a specified point to the coordinate origin.

> Inputs

- **X** (Number)
- **Y** (Number)
- **Phase** (Number)
- **Frequency** (Number)

< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Atan2>

85.8 Average



Full Name: Ops.Math.Average

Description: average of last two values

> Inputs

- **Number** (Number)
- **Influence** (Number)

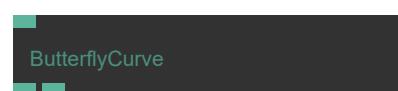
< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Average>

85.9 ButterflyCurve



Full Name: Ops.Math.ButterflyCurve

Description: generate coordinates of a butterfly curve

> Inputs

- **Value** (Number)

< Output

- **X** (Number)

- **Y** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.ButterflyCurve>

85.10 Ceil



Full Name: Ops.Math.Ceil

Description: Returns the smallest integer greater than or equal to a given number

> Inputs

- **Number** (Number)

< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Ceil>

85.11 CircleCoordinates



Full Name: Ops.Math.CircleCoordinates

Description: x and y coordinates of a circle

> Inputs

- **Position** (Number)
- **Radius** (Number)

< Output

- **X** (Number)
- **Y** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.CircleCoordinates>

85.12 Clamp



Full Name: Ops.Math.Clamp

Description: Makes sure a value is within range cuts off the rest

> Inputs

- **Val** (Number)
- **Min** (Number)
- **Max** (Number)
- **Ignore Outside Values** (Number: Boolean)

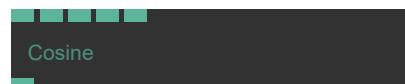
< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Clamp>

85.13 Cosine



Full Name: Ops.Math.Cosine

Description: Calculates the cosine of an angle.

> Inputs

- **Value** (Number)
- **Phase** (Number)
- **Frequency** (Number)
- **Amplitude** (Number)
- **Asine** (Number: Boolean)

< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Cosine>

85.14 Cross



Full Name: Ops.Math.Cross

Description: Computes the cross product of two vec3's

> Inputs

- **Exec** (Trigger)
- **X1** (Number)
- **Y1** (Number)
- **Z1** (Number)
- **X2** (Number)
- **Y2** (Number)
- **Z2** (Number)

< Output

- **Next** (Trigger)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Cross>

85.15 Degrees



Full Name: Ops.Math.Degrees

Description: Converts a radian measurement to its corresponding value in degrees.

> Inputs

- **Radians** (Number)

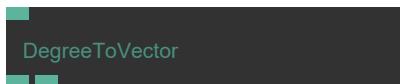
< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Degrees>

85.16 DegreeToVector



Full Name: Ops.Math.DegreeToVector

Description: Calculates a vector (x and y) based on an angle in degrees

> Inputs

- **Degree** (Number)
- **The angle you want to convert** (in degrees)

< Output

- **X** (Number)
- **Y** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.DegreeToVector>

85.17 Delta



Full Name: Ops.Math.Delta

Description: difference to the last value (previous, store)

> Inputs

- **Value** (Number)
- **Change Always** (Number: Boolean)
- **Reset** (Trigger)

< Output

- **Delta** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Delta>

85.18 DeltaSum



Full Name: Ops.Math.DeltaSum

Description: add delta values to an clamped absolute value

> Inputs

- **Delta Value** (Number)
- **Default Value** (Number)
- **Multiply** (Number)
- **Reset** (Trigger)
- **Limit** (Number: Boolean)
- **Min** (Number)
- **Max** (Number)
- **Rubberband** (Number)

< Output

- **Absolute Value** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.DeltaSum>

85.19 Difference



Full Name: Ops.Math.Difference

Description: Difference between two numbers

> Inputs

- **Number A** (Number)
- **Number B** (Number)

< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Difference>

85.20 Distance2d



Full Name: Ops.Math.Distance2d

Description: Calculates the Distance between two 2d points

> Inputs

- **X1** (Number)
- **Y1** (Number)

- **X2** (Number)

- **Y2** (Number)

< Output

- **Distance** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Distance2d>

85.21 Distance3d_v2



Full Name: Ops.Math.Distance3d_v2

Description: distance between two 3d points, calculated when triggered

> Inputs

- **Calc** (Trigger)
- **X1** (Number)
- **Y1** (Number)
- **Z1** (Number)
- **X2** (Number)
- **Y2** (Number)
- **Z2** (Number)

< Output

- **Next** (Trigger)
- **Distance** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Math.Distance3d_v2

85.22 Divide



Full Name: Ops.Math.Divide

Description: Divides a number by another

> Inputs

- **Number1** (Number)
- **Number2** (Number)

< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Divide>

85.23 Ease



Full Name: Ops.Math.Ease

Description: map a value to an easing curve

> Inputs

- **Value** (Number)
- **Min** (Number)
- **Max** (Number)
- **Easing Index** (Number: Integer)

< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Ease>

85.24 Exp



Full Name: Ops.Math.Exp

Description: Calculates the power of Euler's number

> Inputs

- **Number** (Number)

< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Exp>

85.25 FlipSign



Full Name: Ops.Math.FlipSign

Description: positive numbers become negative and vice versa (negate)

> Inputs

- **Value** (Number)

< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.FlipSign>

85.26 Floor



Full Name: Ops.Math.Floor

Description: returns the largest integer less than or equal to a given number

> Inputs

- **Number** (Number)

< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Floor>

85.27 Fract



Full Name: Ops.Math.Fract

Description: returns the fractional part of a number

> Inputs

- **Value** (Number)

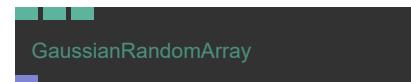
< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Fract>

85.28 GaussianRandomArray



Full Name: Ops.Math.GaussianRandomArray

Description: random numbers fitting a Gaussian, or normal, distribution

> Inputs

- **Num** (Number: Integer)
- **Deviation** (Number)
- **Random Seed** (Number)

< Output

- **Array** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.GaussianRandomArray>

85.29 Incrementor



Full Name: Ops.Math.Incrementor

Description: increment a number by triggering

> Inputs

- **Increment** (Trigger)
- **Decrement** (Trigger)
- **Limit** (Number: Boolean)
- **Length** (Number: Integer)
- **Default** (Number: Integer)
- **Reset** (Trigger)

< Output

- **Changed** (Trigger)
- **Value** (Number)
- **Restarted** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Incrementor>

85.30 IndexFraction



Full Name: Ops.Math.IndexFraction

Description: return fraction of value by index

> Inputs

- **Number** (Number)
- **Index** (Number: Integer)

< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.IndexFraction>

85.31 Interpolate



Full Name: Ops.Math.Interpolate

Description: Interpolate between values, lerp, linear interpolate

> Inputs

- **Value 1** (Number)
- **Value 2** (Number)
- **Percentage** (Number)

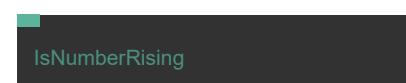
< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Interpolate>

85.32 IsNumberRising



Full Name: Ops.Math.IsNumberRising

Description: detect if a number rising or falling

> Inputs

- **Number** (Number)

< Output

- **Rising** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.IsNumberRising>

85.33 Log



Full Name: Ops.Math.Log

Description: Calculates the logarithm of Number

> Inputs

- **Number** (Number)

< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Log>

85.34 MapGeoCoordsSpherical



Full Name: Ops.Math.MapGeoCoordsSpherical

Description: map geo locations (latitude - longitude) to spherical coordinates

> Inputs

- **Coordinates** (Array)
- **Radius** (Number)

< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.MapGeoCoordsSpherical>

85.35 MapRange



Full Name: Ops.Math.MapRange

Description: Maps a value from one range into another.

> Inputs

- **Value** (Number)
- **Old Min** (Number)
- **Old Max** (Number)
- **New Min** (Number)
- **New Max** (Number)
- **Easing Index** (Number: Integer)
- **Clamp** (Number: Boolean)

< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.MapRange>

85.36 Math



Full Name: Ops.Math.Math

Description: Allows different mathematical operations to be applied to two numbers

> Inputs

- **Number 0** (Number)
- **Number 1** (Number)
- **Math Mode Index** (Number: Integer)

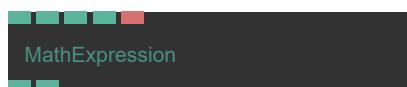
< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Math>

85.37 MathExpression



Full Name: Ops.Math.MathExpression

Description: calculates a user defined mathematical expression

> Inputs

- **A** (Number)
- **B** (Number)
- **C** (Number)
- **D** (Number)
- **Expression** (String)

< Output

- **Result** (Number)
- **Expression Valid** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.MathExpression>

85.38 Max



Full Name: Ops.Math.Max

Description: Sets the output to the input value which is higher

> Inputs

- **Value** (Number)
- **Maximum** (Number)

< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Max>

85.39 MaxSinceReset



Full Name: Ops.Math.MaxSinceReset

Description: Outputs the maximum value since reset has been triggered

> Inputs

- **Value** (Number)
- **Reset** (Trigger)

< Output

- **Maximum** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.MaxSinceReset>

85.40 MercatorCoord



Full Name: Ops.Math.MercatorCoord

Description: project mercator coordinates

> Inputs

- **Latitude** (Number)
- **Longitude** (Number)
- **MapWidth** (Number)
- **MapHeight** (Number)

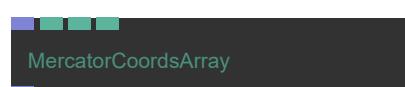
< Output

- **X** (Number)
- **Y** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.MercatorCoord>

85.41 MercatorCoordsArray



Full Name: Ops.Math.MercatorCoordsArray

Description: Mercator map and center an array of latitudes and longitudes to a local coordinate system

> Inputs

- **LatLon Array** (Array)

- **MapWidth** (Number)
- **Center Lat** (Number)
- **Center Lon** (Number)

< Output

- **Result** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.MercatorCoordsArray>

85.42 Min_v3



Full Name: Ops.Math.Min_v3

Description: Result will be the smaller number of the inputs

> Inputs

- **Value 1** (Number)
- **Value 2** (Number)

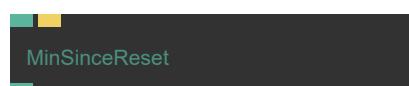
< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Math.Min_v3

85.43 MinSinceReset



Full Name: Ops.Math.MinSinceReset

Description: Outputs the minimum value since reset has been triggered

> Inputs

- **Value** (Number)
- **Reset** (Trigger)

< Output

- **Minimum** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.MinSinceReset>

85.44 Modulo



Full Name: Ops.Math.Modulo

Description: outputs the remainder after division of one number by another

> Inputs

- **Number1** (Number)
- **Number2** (Number)
- **Pingpong** (Number: Boolean)

< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Modulo>

85.45 MulMatrixXyz



Full Name: Ops.Math.MulMatrixXyz

Description: multiply XYZ values with a gl matrix vec3 x mat4

> Inputs

- **Update** (Trigger)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **Matrix** (Array)

< Output

- **Next** (Trigger)
- **Result X** (Number)
- **Result Y** (Number)
- **Result Z** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.MulMatrixXyz>

85.46 Multiply



Full Name: Ops.Math.Multiply

Description: Multiplies two numbers

> Inputs

- Number1 (Number)
- Number2 (Number)

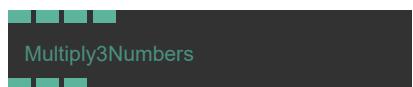
< Output

- Result (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Multiply>

85.47 Multiply3Numbers



Full Name: Ops.Math.Multiply3Numbers

Description: multiply three numbers

> Inputs

- R (Number)
- G (Number)
- B (Number)
- Multiply (Number)

< Output

- ResultR (Number)
- ResultG (Number)
- ResultB (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Multiply3Numbers>

85.48 Normalize



Full Name: Ops.Math.Normalize

Description: normalize a vector

> Inputs

- X (Number)
- Y (Number)
- Z (Number)

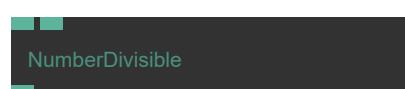
< Output

- Result X (Number)
- Result Y (Number)
- Result Z (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Normalize>

85.49 NumberDivisible



Full Name: Ops.Math.NumberDivisible

Description: is a number capable of being divided.

> Inputs

- Number (Number)
- Divisor (Number)

< Output

- Result (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.NumberDivisible>

85.50 OneMinus



Full Name: Ops.Math.OneMinus

Description: subtract a number from one

> Inputs

- Value (Number)

< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.OneMinus>

85.51 PerlinNoise_v2



Full Name: Ops.Math.PerlinNoise_v2

Description: outputs a perlin noise value like random

> Inputs

- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **Scale** (Number)
- **Seed** (Number)

< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Math.PerlinNoise_v2

85.52 Pi



Full Name: Ops.Math.Pi

Description: returns PI (3.141592653589793) * multiply amount

> Inputs

- **Multiply Amount** (Number)

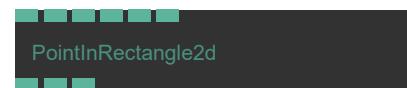
< Output

- **Pi** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Pi>

85.53 PointInRectangle2d



Full Name: Ops.Math.PointInRectangle2d

Description: test if a point is in or outside of a rectangle

> Inputs

- **X** (Number)
- **Y** (Number)
- **Rect Top** (Number)
- **Rect Left** (Number)
- **Rect Right** (Number)
- **Rect Bottom** (Number)

< Output

- **Result** (Number)
- **Pos X** (Number)
- **Pos Y** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.PointInRectangle2d>

85.54 Pow



Full Name: Ops.Math.Pow

Description: value of x to the power of y

> Inputs

- **Base** (Number)
- **Exponent** (Number)

< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Pow>

85.55 PowerOfTwoSize



Full Name: Ops.Math.PowerOfTwoSize

Description: Return the next values as power of two

> Inputs

- **Width** (Number: Integer)
- **Height** (Number: Integer)
- **Strategy Index** (Number: Integer)

< Output

- **Width Result** (Number)
- **Height Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.PowerOfTwoSize>

85.56 Radians



Full Name: Ops.Math.Radians

Description: Converts a degree measurement to its corresponding value in radians.

> Inputs

- **Degrees** (Number)

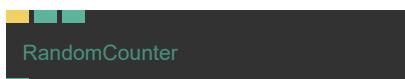
< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Radians>

85.57 RandomCounter



Full Name: Ops.Math.RandomCounter

Description: add up random numbers by triggering

> Inputs

- **Count** (Trigger)
- **Step Min** (Number)
- **Step Max** (Number)

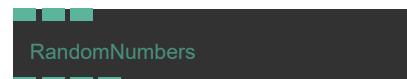
< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.RandomCounter>

85.58 RandomNumbers_v3



Full Name: Ops.Math.RandomNumbers_v3

Description: Simple way to get random numbers without using arrays

> Inputs

- **Seed** (Number)
- **Min** (Number)
- **Max** (Number)

< Output

- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **W** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Math.RandomNumbers_v3

85.59 RandomNumbersFromString



Full Name: Ops.Math.RandomNumbersFromString

Description: Random number generator from a string seed

> Inputs

- **Input String** (String)
- **Random Number Count** (Number: Integer)

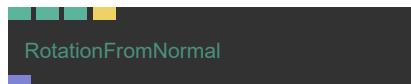
< Output

- **Random Value** (Number)
- **Random Numbers** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.RandomNumbersFromString>

85.60 RotationFromNormal



Full Name: Ops.Math.RotationFromNormal

Description: Create rotation matrix from normal

> Inputs

- **Normal X** (Number)
- **Normal Y** (Number)
- **Normal Z** (Number)
- **Recalculate** (Trigger)

< Output

- **RotationMatrix** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.RotationFromNormal>

85.61 Round



Full Name: Ops.Math.Round

Description: Outputs number rounded to the nearest integer

> Inputs

- **Number** (Number)
- **Decimal Places** (Number: Integer)

< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Round>

85.62 RoundEven



Full Name: Ops.Math.RoundEven

Description: round to the next even number

> Inputs

- **Number** (Number)
- **Mode Index** (Number: Integer)

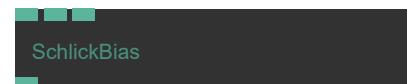
< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.RoundEven>

85.63 SchlickBias



Full Name: Ops.Math.SchlickBias

Description: Custom easing curve via schlick bias and gain

> Inputs

- **Value** (Number)
- **Gain** (Number)
- **Bias** (Number)

< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.SchlickBias>

85.64 Sign



Full Name: Ops.Math.Sign

Description: get sign of value

> Inputs

- Value (Number)
- Remove Zero (Number: Boolean)

< Output

- Result (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Sign>

85.65 SimpleMovingAverage



Full Name: Ops.Math.SimpleMovingAverage

Description: Calculate the Average of the last X values

> Inputs

- Value (Number)
- Number Of Values (Number: Integer)

< Output

- Result (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.SimpleMovingAverage>

85.66 Sine



Full Name: Ops.Math.Sine

Description: Calculates the sine of an angle.

> Inputs

- Value (Number)
- Phase (Number)
- Frequency (Number)
- Amplitude (Number)
- Asine (Number: Boolean)

< Output

- Result (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Sine>

85.67 Speed



Full Name: Ops.Math.Speed

Description: measure speed of how much a value changes

> Inputs

- Update (Trigger)
- Value (Number)

< Output

- Speed (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Speed>

85.68 Sqrt



Full Name: Ops.Math.Sqrt

Description: square root of a number

> Inputs

- Number (Number)

< Output

- Result (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Sqrt>

85.69 Subtract



Full Name: Ops.Math.Subtract

Description: Subtracts Number2 from Number1 (minus, -)

> Inputs

- **Number1** (Number)
- **Number2** (Number)

< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Subtract>

85.70 Sum



Full Name: Ops.Math.Sum

Description: Result of the addition

> Inputs

- **Number1** (Number)
- **Number2** (Number)

< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Sum>

85.71 Tangent



Full Name: Ops.Math.Tangent

Description: Calculates the ratio of the sine and cosine of an angle.

> Inputs

- **Value** (Number)
- **Phase** (Number)
- **Frequency** (Number)
- **Amplitude** (Number)
- **Asine** (Number: Boolean)

< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Tangent>

85.72 TriggerMathExpression



Full Name: Ops.Math.TriggerMathExpression

Description: calculates a user defined mathematical expression

> Inputs

- **Calculate** (Trigger)
- **Expression** (String)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **W** (Number)
- **A** (Number)
- **B** (Number)
- **C** (Number)
- **D** (Number)
- **I** (Number)

< Output

- **Next** (Trigger)
- **Result** (Number)
- **Expression Valid** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.TriggerMathExpression>

85.73 TriggerRandomNumber_v3



Full Name: Ops.Math.TriggerRandomNumber_v3

Description: Generate random number between min and max

> Inputs

- **Generate** (Trigger)

- **Min** (Number)
- **Max** (Number)
- **Integer** (Number: Boolean)
- **No Consecutive Duplicates** (Number: Boolean)

< Output

- **Next** (Trigger)
- **Result** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Math.TriggerRandomNumber_v3

85.74 VectorLength



Full Name: Ops.Math.VectorLength

Description: length of a vector

> Inputs

- **X** (Number)
- **Y** (Number)
- **Z** (Number)

< Output

- **Length** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.VectorLength>

86 Ops.Math.Compare

86.1 Between



Full Name: Ops.Math.Compare.Between

Description: result is true if value is between number1 and number2

> Inputs

- **Value** (Number)
- **Number1** (Number)
- **Number2** (Number)

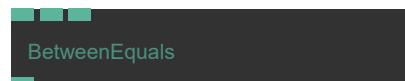
< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Compare.Between>

86.2 BetweenEquals



Full Name: Ops.Math.Compare.BetweenEquals

Description: result is true if value is between or equal number1 and number2

> Inputs

- **Value** (Number)
- **Range 1** (Number)
- **Range 2** (Number)

< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Compare.BetweenEquals>

86.3 CompareNumbers

CompareNumbers

Full Name: Ops.Math.Compare.CompareNumbers

Description: Performs logical comparisons on numbers (compare, operators)

> Inputs

- **Value In** (Number)
- **Comparison Mode Index** (Number: Integer)
- **Condition Value** (Number)
- **Max** (Number)

< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Compare.CompareNumbers>

86.4 Equals

Equals

Full Name: Ops.Math.Compare.Equals

Description: result is true if number1 and number2 are equal

> Inputs

- **Number1** (Number)
- **Number2** (Number)

< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Compare.Equals>

86.5 GreaterOrEquals

GreaterOrEquals

Full Name: Ops.Math.Compare.GreaterOrEquals

Description: result is true if number 1 is greater or equals number 2

> Inputs

- **Number1** (Number)
- **Number2** (Number)

< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Compare.GreaterOrEquals>

86.6 GreaterThan

GreaterThan

Full Name: Ops.Math.Compare.GreaterThan

Description: result is true if number1 is greater than number2

> Inputs

- **Number1** (Number)
- **Number2** (Number)

< Output

- **Result** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Compare.GreaterThan>

86.7 IfBetweenThen

IfBetweenThen

Full Name: Ops.Math.Compare.IfBetweenThen

Description: triggers when value is between min and max

> Inputs

- **Exe** (Trigger)
- **Number** (Number)
- **Min** (Number)
- **Max** (Number)

< Output

- **Then** (Trigger)
- **Else** (Trigger)

- **Bs Between** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Compare.IfBetweenThen>

86.8 IsEven



Full Name: Ops.Math.Compare.IsEven

Description: Checks if Value is even or not

> Inputs

- **Number1** (Number)

< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Compare.IsEven>

86.9 LessThan



Full Name: Ops.Math.Compare.LessThan

Description: Is n1 smaller than n2? (lesser, less)

> Inputs

- **Number1** (Number)
- **Number2** (Number)

< Output

- **Result** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Math.Compare.LessThan>

87 Ops.Net

87.1 CorsProxy_v3



Full Name: Ops.Net.CorsProxy_v3

Description: create a cables.gl CORS proxy URL

> Inputs

- **URL** (String)
- **Use In Export** (Number: Boolean)
- **Active** (Number: Boolean)

< Output

- **CORS URL** (String)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Net.CorsProxy_v3

88 Ops.Net.WebSocket

88.1 WebSocket_v2



Full Name: Ops.Net.WebSocket.WebSocket_v2

Description: Create a websocket connection and receive data from it

> Inputs

- URL (String)

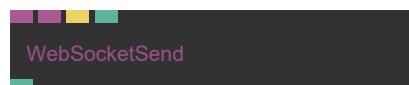
< Output

- Result (Object)
- Valid JSON (booleanNumber)
- Connection (Object)
- Connected (booleanNumber)
- Received Data (Trigger)
- Raw Data (String)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Net.WebSocket.WebSocket_v2

88.2 WebSocketSend



Full Name: Ops.Net.WebSocket.WebSocketSend

Description: send an object to a websocket connection

> Inputs

- Connection (Object:Websocket)
- Object (Object)
- Send (Trigger)
- Send String (Number: Boolean)

< Output

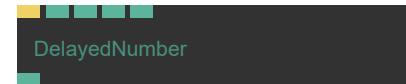
- Sent (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Net.WebSocket.WebSocketSend>

89 Ops.Number

89.1 DelayedNumber



Full Name: Ops.Number.DelayedNumber

Description: delay a value by seconds

> Inputs

- Update (Trigger)
- Value (Number)
- Delay (Number)
- Clear On Change (Number: Boolean)
- Easing Index (Number: Integer)

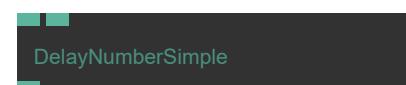
< Output

- Result (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Number.DelayedNumber>

89.2 DelayNumberSimple



Full Name: Ops.Number.DelayNumberSimple

Description: delay the value data flow by x seconds

> Inputs

- Value (Number)
- Delay (Number)

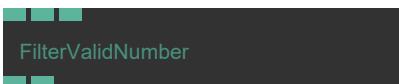
< Output

- Out Value (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Number.DelayNumberSimple>

89.3 FilterValidNumber



Full Name: Ops.Number.FilterValidNumber

Description: Filter valid numbers

> Inputs

- **Number** (Number)
- **Invalid When 0** (Number: Boolean)

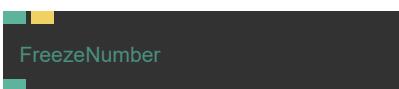
< Output

- **Last Valid Number** (Number)
- **Is Valid** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Number.FilterValidNumber>

89.4 FreezeNumber



Full Name: Ops.Number.FreezeNumber

Description: capture the current input and copy it to the output, even after a reload

> Inputs

- **Number** (Number)
- **Button** (Trigger)

< Output

- **Frozen Number** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Number.FreezeNumber>

89.5 GateNumber



Full Name: Ops.Number.GateNumber

Description: Let's a number through only if control bool is true, like a gate

> Inputs

- **Value In** (Number)
- **Pass Through** (Number: Boolean)
- **Custom Value** (Number)

< Output

- **Value Out** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Number.GateNumber>

89.6 Integer



Full Name: Ops.Number.Integer

Description: Number op which only outputs integers

> Inputs

- **Integer** (Number: Integer)

< Output

- **Number Out** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Number.Integer>

89.7 MaximumSafeInteger



Full Name: Ops.Number.MaximumSafeInteger

Description: Returns the maximum safe integer (number, constant)

> Inputs

- Visit *Ops.Number.MaximumSafeInteger documentation* for input port details

< Output

- **Max Int** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Number.MaximumSafeInteger>

89.8 MinimumSafeInteger



Full Name: Ops.Number.MinimumSafeInteger

Description: Returns the minimum safe integer (number, constant)

> Inputs

- Visit *Ops.Number.MinimumSafeInteger* documentation for input port details

< Output

- Min Int (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Number.MinimumSafeInteger>

89.9 Number



Full Name: Ops.Number.Number

Description: Stores a value, use the same value in different places (was: value.value)

> Inputs

- Value (Number)

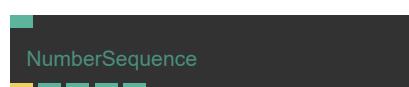
< Output

- Result (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Number.Number>

89.10 NumberSequence



Full Name: Ops.Number.NumberSequence

Description: Copies the input value to the (value sequence)

> Inputs

- In Value (Number)

< Output

- In Value (Number)
- Value Changed (Trigger)
- Out Value 0 (Number)
- Out Value 1 (Number)
- Out Value 2 (Number)
- Out Value 3 (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Number.NumberSequence>

89.11 Preset



Full Name: Ops.Number.Preset

Description: State management of all parameters connected to it - Create presets of multiple ops

> Inputs

- Data (String)
- Sets (String)
- Presetid (String)
- Interpolation Index (Number: Integer)
- Interpolation (String)
- Preset A (Number)
- Preset B (Number)
- Fade (Number)
- Preset Index (Number: Integer)
- Preset (Number: String)
- Create New (Trigger)
- Update (Trigger)
- Move (Trigger)
- Delete (Trigger)
- Rename (Trigger)

< Output

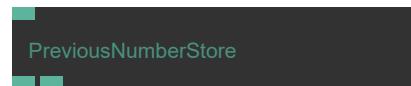
- Create Variable (Dynamic)
- Num Presets (Number)
- Current Preset (Number)
- Dbg_data (Array)

- **Dbg_sets** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Number.Preset>

89.12 PreviousNumberStore



Full Name: Ops . Number . PreviousNumberStore

Description: remember/store last set number

> Inputs

- **Value** (Number)

< Output

- **Current Value** (Number)
- **Previous Value** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Number.PreviousNumberStore>

89.13 RouteNumber



Full Name: Ops . Number . RouteNumber

Description: Routes the value to one of the (based on index, relay)

> Inputs

- **Index** (Number: Integer)
- **Value** (Number)

< Output

- **Index** (Number: Integer)
- **Value** (Number)
- **Default VaonlyOnePortlue** (Number)
- **Set Inactive To Default** (Number: Boolean)
- **Index 0 Value** (Number)
- **Index 1 Value** (Number)
- **Index 2 Value** (Number)
- **Index 3 Value** (Number)
- **Index 4 Value** (Number)

- **Index 5 Value** (Number)
- **Index 6 Value** (Number)
- **Index 7 Value** (Number)
- **Index 8 Value** (Number)
- **Index 9 Value** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Number.RouteNumber>

89.14 SequenceNumbers



Full Name: Ops . Number . SequenceNumbers

Description: control order and flow of numbers

> Inputs

- **Number 0** (Number)
- **Number 1** (Number)
- **Number 2** (Number)
- **Number 3** (Number)
- **Number 4** (Number)
- **Number 5** (Number)
- **Number 6** (Number)
- **Number 7** (Number)
- **Number 8** (Number)
- **Number 9** (Number)
- **Number 10** (Number)
- **Number 11** (Number)
- **Number 12** (Number)
- **Number 13** (Number)
- **Number 14** (Number)
- **Number 15** (Number)

< Output

- **Output 0** (Number)
- **Output 1** (Number)
- **Output 2** (Number)
- **Output 3** (Number)
- **Output 4** (Number)
- **Output 5** (Number)
- **Output 6** (Number)

- **Output 7** (Number)
- **Output 8** (Number)
- **Output 9** (Number)
- **Output 10** (Number)
- **Output 11** (Number)
- **Output 12** (Number)
- **Output 13** (Number)
- **Output 14** (Number)
- **Output 15** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Number.SequenceNumbers>

89.15 SumMultiPort_v2



Full Name: Ops.Number.SumMultiPort_v2

Description: Switch between multiple number inputs

> Inputs

- **Numbers_0** (Number)
- **Add Port** (Number)

< Output

- **Number** (Number)
- **Num Values** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Number.SumMultiPort_v2

89.16 SwitchNumber



Full Name: Ops.Number.SwitchNumber

Description: switch between number values by index

> Inputs

- **Index** (Number: Integer)
- **Value 0** (Number)
- **Value 1** (Number)

- **Value 2** (Number)
- **Value 3** (Number)
- **Value 4** (Number)
- **Value 5** (Number)
- **Value 6** (Number)
- **Value 7** (Number)
- **Value 8** (Number)
- **Value 9** (Number)
- **Value 10** (Number)
- **Value 11** (Number)
- **Value 12** (Number)
- **Value 13** (Number)
- **Value 14** (Number)
- **Value 15** (Number)

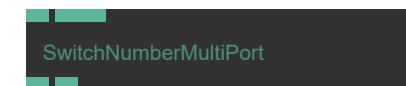
< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Number.SwitchNumber>

89.17 SwitchNumberMultiPort_v2



Full Name: Ops.Number.SwitchNumberMultiPort_v2

Description: Switch between multiple number inputs

> Inputs

- **Index** (Number: Integer)
- **Numbers_0** (Number)
- **Add Port** (Number)

< Output

- **Number** (Number)
- **Num Values** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Number.SwitchNumberMultiPort_v2

89.18 SwitchNumberOnTrigger



Full Name: Ops.Number.SwitchNumberOnTrigger

Description: Sets a specific output value on trigger

> Inputs

- **Trigger 0** (Trigger)
- **Value 0** (Number)
- **Trigger 1** (Trigger)
- **Value 1** (Number)
- **Trigger 2** (Trigger)
- **Value 2** (Number)
- **Trigger 3** (Trigger)
- **Value 3** (Number)
- **Trigger 4** (Trigger)
- **Value 4** (Number)
- **Trigger 5** (Trigger)
- **Value 5** (Number)
- **Trigger 6** (Trigger)
- **Value 6** (Number)
- **Trigger 7** (Trigger)
- **Value 7** (Number)
- **Default Value** (Number: String)

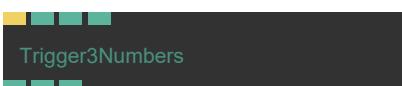
< Output

- **Value** (Number)
- **Last Value** (Number)
- **Triggered** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Number.SwitchNumberOnTrigger>

89.19 Trigger3Numbers



Full Name: Ops.Number.Trigger3Numbers

Description: Stores a 3D coordinate (was Value3)

> Inputs

- **Exe** (Trigger)
- **Value X** (Number)
- **Value Y** (Number)
- **Value Z** (Number)

< Output

- **Exe** (Trigger)
- **Value X** (Number)
- **Value Y** (Number)
- **Value Z** (Number)
- **Result X** (Number)
- **Result Y** (Number)
- **Result Z** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Number.Trigger3Numbers>

89.20 TriggerOnChangeNumber_v2



Full Name: Ops.Number.TriggerOnChangeNumber_v2

Description: triggers every time the input value changed

> Inputs

- **Value** (Number)

< Output

- **Next** (Trigger)
- **Number** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Number.TriggerOnChangeNumber_v2

90 Ops Sidebar

90.1 Button_v2



Full Name: Ops.Sidebar.Button_v2

Description: sidebar push button/trigger element

> Inputs

- **Link** (Object)
- **Text** (String)
- **Grey Out** (Number: Boolean)
- **Visible** (Number: Boolean)

< Output

- **Childs** (Object)
- **Pressed Trigger** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/OpsSidebar.Button_v2

90.2 ColorPicker_v3



Full Name: Ops.Sidebar.ColorPicker_v3

Description: Shows a color-picker in the sidebar

> Inputs

- **Link** (Object)
- **Text** (String)
- **Input Red** (Number)
- **Input Green** (Number)
- **Input Blue** (Number)
- **Input Opacity** (Number)
- **Set Default** (Trigger)
- **Show Opacity** (Number: Boolean)

< Output

- **Children** (Object)
- **Red** (Number)
- **Green** (Number)
- **Blue** (Number)
- **Opacity** (Number)
- **Hex** (String)

Example Patch: Open in Editor

Docs: https://cables.gl/op/OpsSidebar.ColorPicker_v3

90.3 DisplayValue_v2



Full Name: Ops.Sidebar.DisplayValue_v2

Description: display a value or string

> Inputs

- **Link** (Object)
- **Text** (String)
- **Value** (String)

< Output

- **Childs** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/OpsSidebar.DisplayValue_v2

90.4 DropDown_v2



Full Name: Ops.Sidebar.DropDown_v2

Description: Shows a drop-down (select) element in the sidebar

> Inputs

- **Link** (Object)
- **Text** (String)
- **Values** (Array)
- **Grey Out** (Number: Boolean)
- **Visible** (Number: Boolean)
- **Multiple Selection** (Number: Boolean)

- **Lines** (Number: Integer)
- **Set Default** (Trigger)

< Output

- **Children** (Object)
- **Result** (String)
- **Index** (Number)
- **Selected Values** (Array)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops Sidebar.DropDown_v2

90.5 Group



Full Name: Ops Sidebar .Group

Description: organize sidebar elements into groups

> Inputs

- **Link** (Object)
- **Text** (String)
- **Show Title** (Number: Boolean)
- **Default Minimized** (Number: Boolean)
- **Visible** (Number: Boolean)

< Output

- **Next** (Object)
- **Childs** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops Sidebar.Group>

90.6 Incrementor_v3



Full Name: Ops Sidebar .Incrementor_v3

Description: steps through numerical or array values one by one

> Inputs

- **Link** (Object)
- **Label** (String)

- **Min** (Number)
- **Max** (Number)
- **Stepsize** (Number)
- **Default** (Number)
- **Grey Out** (Number: Boolean)
- **Increment** (Trigger)
- **Decrement** (Trigger)
- **Set Default** (Trigger)
- **Reset** (Trigger)

< Output

- **Childs** (Object)
- **Value** (Number)
- **Changed** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops Sidebar.Incrementor_v3

90.7 LocalFileToDataUrl



Full Name: Ops Sidebar .LocalFileToDataUrl

Description: load a local file and output as data url

> Inputs

- **Link** (Object)
- **Text** (String)
- **Button Text** (String)
- **Accept Files** (String)
- **Allow Multiple Files** (Number: Boolean)
- **Id** (Number: String)
- **Visible** (Number: Boolean)
- **Grey Out** (Number: Boolean)
- **Show Dialog** (Trigger)
- **Reset** (Trigger)

< Output

- **Childs** (Object)
- **Data URL** (String)
- **Filename** (String)
- **File Object** (Object)
- **Num Files** (Number)

- **Data URLs** (Array)
- **Filenames** (Array)
- **File Changed** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Sidebar.LocalFileToDataUrl>

90.8 NumberInput_v2



Full Name: Ops.Sidebar.NumberInput_v2

Description: Enter a number in the sidebar

> Inputs

- **Link** (Object)
- **Text** (String)
- **Set Default** (Trigger)

< Output

- **Children** (Object)
- **Result** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Sidebar.NumberInput_v2

90.9 Presets_v2



Full Name: Ops.Sidebar.Presets_v2

Description: manage sidebar presets

> Inputs

- **Link** (Object)
- **Text** (String)
- **Add Preset** (Trigger)
- **Update Current Preset** (Trigger)
- **Preset Title 0** (String)
- **Preset 0** (Object)
- **Preset Title 1** (String)
- **Preset 1** (Object)
- **Preset Title 2** (String)

- **Preset 2** (Object)
- **Preset Title 3** (String)
- **Preset 3** (Object)
- **Preset Title 4** (String)
- **Preset 4** (Object)
- **Preset Title 5** (String)
- **Preset 5** (Object)
- **Preset Title 6** (String)
- **Preset 6** (Object)
- **Preset Title 7** (String)
- **Preset 7** (Object)

< Output

- **Children** (Object)
- **Index** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Sidebar.Presets_v2

90.10 Sidebar



Full Name: Ops.Sidebar.Sidebar

Description: Sidebar overlay to control values

> Inputs

- **Visible** (Number: Boolean)
- **Opacity** (Number)
- **Default Minimized** (Number: Boolean)
- **Minimized Opacity** (Number)
- **Show Undo Button** (Number: Boolean)
- **Show Minimize** (Number: Boolean)
- **Title** (String)
- **Side** (Number: Boolean)
- **Default CSS** (Number: Boolean)

< Output

- **Childs** (Object)
- **Opfened** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Sidebar.Sidebar>

90.11 SidebarDateTime



Full Name: Ops.Sidebar.SidebarDateTime

Description: date or datetime picker in the sidebar

> Inputs

- **Link** (Object)
- **Text** (String)
- **Default** (String)
- **Min** (String)
- **Max** (String)
- **Type Index** (Number: Integer)
- **Grey Out** (Number: Boolean)
- **Visible** (Number: Boolean)

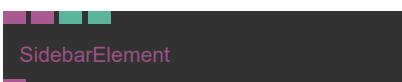
< Output

- **Children** (Object)
- **Result** (String)
- **Focus** (booleanNumber)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops_sidebar.SidebarDateTime

90.12 SidebarElement



Full Name: Ops.Sidebar.SidebarElement

Description: Add custom HTML Elements into the sidebar

> Inputs

- **Link** (Object)
- **Child Element** (Object)
- **Border** (Number: Boolean)
- **Visible** (Number: Boolean)

< Output

- **Childs** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops_sidebar.SidebarElement

90.13 SideBarImage



Full Name: Ops.Sidebar.SideBarImage

Description: Display an image in the sidebar

> Inputs

- **Link** (Object)
- **File** (String)

< Output

- **Childs** (Object)
- **Image Element** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops_sidebar.SideBarImage

90.14 SideBarStyle



Full Name: Ops.Sidebar.SideBarStyle

Description: adjust appearance of sidebar

> Inputs

- **Link** (Object)
- **Width** (Number: Integer)
- **Round Corners** (Number)
- **Special Color** (String)

< Output

- **Childs** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops_sidebar.SideBarStyle

90.15 SideBarSwitch



Full Name: Ops.Sidebar.SideBarSwitch

Description: add tabs or switchbar to a sidebar

> Inputs

- **Link** (Object)
- **Names** (Array)
- **Text** (String)
- **Set Default** (Trigger)
- **Grey Out** (Number: Boolean)
- **Default** (Number)

< Output

- **Childs** (Object)
- **Index** (Number)
- **String** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.SideBarSwitch>

90.16 SidebarText_v3



Full Name: Ops.Sidebar.SidebarText_v3

Description: Display text in the sidebar

> Inputs

- **Link** (Object)
- **Text** (String)
- **Id** (String)
- **Visible** (Number: Boolean)

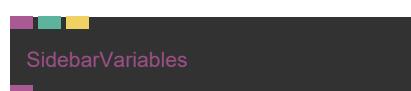
< Output

- **Childs** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.SidebarText_v3

90.17 SidebarVariables



Full Name: Ops.Sidebar_sidebarVariables

Description: show values of all variables in a sidebar

> Inputs

- **Link** (Object)
- **Id** (Number: String)
- **Update** (Trigger)

< Output

- **Childs** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.sidebarVariables>

90.18 Slider_v3



Full Name: Ops.Sidebar.Slider_v3

Description: Sidebar slider element (range)

> Inputs

- **Link** (Object)
- **Text** (String)
- **Min** (Number)
- **Max** (Number)
- **Step** (Number)
- **Suffix** (String)
- **Grey Out** (Number: Boolean)
- **Visible** (Number: Boolean)
- **Set Default** (Trigger)
- **Reset** (Trigger)

< Output

- **Childs** (Object)
- **Result** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Slider_v3

90.19 TextInput_v2



Full Name: Ops.Sidebar.TextInput_v2

Description: Get a string from an sidebar input field

> Inputs

- **Link** (Object)
- **Where to attach the sidebar item to** (Sidebar / Sidebar Group)
- **Text** (String)
- **Default** (String)
- **Placeholder** (String)
- **TextArea** (Number: Boolean)
- **Grey Out** (Number: Boolean)
- **Visible** (Number: Boolean)
- **Spellcheck** (Number: Boolean)
- **Enter Key Prevent Default** (Number: Boolean)
- **Clear** (Trigger)
- **Focus Input** (Trigger)

< Output

- **Children** (Object)
- **Result** (String)
- **Focus** (booleanNumber)
- **Keypress Enter** (Trigger)
- **Keypress ESC** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Sidebar.TextInput_v2

90.20 Toggle_v4



Full Name: Ops.Sidebar.Toggle_v4

Description: sidebar boolean toggle/switch element

> Inputs

- **Link** (Object)
- **Text** (String)
- **Set Default** (Trigger)

- **Grey Out** (Number: Boolean)
- **Visible** (Number: Boolean)

< Output

- **Childs** (Object)
- **Value** (booleanNumber)
- **Toggled** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Sidebar.Toggle_v4

90.21 XYPad



Full Name: Ops.Sidebar.XYPad

Description: 2d coordinate input element

> Inputs

- **Link** (Object)
- **Text** (String)
- **Input X** (Number)
- **Input Y** (Number)
- **Flip X** (Number: Boolean)
- **Flip Y** (Number: Boolean)
- **Set Default** (Trigger)
- **Visible** (Number: Boolean)

< Output

- **Children** (Object)
- **X** (Number)
- **Y** (Number)
- **HTML Element** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Sidebar.XYPad>

91 Ops.String

91.1 AddLineBreaks_v2



Full Name: Ops.String.AddLineBreaks_v2

Description: Insert a line break in a string of words

> Inputs

- **String** (String)
- **Max Characters Per Line** (Number: Integer)

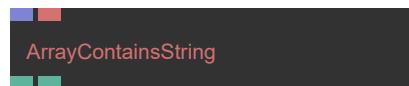
< Output

- **Result** (String)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.String.AddLineBreaks_v2

91.2 ArrayContainsString



Full Name: Ops.String.ArrayContainsString

Description: Check if an array contains a string which can also be a number (find,search,indexOf)

> Inputs

- **Array** (Array)
- **SearchValue** (String)

< Output

- **Found** (booleanNumber)
- **Index** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.String.ArrayContainsString>

91.3ArrayOfStrings



Full Name: Ops.String.ArrayOfStrings

Description: Create an array of strings and optionally attach index-number

> Inputs

- **String** (String)
- **Length** (Number: Integer)
- **Attach Number** (Number: Boolean)

< Output

- **Array** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.String.ArrayOfStrings>

91.4 CharacterRotate



Full Name: Ops.String.CharacterRotate

Description: String rotate characters like a split-flap display

> Inputs

- **Update** (Trigger)
- **Reset** (Trigger)
- **Text** (String)
- **Random Seed** (Number)
- **Characters** (String)

< Output

- **Result** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.String.CharacterRotate>

91.5 Concat_v2



Full Name: Ops.String.Concat_v2
Description: Joins two strings together

- > Inputs**
- **String1** (String)
 - **String2** (String)
 - **New Line** (Number: Boolean)
 - **Active** (Number: Boolean)
- < Output**
- **Result** (String)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.String.Concat_v2

91.6 ConcatMulti_v2



Full Name: Ops.String.ConcatMulti_v2
Description: Joins multiple strings together

- > Inputs**
- **String 0** (String)
 - **String 1** (String)
 - **String 2** (String)
 - **String 3** (String)
 - **String 4** (String)
 - **String 5** (String)
 - **String 6** (String)
 - **String 7** (String)
- < Output**
- **Concat String** (String)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.String.ConcatMulti_v2

91.7 ConcatMultiPort_v2



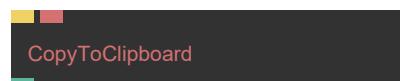
Full Name: Ops.String.ConcatMultiPort_v2
Description: concatenate/join multiple string inputs

- > Inputs**
- **Strings_0** (String)
 - **Add Port** (String)
- < Output**
- **String** (String)
 - **Num Strings** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.String.ConcatMultiPort_v2

91.8 CopyToClipboard



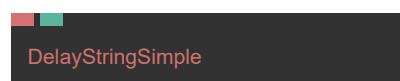
Full Name: Ops.String.CopyToClipboard
Description: Copy string to clipboard on trigger

- > Inputs**
- **Copy** (Trigger)
 - **String** (String)
- < Output**
- **Success** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.String.CopyToClipboard>

91.9 DelayStringSimple



Full Name: Ops.String.DelayStringSimple
Description: delay the output of a string by n seconds

- > Inputs**
- **Value** (String)
 - **Delay** (Number)
- < Output**
- **Out Value** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.String.DelayStringSimple>

91.10 EndsWith



Full Name: Ops.String.EndsWith

Description: does a string starts with another string?

> Inputs

- **String** (String)
- **Search** (String)

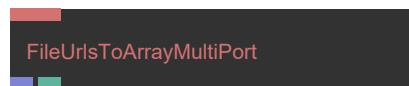
< Output

- **Ends With** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.String.EndsWith>

91.11 FileUrlsToArrayMultiPort_v2



Full Name: Ops.String.FileUrlsToArrayMultiPort_v2

Description: create an array from multiple string

> Inputs

- **Strings_0** (String)
- **Add Port** (String)

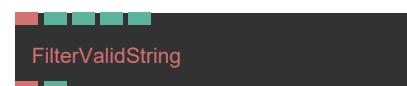
< Output

- **Result** (Array)
- **Num Values** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.String.FileUrlsToArrayMultiPort_v2

91.12 FilterValidString



Full Name: Ops.String.FilterValidString

Description: filter valid strings (not null,undefined or empty)

> Inputs

- **String** (String)
- **Invalid If Null** (Number: Boolean)
- **Invalid If Undefined** (Number: Boolean)
- **Invalid If Empty** (Number: Boolean)
- **Invalid If 0** (Number: Boolean)

< Output

- **Last Valid String** (String)
- **Is Valid** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.String.FilterValidString>

91.13 FreezeString



Full Name: Ops.String.FreezeString

Description: capture the current input and copy it to the output, even after a reload

> Inputs

- **String** (String)
- **Button** (Trigger)

< Output

- **Frozen String** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.String.FreezeString>

91.14 GateString



Full Name: Ops.String.GateString

Description: Output string if pass through is true

> Inputs

- **String In** (String)
- **Pass Through** (Number: Boolean)
- **Custom Value** (String)

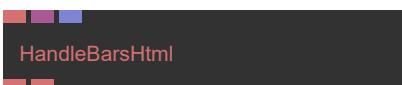
< Output

- **String Out** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.String.GateString>

91.15 HandleBarsHtml_v2



Full Name: Ops.String.HandleBarsHtml_v2

Description: string conversion using handlebars template engine

> Inputs

- **Template** (String)
- **Data** (Object)
- **Array** (Array)

< Output

- **Result** (String)
- **Errors** (String)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.String.HandleBarsHtml_v2

91.16 HtmlDecode



Full Name: Ops.String.HtmlDecode

Full Name: Ops.String.HtmlDecode

Description: convert a html encoded string to a normal UTF8 string

> Inputs

- **String** (String)

< Output

- **Result** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.String.HtmlDecode>

91.17 HtmlEncode



Full Name: Ops.String.HtmlEncode

Description: encode a string to html

> Inputs

- **String** (String)

< Output

- **Result** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.String.HtmlEncode>

91.18 LeftPad_v2



Full Name: Ops.String.LeftPad_v2

Description: create a fixed length string from a number 1 -> 0001

> Inputs

- **Value** (String)
- **Char** (String)
- **Num** (Number: Integer)

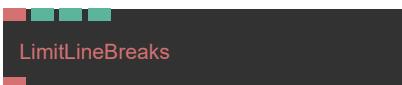
< Output

- **String** (String)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.String.LeftPad_v2

91.19 LimitLineBreaks_v2



Full Name: Ops.String.LimitLineBreaks_v2

Description: Limit number of lines in a string

> Inputs

- **String** (String)
- **Num Lines** (Number: Integer)
- **Reverse** (Number: Boolean)
- **Force Num Lines** (Number: Boolean)

< Output

- **Result** (String)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.String.LimitLineBreaks_v2

91.20 LineBreak



Full Name: Ops.String.LineBreak

Description: Outputs a linebreak, or adds a linebreak to a string

> Inputs

- **String** (String)

< Output

- **Result** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.String.LineBreak>

91.21 LineBreaksHtml



Full Name: Ops.String.LineBreaksHtml

Description: Convert linebreaks to html breaks

> Inputs

- **String** (String)
- **Add Num Breaks** (Number: Integer)

< Output

- **HTML** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.String.LineBreaksHtml>

91.22 LoremIpsum



Full Name: Ops.String.LoremIpsum

Description: Lorem ipsum dolor sit amet

> Inputs

Visit Ops.String.LoremIpsum documentation for input port details

< Output

- **String** (String)
- **HTML String** (String)
- **Array** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.String.LoremIpsum>

91.23 Lowercase_v2



Full Name: Ops.String.Lowercase_v2

Description: convert all characters to small letters

> Inputs

- **String** (String)

< Output

- **Result** (String)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.String.Lowercase_v2

91.24 Md5



Full Name: Ops.String.Md5

Description: Create a md5 hash of a string

> Inputs

- **String** (String)

< Output

- **MD5 Hash** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.String.Md5>

91.25 NumberFormatter



Full Name: Ops.String.NumberFormatter

Description: Format a number to a string in the given locale and format

> Inputs

- **Input Number** (Number)
- **Locale String** (String)
- **Minimum Integer Digits** (Number: Integer)
- **Minimum Fraction Digits** (Number: Integer)
- **Maximum Fraction Digits** (Number: Integer)
- **Minimum Significant Digits** (Number: Integer)
- **Maximum Significant Digits** (Number: Integer)
- **Use Grouping** (Number: Boolean)
- **Currency Name** (String)

< Output

- **Formatted Number** (String)
- **Has Error** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.String.NumberFormatter>

91.26 NumberSwitchByString



Full Name: Ops.String.NumberSwitchByString

Description: associate numbers by strings

> Inputs

- **String** (String)
- **String 1** (String)
- **Number 1** (Number)
- **String 2** (String)
- **Number 2** (Number)
- **String 3** (String)
- **Number 3** (Number)
- **String 4** (String)
- **Number 4** (Number)
- **String 5** (String)
- **Number 5** (Number)
- **String 6** (String)
- **Number 6** (Number)
- **String 7** (String)
- **Number 7** (Number)
- **String 8** (String)
- **Number 8** (Number)
- **String 9** (String)
- **Number 9** (Number)
- **String 10** (String)
- **Number 10** (Number)

< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.String.NumberSwitchByString>

91.27 NumberToString_v2



Full Name: Ops.String.NumberToString_v2

Description: Convert a number to a string

> Inputs

- **Number** (Number)
- **Decimal Places** (Number: Integer)

< Output

- **Result** (String)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.String.NumberToString_v2

91.28 NumTotalLineBreaks



Full Name: Ops.String.NumTotalLineBreaks

Description: Count number of line breaks in a string

> Inputs

- **String** (String)

< Output

- **Total Lines** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.String.NumTotalLineBreaks>

91.29 OrString



Full Name: Ops.String.OrString

Description: outputs the first valid string

> Inputs

- **String 1** (String)
- **String 2** (String)
- **String 3** (String)
- **String 4** (String)
- **String 5** (String)
- **String 6** (String)
- **String 7** (String)
- **String 8** (String)

< Output

- **Result** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.String.OrString>

91.30 ParseInt_v2



Full Name: Ops.String.ParseInt_v2

Description: Parse a string to a integer number / string to number

> Inputs

- **String** (String)

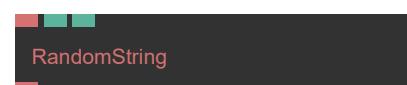
< Output

- **Number** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.String.ParseInt_v2

91.31 RandomString_v3



Full Name: Ops.String.RandomString_v3

Description: Generate a random string of given characters

> Inputs

- **Chars** (String)
- **Length** (Number: Integer)
- **Seed** (Number)

< Output

- **Result** (String)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.String.RandomString_v3

91.32 RightPad_v2



Full Name: Ops.String.RightPad_v2

Description: create a string with a fixed length filling the space with a character

> Inputs

- **Value** (String)
- **Char** (String)
- **Num** (Number: Integer)

< Output

- **String** (String)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.String.RightPad_v2

> Inputs

- **Index** (Number: Integer)
- **String In** (String)
- **Default String** (String)
- **Set Inactive To Default** (Number: Boolean)

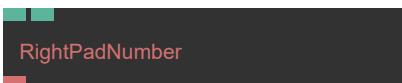
< Output

- **Index 0 String** (String)
- **Index 1 String** (String)
- **Index 2 String** (String)
- **Index 3 String** (String)
- **Index 4 String** (String)
- **Index 5 String** (String)
- **Index 6 String** (String)
- **Index 7 String** (String)
- **Index 8 String** (String)
- **Index 9 String** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.String.RouteString>

91.33 RightPadNumber_v2



Full Name: Ops.String.RightPadNumber_v2

Description: Converts a number to a string with num decimal places, adds 0's

> Inputs

- **Value** (Number)
- **Num** (Number: Integer)

< Output

- **String** (String)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.String.RightPadNumber_v2

91.34 RouteString



Full Name: Ops.String.RouteString

Description: Route a string to an output port

91.35 SaveTextFile



Full Name: Ops.String.SaveTextFile

Description: download a textfile containing the input string

> Inputs

- **Download** (Trigger)
- **Filename** (String)
- **Content String** (String)

< Output

• Visit *Ops.String.SaveTextFile documentation for output port details*

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.String.SaveTextFile>

91.36 SequenceStrings



Full Name: Ops.String.SequenceStrings

Description: control order and flow of strings

> Inputs

- **String 0** (String)
- **String 1** (String)
- **String 2** (String)
- **String 3** (String)
- **String 4** (String)
- **String 5** (String)
- **String 6** (String)
- **String 7** (String)
- **String 8** (String)
- **String 9** (String)
- **String 10** (String)
- **String 11** (String)
- **String 12** (String)
- **String 13** (String)
- **String 14** (String)
- **String 15** (String)

< Output

- **Output 0** (String)
- **Output 1** (String)
- **Output 2** (String)
- **Output 3** (String)
- **Output 4** (String)
- **Output 5** (String)
- **Output 6** (String)
- **Output 7** (String)
- **Output 8** (String)
- **Output 9** (String)
- **Output 10** (String)
- **Output 11** (String)
- **Output 12** (String)
- **Output 13** (String)
- **Output 14** (String)
- **Output 15** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.String.SequenceStrings>

91.37 StartsWith



Full Name: Ops.String.StartsWith

Description: does a string starts with another string?

> Inputs

- **String** (String)
- **Search** (String)

< Output

- **Starts With** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.String.StartsWith>

91.38 String_v3



Full Name: Ops.String.String_v3

Description: String input/output

> Inputs

- **Value** (String)

< Output

- **String** (String)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.String.String_v3

91.39 StringCompose_v3



Full Name: Ops.String.StringCompose_v3

Description: Combine multiple Values to a new String

> Inputs

- **Format** (String)
- **String A** (String)
- **String B** (String)
- **String C** (String)
- **String D** (String)
- **String E** (String)
- **String F** (String)

< Output

- **Result** (String)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.String.StringCompose_v3

91.40 StringContains_v2



Full Name: Ops.String.StringContains_v2

Description: check if string contains another string (find,search,indexOf)

> Inputs

- **String** (String)
- **SearchValue** (String)

< Output

- **Found** (Number)
- **Index** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.String.StringContains_v2

91.41 StringEditor



Full Name: Ops.String.StringEditor

Description: string text editor

> Inputs

- **Value** (String)
- **Syntax Index** (Number: Integer)

< Output

- **Result** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.String.StringEditor>

91.42 StringEquals_v2



Full Name: Ops.String.StringEquals_v2

Description: check if content of two strings is the same

> Inputs

- **String 1** (String)
- **String 2** (String)

< Output

- **Result** (booleanNumber)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.String.StringEquals_v2

91.43 StringGetLineNumAtIndex



Full Name: Ops.String.StringGetLineNumAtIndex

Description: output the line number at the character index

> Inputs

- **String** (String)
- **Index** (Number: Integer)

< Output

- **Line** (Number)
- **Found** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.String.StringGetLineNumAtIndex>

91.44 StringIterator_v2



Full Name: Ops.String.StringIterator_v2

Description: iterate over every character of a string

> Inputs

- **Exec** (Trigger)
- **String** (String)

< Output

- **Next** (Trigger)
- **Character** (String)
- **Index** (Number)
- **Length** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.String.StringIterator_v2

91.45 StringLength_v2



Full Name: Ops.String.StringLength_v2

Description: number of characters in a string

> Inputs

- **String** (String)

< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.String.StringLength_v2

91.46 StringRemoveCharacters



Full Name: Ops.String.StringRemoveCharacters

Description: Remove every occurrences of given characters from a string

> Inputs

- **String** (String)
- **Characters** (String)
- **Replace** (String)

< Output

- **Result** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.String.StringRemoveCharacters>

91.47 StringReplace



Full Name: Ops.String.StringReplace

Description: replace occurrences of a string with another string

> Inputs

- **String** (String)
- **Search For** (String)
- **Replace** (String)
- **Replace What Index** (Number: Integer)

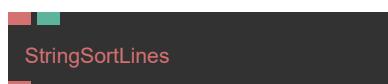
< Output

- **Result** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.String.StringReplace>

91.48 StringSortLines



Full Name: Ops.String.StringSortLines

Description: sort each line of a string alphabetically

> Inputs

- **String** (String)
- **Reverse** (Number: Boolean)

< Output

- **Result** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.String.StringSortLines>

91.49 StringsToArrayMultiPort_v2



Full Name: Ops.String.StringsToArrayMultiPort_v2

Description: create an array from multiple string

> Inputs

- **Strings_0** (String)
- **Add Port** (String)

< Output

- **Result** (Array)
- **Num Values** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.String.StringsToArrayMultiPort_v2

91.50 StringSwitchByString



Full Name: Ops.String.StringSwitchByString

Description: Switch between multiple strings by a string index

> Inputs

- **String** (String)
- **Default** (String)
- **String 1** (String)
- **Result String 1** (String)
- **String 2** (String)
- **Result String 2** (String)
- **String 3** (String)
- **Result String 3** (String)
- **String 4** (String)
- **Result String 4** (String)
- **String 5** (String)
- **Result String 5** (String)
- **String 6** (String)

- **Result String 6** (String)

- **String 7** (String)

- **Result String 7** (String)

- **String 8** (String)

- **Result String 8** (String)

- **String 9** (String)

- **Result String 9** (String)

- **String 10** (String)

- **Result String 10** (String)

< Output

- **Result** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.String.StringSwitchByString>

91.51 StringToNumber



Full Name: Ops.String.StringToNumber

Description: Parses a string and returns a floating point number / string to number

> Inputs

- **String** (String)

< Output

- **Number** (Number)

- **Not A Number** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.String.StringToNumber>

91.52 StringTrim_v2



Full Name: Ops.String.StringTrim_v2

Description: Remove whitespace from both ends of a string

> Inputs

- **String** (String)

< Output

- **Result** (String)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.String.StringTrim_v2

91.53 StripHtml



Full Name: Ops.String.StripHtml

Description: remove html tags from a string

> Inputs

- **String** (String)

< Output

- **Result** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.String.StripHtml>

91.54 SubString_v2



Full Name: Ops.String.SubString_v2

Description: Subset of a string between one index and another

> Inputs

- **String** (String)
- **Start** (Number: Integer)
- **End** (Number: Integer)
- **End Of String** (Number: Boolean)

< Output

- **Result** (String)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.String.SubString_v2

91.55 SwitchString



Full Name: Ops.String.SwitchString

Description: Switch between multiple strings with an index

> Inputs

- **Index** (Number: Integer)
- **String 0** (String)
- **String 1** (String)
- **String 2** (String)
- **String 3** (String)
- **String 4** (String)
- **String 5** (String)
- **String 6** (String)
- **String 7** (String)
- **String 8** (String)
- **String 9** (String)

< Output

- **Result** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.String.SwitchString>

91.56 SwitchStringMultiPort_v2



Full Name: Ops.String.SwitchStringMultiPort_v2

Description: switch between multiple string inputs

> Inputs

- **Index** (Number: Integer)
- **Strings_0** (String)
- **Add Port** (String)

< Output

- **String** (String)
- **Num Values** (Number)

Example Patch: Open in Editor

91.57 Uppercase_v2



Full Name: Ops.String.Uppercase_v2

Description: Convert all characters in a string to uppercase

> Inputs

- String (String)

< Output

- Result (String)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.String.Uppercase_v2

91.58 UUID



Full Name: Ops.String.UUID

Description: outputs a unique identifier string

> Inputs

- Generate (Trigger)

< Output

- Id (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.String.UUID>

92 Ops.String.Base64

92.1 Base64Decode_v2



Full Name: Ops.String.Base64.Base64Decode_v2

Description: decode a string to base64

> Inputs

- String (String)

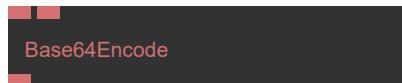
< Output

- Result (String)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.String.Base64.Base64Decode_v2

92.2 Base64Encode_v3



Full Name: Ops.String.Base64.Base64Encode_v3

Description: encode a string to base64

> Inputs

- String (String)
- MimeType (String)

< Output

- Result (String)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.String.Base64.Base64Encode_v3

92.3 DownloadBase64File



Full Name: Ops.String.Base64.DownloadBase64File
Description: trigger a download of a base64 binary file

> Inputs

- **Data URL** (String)
- **Filename** (String)
- **Download** (Trigger)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.String.Base64.DownloadBase64File>

93 Ops.String.File

93.1 FileInput_v2



Full Name: Ops.String.File.FileInput_v2

Description: get URL of a file

> Inputs

- **File** (String)

< Output

- **URL** (String)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.String.File.FileInput_v2

93.2 SwitchFile_v2



Full Name: Ops.String.File.SwitchFile_v2

Description: switch between filenames

> Inputs

- **Index** (Number: Integer)
- **File 0** (String)
- **File 1** (String)
- **File 2** (String)
- **File 3** (String)
- **File 4** (String)
- **File 5** (String)
- **File 6** (String)
- **File 7** (String)
- **File 8** (String)
- **File 9** (String)
- **File 10** (String)
- **File 11** (String)

- **File 12** (String)
- **File 13** (String)
- **File 14** (String)
- **File 15** (String)

◀ **Output**

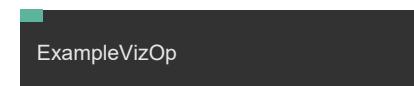
- **Result** (String)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.String.File.SwitchFile_v2

94 Ops.Templates

94.1 ExampleVizOp



Full Name: Ops.Templates.ExampleVizOp

Description: example how to code a viz layer op

▶ **Inputs**

- **Number** (Number)

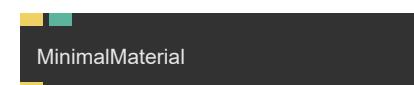
◀ **Output**

• Visit *Ops.Templates.ExampleVizOp documentation* for output port details

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Templates.ExampleVizOp>

94.2 MinimalMaterial



Full Name: Ops.Templates.MinimalMaterial

Description: Material Example Template

▶ **Inputs**

- **Render** (Trigger)
- **Red** (Number)

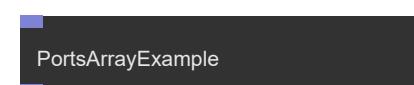
◀ **Output**

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Templates.MinimalMaterial>

94.3 PortsArrayExample



Full Name: Ops.Templates.PortsArrayExample
Description: Is a template for creating Array ports
> Inputs

- **Array In** (Array)

< Output

- **Array Out** (Array)

Example Patch: Open in Editor
Docs: <https://cables.gl/op/Ops.Templates.PortsArrayExample>

94.4 PortsBooleanExample

PortsBooleanExample

Full Name: Ops.Templates.PortsBooleanExample
Description: Is a template for creating Boolean ports
> Inputs

- **Boolean In** (Number: Boolean)

< Output

- **Boolean Out** (Number)

Example Patch: Open in Editor
Docs: <https://cables.gl/op/Ops.Templates.PortsBooleanExample>

94.5 PortsObjectExample

PortsObjectExample

Full Name: Ops.Templates.PortsObjectExample
Description: Is a template for creating Object ports
> Inputs

- **Object In** (Object)

< Output

- **Object Out** (Object)

Example Patch: Open in Editor
Docs: <https://cables.gl/op/Ops.Templates.PortsObjectExample>

94.6 PortsStringExample

PortsStringExample

Full Name: Ops.Templates.PortsStringExample
Description: Is a template for creating String ports
> Inputs

- **String In** (String)

< Output

- **String Out** (String)

Example Patch: Open in Editor
Docs: <https://cables.gl/op/Ops.Templates.PortsStringExample>

94.7 PortsTriggerExample

PortsTriggerExample

Full Name: Ops.Templates.PortsTriggerExample
Description: Is a template for creating Trigger ports
> Inputs

- **Trigger In** (Trigger)
- **Press Me** (Trigger)

< Output

- **Trigger Out** (Trigger)

Example Patch: Open in Editor
Docs: <https://cables.gl/op/Ops.Templates.PortsTriggerExample>

94.8 PortsValueExample

PortsValueExample

Full Name: Ops.Templates.PortsValueExample
Description: Is a template for creating Value ports
> Inputs

- **Number In** (Number)

< Output

- **Value Out** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Templates.PortsValueExample>

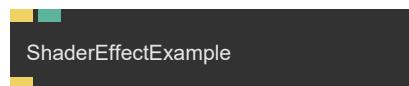
• **This Will Greyout** (Number)

- **Open Prompt** (Trigger)

• **Open Modal** (Trigger)

• **Open New Tab** (Trigger)

94.9 ShaderEffectExample



Full Name: Ops.Templates.ShaderEffectExample

Description: shader effect example template

> Inputs

- **Render** (Trigger)
- **Width** (Number)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Templates.ShaderEffectExample>

94.10 UiTestOp



Full Name: Ops.Templates.UiTestOp

Description: UI indicators example op

> Inputs

- **Loading Task** (Number: Boolean)
- **Loading** (Number: Boolean)
- **Warning** (Number: Boolean)
- **Error** (Number: Boolean)
- **Hint** (Number: Boolean)
- **Not Working** (Number: Boolean)
- **Slider** (Number)
- **Gradient** (Number)
- **Resizable** (Number: Boolean)
- **Trigger** (Trigger)
- **Greyout** (Number: Boolean)

< Output

- **Something** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Templates.UiTestOp>

95 Ops.TimeLine

95.1 Anim



Full Name: Ops.TimeLine.Anim

Description: timeline keyframable animation object

> Inputs

- **Value** (Number)
- **Clip** (Number: Boolean)
- **Clip Name** (String)

< Output

- **Anim** (Object)
- **Loop Length** (Number)
- **Length** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.TimeLine.Anim>

95.2 AnimGetKey



Full Name: Ops.TimeLine.AnimGetKey

Description: Get data from a single key in an animation

> Inputs

- **Anim** (Object)
- **Time** (Number)

< Output

- **Index** (Number)
- **Key Value** (Number)
- **Key Time** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.TimeLine.AnimGetKey>

95.3 AnimGetValue



Full Name: Ops.TimeLine.AnimGetValue

Description: get the animated value at time x of an animation object

> Inputs

- **Anim** (Object)
- **Time** (Number)

< Output

- **Value** (Number)
- **Loop** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.TimeLine.AnimGetValue>

95.4 AnimInfo



Full Name: Ops.TimeLine.AnimInfo

Description: Get information about an anim object

> Inputs

- **Anim** (Object)

< Output

- **Total Keys** (Number)
- **Length Seconds** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.TimeLine.AnimInfo>

95.5 AutoPlay



Full Name: Ops.TimeLine.AutoPlay

Description: Automatically starts the timeline playback when opening patch

> Inputs

- Visit `Ops.TimeLine.AutoPlay` documentation for input port details

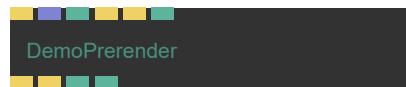
< Output

- Visit `Ops.TimeLine.AutoPlay` documentation for output port details

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.TimeLine.AutoPlay>

95.6 DemoPrerender



Full Name: Ops.TimeLine.DemoPrerender

Description: Prerenderer based on timeline progress

> Inputs

- **Render** (Trigger)
- **Manual Timestamps** (Array)
- **Record Events** (Number: Boolean)
- **Reset** (Trigger)
- **Clear** (Trigger)
- **ReRender On Resize** (Number: Boolean)

< Output

- **Next** (Trigger)
- **Prerendered Frame** (Trigger)
- **Progress** (Number)
- **Num Events** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.TimeLine.DemoPrerender>

95.7 GotoFrame



Full Name: Ops.TimeLine.GotoFrame

Description: jump to a key in the timeline

> Inputs

- **Frame** (Number)

< Output

- Visit `Ops.TimeLine.GotoFrame` documentation for output port details

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.TimeLine.GotoFrame>

95.8 PreRender



Full Name: Ops.TimeLine.PreRender

Description: Render the patch at certain times

> Inputs

- **Render** (Trigger)
- **Max Time** (Number: Integer)
- **Step** (Number: Integer)
- **Reset** (Trigger)

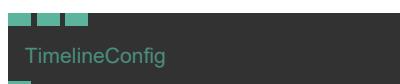
< Output

- **Next** (Trigger)
- **Render Progress** (Trigger)
- **Done** (Trigger)
- **Progress** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.TimeLine.PreRender>

95.9 TimelineConfig



Full Name: Ops.TimeLine.TimelineConfig

Description: configure the timeline for the current patch

> Inputs

- **FPS** (Number: Integer)
- **Restrict To Frames** (Number: Boolean)
- **Fade In Frames** (Number: Boolean)

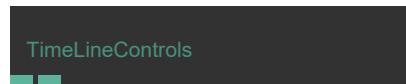
< Output

- **Duration Seconds** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.TimeLine.TimelineConfig>

95.10 TimeLineControls



Full Name: Ops.TimeLine.TimeLineControls

Description: use position and play pause state of cables timeline

> Inputs

- Visit *Ops.TimeLine.TimeLineControls documentation for input port details*

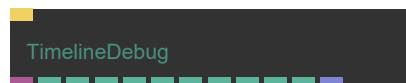
< Output

- **Time** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.TimeLine.TimeLineControls>

95.11 TimelineDebug



Full Name: Ops.TimeLine.TimelineDebug

Description: Visit documentation for details

> Inputs

- **Update** (Trigger)

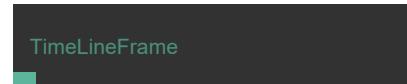
< Output

- **Data** (Object)
- **Time Cursor** (Number)
- **Visible Duration** (Number)
- **Visible Time Start** (Number)
- **Loop Start** (Number)
- **Loop End** (Number)
- **Num Selected Keys** (Number)
- **Selected Values Min** (Number)
- **Selected Values Max** (Number)
- **Selected Times Min** (Number)
- **Selected Times Max** (Number)
- **Selected Keys** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.TimeLine.TimelineDebug>

95.12 TimeLineFrame



Full Name: Ops.TimeLine.TimeLineFrame

Description: Returns the current frame number of the timeline

> Inputs

- Visit *Ops.TimeLine.TimeLineFrame documentation for input port details*

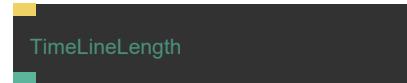
< Output

- **Time** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.TimeLine.TimeLineFrame>

95.13 TimeLineLength



Full Name: Ops.TimeLine.TimeLineLength

Description: current set length of the timeline

> Inputs

- **Update** (Trigger)

< Output

- **Length** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.TimeLine.TimeLineLength>

95.14 TimeLineLoop



Full Name: Ops.TimeLine.TimeLineLoop

Description: Automatic rewind of timeline at a certain time

> Inputs

- **Execute** (Trigger)
- **Duration** (Number)
- **How long the loop should be** (in seconds)

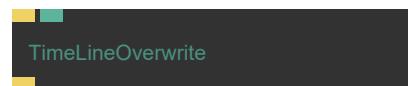
< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.TimeLine.TimeLineLoop>

95.15 TimeLineOverwrite



Full Name: Ops.TimeLine.TimeLineOverwrite

Description: overwrite timeline time value

> Inputs

- **Exe** (Trigger)
- **New Time** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.TimeLine.TimeLineOverwrite>

95.16 TimeLinePlay



Full Name: Ops.TimeLine.TimeLinePlay

Description: Visit documentation for details

> Inputs

- **Play** (Trigger)
- **Pause** (Trigger)

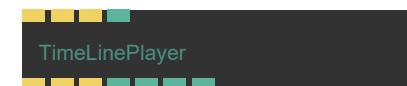
< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.TimeLine.TimeLinePlay>

95.17 TimeLinePlayer



Full Name: Ops.TimeLine.TimeLinePlayer

Description: Player controls for the timeline

> Inputs

- **Play** (Trigger)
- **Pause** (Trigger)
- **Rewind** (Trigger)
- **Set Current Time** (Number)

< Output

- **Play Trigger** (Trigger)
- **Pause Trigger** (Trigger)
- **Rewind Trigger** (Trigger)
- **Is Playing** (booleanNumber)
- **Current Time** (Number)
- **Current Frame** (Number)
- **Current time in frames** (30fps)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.TimeLine.TimeLinePlayer>

95.18 TimeLineRewind



Full Name: Ops.TimeLine.TimeLineRewind

Description: set time of timeline to 0 (rewind, restart)

> Inputs

- **Exe** (Trigger)

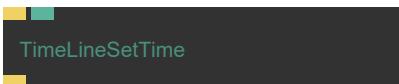
< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.TimeLine.TimeLineRewind>

95.19 TimeLineSetTime



Full Name: Ops.TimeLine.TimeLineSetTime

Description: set current time of timeline

> Inputs

- **Update** (Trigger)
- **Time** (Number)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.TimeLine.TimeLineSetTime>

- **Play** (Number: Boolean)

- **Public** (20): MY IDENTITY PATTERN

< Output

- Visit *Ops.TimeLine.TimeLineTogglePlay* documentation for output port details

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.TimeLine.TimeLineTogglePlay>

95.20 TimeLineTime



Full Name: Ops.TimeLine.TimeLineTime

Description: Returns the current time of the timeline

> Inputs

- Visit *Ops.TimeLine.TimeLineTime* documentation for input port details

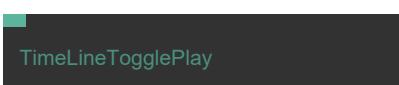
< Output

- **Time** (Number)
- **The current time of the timeline** (in seconds)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.TimeLine.TimeLineTime>

95.21 TimeLineTogglePlay



Full Name: Ops.TimeLine.TimeLineTogglePlay

Description: toggle between timeline playing and being paused

> Inputs



Full Name: Ops.TimeLine.TimelineValue

Description: Animate and get value at "time" of timeline

> Inputs

- **Time** (Number)
- **Value** (Number)
- **Unit Index** (Number: Integer)

< Output

- **Result** (Number)
- **Anim Array** (Array)
- **Anim Finished** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.TimeLine.TimelineValue>

96 Ops.TimeLine.Viz

96.1 TimeLineBPM



Full Name: Ops.TimeLine.Viz.TimeLineBPM

Description: Display current Beat index and BPM timing information as beat rectangles on the timeline

> Inputs

- **BPM** (Number)
- **Offset** (Number)

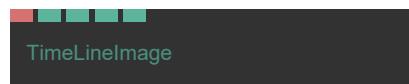
< Output

- Visit *Ops.TimeLine.Viz.TimeLineBPM documentation for output port details*

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.TimeLine.Viz.TimeLineBPM>

96.2 TimeLineImage



Full Name: Ops.TimeLine.Viz.TimeLineImage

Description: Display an image on the timeline

> Inputs

- **File** (String)
- **Slot** (Number: Integer)
- **Opacity** (Number)
- **Start** (Number)
- **End** (Number)

< Output

- Visit *Ops.TimeLine.Viz.TimeLineImage documentation for output port details*

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.TimeLine.Viz.TimeLineImage>

97 Ops.Trigger

97.1 DelayedTrigger



Full Name: Ops.Trigger.DelayedTrigger

Description: delay triggering next port by x seconds

> Inputs

- **Exe** (Trigger)
- **Delay** (Number)
- **Cancel** (Trigger)

< Output

- **Next** (Trigger)
- **Delaying** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Trigger.DelayedTrigger>

97.2 GateTrigger



Full Name: Ops.Trigger.GateTrigger

Description: Allows a trigger to pass only if the gate is open

> Inputs

- **Execute** (Trigger)
- **Pass Through** (Number: Boolean)

< Output

- **Trigger Out** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Trigger.GateTrigger>

97.3 Interval



Full Name: Ops.Trigger.Interval

Description: Timed Trigger every x ms

> Inputs

- **Interval** (Number)
- **Active** (Number: Boolean)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Trigger.Interval>

97.4 IsTriggered



Full Name: Ops.Trigger.IsTriggered

Description: outputs true if being triggered last frame

> Inputs

- **Trigger** (Trigger)

< Output

- **Next** (Trigger)
- **Was Triggered** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Trigger.IsTriggered>

97.5 NthTrigger_v2



Full Name: Ops.Trigger.NthTrigger_v2

Description: Lets a trigger through every nth time (trigger limiter)

> Inputs

- **Execute** (Trigger)
- **Nth** (Number)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Trigger.NthTrigger_v2

97.6 NumberByTrigger



Full Name: Ops.Trigger.NumberByTrigger

Description: Outputs the last number of the input port which was triggered

> Inputs

• Visit *Ops.Trigger.NumberByTrigger documentation* for input port details

< Output

- **Number** (Number)
- **Triggered** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Trigger.NumberByTrigger>

97.7 NumberByTriggerMultiPort_v2



Full Name: Ops.Trigger.NumberByTriggerMultiPort_v2

Description: output a number by triggering an index port

> Inputs

- **Trigger_0** (Trigger)
- **Add Port** (Trigger)

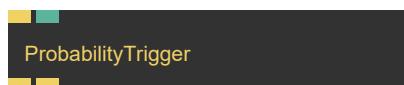
< Output

- **Next** (Trigger)
- **Number Triggered** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Trigger.NumberByTriggerMultiPort_v2

97.8 ProbabilityTrigger



Full Name: Ops.Trigger.ProbabilityTrigger

Description: trigger by chance

> Inputs

- **Trigger In** (Trigger)
- **Probability** (Number)

< Output

- **Trigger Output** (Trigger)
- **Inverse Trigger Output** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Trigger.ProbabilityTrigger>

97.9 RandomTrigger



Full Name: Ops.Trigger.RandomTrigger

Description: randomly trigger

> Inputs

- **Render** (Trigger)
- **Num Times** (Number)
- **Seed** (Number)
- **Only Once** (Number: Boolean)

< Output

- **Render** (Trigger)
- **Num Times** (Number)
- **Seed** (Number)
- **Only Once** (Number: Boolean)
- **Index** (Number)
- **Trigger 0** (Trigger)
- **Trigger 1** (Trigger)
- **Trigger 2** (Trigger)
- **Trigger 3** (Trigger)
- **Trigger 4** (Trigger)
- **Trigger 5** (Trigger)

- **Trigger 6** (Trigger)
- **Trigger 7** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Trigger.RandomTrigger>

97.10 Repeat2d



Full Name: Ops.Trigger.Repeat2d

Description: Triggers all ops underneath Num X * Num Y times

> Inputs

- **Exe** (Trigger)
- **Num X** (Number: Integer)
- **Num Y** (Number: Integer)
- **Mul** (Number)
- **Center** (Number: Boolean)
- **Centers X and Y around the origin (0/0)**

< Output

- **Trigger** (Trigger)
- **X** (Number)
- **Y** (Number)
- **Index** (Number)
- **Total Iterations** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Trigger.Repeat2d>

97.11 Repeat_v2



Full Name: Ops.Trigger.Repeat_v2

Description: Triggers all ops below x times (for loop / while)

> Inputs

- **Execute** (Trigger)
- **Repeats** (Number: Integer)

< Output

- **Next** (Trigger)
- **Index** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Trigger.Repeat_v2

97.12 RouteTrigger



Full Name: Ops.Trigger.RouteTrigger

Description: Triggers one of the out ports - value index switch case (was SwitchTrigger)

> Inputs

- **Execute** (Trigger)
- **Switch Value** (Number: Integer)

< Output

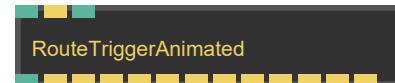
- **Next Trigger** (Trigger)
- **Switched Value** (Number)
- **Trigger 0** (Trigger)
- **Trigger 1** (Trigger)
- **Trigger 2** (Trigger)
- **Trigger 3** (Trigger)
- **Trigger 4** (Trigger)
- **Trigger 5** (Trigger)
- **Trigger 6** (Trigger)
- **Trigger 7** (Trigger)
- **Trigger 8** (Trigger)
- **Trigger 9** (Trigger)
- **Trigger 10** (Trigger)
- **Trigger 11** (Trigger)
- **Trigger 12** (Trigger)
- **Trigger 13** (Trigger)
- **Trigger 14** (Trigger)
- **Trigger 15** (Trigger)
- **Trigger 16** (Trigger)
- **Trigger 17** (Trigger)
- **Trigger 18** (Trigger)
- **Trigger 19** (Trigger)
- **Trigger 20** (Trigger)
- **Trigger 21** (Trigger)

- **Trigger 22** (Trigger)
- **Trigger 23** (Trigger)
- **Default Trigger** (Trigger)
- **Highest Index** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Trigger.RouteTrigger>

97.13 RouteTriggerAnimated



Full Name: Ops.Trigger.RouteTriggerAnimated

Description: animated switching between things

> Inputs

- **Index** (Number: Integer)
- **Exe** (Trigger)
- **Duration** (Number)

< Output

- **Qutsn94pc** (Trigger)
- **Hvylh9o8** (Trigger)
- **T8dvyuoq** (Trigger)
- **A0w7orgi8** (Trigger)
- **R8h4qx4z8** (Trigger)
- **Cr80a86xi** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Trigger.RouteTriggerAnimated>

97.14 RouteTriggerMultiPort_v2



Full Name: Ops.Trigger.RouteTriggerMultiPort_v2

Description: Triggers one of the - value index switch case

> Inputs

- **Execute** (Trigger)
- **Switch Value** (Number: Integer)

< Output

- **Execute** (Trigger)
- **Switch Value** (Number: Integer)
- **Total Connections** (Number)
- **Connected Op Names** (Array)
- **Trigger_0** (Trigger)
- **Trigger_1** (Trigger)
- **Trigger_2** (Trigger)
- **Trigger_3** (Trigger)
- **Trigger_4** (Trigger)
- **Trigger_5** (Trigger)
- **Trigger_6** (Trigger)
- **Trigger_7** (Trigger)
- **Trigger_8** (Trigger)
- **Trigger_9** (Trigger)
- **Trigger_10** (Trigger)
- **Trigger_11** (Trigger)
- **Trigger_12** (Trigger)
- **Trigger_13** (Trigger)
- **Trigger_14** (Trigger)
- **Trigger_15** (Trigger)
- **Trigger_16** (Trigger)
- **Trigger_17** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Trigger.RouteTriggerMultiPort_v2

97.15 RouteTriggerString_v2



Full Name: Ops.Trigger.RouteTriggerString_v2

Description: route trigger output by string

> Inputs

- **Execute** (Trigger)
- **Switch Value** (String)
- **String 0** (String)
- **String 1** (String)
- **String 2** (String)
- **String 3** (String)
- **String 4** (String)
- **String 5** (String)

- **String 6** (String)
- **String 7** (String)
- **String 8** (String)
- **String 9** (String)
- **String 10** (String)
- **String 11** (String)
- **String 12** (String)
- **String 13** (String)
- **String 14** (String)
- **String 15** (String)
- **String 16** (String)
- **String 17** (String)
- **String 18** (String)
- **String 19** (String)
- **String 20** (String)
- **String 21** (String)
- **String 22** (String)
- **String 23** (String)

< Output

- **Next Trigger** (Trigger)
- **Switched Index** (Number)
- **Trigger 0** (Trigger)
- **Trigger 1** (Trigger)
- **Trigger 2** (Trigger)
- **Trigger 3** (Trigger)
- **Trigger 4** (Trigger)
- **Trigger 5** (Trigger)
- **Trigger 6** (Trigger)
- **Trigger 7** (Trigger)
- **Trigger 8** (Trigger)
- **Trigger 9** (Trigger)
- **Trigger 10** (Trigger)
- **Trigger 11** (Trigger)
- **Trigger 12** (Trigger)
- **Trigger 13** (Trigger)
- **Trigger 14** (Trigger)
- **Trigger 15** (Trigger)
- **Trigger 16** (Trigger)
- **Trigger 17** (Trigger)
- **Trigger 18** (Trigger)
- **Trigger 19** (Trigger)

- **Trigger 20** (Trigger)
- **Trigger 21** (Trigger)
- **Trigger 22** (Trigger)
- **Trigger 23** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Trigger.RouteTriggerString_v2

97.16 Sequence



Full Name: Ops.Trigger.Sequence

Description: control the order of execution/triggering

> Inputs

- **Exe** (Trigger)
- **Exe 0** (Trigger)
- **Exe 1** (Trigger)
- **Exe 2** (Trigger)
- **Exe 3** (Trigger)
- **Exe 4** (Trigger)
- **Exe 5** (Trigger)
- **Exe 6** (Trigger)
- **Exe 7** (Trigger)
- **Exe 8** (Trigger)
- **Exe 9** (Trigger)
- **Exe 10** (Trigger)
- **Exe 11** (Trigger)
- **Exe 12** (Trigger)
- **Exe 13** (Trigger)
- **Exe 14** (Trigger)

< Output

- **Trigger 0** (Trigger)
- **Trigger 1** (Trigger)
- **Trigger 2** (Trigger)
- **Trigger 3** (Trigger)
- **Trigger 4** (Trigger)
- **Trigger 5** (Trigger)
- **Trigger 6** (Trigger)
- **Trigger 7** (Trigger)

- **Trigger 8** (Trigger)
- **Trigger 9** (Trigger)
- **Trigger 10** (Trigger)
- **Trigger 11** (Trigger)
- **Trigger 12** (Trigger)
- **Trigger 13** (Trigger)
- **Trigger 14** (Trigger)
- **Trigger 15** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Trigger.Sequence>

97.17 SequenceMultiPort_v2



Full Name: Ops.Trigger.SequenceMultiPort_v2

Description: sequence trigger

> Inputs

- **Input_0** (Trigger)
- **Add Port** (Trigger)

< Output

- **Output_0** (Trigger)
- **Output_1** (Trigger)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Trigger.SequenceMultiPort_v2

97.18 SwitchTrigger



Full Name: Ops.Trigger.SwitchTrigger

Description: route input triggers by index to one output

> Inputs

- **Trigger Index** (Number: Integer)
- **Trigger In 0** (Trigger)
- **Trigger In 1** (Trigger)
- **Trigger In 2** (Trigger)

- **Trigger In 3** (Trigger)
- **Trigger In 4** (Trigger)
- **Trigger In 5** (Trigger)
- **Trigger In 6** (Trigger)
- **Trigger In 7** (Trigger)
- **Trigger In 8** (Trigger)
- **Trigger In 9** (Trigger)
- **Trigger In 10** (Trigger)
- **Trigger In 11** (Trigger)
- **Trigger In 12** (Trigger)
- **Trigger In 13** (Trigger)
- **Trigger In 14** (Trigger)
- **Trigger In 15** (Trigger)

< Output

- **Trigger Out** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Trigger.SwitchTrigger>

97.19 Threshold



Full Name: Ops.Trigger.Threshold

Description: Triggers only once when threshold is crossed

> Inputs

- **Threshold** (Number)

< Output

- Visit *Ops.Trigger.Threshold documentation for output port details*

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Trigger.Threshold>

97.20 TimedSequence



Full Name: Ops.Trigger.TimedSequence

Description: timed switching of trigger

> Inputs

- **Exe** (Trigger)
- **Current** (Number: Integer)
- **OverwriteTime** (Number: Boolean)
- **IgnoreInSubPatch** (Number: Boolean)

< Output

- **TriggerAlways** (Trigger)
- **Names** (Array)
- **CurrentKeyTime** (Number)
- **Current** (Number)
- **Trigger 0** (Trigger)
- **Trigger 1** (Trigger)
- **Trigger 2** (Trigger)
- **Trigger 3** (Trigger)
- **Trigger 4** (Trigger)
- **Trigger 5** (Trigger)
- **Trigger 6** (Trigger)
- **Trigger 7** (Trigger)
- **Trigger 8** (Trigger)
- **Trigger 9** (Trigger)
- **Trigger 10** (Trigger)
- **Trigger 11** (Trigger)
- **Trigger 12** (Trigger)
- **Trigger 13** (Trigger)
- **Trigger 14** (Trigger)
- **Trigger 15** (Trigger)
- **Trigger 16** (Trigger)
- **Trigger 17** (Trigger)
- **Trigger 18** (Trigger)
- **Trigger 19** (Trigger)
- **Trigger 20** (Trigger)
- **Trigger 21** (Trigger)
- **Trigger 22** (Trigger)
- **Trigger 23** (Trigger)
- **Trigger 24** (Trigger)
- **Trigger 25** (Trigger)
- **Trigger 26** (Trigger)
- **Trigger 27** (Trigger)
- **Trigger 28** (Trigger)
- **Trigger 29** (Trigger)
- **Trigger 30** (Trigger)
- **Trigger 31** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Trigger.TimedSequence>

97.21 TimeSinceTrigger



Full Name: Ops.Trigger.TimeSinceTrigger

Description: Get the time since last trigger

> Inputs

- **Exe** (Trigger)
- **Trigger** (Trigger)
- **Reset** (Trigger)

< Output

- **Next** (Trigger)
- **Time** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Trigger.TimeSinceTrigger>

97.22 TriggerButton



Full Name: Ops.Trigger.TriggerButton

Description: simple button to trigger manually

> Inputs

- **Trigger** (Trigger)

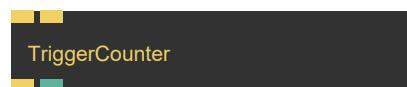
< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Trigger.TriggerButton>

97.23 TriggerCounter



Full Name: Ops.Trigger.TriggerCounter

Description: Counts how often the port was triggered

> Inputs

- **Exe** (Trigger)
- **Reset** (Trigger)

< Output

- **Trigger** (Trigger)
- **TimesTriggered** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Trigger.TriggerCounter>

97.24 TriggerCounterLoop



Full Name: Ops.Trigger.TriggerCounterLoop

Description: Increments with each trigger and loops depending on min and max loop values.

> Inputs

- **Trigger In** (Trigger)
- **Reset** (Trigger)
- **Loop Min** (Number: Integer)
- **Loop Max** (Number: Integer)

< Output

- **Trigger Out** (Trigger)
- **Current Count** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Trigger.TriggerCounterLoop>

97.25 TriggerDistributeByValue



Full Name: Ops.Trigger.TriggerDistributeByValue

Description: triggers evenly distributed by value

> Inputs

- **Exe** (Trigger)
- **Number** (Number)
- **Max** (Number)
- **Num Outputs** (Number)

< Output

- **Num** (Number)
- **Trigger 0** (Trigger)
- **Trigger 1** (Trigger)
- **Trigger 2** (Trigger)
- **Trigger 3** (Trigger)
- **Trigger 4** (Trigger)
- **Trigger 5** (Trigger)
- **Trigger 6** (Trigger)
- **Trigger 7** (Trigger)
- **Trigger 8** (Trigger)
- **Trigger 9** (Trigger)
- **Trigger 10** (Trigger)
- **Trigger 11** (Trigger)
- **Trigger 12** (Trigger)
- **Trigger 13** (Trigger)
- **Trigger 14** (Trigger)
- **Trigger 15** (Trigger)
- **Trigger 16** (Trigger)
- **Trigger 17** (Trigger)
- **Trigger 18** (Trigger)
- **Trigger 19** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Trigger.TriggerDistributeByValue>

97.26 TriggerExtender



Full Name: Ops.Trigger.TriggerExtender

Description: Extends a trigger (useful in big patches for better overview)

> Inputs

- **Execute** (Trigger)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Trigger.TriggerExtender>

97.27 TriggerIfDecreased



Full Name: Ops.Trigger.TriggerIfDecreased

Description: trigger if a value decreases / gets smaller

> Inputs

- **Value** (Number)

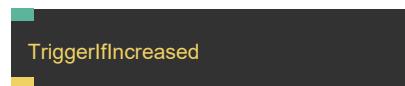
< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Trigger.TriggerIfDecreased>

97.28 TriggerIfIncreased



Full Name: Ops.Trigger.TriggerIfIncreased

Description: Outputs a trigger if the value of a number increases

> Inputs

- **Value** (Number)

< Output

- **Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Trigger.TriggerIfIncreased>

97.29 TriggerLimiter



Full Name: Ops.Trigger.TriggerLimiter

Description: Limits how often a trigger goes through to x ms

> **Inputs**

- **In Trigger** (Trigger)
- **Milliseconds** (Number)

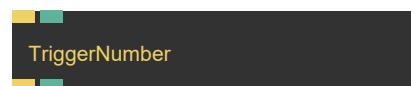
< **Output**

- **Out Trigger** (Trigger)
- **Progress** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Trigger.TriggerLimiter>

97.30 TriggerNumber



Full Name: Ops.Trigger.TriggerNumber

Description: Outputs a number when triggered

> **Inputs**

- **Set** (Trigger)
- **Number** (Number)

< **Output**

- **Next** (Trigger)
- **Out Value** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Trigger.TriggerNumber>

97.31 TriggerOnce



Full Name: Ops.Trigger.TriggerOnce

Description: Trigger the following children once

> **Inputs**

- **Exec** (Trigger)
- **Reset** (Trigger)

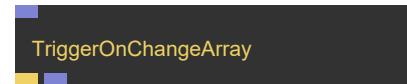
< **Output**

- **Next** (Trigger)
- **Was Triggered** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Trigger.TriggerOnce>

97.32 TriggerOnChangeArray_v2



Full Name: Ops.Trigger.TriggerOnChangeArray_v2

Description: triggers when array has changed

> **Inputs**

- **Array** (Array)

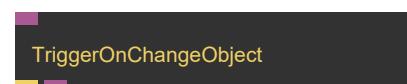
< **Output**

- **Changed** (Trigger)
- **Result** (Array)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Trigger.TriggerOnChangeArray_v2

97.33 TriggerOnChangeObject_v2



Full Name: Ops.Trigger.TriggerOnChangeObject_v2

Description: triggers when Object has changed

> Inputs

- Object (Object)

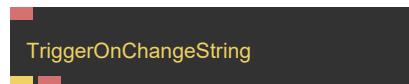
< Output

- Changed (Trigger)
- Result (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Trigger.TriggerOnChangeObject_v2

97.34 TriggerOnChangeString_v2



Full Name: Ops.Trigger.TriggerOnChangeString_v2

Description: triggers when string has changed

> Inputs

- String (String)

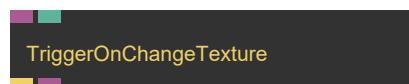
< Output

- Changed (Trigger)
- Result (String)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Trigger.TriggerOnChangeString_v2

97.35 TriggerOnChangeTexture



Full Name: Ops.Trigger.TriggerOnChangeTexture

Description: triggers when texture has changed

> Inputs

- Texture (Object:Texture)

< Output

- Changed (Trigger)
- Result (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Trigger.TriggerOnChangeTexture>

97.36 TriggerReceive



Full Name: Ops.Trigger.TriggerReceive

Description: Receives triggers from a TriggerSend op with the same variable name

> Inputs

- Visit *Ops.Trigger.TriggerReceive* documentation for input port details

< Output

- Triggered (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Trigger.TriggerReceive>

97.37 TriggerReceiveFilter



Full Name: Ops.Trigger.TriggerReceiveFilter

Description: receives all named triggers and relays them, optionally using a filter-prefix on the name

> Inputs

- Prefix (String)

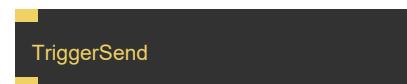
< Output

- Trigger Out (Trigger)
- Trigger Name (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Trigger.TriggerReceiveFilter>

97.38 TriggerSend



Full Name: Ops.Trigger.TriggerSend

Description: Allows triggers to be sent to a TriggerReceive op with the same variable name

- > Inputs
 - **Trigger** (Trigger)

- < Output
 - **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Trigger.TriggerSend>

97.39 TriggerSendNamed

TriggerSendNamed

Full Name: Ops.Trigger.TriggerSendNamed

Description: Allows triggers to be sent to a TriggerReceive op with the same variable name

> Inputs

- **Trigger** (Trigger)
- **Named Trigger** (String)

< Output

• Visit *Ops.Trigger.TriggerSendNamed documentation* for output port details

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Trigger.TriggerSendNamed>

97.40 TriggersPerSecond

TriggersPerSecond

Full Name: Ops.Trigger.TriggersPerSecond

Description: Counts how often the port is triggered per second

> Inputs

- **Exe** (Trigger)

< Output

- **Cps** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Trigger.TriggersPerSecond>

97.41 TriggerString

TriggerString

Full Name: Ops.Trigger.TriggerString

Description: trigger a string

> Inputs

- **Trigger** (Trigger)
- **String** (String)

< Output

- **Next** (Trigger)
- **Result** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Trigger.TriggerString>

97.42 ValueBecameZeroTrigger

ValueBecameZeroTrigger

Full Name: Ops.Trigger.ValueBecameZeroTrigger

Description: Triggers when the input value became zero

> Inputs

- **Value** (Number)

< Output

- **Became Zero Trigger** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Trigger.ValueBecameZeroTrigger>

98 Ops.Ui

98.1 Area



Full Name: Ops.Ui.Area

Description: Organize and group your patch operators

> Inputs

- **Delete** (Trigger)

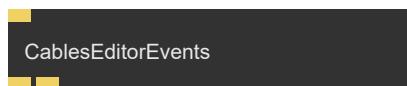
< Output

- Visit *Ops.Ui.Area documentation for output port details*

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Ui.Area>

98.2 CablesEditorEvents



Full Name: Ops.Ui.CablesEditorEvents

Description: Cables UI Event Triggers

> Inputs

- **Set Changed Patch** (Trigger)

< Output

- **Saving Patch** (Trigger)
- **PortValueEdited** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Ui.CablesEditorEvents>

98.3 Comment_v2



Full Name: Ops.Ui.Comment_v2

Description: Displays a comment in the patch area

> Inputs

- Visit *Ops.Ui.Comment_v2 documentation for input port details*

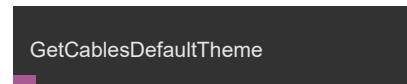
< Output

- Visit *Ops.Ui.Comment_v2 documentation for output port details*

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Ui.Comment_v2

98.4 GetCablesDefaultTheme



Full Name: Ops.Ui.GetCablesDefaultTheme

Description: Get the default theme colors of the cables editor

> Inputs

- Visit *Ops.Ui.GetCablesDefaultTheme documentation for input port details*

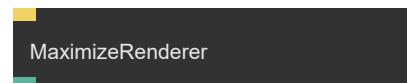
< Output

- **Theme** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Ui.GetCablesDefaultTheme>

98.5 MaximizeRenderer



Full Name: Ops.Ui.MaximizeRenderer

Description: maximize renderer to window size

> Inputs

- **Toggle Maximized** (Trigger)

< Output

- **Maximized** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Ui.MaximizeRenderer>

98.6 PatchInput

PatchInput

Full Name: Ops.Ui.PatchInput

Description: Helper op for sub-patches

> Inputs

- Visit [Ops.Ui.PatchInput documentation](#) for input port details

< Output

- Create Port (Dynamic)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Ui.PatchInput>

98.7 PatchOutput

PatchOutput

Full Name: Ops.Ui.PatchOutput

Description: Helper op for sub-patches

> Inputs

- Create Port (Dynamic)

< Output

- Visit [Ops.Ui.PatchOutput documentation](#) for output port details

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Ui.PatchOutput>

98.8 SetCablesTheme

SetCablesTheme

Full Name: Ops.Ui.SetCablesTheme

Description: Set cables editor colors

> Inputs

- Theme (Object)

< Output

- Missing (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Ui.SetCablesTheme>

98.9 SubPatch

SubPatch

Full Name: Ops.Ui.SubPatch

Description: Visit documentation for details

> Inputs

- Create Port (Dynamic)
- DataStr (Number)
- PatchId (Number)

< Output

- Create Port Out (Dynamic)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Ui.SubPatch>

98.10 Subpatch2Template

Subpatch2Template

Full Name: Ops.Ui.Subpatch2Template

Description: Visit documentation for details

> Inputs

- PatchId (String)
- Public (3): 1

< Output

- Visit [Ops.Ui.Subpatch2Template documentation](#) for output port details

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Ui.Subpatch2Template>

98.11 SubPatchInput



SubPatchInput

Full Name: Ops.Ui.SubPatchInput

Description: Visit documentation for details

> Inputs

- Visit *Ops.Ui.SubPatchInput* documentation for input port details

< Output

- A1jf8yr1w (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Ui.SubPatchInput>

98.12 SubPatchOutput



SubPatchOutput

Full Name: Ops.Ui.SubPatchOutput

Description: Visit documentation for details

> Inputs

- Visit *Ops.Ui.SubPatchOutput* documentation for input port details

< Output

- Visit *Ops.Ui.SubPatchOutput* documentation for output port details

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Ui.SubPatchOutput>

98.13 VizArrayChart



VizArrayChart

Full Name: Ops.Ui.VizArrayChart

Description: Displays information of the distribution of numerical values in an array

> Inputs

- **Array Numbers** (Array)

- **Titles** (Array)

< Output

- Visit *Ops.Ui.VizArrayChart* documentation for output port details

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Ui.VizArrayChart>

98.14 VizArrayGraph



VizArrayGraph

Full Name: Ops.Ui.VizArrayGraph

Description: Visualize Array as line graph

> Inputs

- **Array Numbers** (Array)
- **Curve** (Number: Boolean)

< Output

- **Passthrough Array** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Ui.VizArrayGraph>

98.15 VizArrayTable_v2



VizArrayTable

Full Name: Ops.Ui.VizArrayTable_v2

Description: Show the contents of the input array in a table in the patch, useful for debugging

> Inputs

- **Array** (Array)
- **Stride** (Number: Integer)
- **Scroll** (Number)

< Output

- **Passthrough Array** (Array)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Ui.VizArrayTable_v2

98.16 VizBool



VizBool

Full Name: Ops.Ui.VizBool

Description: Visualize the state of a boolean input in the patch, useful for debugging

➢ **Inputs**

- **Boolean** (Number: Boolean)

◀ **Output**

- **Bool** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Ui.VizBool>

98.17 VizGraph



VizGraph

Full Name: Ops.Ui.VizGraph

Description: Displays graphs for the numbers on the input port in the patch-field

➢ **Inputs**

- **Number 1** (Number)
- **Number 2** (Number)
- **Number 3** (Number)
- **Number 4** (Number)
- **Number 5** (Number)
- **Number 6** (Number)
- **Number 7** (Number)
- **Number 8** (Number)
- **Fill Graph** (Number: Boolean)
- **Reset** (Trigger)

◀ **Output**

- Visit *Ops.Ui.VizGraph documentation for output port details*

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Ui.VizGraph>

98.18 VizImageUrl



VizImageUrl

Full Name: Ops.Ui.VizImageUrl

Description: preview an image URL or a data/base64 URL

➢ **Inputs**

- **File** (String)

◀ **Output**

- **Width** (Number)
- **Height** (Number)
- **Loading** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Ui.VizImageUrl>

98.19 VizLogger



VizLogger

Full Name: Ops.Ui.VizLogger

Description: Log changes of input values line by line, use like a logfile for debugging

➢ **Inputs**

- **Number** (Number)
- **String** (String)
- **Object** (Object)
- **Clear** (Trigger)

◀ **Output**

- Visit *Ops.Ui.VizLogger documentation for output port details*

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Ui.VizLogger>

98.20 VizNumber



VizNumber

Full Name: Ops.Ui.VizNumber

Description: Displays input string on the patchfield

> Inputs

- **Number** (Number)

< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Ui.VizNumber>

98.21 VizNumberBar



Full Name: Ops.Ui.VizNumberBar

Description: Visualize numbers as a bar in patch, useful for debugging

> Inputs

- **Number** (Number)

< Output

- **Passthrough** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Ui.VizNumberBar>

98.22 VizObject



Full Name: Ops.Ui.VizObject

Description: Show information about any object for patch debugging

> Inputs

- **Object** (Object)
- **ZoomText** (Number: Boolean)
- **Line Numbers** (Number: Boolean)
- **Experimental Stringify** (Number: Boolean)
- **Sort Keys** (Number: Boolean)
- **Font Size** (Number)
- **Scroll** (Number)

< Output

- Visit *Ops.Ui.VizObject* documentation for output port details

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Ui.VizObject>

98.23 VizString



Full Name: Ops.Ui.VizString

Description: Displays long input string on the patchfield

> Inputs

- **String** (String)
- **ZoomText** (Number: Boolean)
- **Line Numbers** (Number: Boolean)
- **Whitespace** (Number: Boolean)
- **Wrap Lines** (Number: Boolean)
- **Syntax Index** (Number: Integer)
- **Font Size** (Number)
- **Scroll** (Number)

< Output

- **Passthrough String** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Ui.VizString>

98.24 VizTexture



Full Name: Ops.Ui.VizTexture

Description: Displays texture at input port

> Inputs

- **Texture In** (Object:Texture)
- **Show Info** (Number: Boolean)
- **Show Color** (Number: Boolean)
- **X** (Number)
- **Y** (Number)

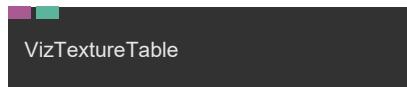
< Output

- **Texture Out** (Object)
- **Info** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Ui.VizTexture>

98.25 VizTextureTable



Full Name: Ops.Ui.VizTextureTable

Description: Show pixel colors of connected texture as a table, useful for debugging

> Inputs

- **Texture** (Object:Texture)
- **Row Start** (Number: Integer)

< Output

- Visit *Ops.Ui.VizTextureTable documentation for output port details*

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Ui.VizTextureTable>

98.26 VizTrigger



Full Name: Ops.Ui.VizTrigger

Description: Visualize triggering for debugging reasons

> Inputs

- **Trigger** (Trigger)
- **Reset** (Trigger)
- **Count Overlay** (Number: Boolean)

< Output

- **Count** (Number)
- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Ui.VizTrigger>

99 Ops.Ui.Debug

99.1 PatchUiCoords



Full Name: Ops.Ui.Debug.PatchUiCoords

Description: Output the current patch coordinates

> Inputs

- Visit *Ops.Ui.Debug.PatchUiCoords documentation for input port details*

< Output

- **X** (Number)
- **Y** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Ui.Debug.PatchUiCoords>

100 Ops.Ui.Routing

100.1 RouteArray



Full Name: Ops.Ui.Routing.RouteArray

Description: Patchfield cable routing helper for array cables

> Inputs

- **Array In** (Array)

< Output

- **Array Out** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Ui.Routing.RouteArray>

100.2 RouteNumber



Full Name: Ops.Ui.Routing.RouteNumber

Description: Patchfield cable routing helper for number cables

> Inputs

- **Value** (Number)

< Output

- **Result** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Ui.Routing.RouteNumber>

100.3 RouteObject



Full Name: Ops.Ui.Routing.RouteObject

Description: Patchfield cable routing helper for object cables

> Inputs

- **Array In** (Object)

< Output

- **Array Out** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Ui.Routing.RouteObject>

100.4 RouteString



Full Name: Ops.Ui.Routing.RouteString

Description: Patchfield cable routing helper for string cables

> Inputs

- **Value** (String)

< Output

- **String** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Ui.Routing.RouteString>

100.5 RouteTrigger



Full Name: Ops.Ui.Routing.RouteTrigger

Description: Routing Helper for trigger cables

> Inputs

- **Trigger** (Trigger)

< Output

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Ui.Routing.RouteTrigger>

101 Ops.Vars

101.1 TriggerVarGetArray

TriggerVarGetArray

Full Name: Ops.Vars.TriggerVarGetArray

Description: Get an array variable value at time of trigger

> **Inputs**

- **Update** (Trigger)

< **Output**

- **Next** (Trigger)
- **Value** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Vars.TriggerVarGetArray>

101.2 TriggerVarGetNumber

TriggerVarGetNumber

Full Name: Ops.Vars.TriggerVarGetNumber

Description: Get a number variable value at time of trigger

> **Inputs**

- **Update** (Trigger)

< **Output**

- **Next** (Trigger)
- **Value** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Vars.TriggerVarGetNumber>

101.3 TriggerVarGetObject

TriggerVarGetObject

Full Name: Ops.Vars.TriggerVarGetObject

Description: Get an object variable value at time of trigger

> **Inputs**

- **Update** (Trigger)

< **Output**

- **Next** (Trigger)
- **Value** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Vars.TriggerVarGetObject>

101.4 TriggerVarGetString

TriggerVarGetString

Full Name: Ops.Vars.TriggerVarGetString

Description: Get a string variable value at time of trigger

> **Inputs**

- **Update** (Trigger)

< **Output**

- **Next** (Trigger)
- **Value** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Vars.TriggerVarGetString>

101.5 VarGetArray_v2

VarGetArray

Full Name: Ops.Vars.VarGetArray_v2

Description: Get a variable array

> **Inputs**

- Visit `Ops.Vars.VarGetArray_v2` documentation for input port details

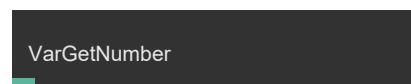
< Output

- **Value** (Array)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Vars.VarGetArray_v2

101.6 VarGetNumber_v2



Full Name: Ops.Vars.VarGetNumber_v2

Description: read a variable number

> Inputs

- Visit `Ops.Vars.VarGetNumber_v2` documentation for input port details

< Output

- **Value** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Vars.VarGetNumber_v2

101.7 VarGetObject_v2



Full Name: Ops.Vars.VarGetObject_v2

Description: Get a variable object

> Inputs

- **Variable** (Number: String)

< Output

- **Value** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Vars.VarGetObject_v2

101.8 VarGetString



Full Name: Ops.Vars.VarGetString

Description: String variable getter

> Inputs

- Visit `Ops.Vars.VarGetString` documentation for input port details

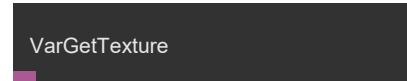
< Output

- **Value** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Vars.VarGetString>

101.9 VarGetTexture_v2



Full Name: Ops.Vars.VarGetTexture_v2

Description: get a texture from a variable

> Inputs

- Visit `Ops.Vars.VarGetTexture_v2` documentation for input port details

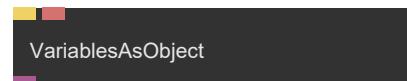
< Output

- **Value** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Vars.VarGetTexture_v2

101.10 VariablesAsObject



Full Name: Ops.Vars.VariablesAsObject

Description: outputs an object containing all variables

> Inputs

- **Execute** (Trigger)
- **Filter Prefix** (String)

< Output

- Result (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Vars.VariablesAsObject>

101.11 VarSetArray_v2



VarSetArray

Full Name: Ops.Vars.VarSetArray_v2

Description: Set a variable array

> Inputs

- Value (Array)

< Output

- Visit *Ops.Vars.VarSetArray_v2 documentation for output port details*

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Vars.VarSetArray_v2

101.12 VarSetNumber_v2



VarSetNumber

Full Name: Ops.Vars.VarSetNumber_v2

Description: set a variable number

> Inputs

- Value (Number)

< Output

- Visit *Ops.Vars.VarSetNumber_v2 documentation for output port details*

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Vars.VarSetNumber_v2

101.13 VarSetObject_v2



VarSetObject

Full Name: Ops.Vars.VarSetObject_v2

Description: Set a variable object

> Inputs

- Value (Object)

< Output

- Visit *Ops.Vars.VarSetObject_v2 documentation for output port details*

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Vars.VarSetObject_v2

101.14 VarSetString_v2



VarSetString

Full Name: Ops.Vars.VarSetString_v2

Description: Set string variable

> Inputs

- Value (String)

< Output

- Visit *Ops.Vars.VarSetString_v2 documentation for output port details*

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Vars.VarSetString_v2

101.15 VarSetTexture_v2



VarSetTexture

Full Name: Ops.Vars.VarSetTexture_v2

Description: set a texture variable

> Inputs

- Value (Object:Texture)

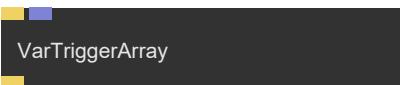
< Output

- Visit *Ops.Vars.VarSetTexture_v2 documentation for output port details*

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Vars.VarSetTexture_v2

101.16 VarTriggerArray



Full Name: Ops.Vars.VarTriggerArray

Description: Set an array variable by a trigger

> **Inputs**

- **Trigger** (Trigger)
- **Value** (Array)

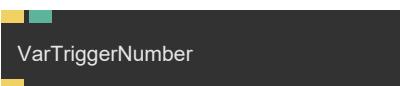
< **Output**

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Vars.VarTriggerArray>

101.17 VarTriggerNumber



Full Name: Ops.Vars.VarTriggerNumber

Description: set number variable by trigger

> **Inputs**

- **Trigger** (Trigger)
- **Value** (Number)

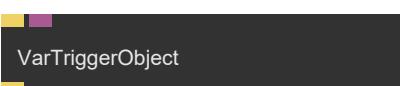
< **Output**

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Vars.VarTriggerNumber>

101.18 VarTriggerObject



Full Name: Ops.Vars.VarTriggerObject

Description: Set an object variable by trigger

> **Inputs**

- **Trigger** (Trigger)
- **Value** (Object)

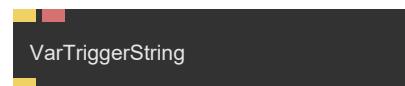
< **Output**

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Vars.VarTriggerObject>

101.19 VarTriggerString



Full Name: Ops.Vars.VarTriggerString

Description: set string variable by trigger

> **Inputs**

- **Trigger** (Trigger)
- **Value** (String)

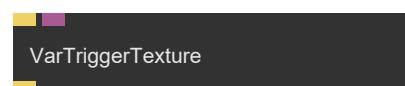
< **Output**

- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Vars.VarTriggerString>

101.20 VarTriggerTexture



Full Name: Ops.Vars.VarTriggerTexture

Description: Set an object variable by trigger

> **Inputs**

- **Trigger** (Trigger)
- **Value** (Object:Texture)

< **Output**

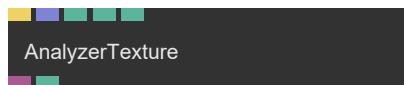
- **Next** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Vars.VarTriggerTexture>

102 Ops.WebAudio

102.1 AnalyzerTexture_v2



Full Name: Ops.WebAudio.AnalyzerTexture_v2

Description: Creates a spectrogram texture from an audio FFT array

> Inputs

- **Refresh** (Trigger)
- **FFT Array** (Array)
- **Mirror Active** (Number: Boolean)
- **Mirror Width** (Number)
- **Texture Size Index** (Number: Integer)

< Output

- **Texture Out** (Object)
- **Position** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.WebAudio.AnalyzerTexture_v2

102.2 AudioAnalyzer_v2



Full Name: Ops.WebAudio.AudioAnalyzer_v2

Description: Extracts FFT, RMS & Waveform data from an incoming audio signal

> Inputs

- **Trigger In** (Trigger)
- **Audio In** (Object:AudioNode)
- **FFT Size Index** (Number: Integer)
- **Smoothing** (Number)
- **Range** (in dBFS)
- **Min** (Number)
- **Max** (Number)

< Output

- **Trigger Out** (Trigger)
- **Audio Out** (Object)
- **FFT Array** (Array)
- **Waveform Array** (Array)
- **Frequencies By Index Array** (Array)
- **Array Length** (Number)
- **Average Volume** (Number)
- **Average Volume Time-Domain** (Number)
- **RMS Volume** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.WebAudio.AudioAnalyzer_v2

102.3 AudioBuffer_v3



Full Name: Ops.WebAudio.AudioBuffer_v3

Description: Holds an audio file / sample in a buffer

> Inputs

- **URL** (String)
- **Create Loading Task** (Number: Boolean)
- **Active** (Number: Boolean)

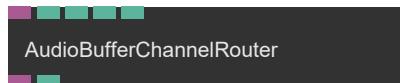
< Output

- **Audio Buffer** (Object)
- **Finished Loading** (booleanNumber)
- **Sample Rate** (Number)
- **Length** (Number)
- **Duration** (Number)
- **Number Of Channels** (Number)
- **IsLoading** (booleanNumber)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.WebAudio.AudioBuffer_v3

102.4 AudioBufferChannelRouter



Full Name: Ops.WebAudio.AudioBufferChannelRouter

Description: Route audio from one input channel to any output channel

> Inputs

- **Audio Buffer** (Object:AudioBuffer)
- **Channel In** (Number: Integer)
- **Channel Out** (Number: Integer)
- **Clear Others** (Number: Boolean)
- **Channel Offset** (Number: Boolean)

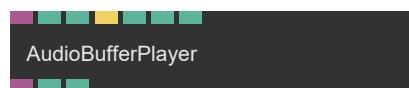
< Output

- **Audio Buffer Out** (Object)
- **Output Channels** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.WebAudio.AudioBufferChannelRouter>

102.5 AudioBufferPlayer_v2



Full Name: Ops.WebAudio.AudioBufferPlayer_v2

Description: Play back audio data stored in an AudioBuffer

> Inputs

- **Audio Buffer** (Object:AudioBuffer)
- **Loop** (Number: Boolean)
- **Restart** (Trigger)
- **Offset** (Number)
- **Playback Rate** (Number)
- **Detune** (Number)

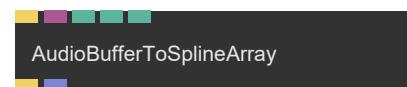
< Output

- **Audio Out** (Object)
- **Is Playing** (booleanNumber)
- **Loading** (booleanNumber)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.WebAudio.AudioBufferPlayer_v2

102.6 AudioBufferToSplineArray



Full Name: Ops.WebAudio.AudioBufferToSplineArray

Description: Outputs the waveform of an audio file as a spline array

> Inputs

- **Render** (Trigger)
- **Audio Buffer** (Object:AudioBuffer)
- **Width** (Number)
- **Height** (Number)
- **Samples Per Pixel** (Number: Integer)

< Output

- **Next** (Trigger)
- **Array Out** (Array)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.WebAudio.AudioBufferToSplineArray>

102.7 AudioPanner



Full Name: Ops.WebAudio.AudioPanner

Description: stereo pan an audio signal from left to right

> Inputs

- **Audio In** (Object:AudioNode)
- **Pan** (Number)

< Output

- **Audio Out** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.WebAudio.AudioPanner>

102.8 AudioRecorder



Full Name: Ops.WebAudio.AudioRecorder

Description: record, playback and download audio

> Inputs

- **Audio In** (Object:AudioNode)
- **Start Recording** (Trigger)
- **Stop Recording** (Trigger)
- **Input Gain** (Number)
- **Start Playback** (Trigger)
- **Stop Playback** (Trigger)
- **Clear Buffer** (Trigger)
- **Playback Gain** (Number)
- **Loop Playback** (Number: Boolean)

< Output

- **Audio Out** (Object)
- **Recorded Audio Out** (Object)
- **Is Recording** (booleanNumber)
- **Is Playing Back** (booleanNumber)
- **State** (String)
- **AudioBuffer Out** (Object)
- **Data URL** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.WebAudio.AudioRecorder>

102.9 BiquadFilter_v2



Full Name: Ops.WebAudio.BiquadFilter_v2

Description: Different kinds of audio filters

> Inputs

- **Audio In** (Object:AudioNode)
- **Type Index** (Number: Integer)
- **Frequency** (Number)
- **Q** (Number)
- **Gain** (Number)
- **Detune** (in cents)
- **Frequency Array** (Array)

< Output

- **Audio Out** (Object)

- **Magnitude Response Array** (Array)

- **Phase Response Array** (Array)

- **Response Arrays Length** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.WebAudio.BiquadFilter_v2

102.10 ClockSequencer



Full Name: Ops.WebAudio.ClockSequencer

Description: send bpm based triggers like a clocked trigger sequencer / clock divider

> Inputs

- **BPM** (Number: Integer)
- **beats per minute** (tempo)
- **Start** (Trigger)
- **Stop** (Trigger)
- **Reset** (Trigger)

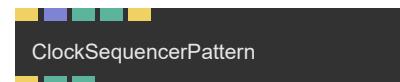
< Output

- **Sequencer Running** (booleanNumber)
- **BPM Out** (Number)
- **Start Out** (Trigger)
- **Stop Out** (Trigger)
- **Reset Out** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.WebAudio.ClockSequencer>

102.11 ClockSequencerPattern



Full Name: Ops.WebAudio.ClockSequencerPattern

Description: sequence triggers by defining a pattern (like a drum machine)

> Inputs

- **Clock Trigger Input** (Trigger)
- **Sequence Array** (Array)
- **Steps Index** (Number: Integer)

- **Steps** (Number: String)
- **Reset** (Trigger)

< Output

- **Sequence Trigger Output** (Trigger)
- **Sequenced Value** (Number)
- **Current Step** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.WebAudio.ClockSequencerPattern>

102.12 Convolver_v2



Full Name: Ops.WebAudio.Convolver_v2

Description: Audio reverb using an impulse response (sample)

> Inputs

- **Audio In** (Object:AudioNode)
- **Impulse Response** (String)
- **Normalize** (Number: Boolean)
- **IR Gain** (Number)
- **Output Gain** (Number)

< Output

- **Audio Out** (Object)
- **Wet Out** (Object)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.WebAudio.Convolver_v2

102.13 CutFilter



Full Name: Ops.WebAudio.CutFilter

Description: dj style filter (lowpass and highpass)

> Inputs

- **Audio In** (Object:AudioNode)
- **Highpass Active** (Number: Boolean)
- **Low Frequency** (Number)

- **Low Q** (Number)
- **Lowpass Active** (Number: Boolean)
- **High Frequency** (Number)
- **High Q** (Number)

< Output

- **Audio Out** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.WebAudio.CutFilter>

102.14 Delay



Full Name: Ops.WebAudio.Delay

Description: add a delay effect to an audio stream

> Inputs

- **Audio In** (Object:AudioNode)
- **Feedback** (Number)
- **BPM Based Delay Time** (Number: Boolean)
- **BPM** (Number)
- **Highpass Frequency** (Number)
- **Highpass Q** (Number)
- **Lowpass Frequency** (Number)
- **Lowpass Q** (Number)
- **LFO Intensity** (Number)
- **LFO Waveform Index** (Number: Integer)

< Output

- **Mix Out** (Object)
- **Wet Out** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.WebAudio.Delay>

102.15 FFTAreaAverage_v3



Full Name: Ops.WebAudio.FFTAreaAverage_v3

Description: get average value in an area of a fft audio analysis buffer

> Inputs

- **Refresh** (Trigger)
- **FFT Array** (Array)
- **X Position** (Number)
- **Y Position** (Number)
- **Width** (Number)
- **Height** (Number)
- **Create Texture** (Number: Boolean)

< Output

- **Texture Out** (Object)
- **Area Average Volume** (Number)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.WebAudio.FFTAreaAverage_v3

102.16 Gain



Full Name: Ops.WebAudio.Gain

Description: Changes the gain / volume

> Inputs

- **Audio In** (Object:AudioNode)
- **Gain** (Number)
- **Mute** (Number: Boolean)

< Output

- **Audio Out** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.WebAudio.Gain>

102.17 KeyPiano



Full Name: Ops.WebAudio.KeyPiano

Description: Generates notes based on key presses

> Inputs

- **C Note On** (Trigger)

- **C Note Off** (Trigger)

- **Cis Note On** (Trigger)

- **Cis Note Off** (Trigger)

- **D Note On** (Trigger)

- **D Note Off** (Trigger)

- **Dis Note On** (Trigger)

- **Dis Note Off** (Trigger)

- **E Note On** (Trigger)

- **E Note Off** (Trigger)

- **F Note On** (Trigger)

- **F Note Off** (Trigger)

- **Fis Note On** (Trigger)

- **Fis Note Off** (Trigger)

- **G Note On** (Trigger)

- **G Note Off** (Trigger)

- **Gis Note Ons** (Trigger)

- **Gis Note Off** (Trigger)

- **A Note On** (Trigger)

- **A Note Off** (Trigger)

- **Ais Note On** (Trigger)

- **Ais Note Off** (Trigger)

- **B Note On** (Trigger)

- **B Note Off** (Trigger)

- **Octave** (Number)

< Output

- **Frequency** (Number)

- **Is Pressed** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.WebAudio.KeyPiano>

102.18 MicrophoneIn_v2



Full Name: Ops.WebAudio.MicrophoneIn_v2

Description: Access to the microphone and/or audio input devices

> Inputs

- **Audio Input Index** (Number: Integer)

- **Volume** (Number)
- **Mute** (Number: Boolean)
- **Start** (Trigger)

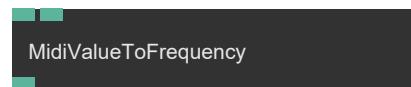
< Output

- **Audio Out** (Object)
- **Listening** (booleanNumber)
- **List Of Input Devices** (Array)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.WebAudio.Microphoneln_v2

102.19 MidiValueToFrequency



Full Name: Ops.WebAudio.MidiValueToFrequency

Description: Converts a midi value to a frequency

> Inputs

- **MIDI Value** (Number)
- **Tuning** (Number)

< Output

- **Frequency** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.WebAudio.MidiValueToFrequency>

102.20 Mixer



Full Name: Ops.WebAudio.Mixer

Description: Mix audio signals together

> Inputs

- **Audio In 0** (Object:AudioNode)
- **Audio In 1** (Object:AudioNode)
- **Audio In 2** (Object:AudioNode)
- **Audio In 3** (Object:AudioNode)
- **Audio In 4** (Object:AudioNode)
- **Audio In 5** (Object:AudioNode)
- **Audio In 6** (Object:AudioNode)

- **Audio In 7** (Object:AudioNode)
- **In 0 Gain** (Number)
- **In 1 Gain** (Number)
- **In 2 Gain** (Number)
- **In 3 Gain** (Number)
- **In 4 Gain** (Number)
- **In 5 Gain** (Number)
- **In 6 Gain** (Number)
- **In 7 Gain** (Number)
- **In 0 Pan** (Number)
- **In 1 Pan** (Number)
- **In 2 Pan** (Number)
- **In 3 Pan** (Number)
- **In 4 Pan** (Number)
- **In 5 Pan** (Number)
- **In 6 Pan** (Number)
- **In 7 Pan** (Number)
- **Output Gain** (Number)

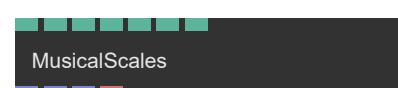
< Output

- **Audio Out** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.WebAudio.Mixer>

102.21 MusicalScales



Full Name: Ops.WebAudio.MusicalScales

Description: Outputs a musical scale array (major, minor, ...) as strings, steps and midi notes

> Inputs

- **Root Note Index** (Number: Integer)
- **Root Note** (Number: String)
- **Scale Type Index** (Number: Integer)
- **Scale Type** (Number: String)
- **Include Upper Root Note** (Number: Boolean)
- **Octave** (Number: Integer)
- **the octave of the scale** (only for string & midi note outputs)
- **Append Octave To Names** (Number: Boolean)

< Output

- **Note Names Array** (Array)
- **Note Step Number Array** (Array)
- **Midi Note Array** (Array)
- **Current Scale** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.WebAudio.MusicalScales>

102.22 Output_v2



Full Name: Ops.WebAudio.Output_v2

Description: Sends an audio signal to your speakers

> Inputs

- **Audio In** (Object:AudioNode)
- **Volume** (Number)
- **Mute** (Number: Boolean)
- **Show Audio Suspended Button** (Number: Boolean)

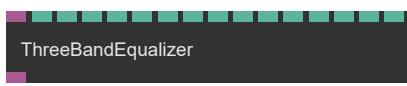
< Output

- **Current Volume** (Number)
- **Number Of Channels** (Number)
- **Context State** (String)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.WebAudio.Output_v2

102.23 ThreeBandEqualizer



Full Name: Ops.WebAudio.ThreeBandEqualizer

Description: 3 filters in one - an eq to quickly process an audio signal

> Inputs

- **Audio In** (Object:AudioNode)
- **Low Filter Type Index** (Number: Integer)
- **Low Filter Type** (Number: String)
- **Low Frequency** (Number)

> Output

- **Low Q** (Number)
- **Low Gain** (Number)
- **Mid Filter Type Index** (Number: Integer)
- **Mid Filter Type** (Number: String)
- **Mid Frequency** (Number)
- **Mid Q** (Number)
- **Mid Gain** (Number)
- **High Filter Type Index** (Number: Integer)
- **High Filter Type** (Number: String)
- **High Frequency** (Number)
- **High Q** (Number)
- **High Gain** (Number)

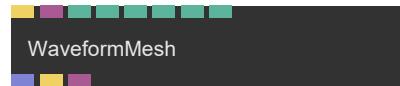
< Output

- **Audio Out** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.WebAudio.ThreeBandEqualizer>

102.24 WaveformMesh



Full Name: Ops.WebAudio.WaveformMesh

Description: Outputs the waveform of an audio file as a geometry

> Inputs

- **Render** (Trigger)
- **Audio Buffer** (Object:AudioBuffer)
- **Render Active** (Number: Boolean)
- **Show Bottom Half** (Number: Boolean)
- **Center Origin** (Number: Boolean)
- **Width** (Number)
- **Samples Per Pixel** (Number: Integer)
- **Calculate Tex Coords** (Number: Boolean)

< Output

- **Spline Points** (Array)
- **Next** (Trigger)
- **Geometry** (Object)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.WebAudio.WaveformMesh>

102.25 Waveshaper



Full Name: Ops.WebAudio.Waveshaper

Description: add waveshaping (distortion, overdrive, fuzz) to an audio stream

> Inputs

- **Audio In** (Object:AudioNode)
- **Oversampling Index** (Number: Integer)
- **Distortion Amount** (Number: Integer)
- **Waveshape Array In** (Array)
- **array input for the waveshaper** (custom distortion transfer function)
- **Output Gain** (Number)

< Output

- **Audio Out** (Object)
- **Curve Out** (Array)
- **distortion curve array output** (one-dimensional)
- **Curve Length** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.WebAudio.Waveshaper>

103 Ops.Website

103.1 Cookie



Full Name: Ops.Website.Cookie

Description: cookie of the current website as object

> Inputs

- Visit *Ops.Website.Cookie documentation for input port details*

< Output

- **Cookie** (Object)
- **Cookie String** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Website.Cookie>

103.2 FileInfo



Full Name: Ops.Website.FileInfo

Description: information about a filename, like url protocol, suffix etc

> Inputs

- **URL** (String)

< Output

- **Protocol** (String)
- **Host** (String)
- **Full Path** (String)
- **Filename** (String)
- **Basename** (String)
- **Suffix** (String)
- **Is URL** (String)
- **queryParams** (String)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Website.FileInfo>

103.3 ForceHttps



ForceHttps

Full Name: Ops.Website.ForceHttps

Description: will redirect to same URL using https protocol

> Inputs

- Visit [Ops.Website.ForceHttps documentation for input port details](#)

< Output

- Visit [Ops.Website.ForceHttps documentation for output port details](#)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Website.ForceHttps>

103.4 InfoURL



InfoURL

Full Name: Ops.Website.InfoURL

Description: Information about the current URL

> Inputs

- Visit [Ops.Website.InfoURL documentation for input port details](#)

< Output

- **URL** (String)
- **Host** (String)
- **Hash** (String)
- **Pathname** (String)
- **Protocol** (String)
- **Port** (String)
- **Hash Changed** (Trigger)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Website.InfoURL>

103.5 InIframe



InIframe

Full Name: Ops.Website.InIframe

Description: Outputs true if the patch is inside of an iframe

> Inputs

- Visit [Ops.Website.InIframe documentation for input port details](#)

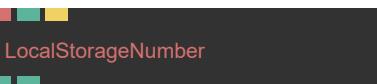
< Output

- **In Iframe** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Website.InIframe>

103.6 LocalStorageNumber



Full Name: Ops.Website.LocalStorageNumber

Description: Store and retrieve a number in browser localstorage

> Inputs

- **Key** (String)
- **Number** (Number)
- **Store** (Trigger)

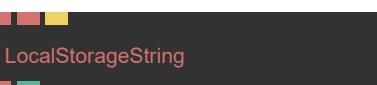
< Output

- **Stored Number** (Number)
- **Storage Support** (Number)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Website.LocalStorageNumber>

103.7 LocalStorageString



Full Name: Ops.Website.LocalStorageString

Description: Store and retrieve a string in browser localstorage

> Inputs

- **Key** (String)
- **String** (String)
- **Store** (Trigger)

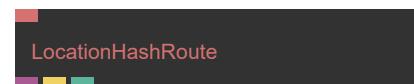
< Output

- **Stored String** (String)
- **Storage Support** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Website.LocalStorageString>

103.8 LocationHashRoute



Full Name: Ops.Website.LocationHashRoute

Description: gives updated information about window.location.hash

> Inputs

- **Route** (String)
- **pattern for url and variables** (i.e. /scene/:id)

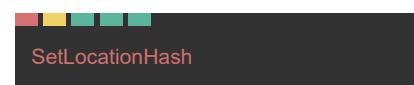
< Output

- **Values** (Object)
- **Changed** (Trigger)
- **Matching** (booleanNumber)

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Website.LocationHashRoute>

103.9 SetLocationHash



Full Name: Ops.Website.SetLocationHash

Description: sets window.location.hash to the specified value(s)

> Inputs

- **Hash** (String)
- **Update** (Trigger)
- **Active** (Number: Boolean)
- **Silent** (Number: Boolean)
- **Allow Empty** (Number: Boolean)

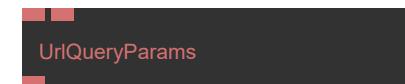
< Output

- Visit *Ops.Website.SetLocationHash* documentation for output port details

Example Patch: Open in Editor

Docs: <https://cables.gl/op/Ops.Website.SetLocationHash>

103.10 UrlqueryParams_v2



Full Name: Ops.Website.UrlqueryParams_v2

Description: Returns a URL query parameter

> Inputs

- **Parameter** (String)
- **Default** (String)

< Output

- **Result** (String)

Example Patch: Open in Editor

Docs: https://cables.gl/op/Ops.Website.UrlqueryParams_v2