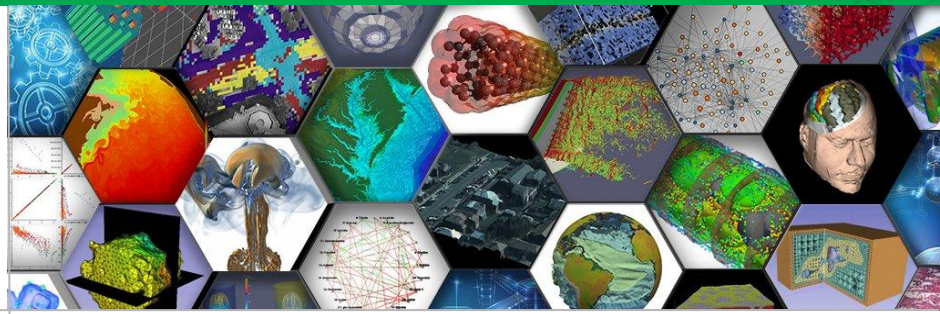
Web Visualization

Sebastien Jourdain @ Kitware

For tutorial

Make sure you have Python 3.6+
Python 3.9 is mandatory for ParaView

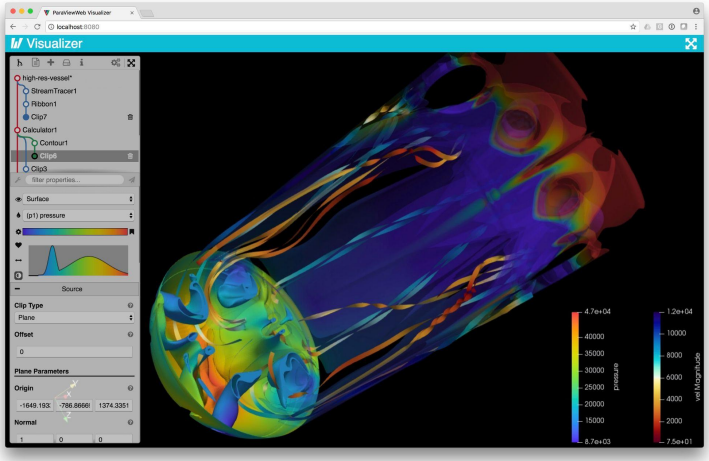
Kitware - Open Source softwares

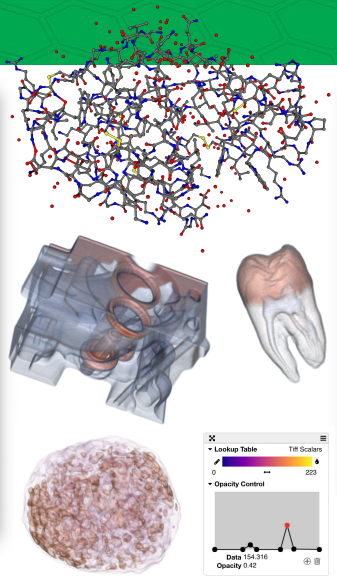


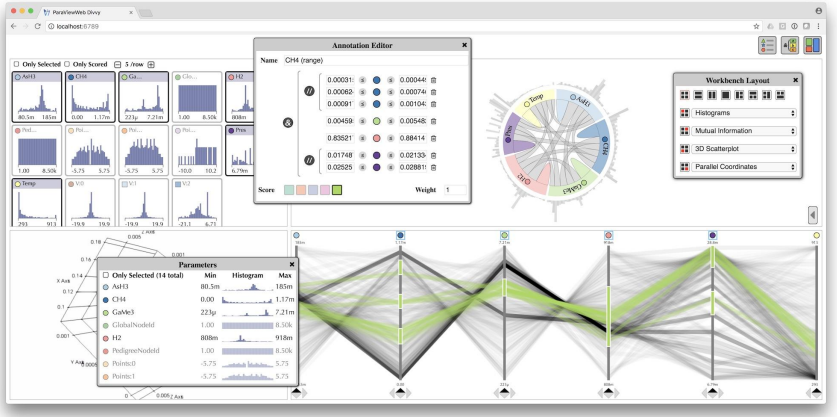
Five core areas of expertise

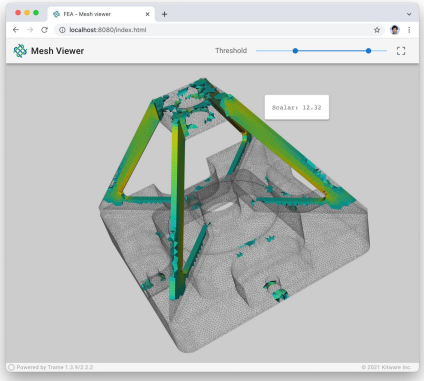
- Computer Vision — KWIVER, TeleSculptor
- Data and Analytics — Resonant
- HPC and Visualization — VTK, ParaView, CMB, tomviz
- Medical Computing — ITK, 3DSlicer, Pulse Physiology Engine, mstk
- Software Process — CMake

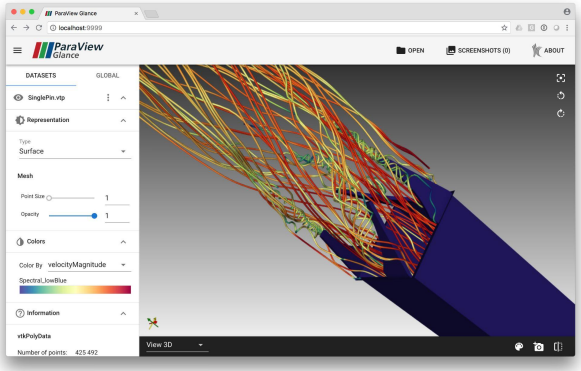
Visualization in the Web

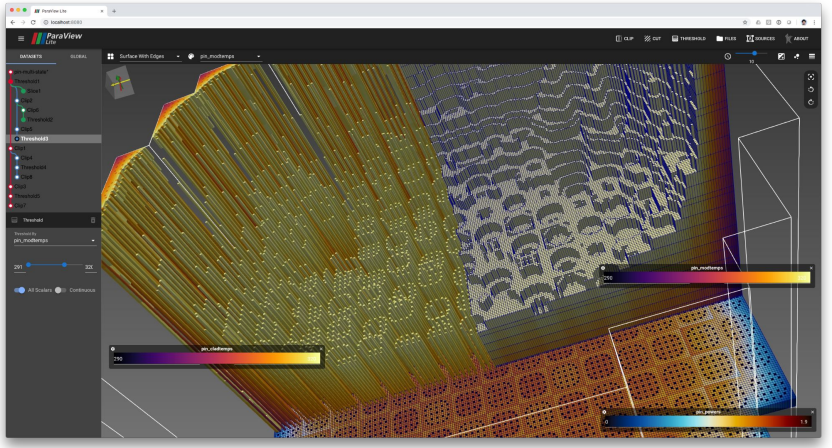












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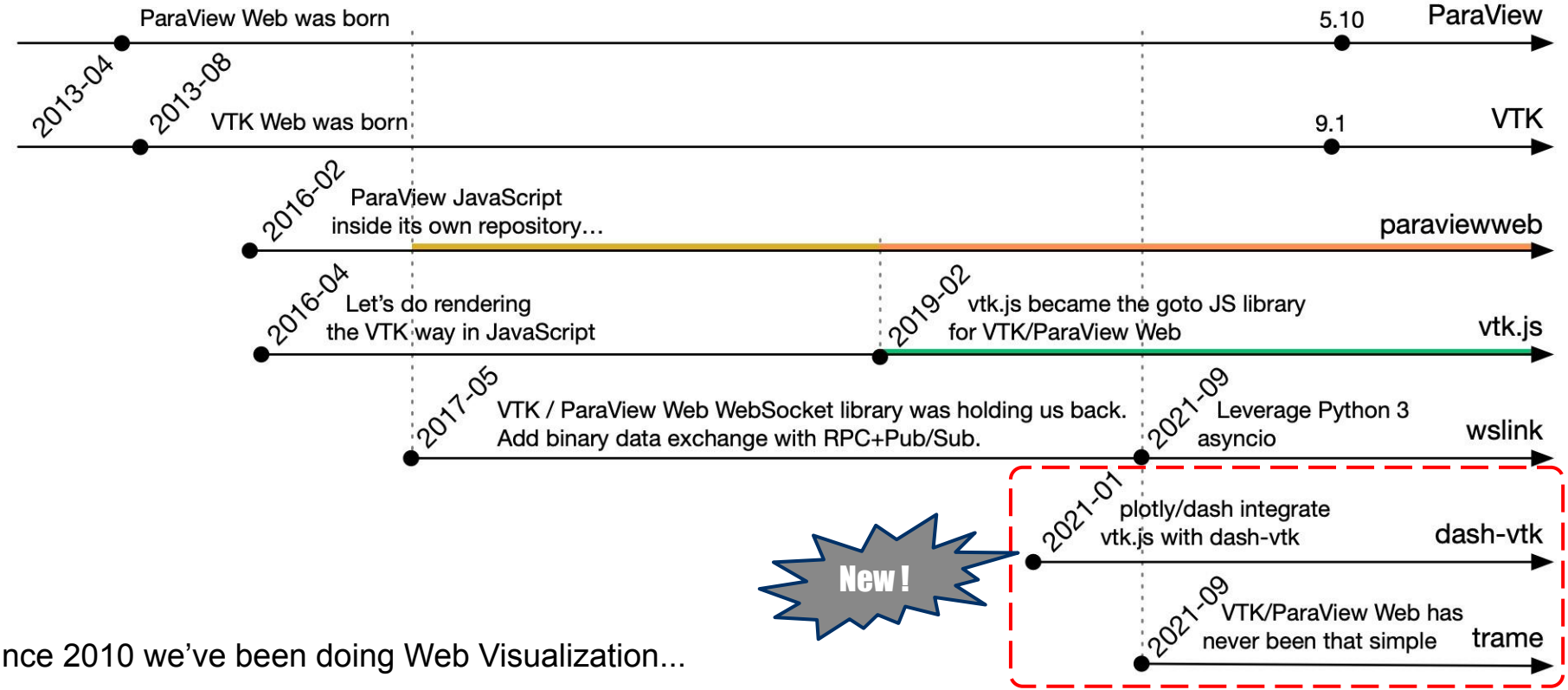
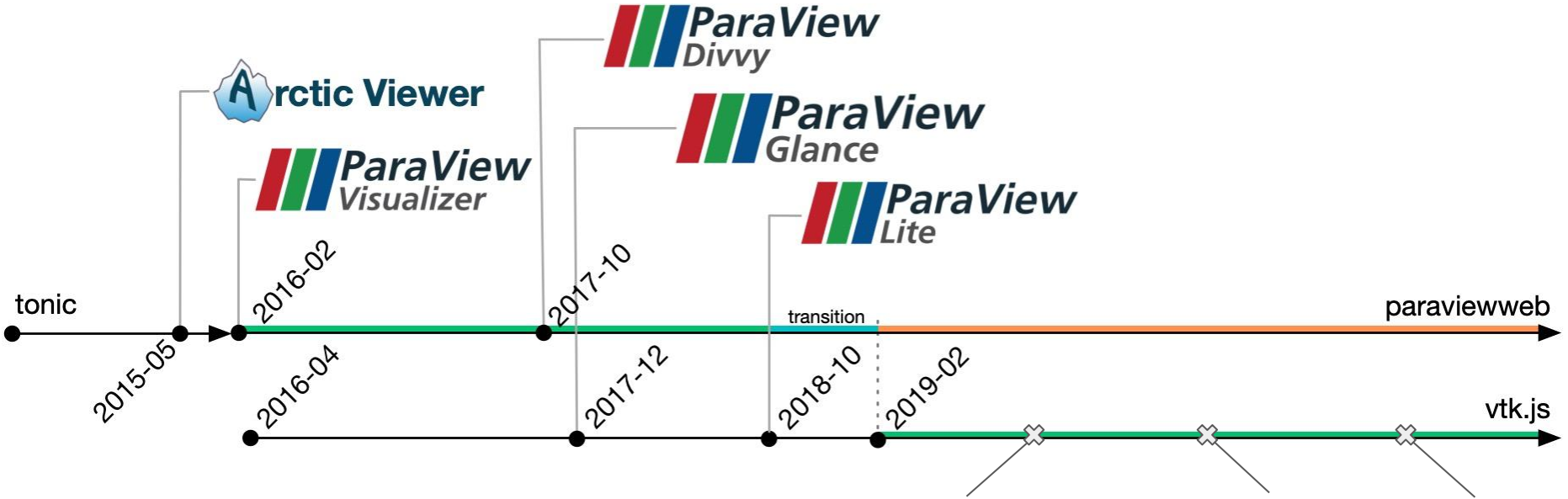
History and background



Since 2010 we've been doing Web Visualization...

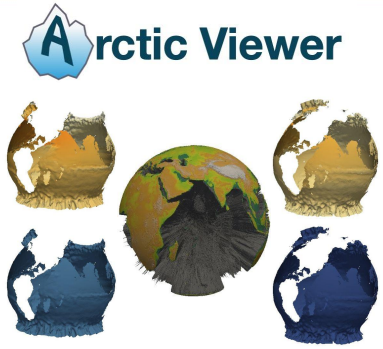
Web Visualization Applications/Demonstrators

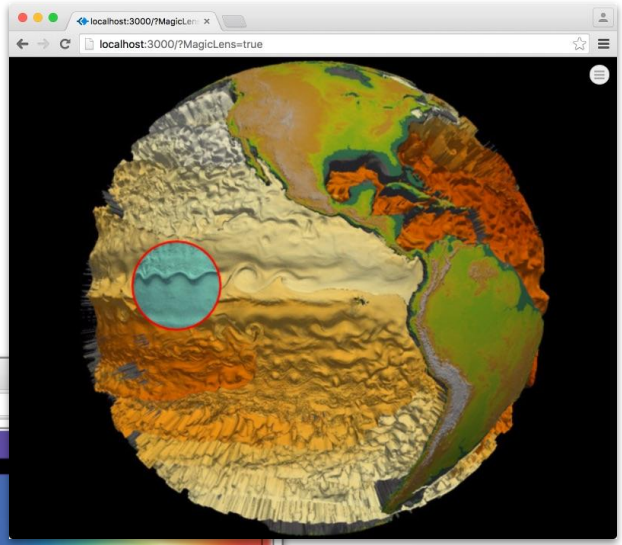


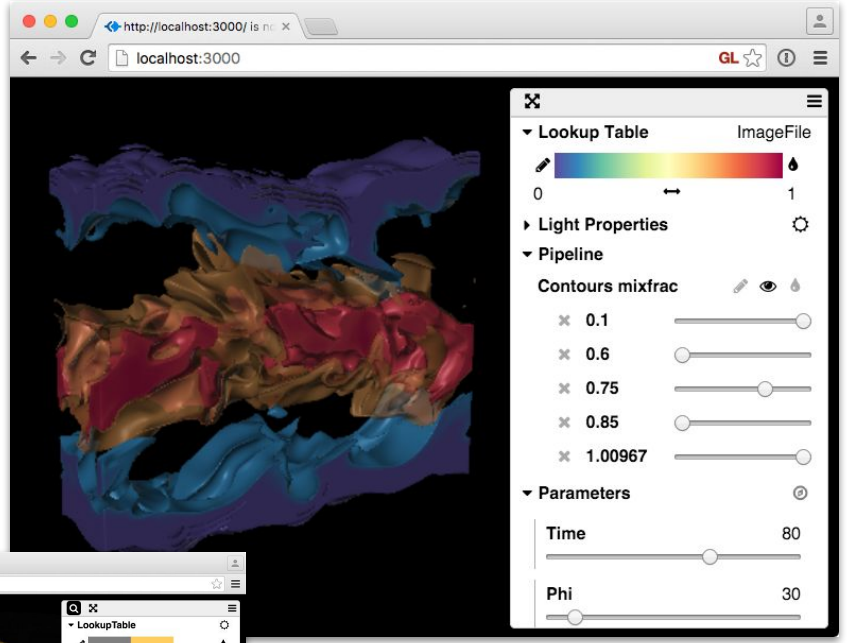
Applications / Demonstrators

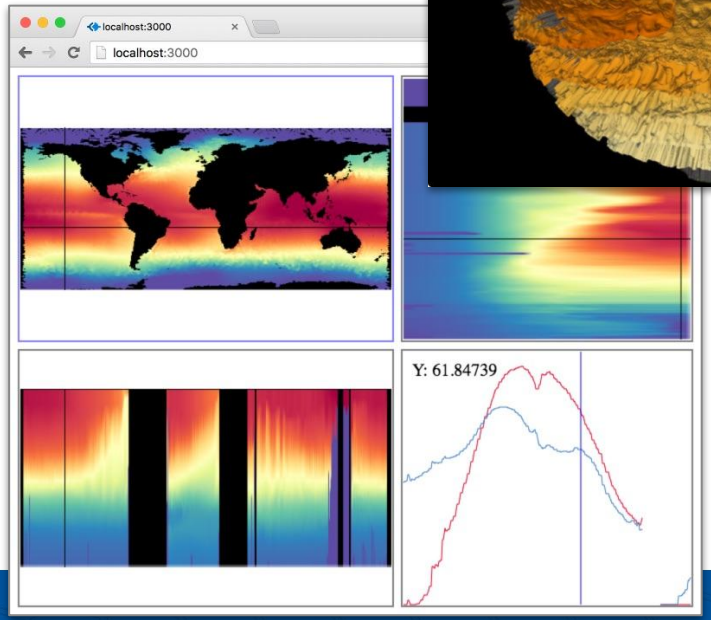
- Arctic Viewer (2015)
  - Fast and interactive viewer for ParaView based pre-processed assets
- ParaView Visualizer (2016)
  - The ParaView like application in the Web
- ParaView Divvy (2017)
  - Interactive data analytic with ParaView that does not look like ParaView
- Glance (2018)
  - The ultimate vtk.js viewer in a serverless fashion
- ParaView Lite (2018)
  - A fresh look at what ParaView in the Web could look like

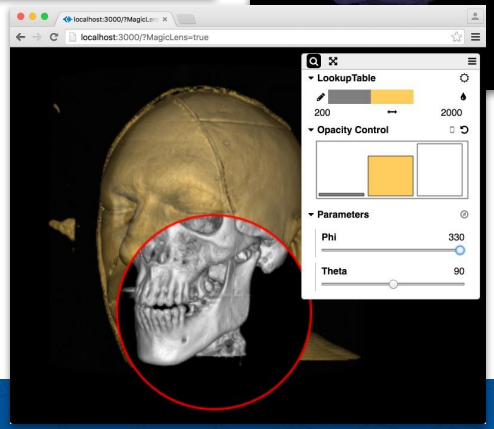
Fast and interactive viewer for ParaView/Catalyst based pre-processed assets

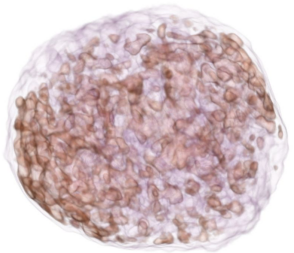


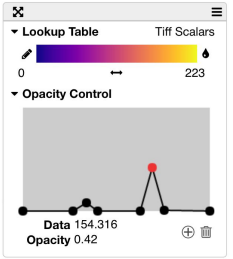












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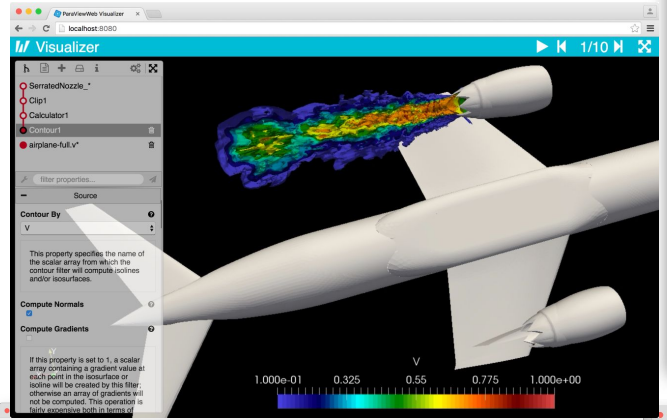
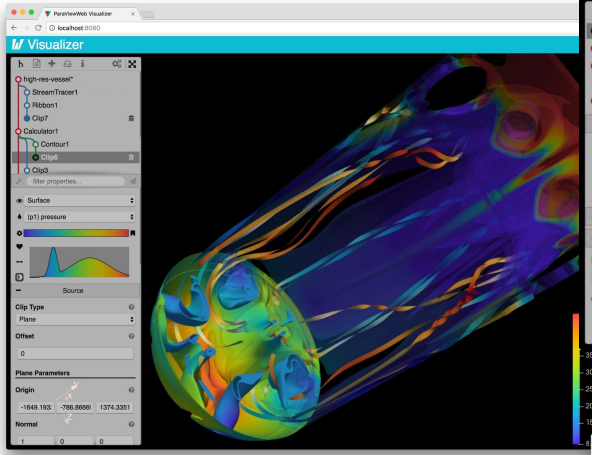
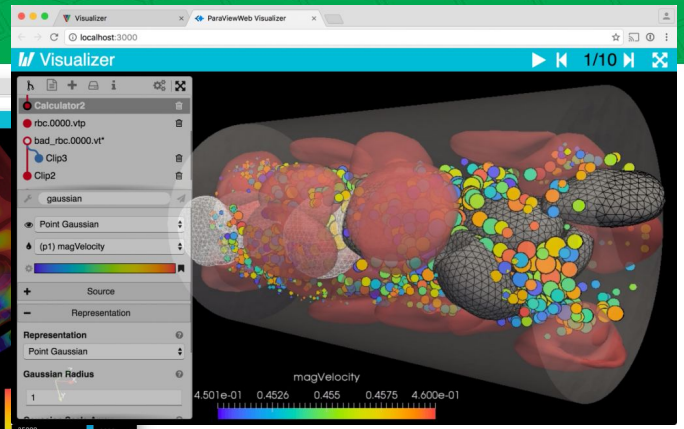
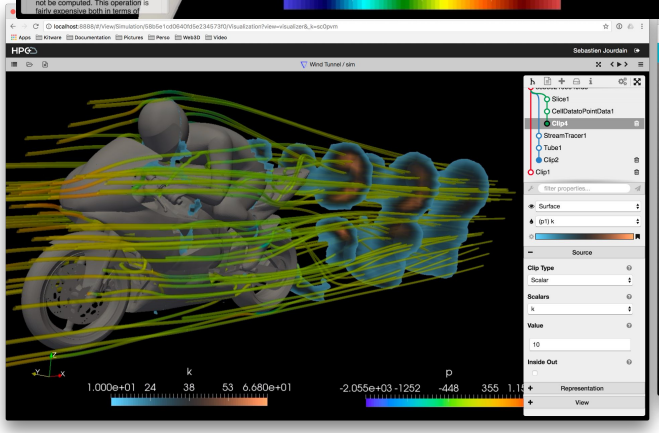
The ParaView like application in the Web

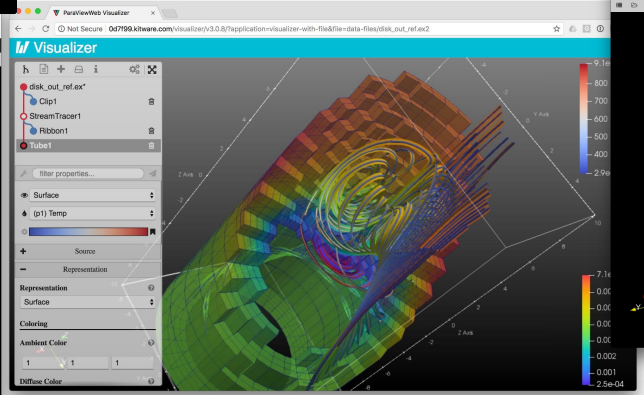
ParaView Visualizer

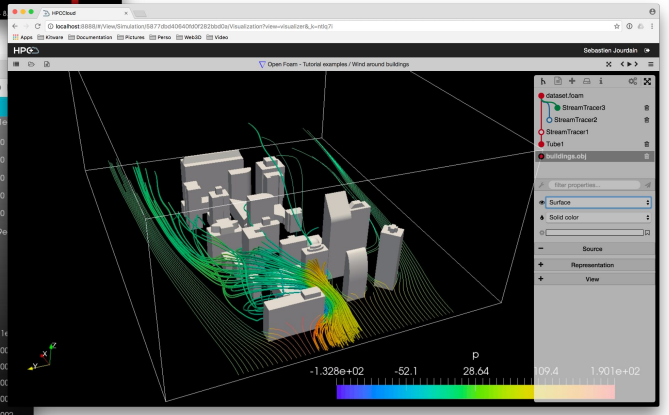












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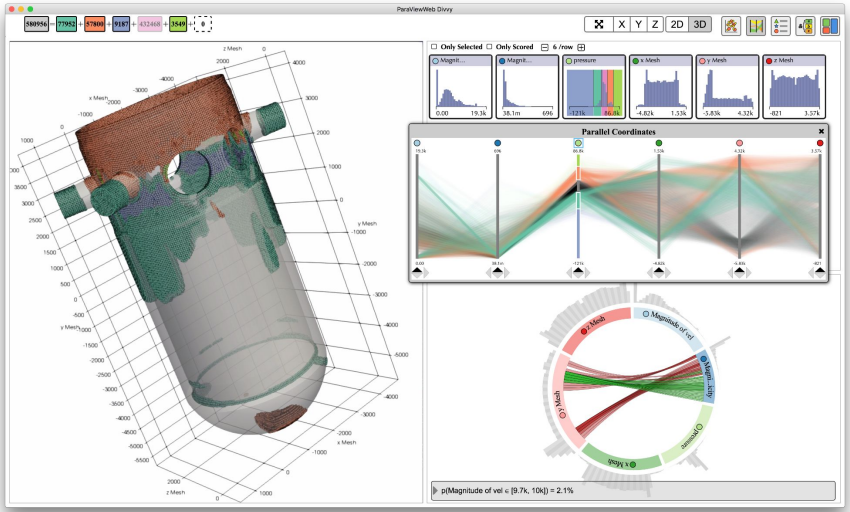
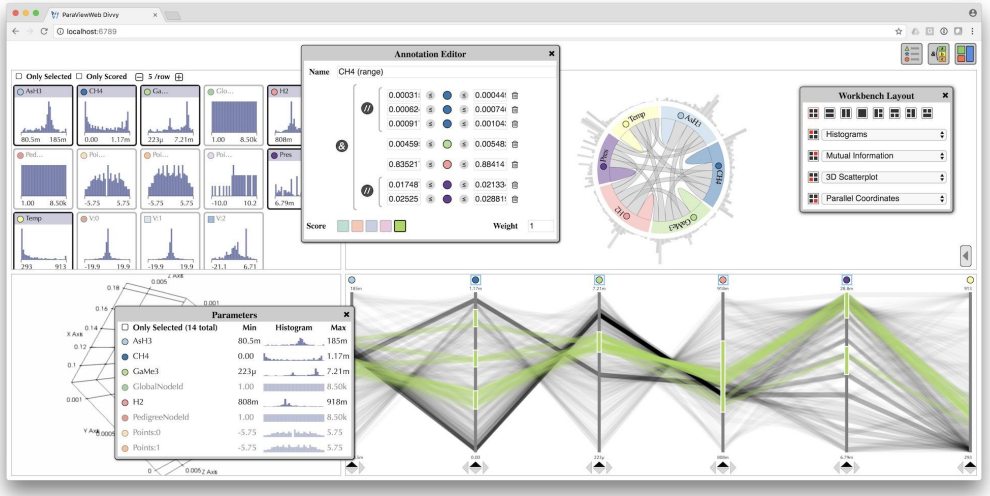
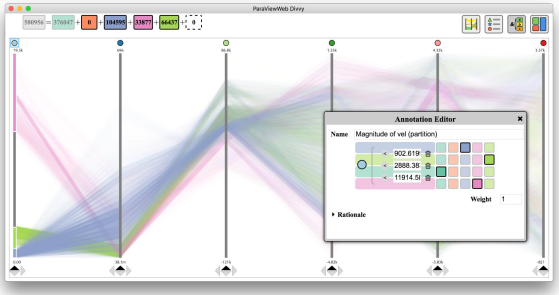
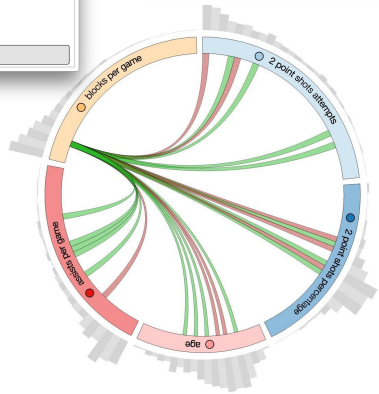
Interactive data analytic with ParaView that does not look like ParaView

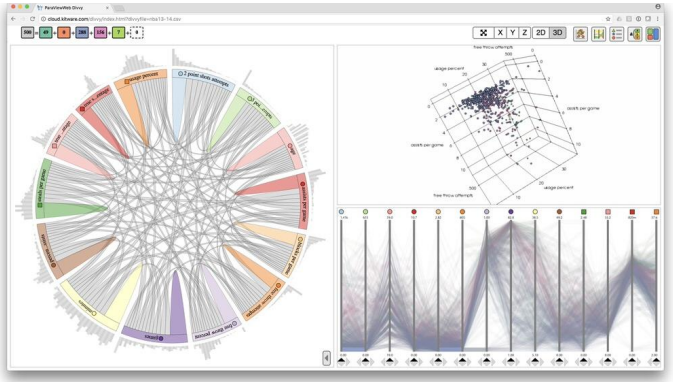
ParaView Divvy











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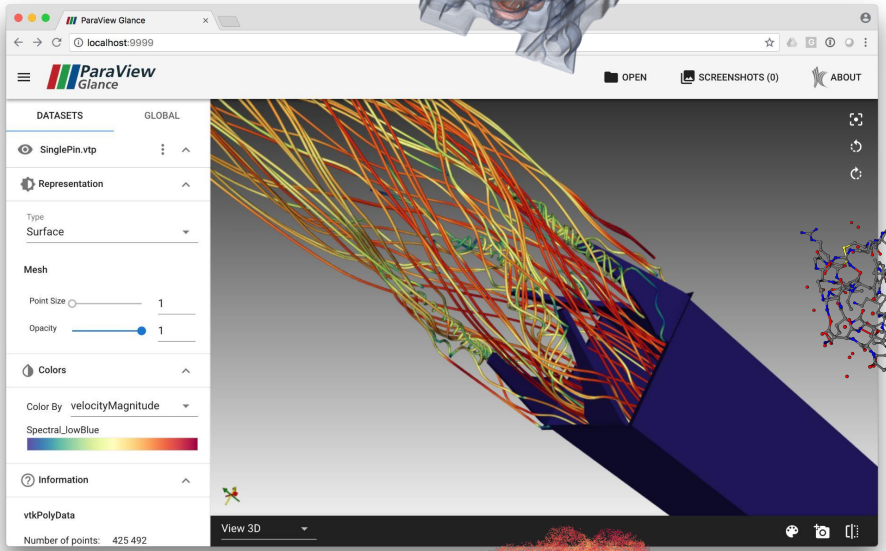
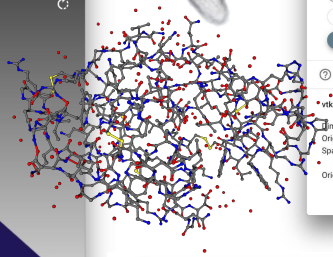
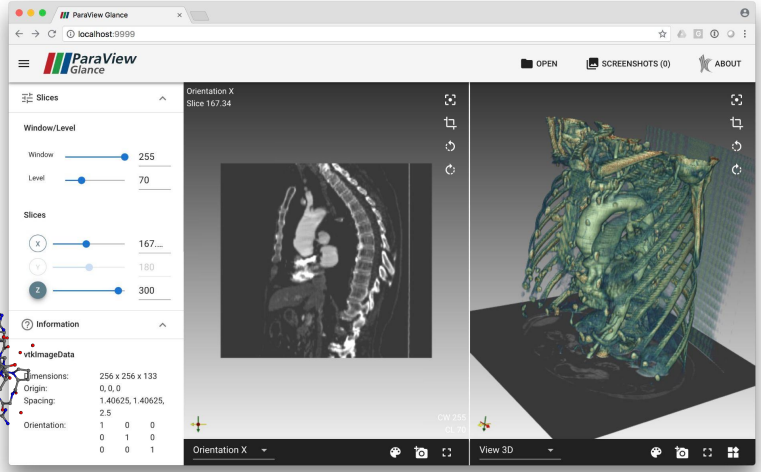
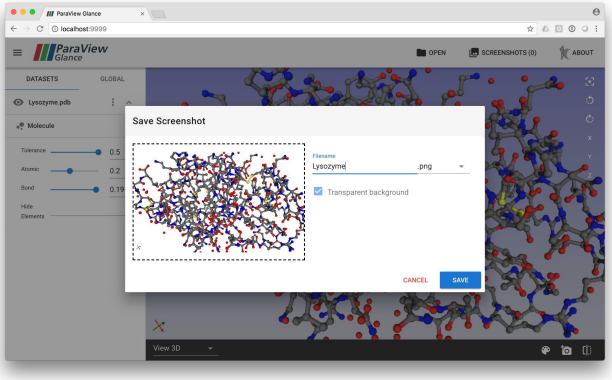
The ultimate vtk.js viewer in a serverless fashion

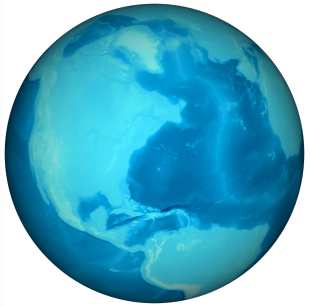
ParaView Glance



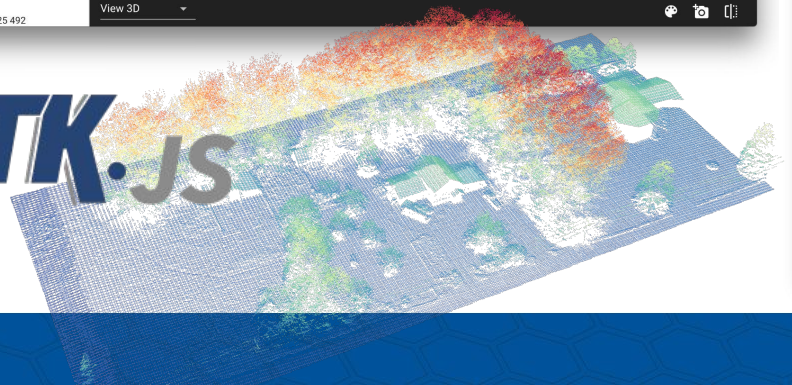








VTK.JS



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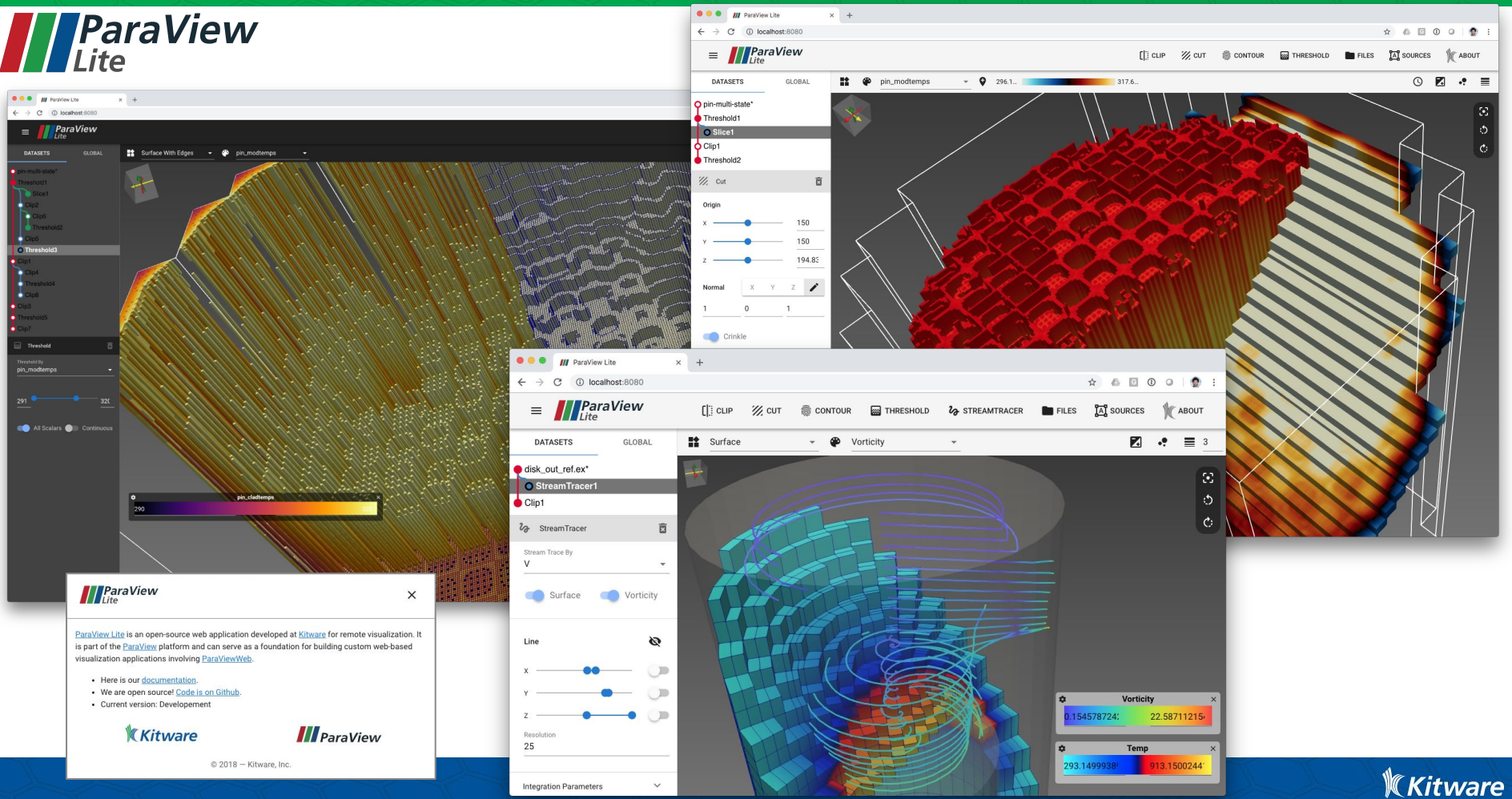
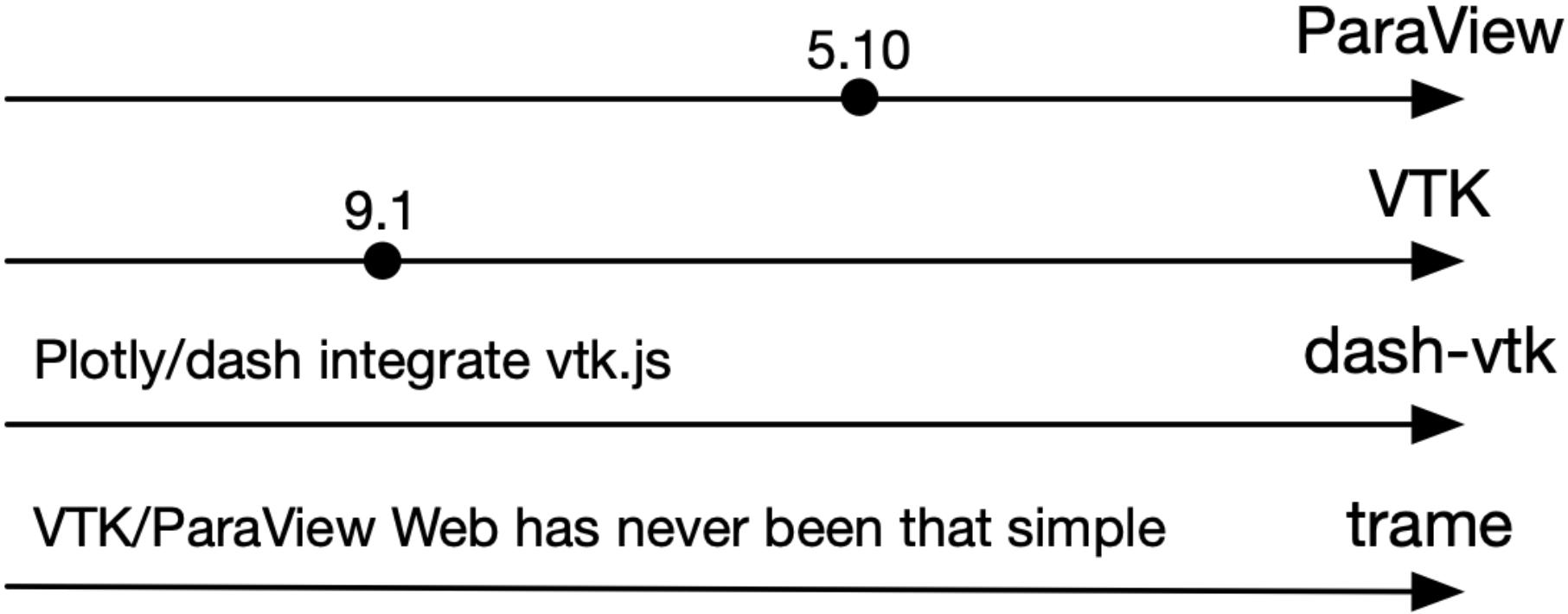
A fresh look at what ParaView in the Web could look like

ParaView Lite



What's new?


5.10
ParaView
9.1
VTK
Plotly/dash integrate vtk.js
dash-vtk
VTK/ParaView Web has never been that simple
trame

ParaView (5.10) and VTK (9.1) releases

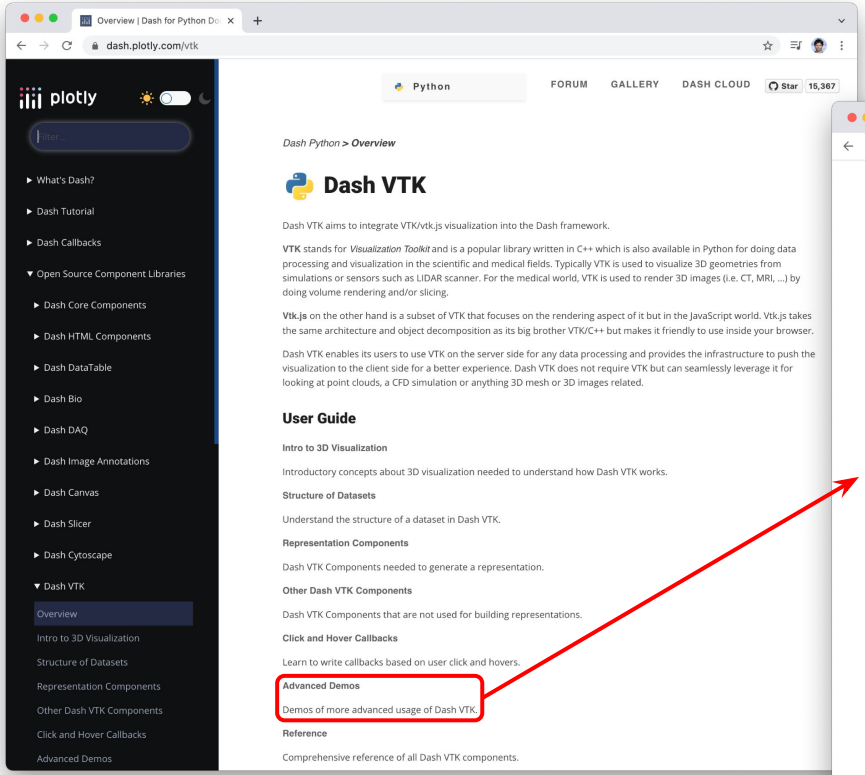
They both include the latest version of ***wslink***

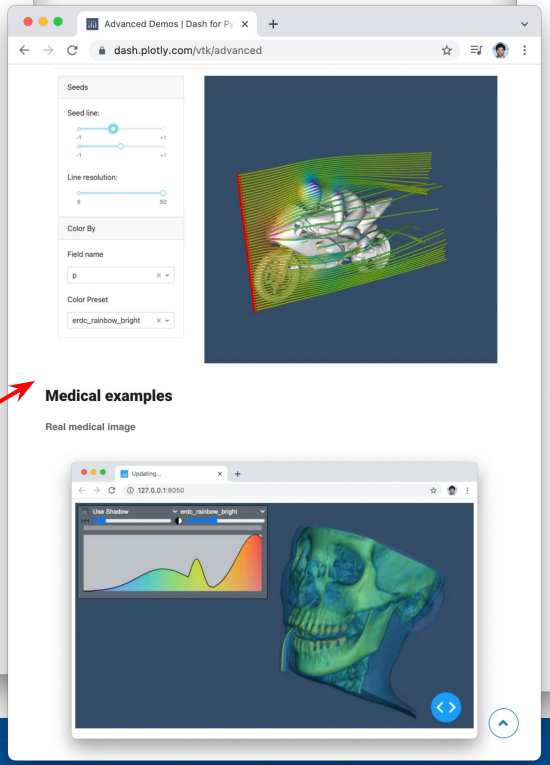
- Python 3.6+ with ***asyncio*** and ***aiohttp***

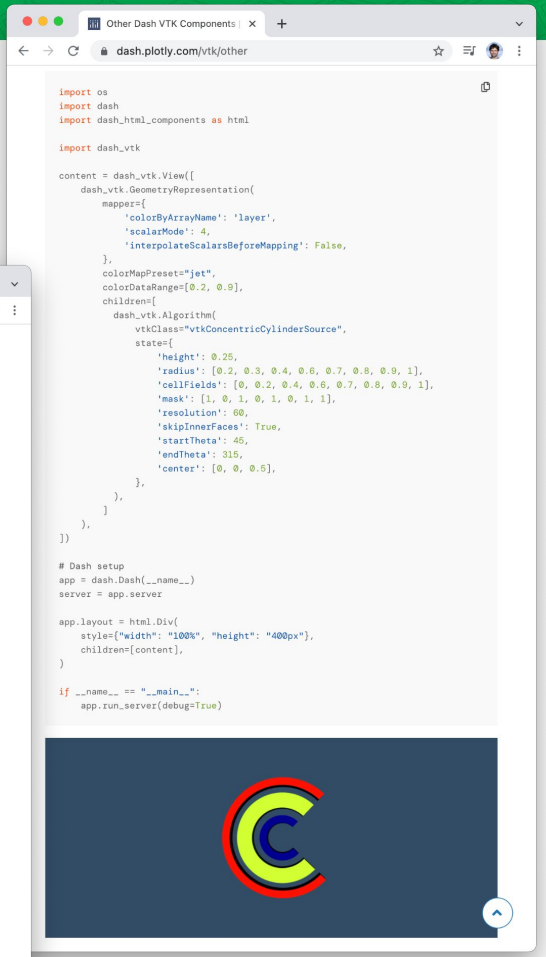
They both include improvements and fixes for their Web protocols

- Mouse wheel handling
- Support for vtkRenderView synchronization with vtk.js for
  - Volume Rendering, Cube Axes, Scalar Bar Actor

Plotly/Dash add support for 3D Viz with vtk.js







Supported languages: Python, R and Julia

Kitware

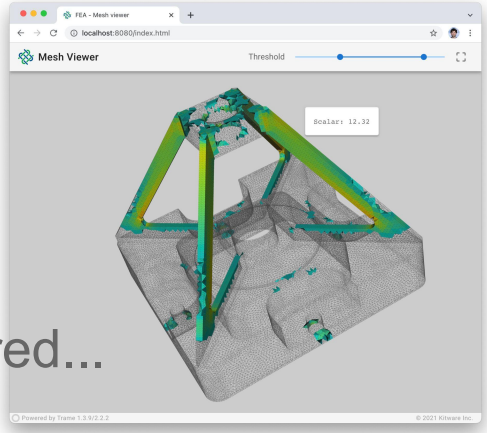
trame - VTK/ParaView Web has never been that simple!

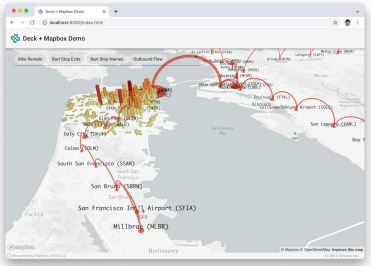
trame provides the frame for building your next Web application

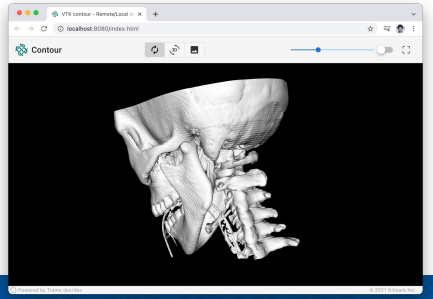
- Python is all you need to know

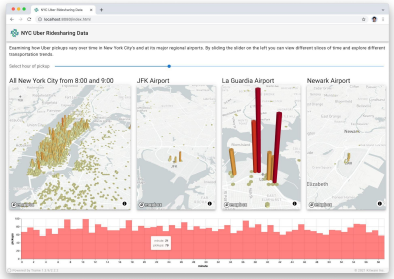
Make your first Web app today - (tutorial coming next)

- Rich set of UI components
- Play well with VTK 9.1 and ParaView 5.10
- Charts, 3D maps or 3D views, trame has you covered...










```
pip install “vtk>=9.1.0”
pip install “trame”
```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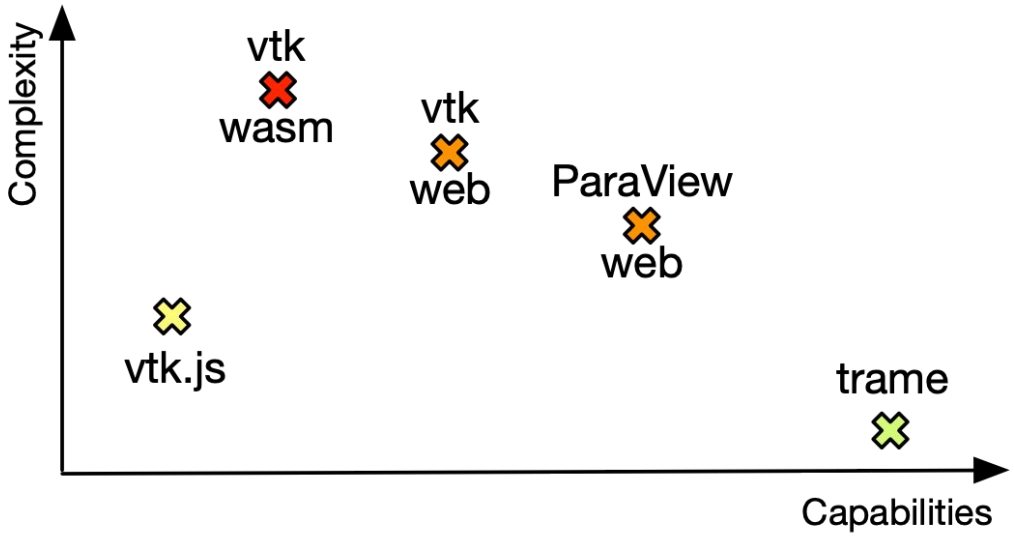
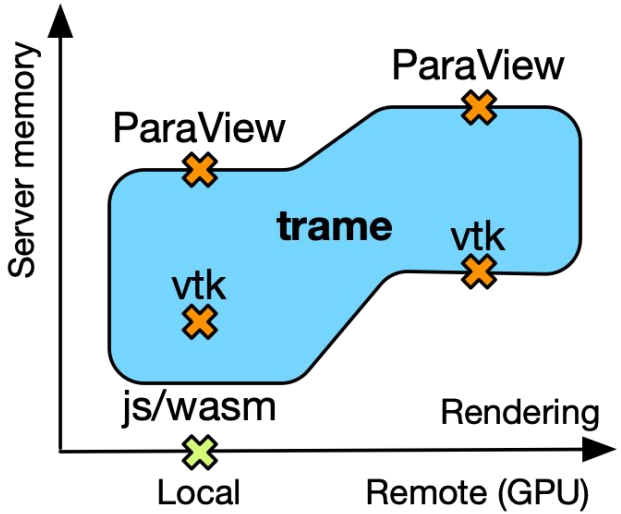
But wait a minute...

Why do we have so many options?

Blend of needs and constraints

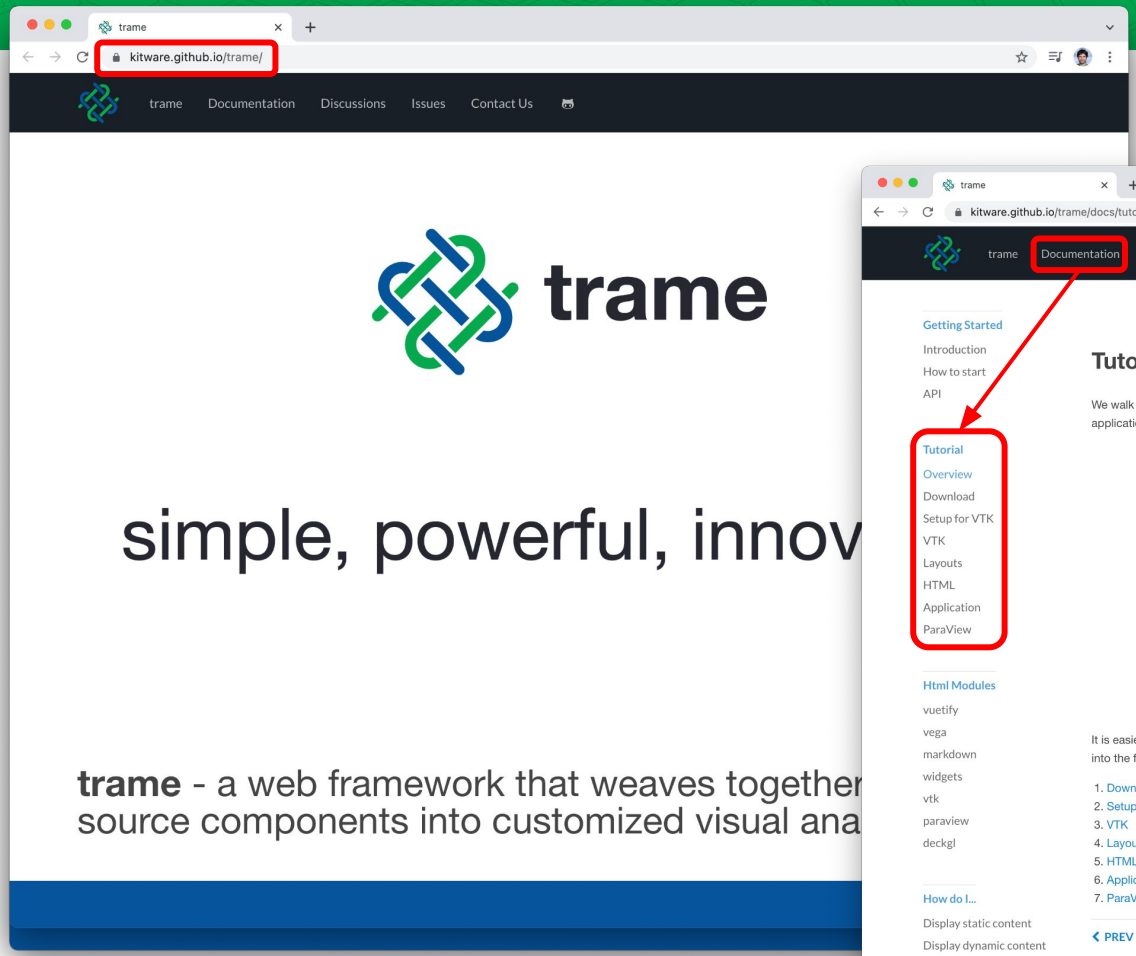
- Client vs client+server
- Resources (knowledge, hardware, operating cost…)

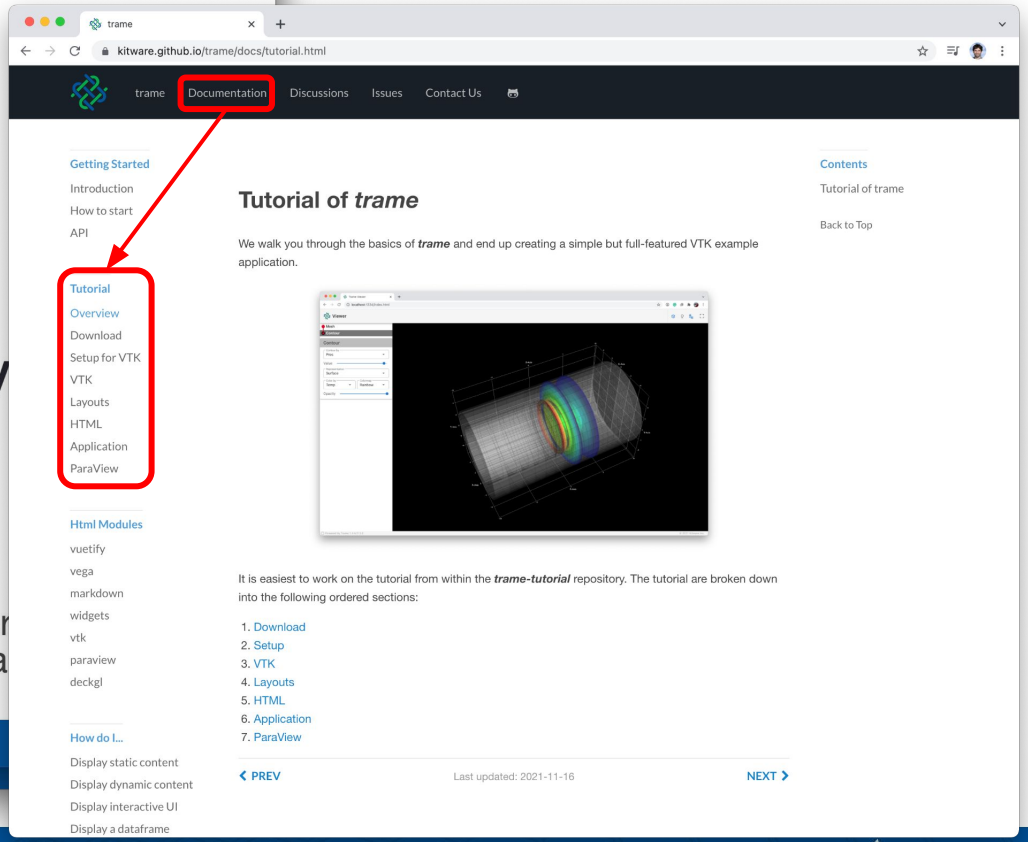




Tutorial - trame

https://kitware.github.io/trame/docs/tutorial.html

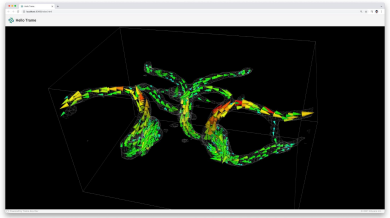


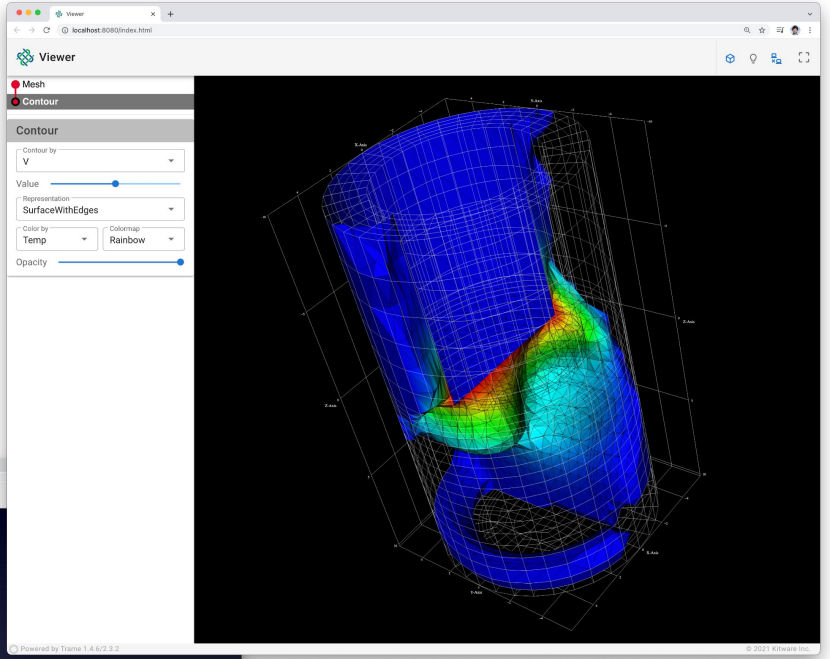


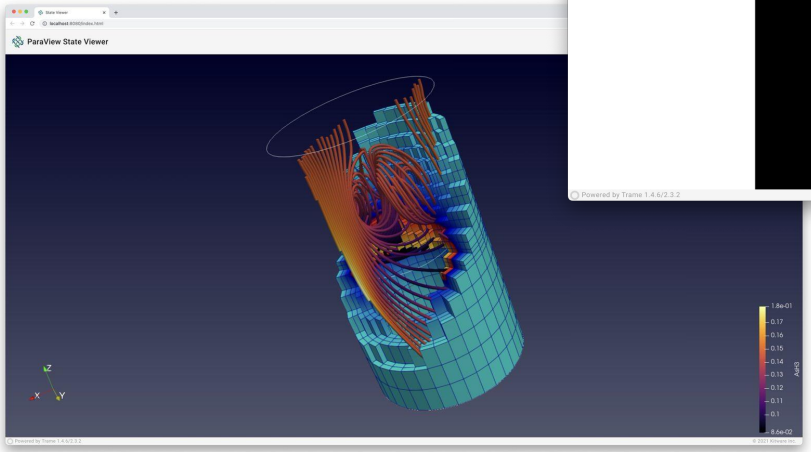
https://kitware.github.io/trame/

Kitware

Tutorial







- Download code with exercises
- Setup your Python environment
- VTK for doing 3D visualization
- Trame UI
  - Layouts
  - HTML
- Application
- ParaView

Download exercises

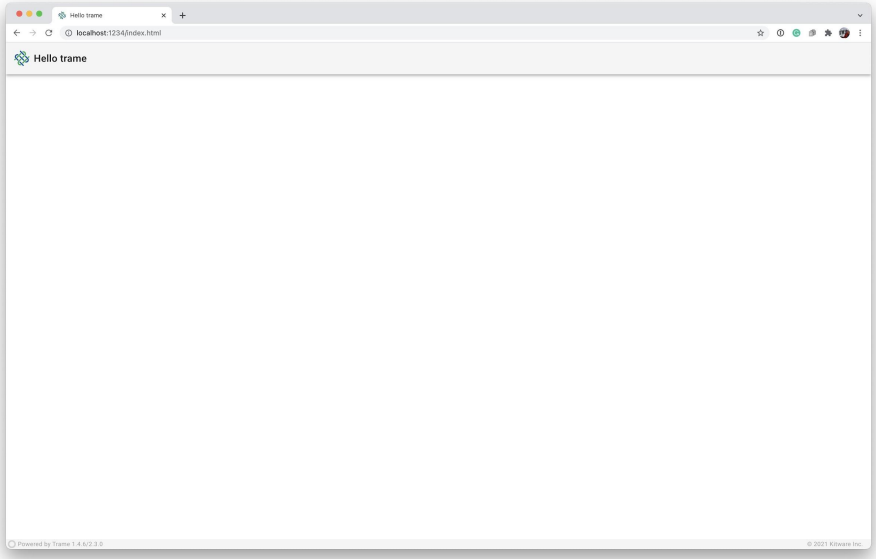
git clone https://github.com/Kitware/trame-tutorial.git

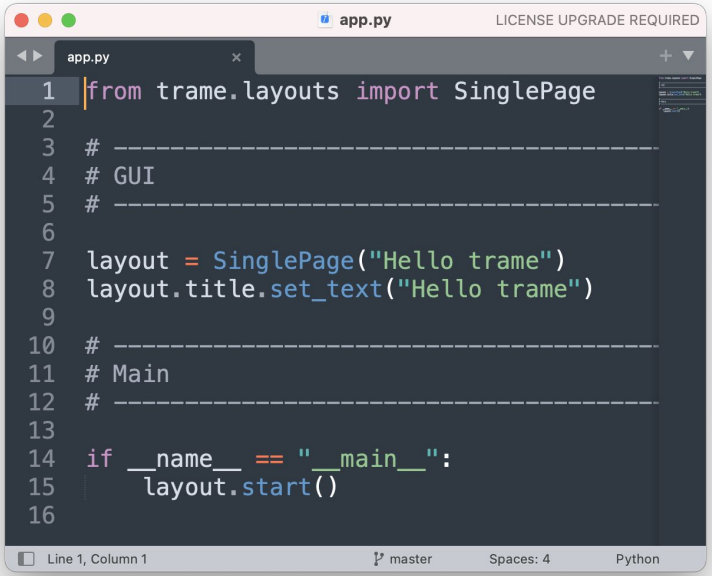
Setup a Python virtual environment

```
cd trame-tutorial
python3.9 -m venv .venv
source ./.venv/bin/activate
python -m pip install --upgrade pip
pip install "trame"
pip install "vtk>=9.1.0"
```

Run your first trame application

```
$ python ./00_setup/app.py --port 1234
```





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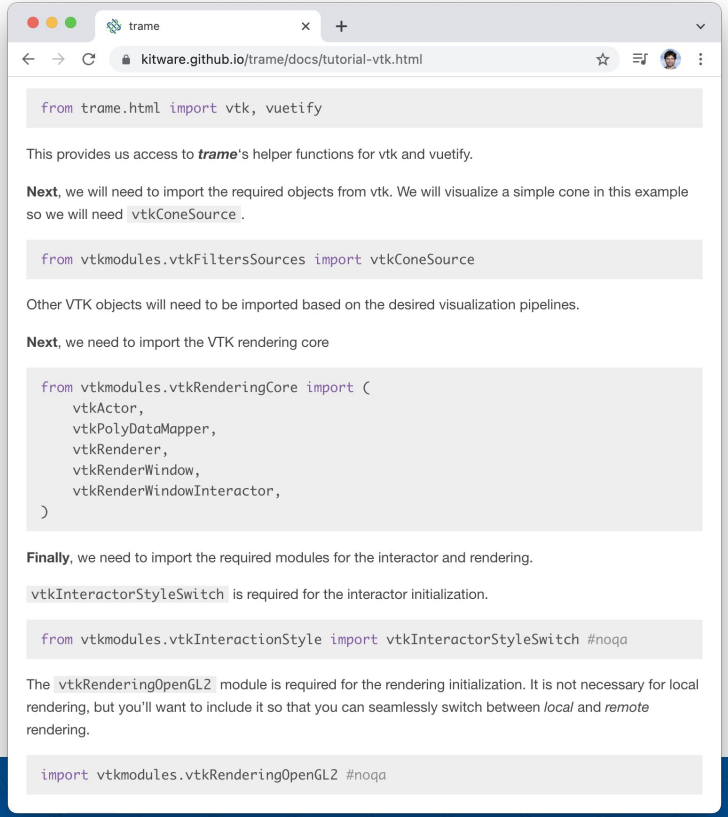
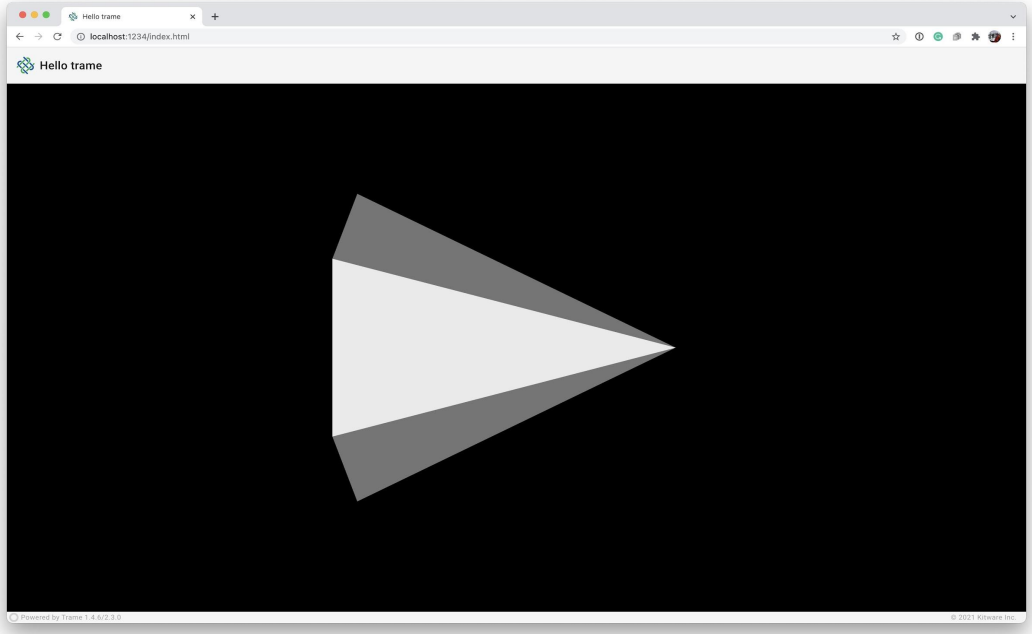
VTK inside trame

Start editing the file in `01_vtk/app_cone.py` which has the same content as `00_setup/app.py`.





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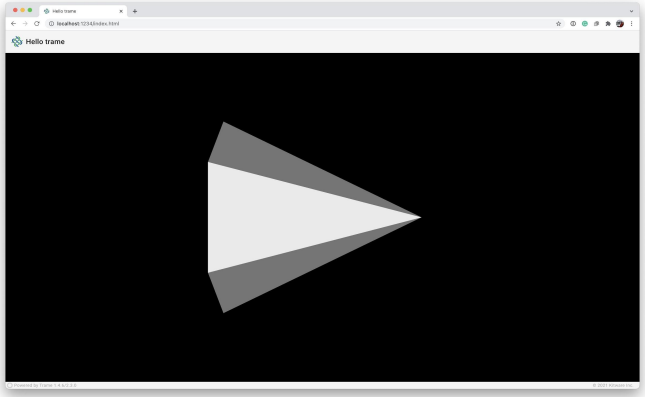
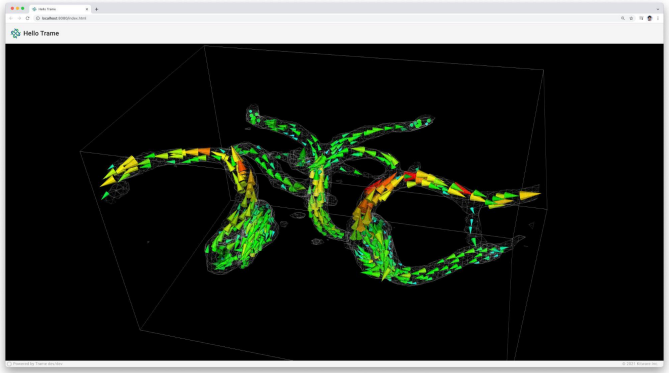
Coding time...





solution_cone.py

LICENSE UPGRADE REQUIRED

solution_cone.py

```python
from vtkmodules.vtkFiltersSources import vtkConeSource
from vtkmodules.vtkRenderingCore import (
    vtkActor,
    vtkPolyDataMapper,
    vtkRenderer,
    vtkRenderWindow,
    vtkRenderWindowInteractor,
)

# Required for interactor initialization
from vtkmodules.vtkInteractionStyle import vtkInteractorStyleSwitch  # noqa

# Required for rendering initialization, not necessary for
# local rendering, but doesn't hurt to include it
import vtkmodules.vtkRenderingOpenGL2  # noqa


# -----------------------------------------------------------------------------
# VTK pipeline
# -----------------------------------------------------------------------------

renderer = vtkRenderer()
renderWindow = vtkRenderWindow()
renderWindow.AddRenderer(renderer)

renderWindowInteractor = vtkRenderWindowInteractor()
renderWindowInteractor.SetRenderWindow(renderWindow)
renderWindowInteractor.GetInteractorStyle().SetCurrentStyleToTrackballCamera()

cone_source = vtkConeSource()
mapper = vtkPolyDataMapper()
mapper.SetInputConnection(cone_source.GetOutputPort())
actor = vtkActor()
actor.SetMapper(mapper)

renderer.AddActor(actor)
renderer.ResetCamera()
```

Line 58, Column 1 master Spaces: 4 Python

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Local and Remote rendering

Local Rendering

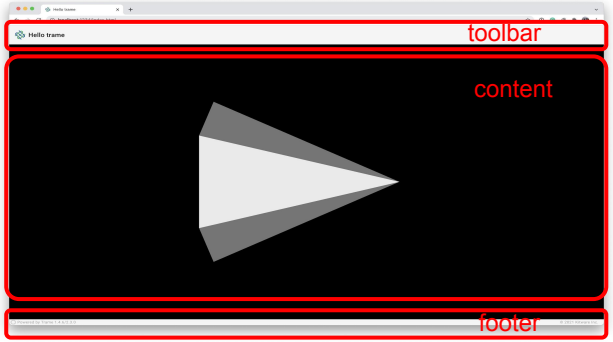
- Advantages
  - The server doesn't need a GPU
  - Interacting with the scene is as fast as it can get
- Disadvantages
  - The geometry needs to be send to the client. This can be big and therefore slow.
  - The client rendering capabilities is not known

Remote Rendering

- Advantages
  - No data movement except the rendered image
  - Rendering can use parallel and distributed processing
  - Application can serve a more diverse set of client (phone)
- Disadvantages
  - The framerate will be capped by the speed and latency of the network (~20-30 fps).
  - The server needs a GPU for faster rendering

Layouts

SinglePage

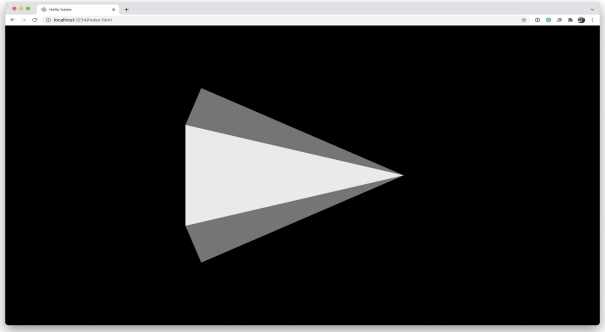


- toolbar
- logo
- title

Inside toolbar

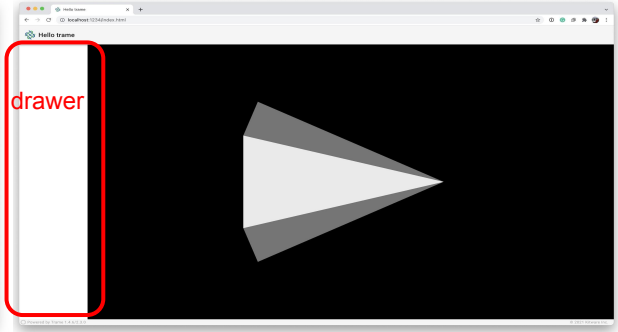
- content
- footer

FullScreenPage



- children

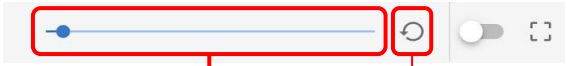
SinglePageWithDrawer



- toolbar
- logo
- title
- content
- footer
- drawer

HTML

- Vuetify (-:@) => (_)
- Shared state / actions

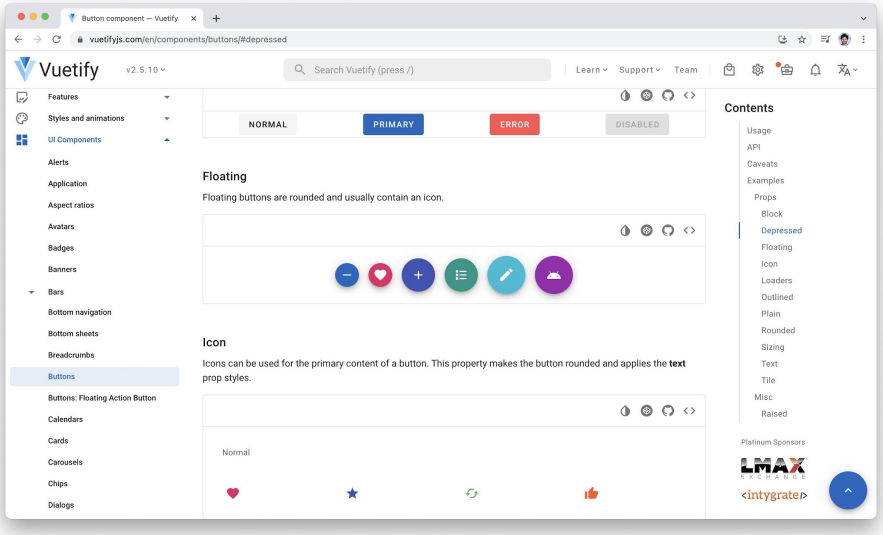


```
vuetify.VSlider(
    v_model=("resolution", DEFAULT_RESOLUTION),
    min=3,
    max=60,
    step=1,
    hide_details=True,
    dense=True,
    style="max-width: 300px",
)
```

```
@change("resolution")
def update_resolution(resolution, **kwargs):
    cone_source.SetResolution(resolution)
    html_view.update()
```

```
vuetify.VBtn(icon=True, click=reset_resolution)
```

```
def reset_resolution():
    update_state("resolution", DEFAULT_RESOLUTION)
```



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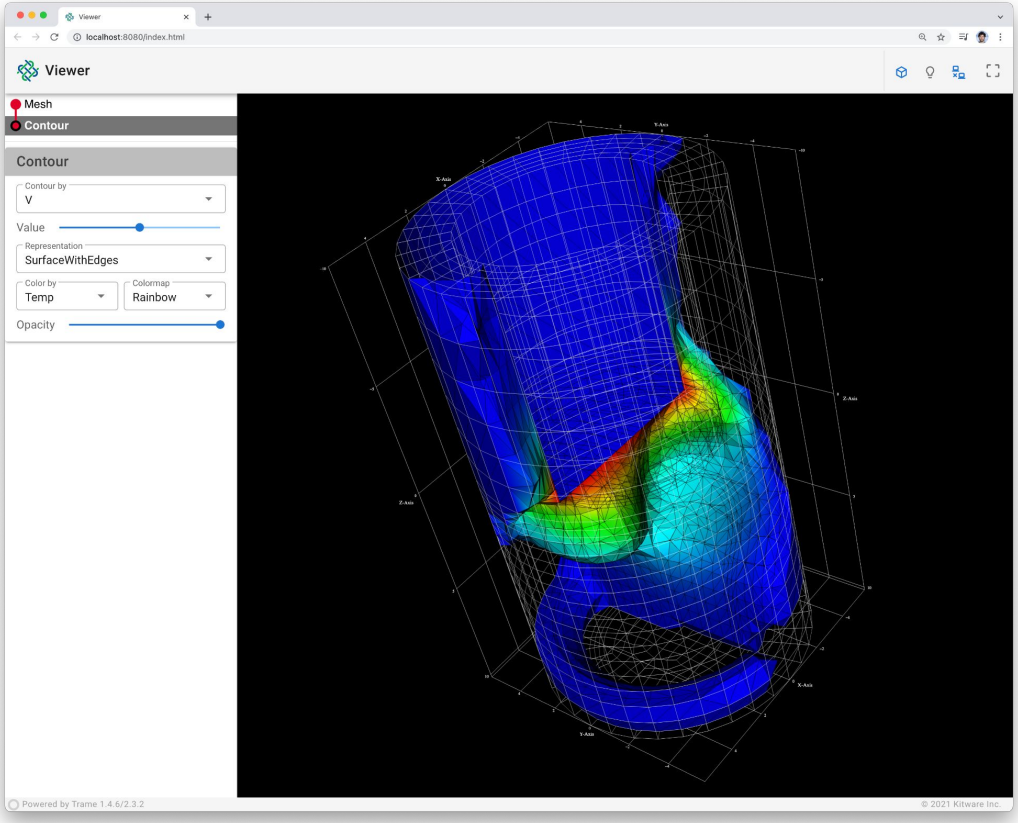
Coding time...

Application

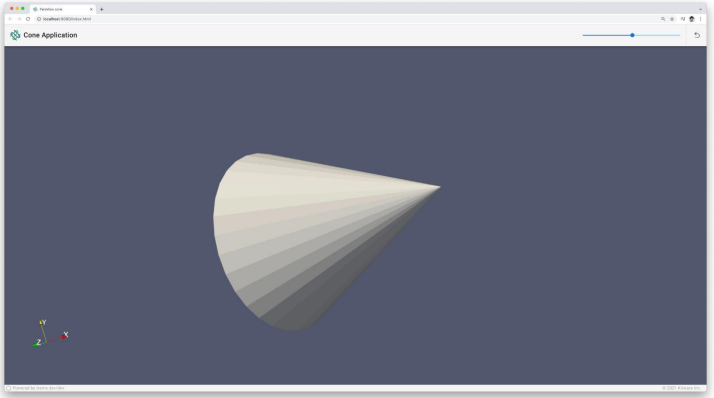
- VTK pipeline
  - CubeAxes
  - Mesh (unstructured grid)
  - Contour (filter)
- UI to control
  - Visibility
  - Representation
  - Color By
  - Color maps
  - Opacity
  - Contour By (field+value)
  - Local / Remote rendering

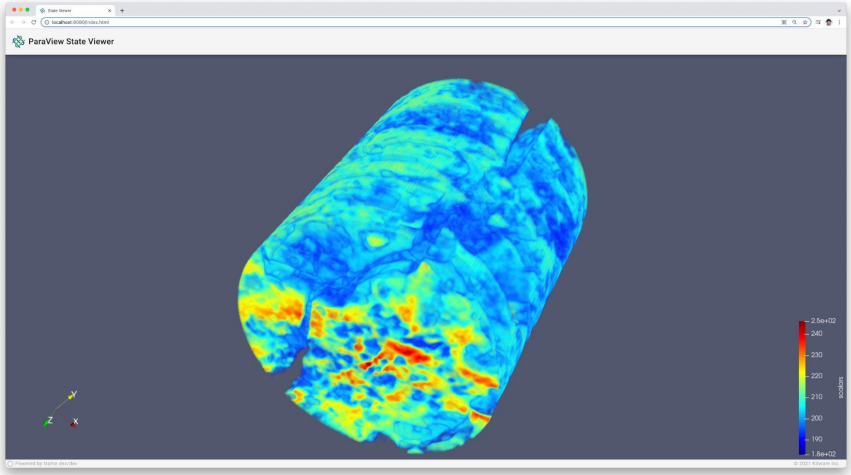


Coding time...

ParaView

- --venv path/to/venv
- Cone example
- StateLoader





Demo time...

Thank you!

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