UniFlex

Last edited: 5 June 2020

Description

UniFlex is the simulation engine for Soft Body, Cloth and Ropes and more.

Requirements

To use this plug-ins, you will need MAXON Cinema 4D R20 or higher on Windows or MacOS(no GPU support) and the modern AMD or Intel CPU with AVX support. For Nvidia Flex solver fast GPU is also required, AMD GPU’s may work but are not tested.

Installation

Extract the 7Z file into MAXON -> CINEMA4D -> PLUGINS folder.
Please remove all old or demo versions of UniFlex before installation, if you have some.

Information

Only vertices against triangles collision is supported for now.
Collision of vertices against Floor is supported.

Changes

…

Supported Shapes

Splines. as soft-spline.

Polygonal Meshes. as soft-body or collider. GPU FleX solver also support primitives that can be converted to polygon mesh.

Null Object. as fixed particle usual for constraining, “Active” in the name will make it dynamic!

Floor Object. as infinite collision plane.

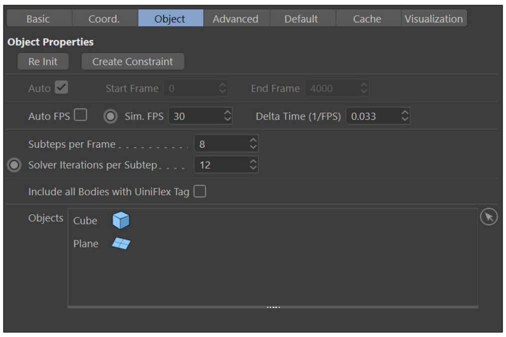
Particle Emitter Object. as independent particles.

Sphere Object. as independent particle, “Fixed” in the name will make it fixed!

UniFlex for C4D

UniFlex is the simulation engine for Soft Body, Cloth and Ropes and more.

UniFlex Simulator Object



Basic | Coord. | Object | Advanced | Default | Cache | Visualization

Object Properties

Re Init   Create Constraint

Auto ☑   Start Frame 0   End Frame 4000

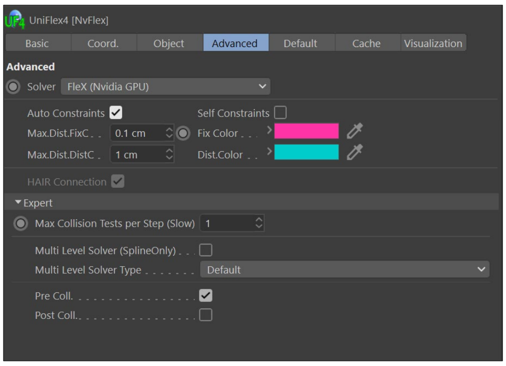
Auto FPS □   ● Sim. FPS 30   Delta Time (1/FPS) 0.033

Subteps per Frame 8

Solver Iterations per Subtep. . . . 12

Include all Bodies with UniFlex Tag □

Objects   Cube
Plane



UniFlex4 [NvFlex]

Basic | Coord. | Object | Advanced | Default | Cache | Visualization

Advanced

Solver FleX (Nvidia GPU)

Auto Constraints ☑   Self Constraints □

Max.Dist.FixC. . 0.1 cm   Fix Color . .

Max.Dist.DistC . 1 cm   Dist.Color . .

HAIR Connection ☑

Expert

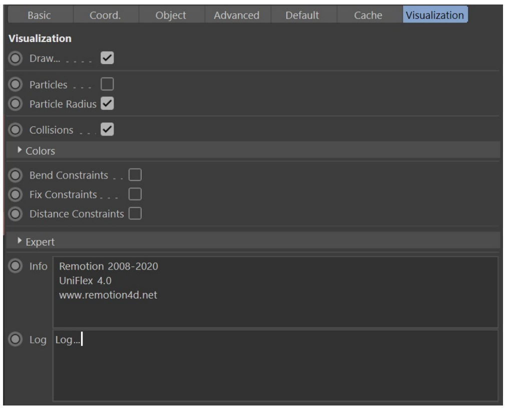
Max Collision Tests per Step (Slow) 1

Multi Level Solver (SplineOnly) . . □

Multi Level Solver Type . . . . Default

Pre Coll. . . . . ☑

Post Coll.. . . . . □



Basic | Coord. | Object | Advanced | Default | Cache | Visualization

Visualization

Draw... . . . . ☑

Particles . . . □

Particle Radius ☑

Collisions . . ☑

Colors

Bend Constraints . . □

Fix Constraints . . . □

Distance Constraints □

Expert

Info   Remotion 2008-2020
UniFlex 4.0
www.remotion4d.net

Log   Log...

Create Constraint: Select 2 object (mesh, splines) and only one vertex in every of it.
Then this button will create new Constraint between it.

Start, End frames: The simulator will simulate only inside this time interval.
Sim FPS: Delta Time = 1 / FPS ….

Sub Steps: every simulation frame will be internally subdivided into sub steps this parameter specify in how may. Too big values will slow down simulation times but make precise results.

Solver Iterations: How many steps solver can be executed…
More Iteration will allow better simulation.

Gravity: Global default gravitation force that act at all objects inside simulation.

Objects: List of objects inside simulation, alternative you can place object as child under UniFlex Sim.Object.

Friction: Global collision friction... (in work) (Classic-Solver only)

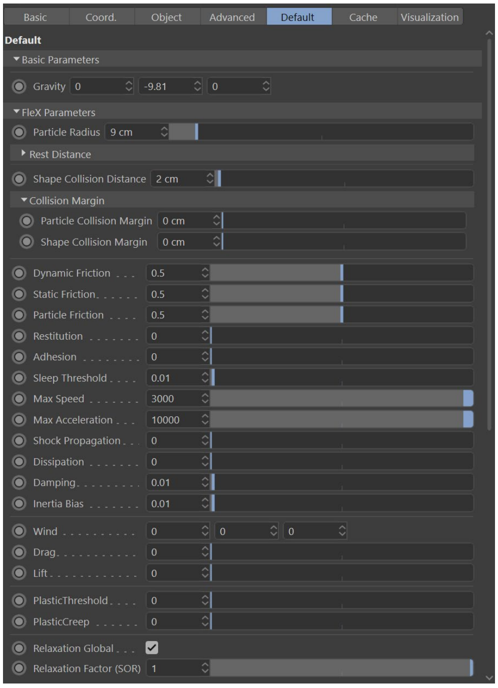
Particle Radius: radius of the collision particles… (in work) (Classic-Solver only)

Solver:
Classic: Initial solver system. (very stiff constrains are possible but not symmetric!)
Balanced: New balanced solver system (Please do not use "Balanced Solver" it is too weak, and all constrains even Fixed are too weak if this solver is used! The "Balanced Solver" is available only for backward compatibility! It needs more solver iterations for now.)
Only 2D: restrict simulation only to X and Y axis. Usual for 2d spline simulation.

V Solver It.: usually only 1 iteration is needed to improve quality of Classic-Solver. Balanced-Solver may profit from it too...

Auto Constraint: if activated then UniFlex will create constraint by is self. In case it detects two points with distance smaller that 'Max Distance'. If distance is near 0 then Fix-Constraint will be created else Distance-Constraint will be created.
Self Constraints: Usually auto constraints are created only between different objects, enabling this allow to auto create constraints between points of single object.

FleX (GPU) parameters (GPU FleX solver only!)



Default

Basic Parameters

Gravity 0 -9.81 0

FleX Parameters

Particle Radius 9 cm

Rest Distance

Shape Collision Distance 2 cm

Collision Margin

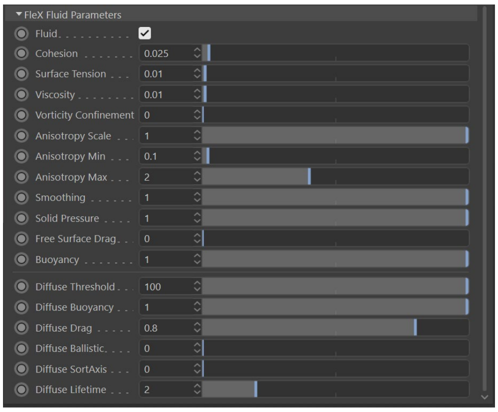
Particle Collision Margin 0 cm
Shape Collision Margin 0 cm

Dynamic Friction 0.5
Static Friction 0.5
Particle Friction 0.5
Restitution 0
Adhesion 0
Sleep Threshold 0.01
Max Speed 3000
Max Acceleration 10000
Shock Propagation 0
Dissipation 0
Damping 0.01
Inertia Bias 0.01

Wind 0 0 0
Drag 0
Lift 0

PlasticThreshold 0
PlasticCreep 0

Relaxation Global ☑
Relaxation Factor (SOR) 1



FleX Fluid Parameters

Fluid ☑
Cohesion 0.025
Surface Tension 0.01
Viscosity 0.01
Vorticity Confinement 0
Anisotropy Scale 1
Anisotropy Min 0.1
Anisotropy Max 2
Smoothing 1
Solid Pressure 1
Free Surface Drag 0
Buoyancy 1

Diffuse Threshold 100
Diffuse Buoyancy 1
Diffuse Drag 0.8
Diffuse Ballistic 0
Diffuse SortAxis 0
Diffuse Lifetime 2

Particle Radius: The maximum interaction radius for particles
Solid Rest Distance: The distance non-fluid particles attempt to maintain from each other, must be in the range (0, radius]
Fluid Rest Distance: The distance fluid particles are spaced at the rest density, must be in the range (0, radius], for fluids this should generally be 50-70% of Radius, for rigids this can simply be the same as the particle radius

Collision Distance: Distance particles maintain against shapes, note that for robust collision against triangle meshes this distance should be greater than zero
Particle Collision Margin: Increases the radius used during neighbor finding, this is useful if particles are expected to move significantly during a single step to ensure contacts aren't missed on subsequent iterations
Shape Collision Margin: Increases the radius used during contact finding against kinematic shapes

Dynamic Friction: Coefficient of friction used when colliding against shapes
Static Friction: Coefficient of static friction used when colliding against shapes
Particle Friction: Coefficient of friction used when colliding particles
Restitution: Coefficient of restitution used when colliding against shapes, particle collisions are always inelastic
Adhesion: Controls how strongly particles stick to surfaces they hit, default 0.0, range [0.0, +inf]
Sleep Threshold: Particles with a velocity magnitude < this threshold will be considered fixed

Max Speed: The magnitude of particle velocity will be clamped to this value at the end of each step
Max Acceleration: The magnitude of particle acceleration will be clamped to this value at the end of each step (limits max velocity change per-second), useful to avoid popping due to large interpenetrations

Shock Propagation: Artificially decrease the mass of particles based on height from a fixed reference point, this makes stacks and piles converge faster
Dissipation: Damps particle velocity based on how many particle contacts it has
Damping: Viscous drag force, applies a force proportional, and opposite to the particle velocity

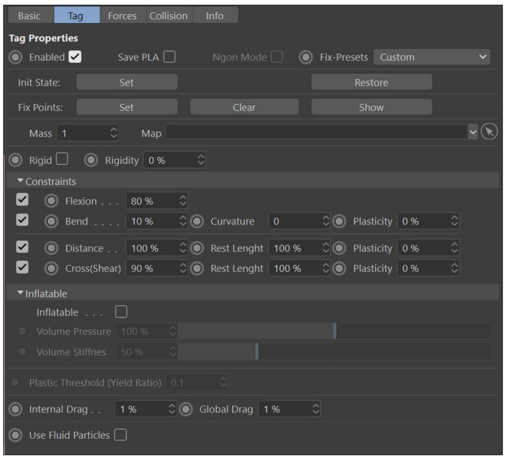
Wind: Constant acceleration applied to particles that belong to dynamic triangles, drag needs to be > 0 for wind to affect triangles
Drag: Drag force applied to particles belonging to dynamic triangles, proportional to velocity^2*area in the negative velocity direction
Lift: Lift force applied to particles belonging to dynamic triangles, proportional to velocity^2*area in the direction perpendicular to velocity and (if possible), parallel to the plane normal

Fluid params

Cohesion: Control how strongly particles hold each other together, default: 0.025, range [0.0, +inf]
Surface Tension: Controls how strongly particles attempt to minimize surface area, default: 0.0, range: [0.0, +inf]
Viscosity: Smoothes particle velocities using XSPH viscosity
Vorticity Confinement: Increases vorticity by applying rotational forces to particles
Anisotropy Scale: Control how much anisotropy is present in resulting ellipsoids for rendering, if zero then anisotropy will not be calculated
Anisotropy Min: Clamp the anisotropy scale to this fraction of the radius
Anisotropy Max: Clamp the anisotropy scale to this fraction of the radius
Smoothing: Control the strength of Laplacian smoothing in particles for rendering, if zero then smoothed positions will not be calculated
Solid Pressure: Add pressure from solid surfaces to particles
Free Surface Drag: Drag force applied to boundary fluid particles
Buoyancy: Gravity is scaled by this value for fluid particles

Diffuse Threshold: Particles with kinetic energy + divergence above this threshold will spawn new diffuse particles
Diffuse Buoyancy: Scales force opposing gravity that diffuse particles receive
Diffuse Drag: Scales force diffuse particles receive in direction of neighbor fluid particles
Diffuse Ballistic: The number of neighbors below which a diffuse particle is considered ballistic
Diffuse Lifetime: Time in seconds that a diffuse particle will live for after being spawned, particles will be spawned with a random lifetime in the range [0, Diffuse Lifetime]
Relaxation Global: How the relaxation is applied inside the solver
Relaxation Factor: Control the convergence rate of the parallel solver, default: 1, values greater than 1 may lead to instability

UniFlex Simulator Tag



Tag Properties

Enabled ☑ Save PLA □ Ngon Mode □ Fix-Presets Custom

Mass 1 Map

Rigid □ Rigidity 0 %

☑ Flexion . . . 80 %
☑ Bend . . . . 10 % Curvature 0 Plasticity 0 %
☑ Distance . . 100 % Rest Lenght 100 % Plasticity 0 %
☑ Cross(Shear) 90 % Rest Lenght 100 % Plasticity 0 %

Inflatable . . . □
Volume Pressure 100 %
Volume Stiffnes 50 %

Plastic Threshold (Yield Ratio) 0.1

Internal Drag . . . 1 % Global Drag 1 %

Use Fluid Particles □

Enable: If you disable this then this object will be ignored by the simulator.
Save PLA: Save simulation to PLA.

Internal Drag: This is dampening for internal forces created by constraints.
Gravitation and such external forces will be NOT affected by this dampening.
If this set to 100% then object will behave just like Rigid-Body.

Extern Drag: Specify dampening for external forces like gravity. Internal forces will be affected too.

Rigidity: Specify how strong object will try return to its initial shape.
If this set to 100% then object will behave just like Rigid-Body.
Can be combined with “**Internal Drag**”!

Flexion: Specify how strong will be the bend constraint. (for meshes only.)
Distance: Specify how strong will be the stretch constraint.
Stretch constraints will be created on mesh edges or between two neighbors’ vertices of spline.
For Balanced solver this can be up to ~400%.

Cross: For polygon mesh this will set how strong will be cross for Quadrangles strong.
For Spline this is a distance constraint between vertices 0 and 2, 1 and 3 and so on...

Cross 1..5: Specify how strong will be the stretch constraint for the spline.
These constraints are created between two vertices that are 1,2,3,4 and 5 vertices away from other…

Volume Stiffnes: Specify how strong the closed object will try to return to its initial volume.

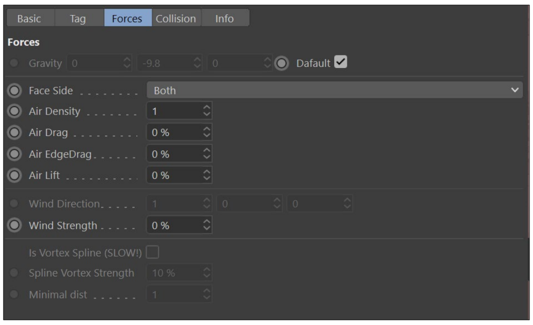
Volume Pressures: Scales the initial volume. You can pump up the object with this parameter…

Total Mass: The mass of the whole body.
If you have set it to 1 and 4 particles in the spline then every will have mass = 0.25.
“m” with this Vertex Map you can individually adjust scale mass of every particle (vertex).

Plastic Threshold (Yield Ratio): limits Plasticity to changes that are above this threshold.
If "Plastic Threshold (Yield Ratio)" is 0 then all even small changes will affect Plasticity.

So, for example if we have Distance Constraint witch Rest Length = 10 and "Plastic Threshold (Yield Ratio)" = 0.1 then Length changes smaller that 1.0 (10 * 0.1) will be ignored by Plasticity.

UniFlex Simulator Tag



Forces

Gravity 0 -9.8 0 Dafault ☑

Face Side . . . . Both

Air Density 1

Air Drag . . . . 0 %

Air EdgeDrag . . . . . . 0 %

Air Lift . . . . 0 %

Wind Direction. 1 0 0

Wind Strength . . . . . 0 %

Is Vortex Spline (SLOW!) □

Spline Vortex Strength 10 %

Minimal dist 1

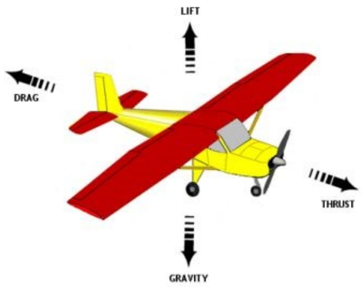
[Wind Properties]

(Not used by GPU FleX solver!)

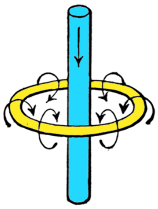
Face Side: if set to Front then the drag and lift will be added only if polygon face is frontal.
This is helpful for example for closed Sphere where only shell must react to wind or air drag but not internal.

Air Density: 0 will disable all Air or Wind properties.
Big values make from Air something like Water.

Air Drag: polygons face drag force is quadratic to face speed....
Air EdgeDrag: polygons edge drag...
Air Lift: polygons lift force...



Wind Direction: Direction of the wind.
Wind Strength: Scales wind direction.

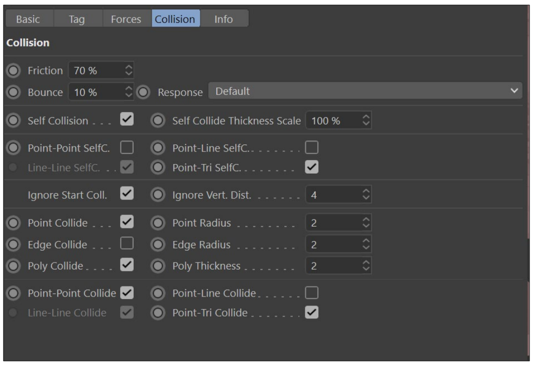


Is Vortex Spline: enable this to force spline generate Vortex forces on all particles.
This can be really slow if you have too many particles in the simulation.
It is better to make this spline static, fix all its points.

Spline Vortex Strength: how strong are Vortex forces.

Minima dist.: minimal distance to the spline to prevent too strong forces.

UniFlex Simulator Tag



Collision

Friction 70 %
Bounce 10 % Response Default
Self Collision . . . ☑ Self Collide Thickness Scale 100 %
Point-Point SelfC. □ Point-Line SelfC. . . . . □
Line-Line SelfC. . . ☑ Point-Tri SelfC. . . . . ☑
Ignore Start Coll. ☑ Ignore Vert. Dist. 4
Point Collide . . . ☑ Point Radius 2
Edge Collide . . . □ Edge Radius 2
Poly Collide . . . . ☑ Poly Thickness 2
Point-Point Collide ☑ Point-Line Collide . . . . . . □
Line-Line Collide ☑ Point-Tri Collide . . . . ☑

[Collision Properties]

(Not used by GPU FleX solver!)

Friction: Specify friction of this object…
Bounce: Specify bounce of this object…
Adhesion: (Not used for now!)

Response: Allow selecting different collision response system. The Default it the most common and realistic from all. The other Types are still experimental.

Self Collision: Enable self-collision. The collision of mesh, spline with itself.
Self Collide Thickness Scale: Allow to scale Point Radius, Edge Radius and Triangle thickness for self-collision.

Point Coll: Enable collision versus particles.
Point Radius: Point, particle, vertex collision radius. (Point EPS)

Edge Coll: Enable collision versus edges.
Edge Radius: Edge, Line, Spline-Segment collision radius. (Edge EPS)

Poly Coll: Enable collision versus triangles.
Poly Thickness: Polygon, Triangle collision thickness. (Poly EPS)

Point-Point Collide: if enabled then this body is allowed to use Point (Vertex) vs Point (Vertex) collision with another body.
Point-Line Collide: if enabled then this body is allowed to use Point (Vertex) vs Line (Edge) collision with another body.
This one is disabled by default and is necessary only in special cases. (for Spline for example)

Line-Line Collide: if enabled then this body is allowed to use Line (Edge) vs Line (Edge) collision with another body.
Disabling this for Polygonal bodies could improve collision some times.

Point-Tri Collide: if enabled then this body is allowed to use Point (Vertex) vs Triangle (Face) collision with another body.

Conclusion

I will thank to all Beta testers for testing this Plug-ins, a lot of ideas and motivation and other support!!!
Without you this Plug-ins could not be made!

And of course, big thanks to all user!

www.remotion4d.net