

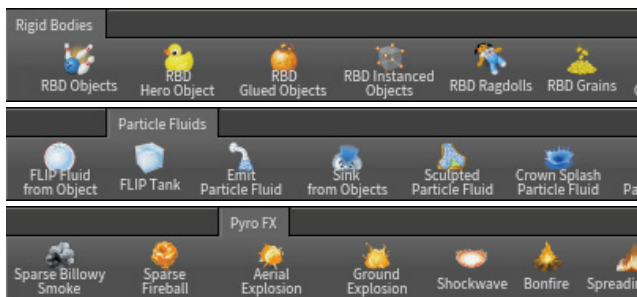


Dynamic Simulations

Whether you are creating Bullet Rigid Body destruction, Pyro FX fire and smoke, Vellum Soft Bodies or FLIP fluids, Houdini lets you work in an integrated dynamics environment. Different solvers know how to talk to each other to allow for more directable results.

SHELF TOOLS

Setting up dynamic simulations involve a network of nodes in the **Dynamic** or **DOPS** context, as well as nodes at the **Geometry** or **SOPS** context. It is always a good idea to use the shelf tools because they will add all of these nodes for you and reduce the number of clicks needed to set up a sim. You can then dive into the networks to explore all of the nodes.



The shelf tools are great for setting up groups of nodes automatically. Seeing how these shelf-built networks are put together can be very useful later if you choose to set up DOP networks from scratch.

DYNAMIC SOLVERS

At the center of any simulation is the dynamic solver. It is the brain of the simulation and takes all of the dynamic objects, forces and collision objects and integrates them to create the final result. The shelf tools put these solvers into a Dynamic Network and wire up the nodes for you.

Rigid Body Solver- Simulate rigid objects falling and colliding using the efficient Bullet solver or Houdini's built-in solver.

Static Solver- For situations where you want objects to work as collision geometry but not be affected by the simulation.

Flip Solver - This solver creates FLIP Fluid simulations to create splashing and wave effects.

Whitewater Solver - After completing a FLIP solve, you can run this solver to create foam, spray and bubbles.

Vellum Solver- A type of POP Solver that includes integrated support for cloth, hair, grains, fluids and soft bodies such as balloons.

POP Solver- Used for particles and grains, this solver simulates a wide range of different particle-based scenarios. Grain simulations can also be used for soft body and cloth-like simulations.

Wire Solver- You can use this solver for hair and fur or other wiry objects such as the rigging of a ship or the branches of a tree.

Finite Element Solver- Simulates the physics of continuous materials or solids as determined by tetrahedrons. This solver is used for muscles, soft body sims and destructions shots such as breaking wood.

Cloth Solver- Create cloth simulations that can collide with deforming geometry such as a character.

SOP Solver- Use a SOP network to evolve an object's shape over time such as a wall being dented as it gets hit by objects.

OPENCL

You can use the GPU for faster sim times using **OpenCL** on solvers such as the **POP Grain** node, the **Pyro** solver (**Advanced** tab) and the **FLIP** solver (**Volume Motion** > **Solver** tab).

FORCES

To create dynamic motion, forces are needed to "get the ball rolling." The most basic of forces is gravity although other external forces such as fans, fluids and magnets can also play a role in initiating motion in your simulation.

Gravity Force A downward force on objects which works as if they were inside a gravity field.

Drag Force - Applies force and torque to oppose an object's existing motion to slow it down or dampen its momentum.

Uniform Force- A precise amount of force and torque that can be augmented by a noise DOP to add turbulence.

Fan Force- Applies a cone-shaped force on objects.

Fluid Force- Deform soft bodies such as cloth or wires with fluids.

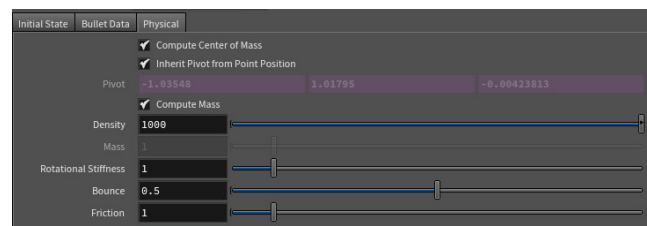
Wind Force- A pushing force that will increase the velocity of objects up to but not beyond its own speed.

Magnet Force- Attracts or repels objects using metaballs to represent a force field.

Vortex Force- Creates a vortex-like force that causes objects to orbit around a curve much like objects around a tornado.

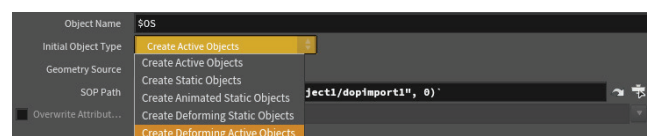
DYNAMIC OBJECTS

When you select an object and use a shelf tool to add it to your simulation, Houdini creates a Dynamic Object that uses the object's geometry and adds dynamic properties such as *density*, *friction*, and *bounciness*.



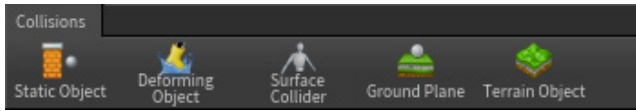
ACTIVE VS STATIC

Active dynamic objects are affected by forces and collisions while Static objects are not. If you want to use animated or deforming geometry then you must define this on the dynamic object using either the **Initial Object Type** menu or the **Use Deforming Geometry** checkbox.

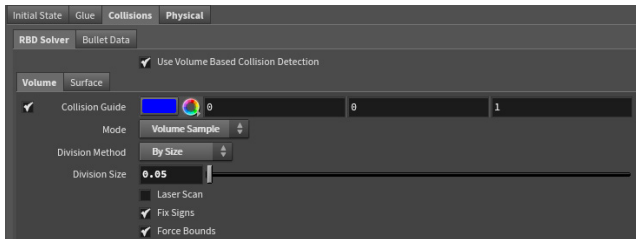


COLLISIONS

Collision objects are also a big part of any simulation. You can set up a **Ground Plane** to create a continuous surface for collisions or use either static or deforming objects.

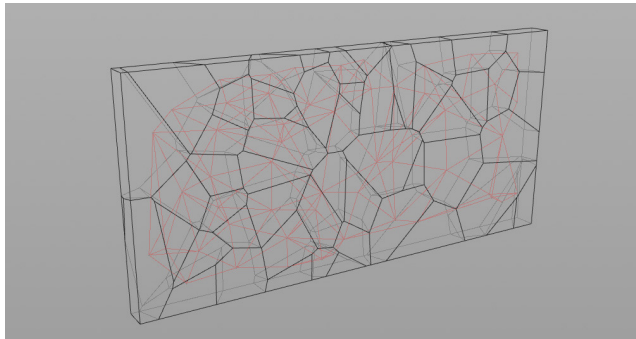


On each **Dynamic Object**, there are also settings for displaying and optimizing the collision volume. While you often want collisions to be as accurate as possible, you need to balance that with the need for faster simulation times.



RIGID BODY CONSTRAINTS

On the Rigid Bodies shelf, you will find a number of constraints that can also be used to influence a simulation. These include **Pin**, **Spring** and **Slider** Constraints. You can also use **Glue Objects** when you set up a rigid body sim to hold objects together until you either “loosen up” the glue or a collision occurs.



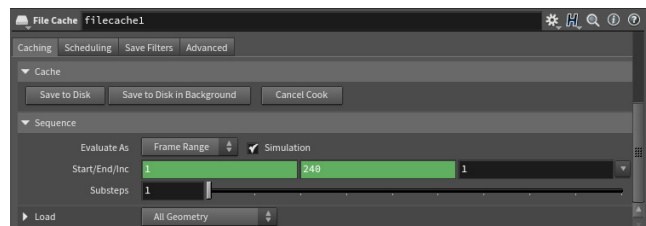
PLAYBAR FEEDBACK

To start a simulation, you press **Play** in the Playbar. As the simulation progresses, the Playbar is highlighted to show how much of the sim has been cached to memory. You can then scrub through that area without re-simming.



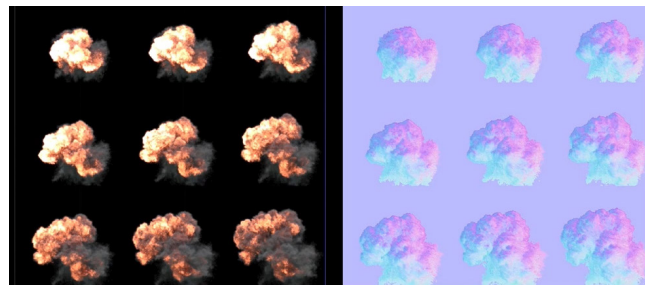
CACHING TO DISK

Once you have completed a simulation, you can either lock it down by saving out a **sim** file from within DOPs or more commonly, write out the simulated geometry to a **bgeo** sequence using the **File Cache** node. This will make it easier to work with the results of a sim during the lighting and rendering stages of production.



REALTIME FX FOR GAMES

In games, you need effects, such as explosions, to be optimized for real time in the game engine. Check out the **SideFX Labs Tools** to learn more about converting different kinds of Houdini sims such as rigid bodies, Pyro FX and Fluids into game ready art.



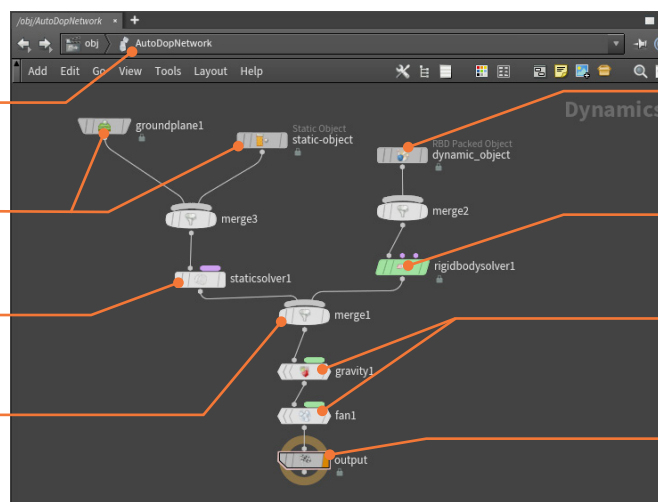
AUTODOPNETWORK

When you use a shelf tool to create a dynamic object, collision object or force, the AutoDopNetwork is created to combine all of the parts.

Static Objects - These nodes set up the properties of the ground plane and a static collision object.

Static Solver - This solver keeps the incoming objects still while dynamic objects interact with them.

Merge Node - Brings together parts of a dynamic system. During simulation nodes are evaluated up and down the chain so that everything interacts.



Dynamic Object - This node brings geometry into the DOPs environment and assigns basic properties.

Rigid Body Solver - The solver that generates the simulation of the participating objects.

Forces - The nodes that influence the dynamic objects using forces such as gravity or wind.

Output node - You can use this node to output .sim files if you want to cache out the simulation.