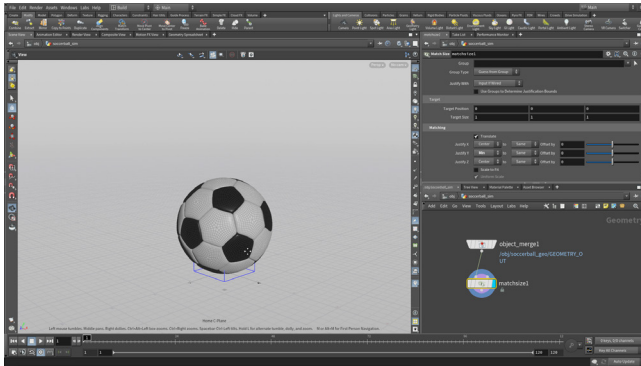


## PART TEN

# Set up a Rigid Body Simulation

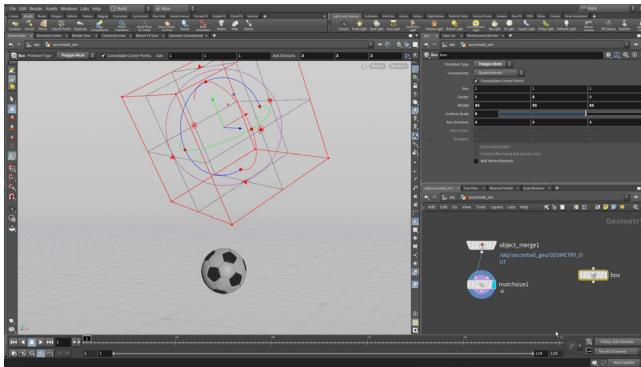
While traditional animation is great for animating a single soccer ball, dynamics would be a better option if you want to animate a bunch of soccer balls. Dynamics requires a simulation so that the solver can go frame by frame determining how each of the participating objects interact with each other. You will use packed geometry to get an efficient result for this simulation.



**01** Change back to the **Build** desktop and navigate to the object level. Hide all of the animation rig nodes and the *extract\_object* node by turning off their display flags. Turn on the *soccerball\_geo* display.

Select the *soccerball\_geo* node then from the **Modify** shelf click on the **Extract** tool. This creates a new object with the soccerball object merged. Jump up one level and rename *extract\_object* to *soccerball\_sim*. Hide the *soccerball\_geo* object.

Dive back in to the *soccerball\_sim* object to work with the geometry. Add a **Match Size** node to center the ball around the origin.

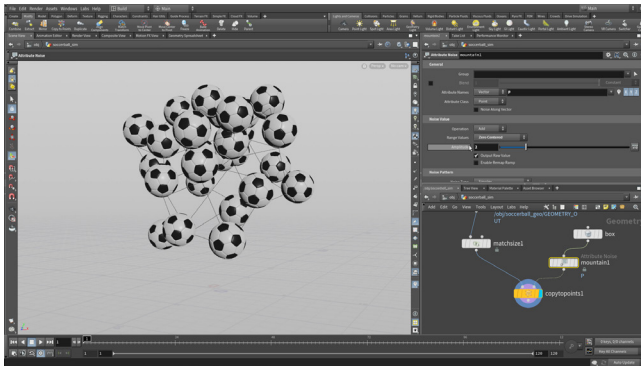


**02** In the Network view, press **tab > Box** then place it to the right of the *matchsize* node.

Set the following on the *box* node:

- **Center** to 0, 8, 0
- **Rotate** to 45, 45, 45
- **Primitive Type** to Polygon Mesh
- **Uniform Scale** to 6
- **Axis Divisions** to 3, 3, 3

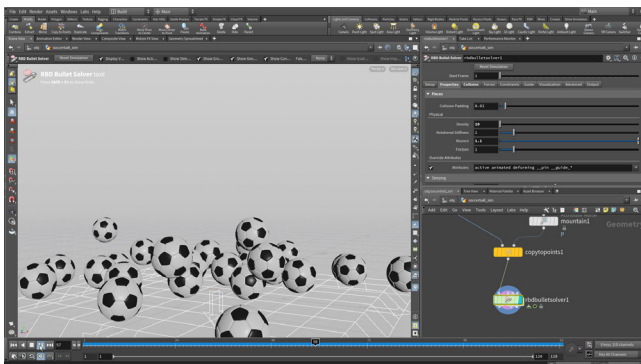
This puts it in the right position for the simulation.



**03** In the Network view, add a **Copy to Points** node just below the other nodes. Wire the *matchsize* node into the first input and the *box* node into the second.

Turn **ON** the **Pack and Instance** option. This will create a faster simulation because the geometry is being instanced to the points of the cube. Set the *copytopoints* node's **Display Flag**.

In the Network view, press **tab > Mountain** and place the node between the *box* and the *copytopoint* nodes. Turn **Off** the **Noise Along Vector** option then set **Amplitude** to 2 and **Range Values** to **Zero Centered**. This will jiggle the points on the box.



**04** Make sure you are on **Frame 1**. Add a **RBD Bullet Solver** node after the *copytopoints* node. Click on the **Collision** tab, scroll down to **Ground Collision**, and set **Ground Type** to **Ground Plane** to **Ground Plane**. Press **Play** to test out the simulation. The sim is cached which lets you scrub in the timeline to review the results.

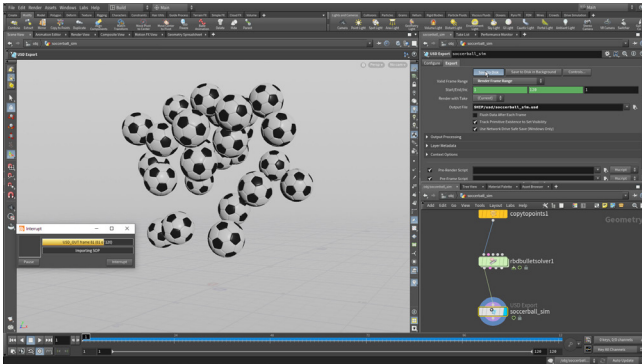
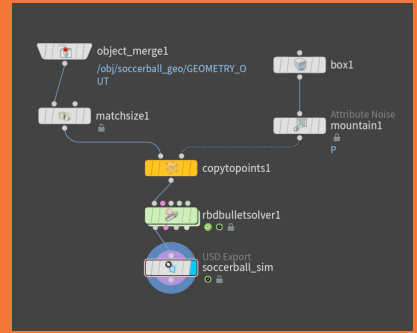
Under the **Collisions** tab, set **Bounce** to 0.8. Under the **Properties** tab, set **Density** to 10, **Bounce** to 1.1. At the top of the Parameter pane for this node, click the **Reset Simulation** button and then press **Play** to resim. Scrub to evaluate.



## DOPS hidden inside SOPS

In Houdini, simulations are processed using the **Dynamic Operators** or **DOPs**. With the **RBD Bullet Solver** node in the **Geometry/SOP** context, you are working with a node that has a Dynamics network buried inside it.

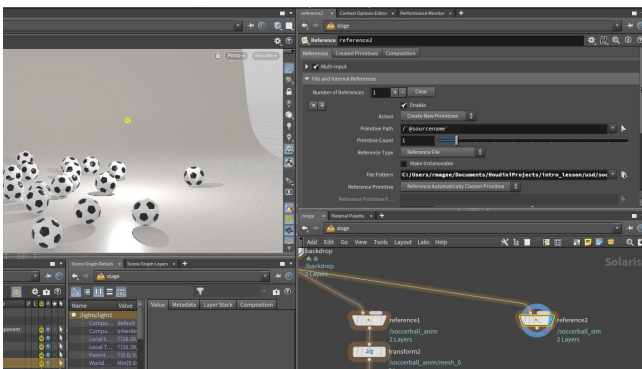
This makes it easy to set up at the geometry level with all the DOP nodes are wired up and ready to go but hidden from view. For simpler setups, working at the geometry level will give you a proper simulation. If you need more control over the different solvers then you would need to work directly in DOPs.



**05** At the end of the chain, add a **USD Export** node, set its **Display flag** and rename it to **soccerball\_sim**.

Set **Valid Frame Range** to **Render Frame Range** and set the **Output File** to **\$HIP/geo/soccerball\_sim.usd**.

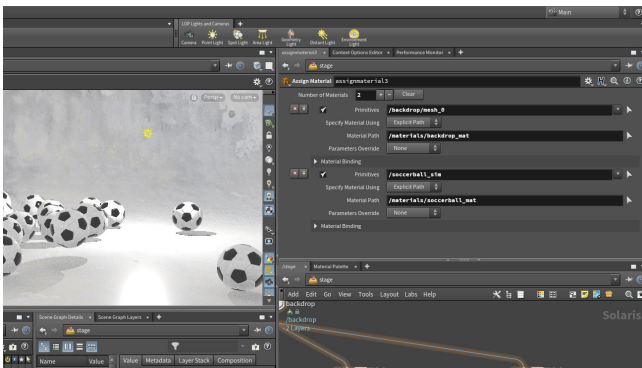
Click on the **Save to Disk** button and this will save the USD file into your geo directory. You will reference this cached asset into the Solaris setup as a third shot.



**06** Change your **Desktop** back to **Solaris** and set the path to **/stage**. Make sure you are choose **Houdini GL** from the **persp** menu.

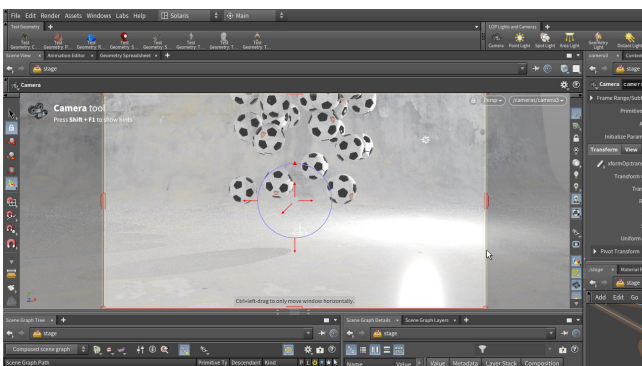
Alt-drag the **soccerball\_anim** **Reference** node and set its **Display Flag**. Set **File Pattern** to **\$HIP/geo/soccerball\_sim.usd**.

Rename this node to **soccerball\_sim**.



**07** In the Network view, **Select** the **assignmaterial** node from the SHOT 2 network then **Alt-drag** to create a copy of this node. Wire the **soccerball\_anim** node into it the **assignmaterial** node then set its **Display Flag**. This will assign the material to the **backdrop** but since the soccerball primitive has changed it needs to be reassigned.

In the field next to **Primitives** for the **soccerball\_mat**, change the primitive name to **/soccerball\_sim** to reassign the material to the new geometry.



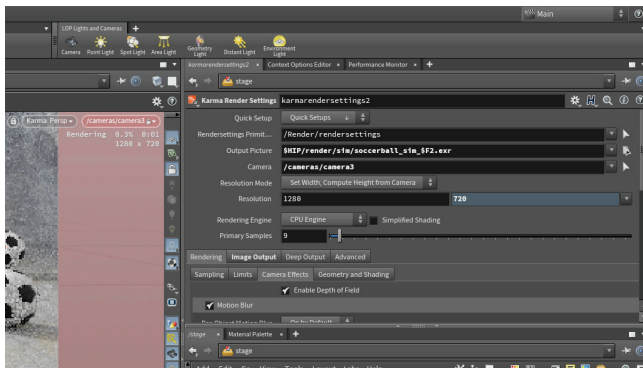
**08** Tumble around until you see the balls animated towards the camera. In the **LOP Lights and Cameras** shelf, **Alt-click** on the Camera tool to place a camera from the angle you are currently looking.

Press the **Lock Camera/Light to View** button so that view changes can be used to reposition the camera. Now **Tumble**, **Pan** and **Dolly** in the viewport to tweak the camera to get the framing that you want for the shot. Scrub the timeline to make sure the camera works for the whole sequence.



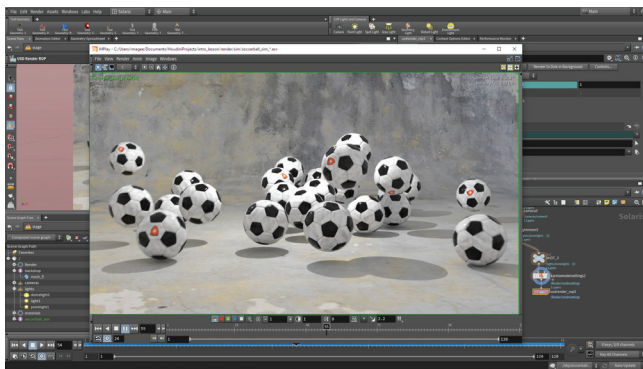
**09** Add a **Light Mixer** node after the *camera*. On the *lightmixer* node you will need to move over the lights. This will let you use the same light handles you learned about earlier to make lighting decisions for this shot and use the **Karma** display in the viewport to verify your setup. You can also use the *lightmixer* node to play with **intensity** and **exposure** for this shot.

These edits are being held in the *lightmixer* node and changes are not being made to the original lights. The *lightmixer* lets you tweak existing lights when working in a multi-shot setup.



**10** In the Network view, **Alt-drag** the *SHOT\_02* and *karmarendersettings* and *usdrender\_rop* nodes.

Wire the new *lightmixer* node into this chain. Select the new *karmarendersettings* node and make sure that **Camera** is set to / *camera3*.



**11** On the *usdrender\_rop* node, set **Valid Frame Range** to **Render Frame Range** and set the **Output Picture** to *\$HIP/render/sim/soccerball\_sim\_5f2.exr*. Click **Render to Disk**.

When you finish, choose **Render > Mplay > Load Disk Files** and open up the rendered images to review the final sequence.



## CONCLUSION

You have now built a scene from scratch, touching on many different aspects of Houdini. You have modeled, set up textures, animated, rendered and simulated. Along the way you have learned about the different Houdini contexts and how to navigate back and forth between them.

While this lesson doesn't result in blockbuster VFX, it introduces you to fundamental skills which you will carry with you as you dive deeper into Houdini and begin exploring its comprehensive toolset.

There is a wealth of learning material available on the SideFX website to help you take your next steps.

**Best of luck on your journey!**

