

The sleeping puzzle - Procedural short film

The idea

The sleeping puzzle was born from a need to test the results of my Houdini's studies I'd begun four months early. The original purpose was less ambitious than a full short.

Actually the initial idea was to create a simple digital asset that could generate different puzzles just changing a few parameters of the interface, as it was a rig. A rig with the aim of helping an artist to model and not, as usual, to animate things. So, Why a puzzle?

I was looking for something simple that could have an high and variable amount of elements that would had a main common characteristic and at the same time many characteristics to distinguish each single element from the others.

In fact by dimensions, proportions, number of pieces and so on, an infinity of different puzzles exist and in one single puzzle each piece is different from the others by shape, dimensions, position and number of joins.

The pieces of a puzzle have many properties that make each single piece an unique piece, and at the same time they have common characteristics that let us understand they are pieces of the same puzzle.

The final result

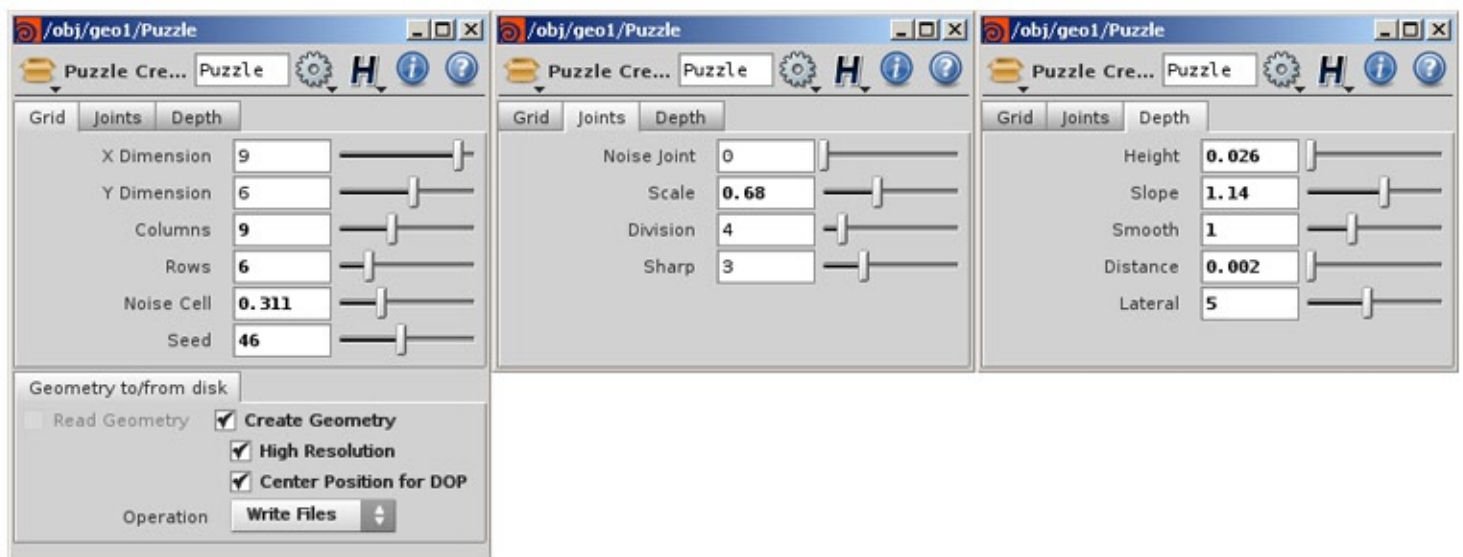
The sleeping puzzle is a personal project, for this reason I had to cover different role as technical director, art director and CG artist at the same time.

That situation had brought me to study a user interface that could simplify the process to do the changing I asked myself to do. When I reached the purpose to create a digital asset to control the puzzle's modelling, at that time I was studying CHOPs, I'd like to implement what I had realized so far with a new module that lets me to modify the parameters of the puzzle's animation too.

At the end, I've achieved a short where everything is related with everything else... it's based on a unique procedural flow.

The technical aspects

First of all I want to say that this short has been done entirely but the compositing in Houdini 10, with the HD Apprentice license. The digital asset that I created is divided in two main sections, one about the geometry creation and another about the animation. This is the user interface to control the puzzle's modelling.



The geometry creation's section lets to diversify the generated puzzles, changing the follow parameters:

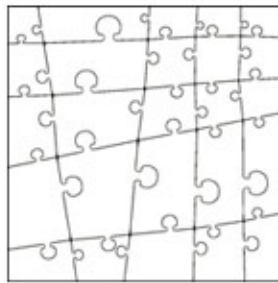
- puzzle's total dimensions,
- number of columns and rows,
- square pieces' shape based on a noise function,
- noise and scale of joins,
- number of shared edge's divisions,
- sharpness of pieces' corner,
- piece's height,
- slope of pieces' lateral section,
- level of smooth,
- how many rows of lateral faces are textured by the frontal texture instead of the lateral one.

There's also one subsection to change what we want to save to or to read from disk, proxy or highres geometry, placed at the solved puzzle's position to set the uvs or centered at the world's center to be used into DOPs and CHOPs.

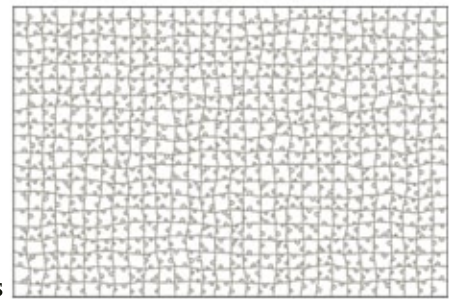
The digital asset can also take a given grid as input if we want to generate a puzzle from a geometry with a customized shape.

Here a couple of examples:

Custom solution



600 pieces



Although this project is a small project, I've encountered many technical issues, I believe because my Houdini experience is about five months short and probably also because I'd do a project from start to end, passing through every step of a workflow.

The main difficult has been my laptop's memory limit with a 32bit OS. The situation brought me to find solutions to optimize everything in the scene. During the tests on the digital asset, I've generated puzzles from six to six hundred pieces, with acceptable performance feedbacks. Because I decided to add the dynamic falling simulation, I implemented a proxy geometry generation's procedure into the asset. That geometry has been used in Dops to compute the dynamic animation and then transferred to the highres version for the lighting and the final rendering. After the dynamic animation, when the puzzle has reached a rest position, each single piece is animated by a CHOPs. That animation could be controlled by this user interface that lets change the following animation's parameters:

- middle and final position of each piece,
- amount of frames of gap between each different piece to arrive at or to start from the three main positions: start, middle and end, before starts toward the next one,
- noise's amount,
- final falling with random sequence or number based,
- amount of frame of gap between each different piece and its velocity in the final rotation.

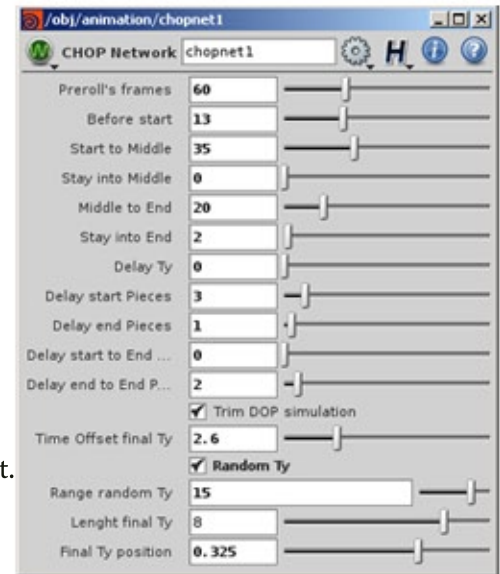
When I had reached a satisfying solution from my artistic point of view, I corrected by hand a few interpenetration errors between the pieces because they wasn't dynamics anymore, so didn't collide each others.

When the lighting process began, it was impossible to render the scene with all the pieces at highres, because I reached the memory limit before the render could even start. For that reason I studied how the pointsinstance works.

Thanks to pointsinstance procedure I've been able to render everything with my 32bit laptop... :) and with a simple switch I visualized the proxy geometry during the cameras' animations, procedural animations and checking of interpenetrations step, while for the renders, the highres geometry version, connected to the points through the pointsinstance, was shaded and calculated.

For the compositing, I've generated thirteen different render passes, divided by elements and by typology:

- beauty passes of puzzle's pieces, background and puzzle's box, relative passes of occlusion, velocity and depth,
- another masks render pass to separate the puzzle geometry in three different passes based on the different textures (front, lateral and back),
- lights render passes for the final shiny effect.



Possible future implementations

In the realization of any project, if it's personal or not, we have to fix purposes and, maybe most important, limits because we don't want to risk to do infinite changes and improvements that could obstruct the conclusions.

For that reason I decided to don't implement all the idea that I had had during its realization.

Ideas that could improve the artistic ways as:

- be able to create not just a square puzzles but also puzzles with irregular shapes or even three-dimensional,
- be able to decide different join's shapes for the join between adjacent pieces,

or ideas that could improve the technical skills as:

- coexistence of dynamic animation by DOPs and the procedural animations by CHOPs, to achieve a better integrated animation.

I'd like to thank you to have read up to this point, I'm sorry for my bad English,

I hope you have enjoyed this small personal project.

If you have any critics, comments or questions, feel free to write me at leleberti@gmail.com

Cheers

Emanuele