

Frozen 2: Effects Vegetation Pipeline

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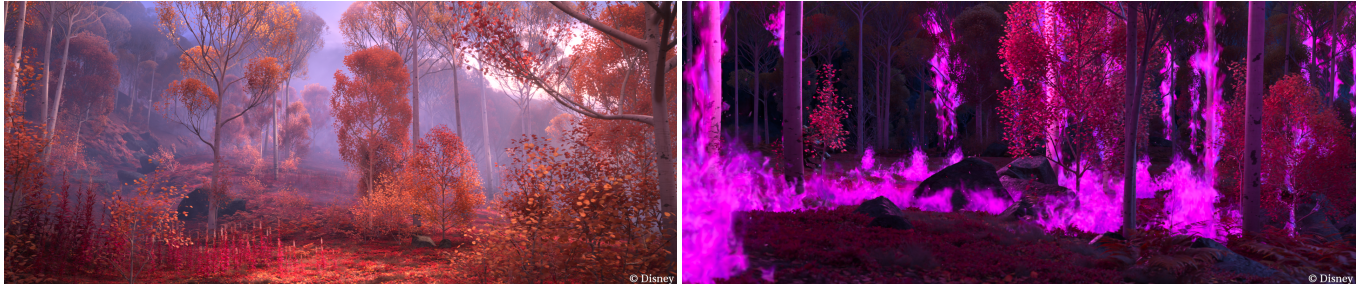


Figure 1: Example Vegetation shots in *Frozen 2*.

ABSTRACT

Walt Disney Animation Studios' "Frozen 2" takes place in the Enchanted Forest, which is full of vegetation (e.g. distinctive leaves and foliage) that is manipulated by other characters, including the wind character, Gale. "Frozen 2" also has multiple scenes where a large portion of the forest is on fire. The quantity and scale of vegetation effects in "Frozen 2" presented a challenge to our Effects department. We developed two workflows, the Vegetation Asset workflow and the Fire Tree workflow, to help us achieve high quality artistic performance of procedural tree animation and fire tree simulations on "Frozen 2". Using the new workflows we not only saw an order of magnitude improvement in the work efficiency of our Effects artists, but also saw an increase in work satisfaction and overall artistic quality since the workflows handled the data management of various assets in the shot, allowing artists to concentrate more on their craft.

CCS CONCEPTS

• Computing methodologies → Procedural animation;

KEYWORDS

Vegetation, Pipeline, Simulation

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*The presented work was conducted while this author was employed at Walt Disney Animation Studios.

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1 INTRODUCTION

Walt Disney Animation Studios has developed several tools for creating procedural vegetation, including Disney's XGen (grass, moss, trees, etc.), Bonsai (branched structures), and Aurora (point and nested instancing) [Keim et al. 2016; Shek et al. 2010; Thompson et al. 2003]. Each tool has its own unique strengths and purposes, so our artists use them all when creating complex environments with many different art-directed vegetation assets. However, each of these tools store data differently to efficiently match the internal representation. Thus, working with different types of vegetation assets has been difficult for the Effects department; the previous tool set required Effects artists to manually track different asset types and their corresponding separate import/export processes. Additionally, different asset types required separate setups in Houdini for simulation. This overhead distracted artists from the artistic side of their work and made building large-scale scenes difficult. Figure 1 Left shows an example of the scale of the enchanted forest.

"Frozen 2" contains a sequence where the whole forest is on fire. The circular dependency between the departments in our prior workflow made it difficult to accurately visualize their work without many iterations: layout artists require final fire simulations to choose which trees should be on fire, but Effects artists could not design the look of the burning trees in the shot until layout artists decided which trees should be on fire. Figure 1 Right shows an example of the Enchanted Forest on fire. To solve the above problems, we developed the Vegetation Asset and Fire Tree workflows presented here.

2 VEGETATION ASSET WORKFLOW

We introduced a new Vegetation Asset workflow that allowed the Effects artists to concentrate on the artistic performances while animating large amounts of vegetation by reducing the time spent importing and working with different types of data sets in our vegetation database. This workflow consisted of the following three new proprietary Houdini nodes: the Vegetation Picker, Vegetation Updater and Vegetation Visualizer/Instancer. Figure 2 shows an overview of the Houdini-based workflow.

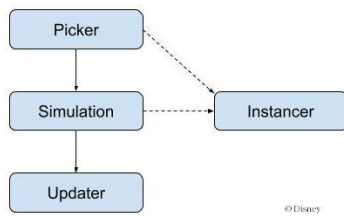


Figure 2: Vegetation Asset Workflow

The Vegetation Asset workflow lets Effects artists select multiple vegetation assets at the same time, regardless of the asset type, using the Vegetation Picker node. This simplified the import process by introducing the ability to import different types of assets into Houdini from the same node. The tool then converts and flattens these different types of vegetation assets to a consistent point representation at the same instancing level. This workflow streamlined data conversions and gave artists an easy way to receive consistent data. Using the same point representation gave artists confidence that all Houdini solvers would have the same effect across all vegetation asset types, thereby opening the possibility of using different Houdini solvers, such as Vellum.

Once artists finish working on their simulation, the point data is passed to the Vegetation Updater node. This node looks at the point data and automatically updates each of the vegetation assets (i.e. points and curves) such that each asset contains updated simulation data. Using these nodes, artists only need to worry about their simulation. Artists can use the Vegetation Instancer node to visualize the vegetation throughout the workflow using the asset geometry, allowing artists to check how the simulation looks at any point of the process in real time, even when using the consistent point representation. This node also gives artists access to the original geometry, which they can use in their simulations, and pass the updated geometry back to the asset using the Vegetation Updater node. This process can be run after each simulation to update geometry with changes. This workflow can be used with any procedural element, not just vegetation elements, and was also used to animate other elemental effects in “Frozen 2”, such as the wind-whipped leaves and the rolling bricks in Figure 3.



Figure 3: Example effects using Vegetation Asset workflow

3 FIRE TREE WORKFLOW

Given the scale of the Enchanted Forest fire, we developed a new database of pre-simulated burning trees and a new Maya plugin, FireStarter, to allow layout artists to set trees on fire without having to iterate through the Effects department. During tree asset creation, we developed a process to add fire simulation (combination of

VDBs [Museth 2013], shaders and ember particles) at the asset level. Layout artists would populate the forest with trees from the aforementioned database of pre-simulated trees and select trees in the viewport to set on fire using the FireStarter tool, regardless of the selected tree’s procedural hierarchical structure.

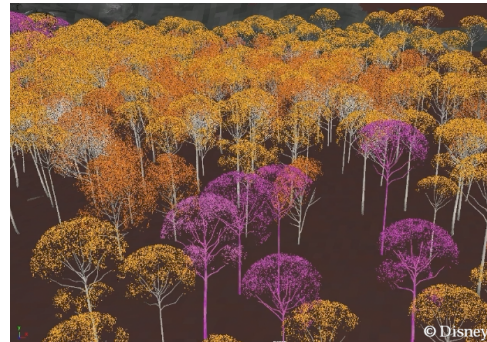


Figure 4: Trees colored pink in Maya viewport representing fire variants

Burning trees would appear pink in the interactive Maya viewport, shown in Figure 4. Ember particles would display on the trees during Maya playback, and the fully simulated fire effect would be displayed when scenes were rendered from layout. This workflow enabled layout artists to place cameras to frame and compose burning trees, and to adjust which trees were on fire without waiting for the Effects department. The Fire Tree workflow also allowed artists to add frame offsets to fire animations to help reduce similar looking simulations. Overall these new workflows optimized and streamlined our production process, and reduced the iteration time between departments, allowing for more work to stay within a single department.

4 CONCLUSIONS

Elemental interaction with vegetation is a core part of the story and world building in “Frozen 2”. Artists reported the Vegetation Asset workflow let them complete work on shots previously bid for 5 days in just 5 hours. Removing data management allowed artists to concentrate on the artistry, also increasing their work satisfaction. The Fire Tree workflow allowed layout artists to work on and get director approval on shots without intermediate iteration with the Effects department. These workflows were used in more than 600 shots in the movie, reduced the workload on each department involved, and enabled both more enjoyable and higher quality work.

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