

Constructing the Underwater World of *Finding Dory*

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Figure 1: Examples of a coral reef set and a kelp forest set. © Disney/Pixar. All rights reserved.

Abstract

One of the primary challenges in making a sequel to a beloved film, such as *Finding Nemo*, is finding a way to make the world familiar while also awe-inspiringly new. In *Finding Dory*, we not only revisited familiar coral reefs, but also ventured through the wreckage of a container ship, and swam through a swaying kelp forest. Starting with sets that were extracted from rib files from the first film, we painstakingly reconstructed some of the iconic reef environments in our modern pipeline. The level of desired complexity in these sets required us to build and adopt a point-and-click method of prop placement, in order to speed construction. Parts of the reef that were cheats in the first film were rebuilt in Maya and Houdini as true geometry with far greater levels of detail. Props that needed movement were simulated and cached in a generic way that could be adjusted in each shot. The set dressing artists employed a wide variety of coral, rock and vegetation models in the initial construction of the sets, followed by extensive dressing on a per-shot basis, to better lead the eye of the viewer. Combining technical and artistic effort, the modeling, dressing and tech teams came together to breathe new life into some old sets.

Keywords: modeling, set dressing, Houdini, Maya, environments, Finding Dory, vegetation

Concepts: • *Computing methodologies~Procedural animation* • *Computing methodologies~Mesh geometry models* • *Computing methodologies~Parametric curve and surface models*

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1 How

The first order of business in building the underwater world of *Finding Dory* was to bring back some of the coral reef sets from *Finding Nemo*. Since the *Finding Nemo* and *Finding Dory* pipelines were wholly incompatible, the only option was to extract geometric data out of rib files from renders of the first film. This gave us a starting point from which to work. We were then able to extract many coral and terrain models and reconstruct the basic sets in our current pipeline, achieving geometric parity with *Finding Nemo*. Once that was done, we took stock to see what and where things could be improved upon.

Foremost was level of complexity. Since the computing power in 2016 is far greater than in 2003, we were able to do away with many of the cheats that were necessary in the first film. The tabletop coral, which in the first film were parametric renderable curves, were regenerated in Houdini, allowing for a much more realistic depiction of the coral structure. Instead of using displacement and shader tricks to fake coral coverage, we were able to fill in much of the visible space with dressed coral models, leading to a much richer and denser reef. This required that thousands of pieces of coral be hand-placed in a pleasing manner into each reef set. In order to expedite this process a new tool was developed that allowed for a fast point-and-click duplication of our model references. Called 'Quickhook', this tool allowed for instant duplication of our USD model references, while aligning them to the underlying subdivided surface, which was itself a reference of a USD model. At the same time, the tool provided naturalistic variation in scale and orientation.

A number of our underwater props required motion. In the case of sea fans and tube coral, this was a simple keep-alive swaying. In the case of various vegetation models, such as sea grass, sargassum, sea lettuce and kelp, this ranged from cached swaying to fully simulated character interaction. All of these props went through Houdini, which was used to generate 1000-frame caches of their movement. This allowed us to adjust playback of the cache in shots so that the movement could be slipped, sped up, slowed down or completely stopped, based on creative and story requirements. This flexible movement cache became the cornerstone of how we worked with kelp in the various sequences set in kelp forests.

Also of note was that many of our hero coral and vegetation models were generated procedurally in Houdini. With Houdini generating the movement and writing out USD caches, we were able to maintain this procedural information through the entire pipeline, so that it could be used by shading and lighting.

2 Why

Something often glossed over is the reasoning behind the way that our sets are constructed. In a production environment where it is possible that a given set may be seen from nearly any angle, the dressing artists must work with a certain compositional structure in order to have all of the reef sets feel as though they are part of the same world. The coral reef sets of *Finding Dory* included three main scales of coral: large tabletops, rocks and sea fans to provide the visual landmarks of a set; the medium-sized cats paw and tube corals to provide most of the shaping, texture and color; and finally the smaller button, blueberry and barnacle-shaped corals to provide the finer details, blending of edges and filling of gaps. Each of these types of coral was set up so that the dressing artist could easily choose from a set of model variants in Maya, allowing them to add natural variation, scale difference and shot-specific models all from a right-click menu.

Once initial set construction was complete and the camera and staging department finished their scout, and had set up cameras for each shot in the sequence, the set dressers adjusted props in each shot. This accomplished a few important things: it allowed us to reposition large items to help lead the eye towards the characters or towards other points of interest and it also allowed us to do a bit of cleanup, to fill in holes where the sky/water surface is seen and could be distracting, to remove tangents between props and to clear items out of the path of action. In the case of the props with cached motion, it allowed us to slip the cache timing, as well as to speed it up or slow it down to suit the composition and story requirements of a given sequence or shot.

The combination of all of these techniques allowed the set to do its part in telling the story of *Finding Dory* by making sure that the eyes of the audience fell in just the right spot.