Simulating the Balloon Canopy in *Up*

Jon Reisch*  
Pixar Animation Studios  
Eric Froemling†  
Pixar Animation Studios

Comprised of over 10,000 brightly colored balloons, the Balloon Canopy in *Up* is one of the film’s most recognizable visual icons. Propelling Carl and Russell skyward on the adventure of a lifetime, the Canopy endures the harsh elements of the South American jungle, with balloons popping, deflating, and responding to the dynamic environment of the story.

Figure 1: The Balloon Canopy lifts off! ©2009 Disney/Pixar. All rights reserved.

The Up FX team was tasked with the enormous challenge of simulating the motion of thousands of balloons along with the strings that tether them to Carl’s house. The sheer number of dynamic bodies that comprise the Canopy required a reimagining of our rigid-body simulation environment, and as well as the development of concise rigs and flexible artists’ tools. We will discuss both the technical and artistic challenges of bringing the Balloon Canopy to life in close to 200 shots in *Up*.

1 Rigid Body Simulation Environment

The number of balloons was a significant challenge in this project. From early tests, it was determined that simulating full soft-body balloons would be cost-prohibitive, while simple procedural motion or particles would be unconvincing. Our chosen technique fell in the middle and consisted of rigid body simulation of balloons with particle-spring or linked-rigid-body strings, depending on the level of detail and interaction required.

Handling such large simulations involved significant retooling of our rigid body pipeline. Our existing simulator, run inside of Maya, consisted of a standard setup of individual nodes representing each body or constraint. This system became unwieldy when scaled past several thousand bodies. The new simulation environment developed for the balloons separated the simulator into a standalone program with a thin Python control layer. A Maya interface was then set up to generate code for this simulator and display its cached output. This standalone approach afforded us greater speed and scalability and allowed the artist to easily run simultaneous wedge-tests in the background or on the render-farm. It also provided increased flexibility, such as the ability to create or destroy bodies, constraints, or other dynamic elements over time within a simulation.

* e-mail: jreisch@pixar.com  
† e-mail: ericf@pixar.com

2 Rig Development and Artists’ Tools

With so many Canopy shots to realize in the film, minimizing artist iteration time was critical. One early step towards this goal was separating the simulation of the balloons themselves from their strings. While initially we envisioned a fully-coupled dynamic relationship between the balloons and strings, the director’s concern was much more focused on the motion and performance of the balloons in the shot. Our rigs therefore focused on minimizing iteration time in achieving believable balloon motion, and then using balloons’ cached simulation output to drive a less directed string simulation.

The motion of the balloons was motivated primarily by simple force fields, and the collision response that our rigid body simulator provided. We developed a very intuitive, artist-friendly system of sculpting our dynamic fields which we referred to as “field shapers.” This component-based system allowed artists to composite the effects of simple functions that modulated the strength or direction of a field in a visual, hand-placeable way.

Figure 2: The Balloon Simulation Environment. ©2009 Disney/Pixar. All rights reserved.

3 Highly Dynamic Shots

Certain shots in the film, particularly during the turbulent storm sequence, required the Canopy to undergo very large, but directed deformations and hit specific key poses. To address this challenge, we extended the basic canopy rig to include a central “spine” which each balloon was attached to. By attaching keyframed locators to articulation points along the spine via dynamic springs, fx artists could more readily pull the form of the Canopy into specific shapes.

4 Popping Balloons, Dangling Strings, and Other Dynamic Events

Popping and releasing balloons in the Canopy are examples of phenomenon that were localized both to specific selections of balloons and specific points in time. By repurposing the same shapers we used to sculpt our dynamic fields, we created localized, but random selections of balloons to operate on. Combined with the flexibility that our simulation environment provided to trigger callback functions at certain frames, or in response to dynamic events such as collisions, we had the basis for choreographing these complex procedural actions.