



# Disney Supercomputer Renders *Big Hero 6*

**B**ig Hero 6 (*BH6*) is a story about a boy, Hiro, and his super robot, Baymax. It is a very big robot (Fig. 1).

But that is not this story. This story is about a boy and his super computer. The boy in this case is Andy Hendrickson, chief technology officer at Walt Disney Animation Studios. He oversaw the creation of *BH6*, working with directors Don Hall and Chris Williams—both Disney Animation veterans—and turning vision into virtual reality.

## THE RENDER FARM

Walt Disney Animation Studios' render farm is actually a cloud spread across four sites. It ranks about 75th compared to other supercomputers with over 55,000 Intel cores (Fig. 2). The system has 400 Tbytes of memory and sucks down 1.5 MW of power. That is actually a small amount of power compared to the system size.

The system is built around 1U COTS servers. It is linked via 10 Gigabit Ethernet links. All non-volatile storage is solid-state disks. The only thing moving in the system are the cooling fans.

The Disney archives are currently 4 Pbytes. The average movie consumes about 4 Tbytes of information.

Disney's in-house CODA job distribution system makes the system appear as a single virtual system. It handles a range of chores from rendering to asset management. The system typically performs 1 million render hours per day. This equates to about 400 jobs per day. The system is so automated that there is no overnight staff. (Of course, there is an app for that. This lets everyone check job status using an iPhone or Android phone.)

A director can interact with the system using dPIX, an internally created asset browsing system. It can show all the renderings done in the last 24 hours and allows progressive creative refinement. It can be used on a PC or in a darkened theater.

## LIGHTING BY HYPERION

The big change with *BH6* is the use of Disney's new rendering system called Hyperion, which uses a new lighting sys-




1. Baymax and Hiro are the stars in Disney Animation's *Big Hero 6*.

tem for Disney that supports global illumination. Directors can set up a scene similar to a physical environment by placing light sources and objects along with selecting materials with which the objects are covered.

Ray tracing tracks the light from the source. This is typical for rendering animated scenes, but Hyperion uses an energy-conserving transport approach that addresses subsurface scattering. This allows effects such as light through a translucent object.

The system is more complex, but it allows Hyperion to employ a single shader. This uses a bidirectional scattering distribution function. It also uses a streaming geometry rendering system, allowing more complex scenes to be rendered more quickly. The combination allows more complexity than what

Disney previously had available, making it possible for Disney animators to build an extremely detailed version of "San Fransokyo," where *BH6* is set—an artistic challenge because it was three times as complex as any Disney film so far.

Hyperion took two years for Disney to build. It is now in production use on other animated films like *BH6*. Scalable quality is another thing Hyperion does well. Dial down the quality and the rendering time goes down as well. This is especially useful when a director needs to see what a scene will look like, but final-cut quality is not required. 



2. Walt Disney Animation Studios' supercomputer is about the 75th largest in the world with over 55,000 cores.