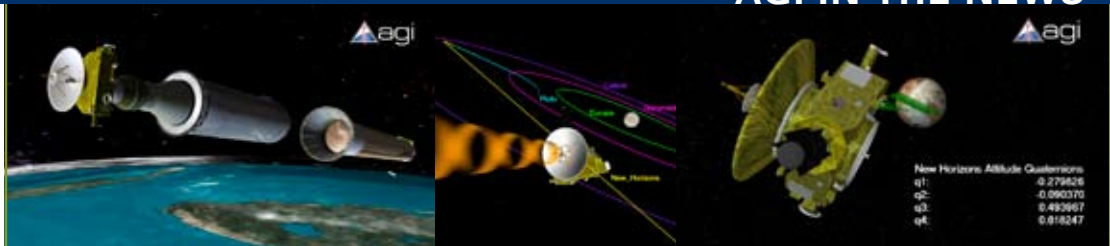


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Interplanetary Pinball

NASA's Mission to Pluto is Like a Celestial Arcade Game—Using STK, Mission Planners Score Big

FOR DR. YANPING GUO, NEW HORIZONS MISSION design team leader at the Johns Hopkins University Applied Physics Laboratory (APL) in Laurel, MD, planning NASA's New Horizons mission to Pluto and its moon Charon was a bit like playing celestial pinball. Not only did she and her team have to determine how to propel the spacecraft 3 billion miles from Earth to the outermost reaches of our solar system, but they had to time the journey exactly so that Jupiter's gravity could grab the craft and sling it in the direction of the icy bodies.

According to the APL, once at Pluto and Charon, the probe has to thread through a needle in space just 186 miles across to accomplish its scientific objectives: imaging and mapping the surface compositions of Pluto and Charon during a flyby; then looking back at Earth and the Sun while flying through Pluto and Charon's shadows. By measuring distortions in the lightwaves from the Sun and radio waves beamed from Earth, scientists will learn volumes about the makeup of these bodies and about Pluto's dynamic atmosphere.

"It is an ambitious plan, and the Pluto encounter is complicated," says Guo. She planned the mission with two optimal back-to-back trajectories that met all mission requirements, and planned a rare 35-day launch window

to account for energy/mass tradeoffs. STK was one of the main tools used by Guo in her mission design and planning. Adding to the complexity, Pluto's highly elliptical orbit made each potential missed launch day expensive in terms of energy requirements, and risked that the planet would travel so far from the Sun that its atmosphere would freeze and collapse onto its surface. The launch was delayed two days because of bad weather, and on Jan. 19, 2006, it lifted off flawlessly for its nine-year mission.

In the weeks that followed the launch, Guo used STK/Astrogator, AGI's deep space trajectory modeling and simulation component, to design trajectory correction maneuvers that kept the probe aimed at its targets. Other software that aided in the planning included the dynamic 3-D visualization components found in STK Professional Edition, plus STK/Analyzer, STK/Attitude; and the interconnectivity tool STK/Integration Module.

While STK's analysis capability was its main strength during mission planning, Guo found the visualization component helpful, as well. "After we figured out a trajectory, we could plot it out and see how it actually worked," she says.

To view animations created by AGI for New Horizons, visit www.agi.com/currentevents. ▲

MISSION TO PLUTO FEATURES STUDENT-BUILT PAYLOAD

Two years ago, Tiffany Finley—a former AGI application support engineer—was a master's degree candidate at the University of Colorado-Boulder (CU-Boulder) when a friend from her spacecraft design class told her about a job opening in the CU-Boulder Laboratory for Atmospheric and Space Physics (LASP). The students were working on a dust counter that would become the first student-built instrument ever selected by NASA to fly on an interplanetary mission: New Horizons. During the nine-year trip to Pluto, the dust counter would identify as-yet-undetected clumps of dust formed by gravity from the outer planets as it flew through the solar system's dust disk. That data would help scientists understand the formation of our planets, as well as those seen in dust disks around other stars.

On the dust counter project, the students proposed, designed, and built engineering models, but the actual flight hardware was built by NASA-qualified technicians. Finley's job as project manager was to keep the operation running smoothly, including managing the students, maintaining the budget, making presentations at reviews, and helping out in any area that needed extra manpower.

An added bonus to working on the dust counter project came when she was asked to do a presentation on NASA TV. Just prior to the New Horizons launch on Jan. 19, she found herself in front of the cameras with preeminent scientists such as New Horizons principal investigator Alan Stern and project scientist Hal Weaver.

Finley has nine years to look forward to the dust counter's findings. By that point, the project will have passed to a new generation of young scientists and engineers, who will explain to the world the results of the instrument that she helped build. She has no problem, though, about passing the torch. "It's up to the scientists, now," Finley says. ▲

