Scientist's Innovation Leads to U. S. Patent Award and a Competitive Boost for Boeing Satellite Systems

Star-Tracker Breakthrough Helped Company Capture Major NASA Contract

A deceptively simple innovation has led to a U.S. patent award as well as significant business benefits for Boeing Satellite Systems (BSS), the world's largest satellite manufacturer. The invention - a new method of positioning optical star trackers on satellites - enables BSS to achieve extremely precise determination of spacecraft attitude. This technology helped BSS win a significant U.S. government weather-satellite contract and meet the demanding design requirements for the Spaceway broadband satellite system being built at BSS, a unit of The Boeing Company (NYSE: BA).

For this invention, BSS scientists Yeong-Wei "Andy" Wu, Douglas H. Hein and David L. Augenstein, along with Garry Didinsky, a former BSS employee, received U.S. Patent 6,236,939, "Method and apparatus for controlling spacecraft attitude with rotational star trackers." Spacecraft attitude describes the orientation and position of the satellite relative to the earth's surface. Their work advances the field of stellar inertial technology, which involves the use of star trackers rather than earth sensors to achieve up to 50 percent greater pointing accuracy for satellites in orbit. This patent is one of more than 20 stellar inertial systems patents that BSS scientists have received or are submitting.

"I am extremely proud of Andy, Doug and David for their role in this innovation, which has given us an important competitive advantage," said Randy H. Brinkley, president of Boeing Satellite Systems. "Spacecraft attitude must be tightly controlled for the next-generation GOES weather satellites we're building for NASA, and for high-frequency Ka-band spacecraft such as Spaceway, which uses multiple spot beams to fulfill its mission requirements. What's more, Spaceway will mark the first uses of stellar inertial technology for attitude control aboard a commercial geosynchronous spacecraft."

Star trackers are on-board telescopes that scan areas in space and digitally record the position and brightness of stars. Processors aboard the spacecraft compare those images with star maps in memory to determine the spacecraft's exact attitude and position. That information helps ground controllers to more precisely orient the satellite for maximum pointing accuracy.

However, distortions in the trackers' optical components have traditionally led to a relatively high level of errors that lessened the accuracy of the star tracker images.

"The innovation covered by the star tracker patent is both simple and profound. The co-inventors discovered that, by rotating the star tracker 45 degrees so that imaged stars cross its pixels on a diagonal path, errors in the images were reduced by approximately 50 percent," explained Loren Slafer, a BSS chief technologist. "That reduction in image errors allows for the precision pointing accuracy called for in a number of leading-edge satellite systems being built here at BSS."

Slafer added that their work was part of intensive internal research and development efforts mounted to give BSS this technical capability, and it is now being used on a number of programs, especially GOES, which stands for Geostationary Operational Environmental Satellites. BSS is currently under contract to build GOES N through GOES Q in the alphabetical series. Based on the highly successful Boeing 601 spacecraft, the new GOES satellites will provide more accurate location of severe storms and other weather phenomena, resulting in more precise warnings to the public. The next spacecraft, GOES N, is scheduled for launch in 2003.

The company also built GOES D through GOES H, but NASA later awarded GOES I through GOES M to another contractor. "This patent really gave us the edge, and helped us take GOES back from the incumbent," Wu said.

BSS' development of stellar inertial attitude-determination systems over the last five years has resulted in more than 20 BSS patent applications, with three patents awarded so far.

"Together these patents represent a gold mine of innovative ideas that have improved the state of the art in stellar inertial systems, and we are applying them on five major satellite programs to date," Hein said.

Boeing Satellite Systems is the world's leading manufacturer of communications satellites and a major provider of space systems, satellites, and payloads for national defense, science and environmental applications.

The Boeing Company is the largest aerospace company in the world and the United States' leading exporter. It is NASA's largest contractor and the largest manufacturer of commercial jetliners and military aircraft. The company's capabilities in aerospace also include rotorcraft, electronic and defense systems, missiles, rocket engines, launch vehicles, satellites, and advanced information and communication systems. The company has an extensive global reach with customers in 145 countries.

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