Lockheed Martin Distributed Aperture Imaging Technology Expands The Horizon On Telescope Capability

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Engineers at the Lockheed Martin Advanced Technology Center (ATC) have designed and built a prototype nine-aperture wide-field imaging telescope that overcomes the increase in mass, volume and cost associated with large single-optics telescopes for space-based applications. The ability of a telescope to resolve fine detail is a direct function of its light-gathering power. Larger apertures -- mirrors or lenses -- gather more light and provide greater resolution of detail.

(Photo: http://www.newscom.com/cgi-bin/prnh/20060627/SFTU087)

"The key to making a distributed aperture optical system work is to properly phase the individual modules. Phasing means that all telescopes present an equal path length, to tolerances considerably less than the wavelength of light," said Peter Dean, the Star-9 program manager at the ATC. "We have demonstrated the fundamental feasibility of this approach with the Star-9 test bed and quantified performance with subsequent test bed activities."

The ATC prototype, called Star-9 due to the number and arrangement of apertures, uses multiple small telescope modules that yield a system with a much larger effective aperture. This distributed aperture imaging approach provides a new path to affordable high resolution by packaging the modules in a smaller envelope thus reducing the size, weight and cost of the system.

Multiple apertures also provide a multifunctional capability unavailable with a single monolithic mirror. A distributed-aperture approach could be incorporated in space-based remote sensing instruments that might use individual telescope modules, or groups of modules, to simultaneously view a scene at several different wavelengths or polarizations. On subsequent orbits the system could be reconfigured through software to make completely different sets of observations. Adaptability and flexibility is a key feature since several small apertures can be grouped as a sub-array to image multiple objects on a single pass. The Star-9 telescope could easily serve as the imaging front end for an entire suite of space-based instruments.

Distributed aperture imaging technology also provides redundancy, reliability and thus lower-risk. A single point failure in a monolithic mirror system could doom a mission to failure, while the loss of a single aperture in a multiple aperture system could be overcome through reconfiguration of the system.

The Star-9 performance demonstrations done at the ATC used off-the-shelf focal planes, electronics and mirror actuators. The experiments show clearly that high-quality imagery can be acquired over a useful field of view for an Earth-imaging or an astronomical-distributed-aperture imaging system.

Lockheed Martin Space Systems Company, a major operating unit of Lockheed Martin Corporation, designs, develops, tests, manufactures and operates a variety of advanced technology systems for military, civil and commercial customers. Chief products include a full-range of space launch systems, including heavy-lift capability, ground systems, remote sensing and communications satellites for commercial and government customers, advanced space observatories and interplanetary spacecraft, fleet ballistic missiles and missile defense systems.

Headquartered in Bethesda, Md., Lockheed Martin employs about 135,000 people worldwide and is principally engaged in the research, design, development, manufacture, integration and sustainment of advanced technology systems, products and services. The corporation reported 2005 sales of $37.2 billion.

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