Air Force SBIR/STTR Innovation

Topic Number:
AF063-002

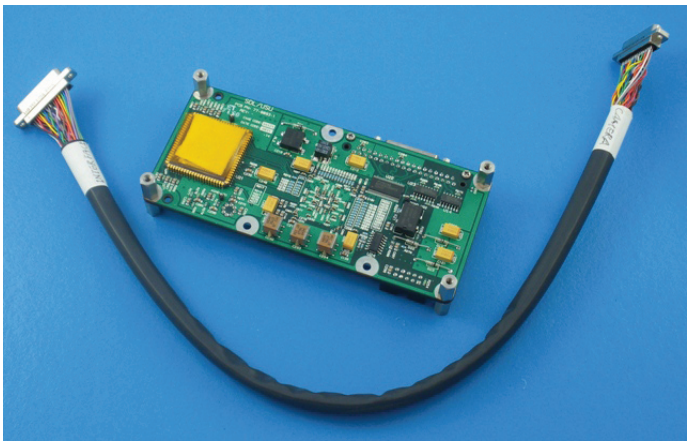
Title:
Radiation-Hardened, High-Precision Agile Star Tracker

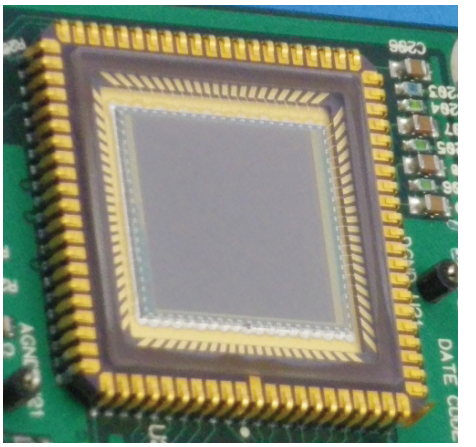
Contract Number:
FA9453-08-C-0001

Company Name:
Space Micro Inc., San Diego, CA

Technical Project Office:
AFRL Space Vehicles Directorate, Kirtland AFB, NM

This Air Force SBIR/STTR Innovation Story is an example of Air Force supported SBIR/STTR technology that met topic requirements and has outstanding potential for Air Force and DoD.





Left: Camera unit with the Advanced Pixel Sensor (APS), covered in the photograph, along with the connector cable shown. Right: Close-up of the APS.

Radiation-Hardened, High-Precision Agile Star Tracker

- Demonstrated need for a star tracker that is less susceptible to radiation in the space environment and which is agile enough to provide high precision during spacecraft slew
- Space Micro developed a radiation-hardened star tracker that has broad range applications due to its radiation hardness, improved performance during space craft slew, small size and weight, and affordability
- It uses an advanced complementary metal oxide semiconductor (CMOS) active pixel sensor (APS) rather than a charge-coupled device (CCD), as well as an advanced, high performance space computer, providing radiation hardness that makes it ideal for high orbit, longer duration missions
- This star tracker's small size and weight make it ideal for smaller satellites, Operationally Responsive Space (ORS) class satellites, and nanosatellites

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Air Force Requirement

Star trackers are very important to determine the orientation for all spacecraft. However, star trackers are susceptible to radiation in the space environment and are not agile enough to provide high precision during spacecraft slew. Furthermore, size, weight, cost, and power are concerns for any satellite, large or small.

Specifically, the goal was to provide a longer in-orbit operation star tracker for Department of Defense (DoD) space programs.

SBIR Technology

Under this SBIR project, Space Micro has made a number of relevant technological improvements for a radiation-hardened, agile star tracker. Greatly improved image processing has led to enhanced Kalman filtering and, therefore, faster determination of spacecraft orientation, with quaternion updates approaching 1 Hz.

Throughout the process, Space Micro researched and selected or developed the best advanced components for the star tracker, which resulted in a reduction of the size, weight, power, and cost of the instrument, providing a wide range of applicability.

Potential Air Force Application

This radiation-hardened star tracker has a broad range of Air Force applications due to its radiation hardness, improved performance during space craft slew, small size and weight, and affordability. It uses an advanced complementary metal oxide semiconductor (CMOS) active pixel sensor (APS) rather than a charge-coupled device (CCD), as well as an advanced, high performance space computer, providing radiation hardness that makes it ideal for high orbit, longer duration missions where total dose radiation, both natural space as well as man-made, would otherwise dramatically degrade performance over time.

The improved image processing will allow a spacecraft to maneuver more quickly and efficiently, which will save time and valuable fuel during spacecraft slew. This star tracker's small size and weight make it ideal for smaller satellites or Operationally Responsive Space (ORS) class satellites. Since this star tracker costs much less than the industry standard, it provides high performance for any Air Force satellite at an affordable price. Overall, this star tracker has applicability to a wide range of satellite programs.

Company Impact

This Phase II SBIR project has allowed Space Micro to advance in several technical areas and to further expand its expertise in radiation-hardened space equipment. This star tracker technology has the potential to transition into a number of defense and commercial satellite programs, including the increasing number of small and nanosatellites as well as the large, longer duration, high orbit satellites that continue to provide a major marketplace.

Additionally, the experience in developing this star tracker has expanded Space Micro's abilities for improving existing products. For example, Space Micro's Proton200K space computer was upgraded in several ways to meet the needs of this project, including implementing a more robust single event effects (SEE) detection/correction architecture, and improved power regulation and efficiency. Space Micro gained experience with active pixel sensors, which will be used for current and future optical systems research and development (R&D).

Space Micro has developed a strong working relationship with Draper Labs as well as SDL. These are industry leaders, and the connections will be invaluable in future R&D as well as sales.

Space Micro is a high technology firm with a special focus on space and military applications. Founded in 2002, Space Micro is a privately held, employee-owned company, with headquarters in San Diego, California. It is a pioneer in providing radiation hardened by design solutions for advanced electronic systems and microelectronics.

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