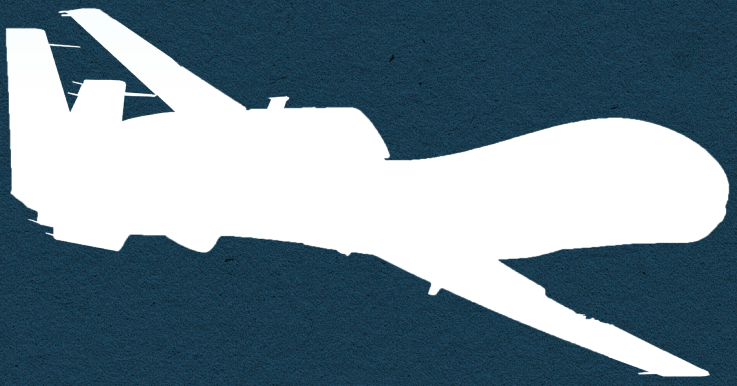
INTELLIGENCE with ALTITUDE

Advanced radar architecture helps UAVs autonomously "see" the sky



As unmanned aerial vehicles (UAV) become more numerous, defense and civilian airspace grows increasingly crowded. The Air Force alone already employs thousands of UAVs. The full potential payoff however, is constrained by the UAV's ability to safely and predictably share the sky. As research into new radar capabilities expands to support UAVs, particular focus has been given to an autonomous airborne sense-and-avoid (SAA) capability that will allow UAVs to automatically detect and avoid potential collision hazards (e.g. other aircraft) and be piloted more effectively through shared air space.

But even the largest UAVs have strict size, weight, and power restrictions, making the design of a platform-based SAA system daunting, particularly within traditional computing architectures. Metal server boxes can hold only a finite number of sub-components (e.g. memory cards, graphics cards, storage devices), and once this physical limit is reached, an

entire box must be added or removed to scale the architecture up or down. These server boxes also rely on the use of a backplane to connect sub-components together, which represents a single point of failure for the system. This configuration can be particularly limiting for applications with strict size, weight, and power restrictions like UAVs.

Under the SBIR program, Colorado Engineering, Inc., a woman-owned small business based in Colorado Springs, Colorado, developed a groundbreaking computing architecture that enabled the creation of a SAA radar design capable of fitting on a UAV. Richard Bayley, business development manager for Colorado Engineering, described it as a "technology breakthrough" that became a solution for a variety of military and commercial radar applications, and the backbone for an extensive Colorado Engineering product line.

Colorado Engineering's SBIR successes have led to expanded opportunity for the company as well as increased effectiveness and cost efficiency for defense programs.

The Radar Advanced Receiver/Exciter (RARE) architecture provides a modular hardware solution that can be more precisely scaled by stacking or tiling together individual computing sub-components and arranging them like building blocks without the need for a backplane. Sub-component combinations can be customized to meet specific computing requirements. Additionally, the design allows for the overall end-state functionality to be defined (and changed) through software changes in the architecture. This flexibility meets the needs for data processing speed as well as size, weight, and power constraints in radar system designs for UAVs.

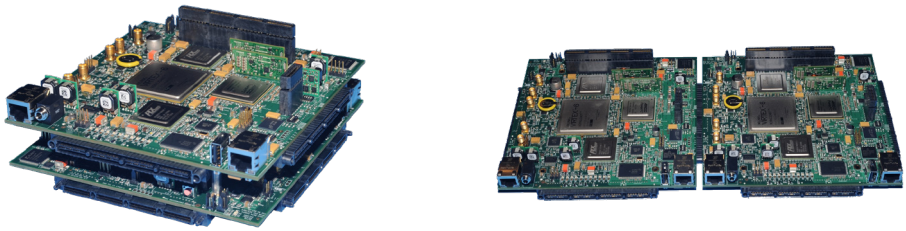
Development of the RARE architecture first started under a 2006 SBIR contract from the Missile Defense Agency (MDA) seeking more affordable and flexible systems for ground-based radar for ballistic missile defense. Colorado Engineering completed development of the foundational technology under a 2010 U.S. Air Force SBIR contract focused on development of an onboard SAA sensor suite, including an air-to-air radar. The technology has since been explored for a variety of military and civilian applications.

The U. S. Air Force and U. S. Navy have both pursued the RARE architecture as the core technology for an all-weather autonomous radar SAA capability to the U.S. Air Force Global Hawk and U.S. Navy Triton long-range surveillance UAVs. There is also interest

Richard Bayley, Business Development Manager

Nancy Scally, co-founder and Chief Executive Officer

Larry Scally, co-founder and Chief Technical Officer



Sub-components for Colorado Engineering's RARE architecture.

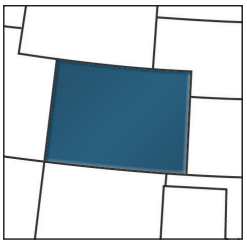
from U.S. Customs and Border Protection under the Department of Homeland Security in using the technology mounted on a pole to operate as a "looking device," or on a dirigible (i.e. airship/aerostat) for a "tethered aerial recon system" for use in border/coastal protection. Variants of the RARE technology are also being investigated to expand the functionality of the seeker component on missiles. Colorado Engineering is adapting its SAA radar technology to meet commercial aviation collision avoidance requirements, with potential application to both manned and unmanned aircraft. Colorado Engineering has received multiple contract awards related to its SBIR technology developments, totaling almost $10 million.

Colorado Engineering leveraged RARE and SAA radar technologies to capture a Small Business Technology Transfer (STTR) contract focused on development of a landing radar for helicopters in degraded visual environments, as well as a Cooperative Research and Development Agreement to develop a system for automated identification of UAVs in the battlespace. Colorado Engineering is leveraging the RARE architecture for a Navy Rapid Innovation Fund research and development initiative to shrink the amount of hardware needed for the back-end computing components of the shipboard AN/SPS-49 long range air search radar.

The expanded business opportunity for the company has been enormous. At the start of its SBIR efforts, Colorado Engineering was a very small company. "We were only 8 people, going head-to-head with multi-billion-dollar aerospace and defense companies" said Bayley. Through the SBIR technology development, Colorado Engineering was able to team with a variety of external entities, including leading defense and aerospace companies and nationally recognized research institutions, to advance technology development and grow its staff over 200 percent. Colorado Engineering has since transferred the SBIR technology into an extensive product line with millions of dollars in sales to DoD entities and commercial companies.

Colorado Engineering's SBIR successes have led to expanded opportunity for the company as well as increased effectiveness and cost efficiency for defense programs. Because of their success, Colorado Engineering was presented with the 2011 Tibbetts Award, the U.S. Small Business Administration's highest award for achievement under the SBIR program. Complete with a reception at the White House, Colorado Engineering was presented with the award as one of the select few companies that best exemplify achievement of SBIR program goals, including technological innovation, meeting federal research and development needs, and economic impact from commercialization of federal research.

"We have made the SBIR program a cornerstone of our business development," said Colorado Engineering CEO Nancy Scally. "Before participating in the SBIR program, we had started with just two people. Today, thanks to projects like RARE and our many SBIR successes, we've expanded our staff and have seen revenues grow year after year."



Colorado Engineering, Inc.

Modernization Priority: Autonomy

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