

Innovation

SBIR Topic Number:
AF071-059

SBIR Title:
Planar Wideband Phased-Array Element for Very High Frequency Radar

Contract Number:
FA8750-08-C-0124

SBIR Company Name:
FIRST RF Corporation,
Boulder, CO

Technical Project Office:
AFRL Information
Directorate, Rome, NY

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: Aerodynamic North Atlantic Treaty Organization (NATO) mount supports twin broadband Very High Frequency dipoles. Right: Close-up view showing the attachment of the antennas and mount on the C-131 aircraft.

Planar Wideband Phased-Array Element for Very High Frequency Radar

- FIRST RF Corporation was awarded Phase I and Phase II SBIR contracts to identify and implement an effective method of reducing the size of the antenna aperture for Very High Frequency (VHF) Synthetic Aperture Radar (SAR) systems
- The FIRST RF method uses two antenna elements to form a beam while maintaining a high level of signal fidelity in the desired direction
- During Phase II of this Air Force program, FIRST RF constructed a flightworthy prototype of this system; the electrical and mechanical characteristics of this system also drew interest from another military service and prime contractor for a radar technology program
- The success of this SBIR project was further enhanced by the inter-directorate cooperation between the Air Force Research Laboratory's Information Directorate and the AFRL Sensors Directorate, as well as the active sponsorship of the Aeronautical Systems Center's Advanced Imagery Technology Branch

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Air Force Requirement

Very High Frequency (VHF) is a useful operating band for Synthetic Aperture Radar (SAR) systems for two main reasons: the radar hardware at these frequencies is relatively inexpensive, and the wavelengths allow foliage and ground penetration. However, antenna design is a perpetual problem with VHF SAR systems. In order to produce high fidelity images, SAR systems require high isolation between the antenna main beam and the conjugate beam.

The conjugate beam is energy radiated at the opposing depression angle. In order to achieve this high front-to-back (F/B) ratio, conventional arrays need a large number of elements and or area for a reflector. Operating at VHF, this array would be very large and its installation aboard any platform is permanent due to the inherent difficulty in installing an array of its size.

The goal of this program was to develop an electrically small array that could meet the requirements for SAR (high F/B ratio) and could be quickly installed and removed.

SBIR Technology

FIRST RF Corporation was awarded Phase I and Phase II SBIR contracts to identify and implement an effective method of reducing the size of the antenna aperture for VHF SAR systems.

The FIRST RF method uses two antenna elements to form a beam while maintaining a high level of signal fidelity in the desired direction. The two antennas are combined using a novel phase steering mechanism which directs energy from horizon to nadir while simultaneously placing a null at the direction of the conjugate beam. The FIRST RF array is capable of pointing a beam at a desired depression angle on both sides of the aircraft over the entire bandwidth. FIRST RF initially set a goal of a 10 decibel (dB) front to back ratio to make it effective for imaging.

Potential Application

SAR is a strong airborne asset used to detect ground-based threats and provide enhanced situational awareness to battlefield commanders. Foliage Penetration (FOPEN) capability provides obvious enhancements to the utility of a SAR system.



C-131 aircraft carries the VHF SAR antennas during a test flight

During Phase II of this Air Force program, FIRST RF constructed a flightworthy prototype of this system. The electrical and mechanical characteristics of this system also drew interest from another military service and a defense prime contractor for a radar technology program. In October 2010, the FIRST RF VHF antenna system was tested on board a C-131 aircraft. The antenna was able to be installed and removed from the aircraft very quickly, as was initially intended with the program.

The success of this SBIR project was further enhanced by the inter-directorate cooperation between the Air Force Research Laboratory's Information Directorate and the AFRL Sensors Directorate, as well as the active sponsorship by the Aeronautical Systems Center's Advanced Imagery Technology Branch.

Company Impact

"This SBIR program led to the demonstration of technology which was eventually flown aboard manned aircraft," states Dean Paschen, Director of Advanced Programs, FIRST RF Corporation. "Though FIRST RF personnel have hundreds of products to their name aboard platforms of all types, this program represented the first manned-flight program in which FIRST RF, as a company, was involved. Further, this project literally opened the doors to business with several government agencies and prime contractors. Finally, it was the springboard for insertion into a major national program of record. The antennas demonstrated through this program are now an integral part of multiple key systems developed and used by several prime contractors."



SBIR/STTR

Air Force SBIR Program
AFRL/XP
1864 4th Street
Wright-Patterson AFB OH 45433

AF SBIR/STTR Program
Manager: Augustine Vu
Website: www.afsbirsttr.com
Comm: (800) 222-0336
Fax: (937) 255-2219
e-mail: afrl.xppn.dl.sbir.hq@wpafb.af.mil

