Air Force SBIR/STTR

Innovation

Air Force SBIR/STTR Innovation Story

SBIR Topic Number:
AF081-068

SBIR Title:
Combined GPS & Communications Antenna Technology

Contract Number:
FA8650-09-C-1620

SBIR Company Name:
MesoScribe Technologies, Inc., St. James, NY

Technical Project Office:
AFRL Sensors Directorate, Wright-Patterson AFB, OH

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.

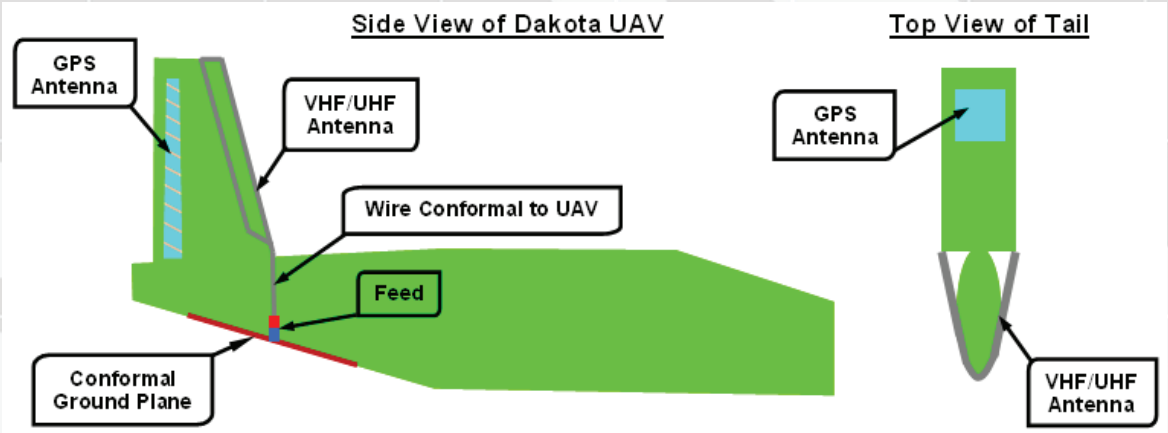

Figure 1: Illustration of VHF and UHF antennas on a Dakota UAV

Conformal Global Positioning System and Communications Antenna

- Global Positioning System (GPS) and communications capabilities aboard small unmanned aerial vehicles (UAVs) can derive substantial benefit from advances in aperture design and maturation of fabrication techniques
- MesoScribe Technologies, Inc., proposed and refined compact antenna designs for very high frequency (VHF) and ultra high frequency (UHF) communications (30-512 MHz) and GPS (1.575/1.227 GHz) bands, suitable for installation on a small UAV; the antenna serving the lower band fits conformally to the surface of the tail of a Dakota UAV, while the latter is embedded within the tail
- Complementary to the antenna design work, MesoScribe refined the procedures for fabricating the antennas using its Direct Write Thermal Spray technique
- In addition to the military realm, potential applications exist in the businesses of commercial aviation, wireless telephony, and homeland security

01-04JAN12/AF081-068

Air Force Requirement

Global Positioning System (GPS) and communications capabilities aboard small unmanned vehicles (UAVs) can derive substantial benefit from advances in aperture design and maturation of fabrication techniques. Direct printing technologies, whereby conductive patterns are deposited onto non-planar substrates, allow realization of affordable antenna designs that can be fitted to small, irregularly shaped platforms. Integration of antenna elements into structural assemblies is another maturing technical area that can provide substantial benefit to the solution of multifunctional, conformal aperture design.

SBIR Technology

MesoScribe Technologies, Inc., proposed and refined compact antenna designs for very high frequency (VHF) and ultra high frequency (UHF) communications (30-512 MHz) and GPS (1.575/1.227 GHz) bands, suitable for installation on a small UAV. The antenna serving the lower band fits conformally to the surface of the tail of a Dakota UAV, while the latter is embedded within the tail. In order to accommodate a vertically polarized antenna, the portion of the aircraft with the greatest vertical extent (i.e., the tail) was selected as the location for the communications antenna.

The design solution, which is depicted in Figure 1 on page 1, was to embed a back-fire bifilar helical antenna within the tail section as the GPS antenna and to use an asymmetrical dipole conformal to the front surface of the tail and underside of the fuselage as the VHF communications antenna. The helical antenna maintains good circular polarization in the upper hemisphere, while the dipole pattern is vertically polarized and omnidirectional. The design utilizes the available space to the greatest extent possible while introducing only mild modifications to the radiation patterns due to coupling.

Complementary to the antenna design work, MesoScribe refined the procedures for fabricating the antennas using its Direct Write Thermal Spray technique. The first step was selecting the proper core and surface finishing materials for the tail section. A technique was developed for hollowing out a rectangular cavity within the tail to hold the GPS antenna. The Direct Write process parameters including motion capability, motion programming, and deposit capability were optimized for throughput and manufacturing cost. MesoScribe's 6-axis articulated robot Direct Write cell was fully upgraded with an integrated rotary 7th axis for depositing continuous helix patterns across a wide variety of substrates and objects.

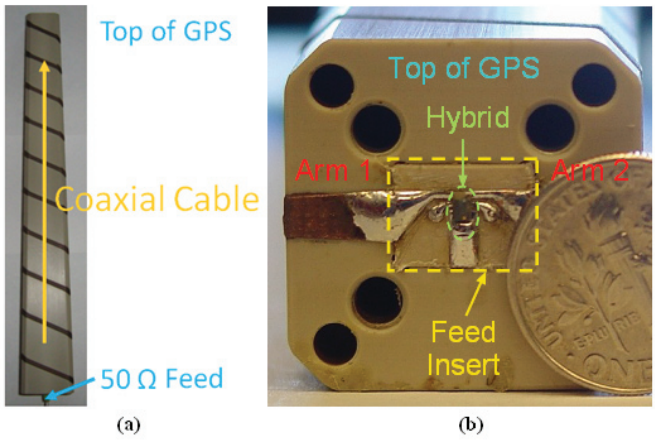

Figure 2: (a) Finished GPS antenna, and (b) detail of feeding network

Potential Application

The Air Force and Department of Defense would benefit from technology that allows for retrofitting small vehicles with conformally applied antennas. This SBIR project has demonstrated the level of material and process engineering needed to:

- Deposit metallic traces of predictable widths on the relatively large scale required for antennas.
- Maintain continuity and a controlled depth of penetration into the surface so as to achieve uniform conductivity.
- Provide protection against peeling and corrosion.
- Apply such traces in an automated fashion on surfaces of arbitrary curvature.

Furthermore, the automation inherent in the Direct Write Thermal Spray process could be particularly valuable in conformal installations of metallic patterns in large quantity. Outside of the military realm, potential applications exist in the businesses of commercial aviation, wireless telephony, and homeland security.

Company Impact

"This SBIR project provided us the opportunity to advance our expertise relative to combined GPS and communications antenna research and development," states Dr. Jeff Brogan, MesoScribe's chief executive officer. "We were able to apply and refine our Direct Write technology, developed under an earlier Defense Advanced Research Projects Agency (DARPA) program, in arriving at a proposed solution. There are promising prospects for commercialization of this antenna technology in both the defense and private sector markets."

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