

SBIR Topic Number:
AF05-155

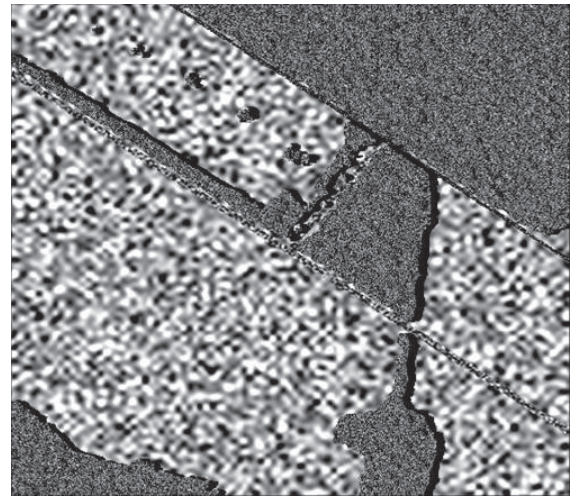
SBIR Title:
Statistical Modeling
of Obscured Targets
with Environmental
Returns

Contract Number:
FA8651-06-C-0133

SBIR Company Name:
Polatin Corporation,
New Hartford, NY

Technical Project Office:
AFRL Munitions
Directorate, Eglin AFB, FL

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: Ground Terrain Image – Real (with Bunker and Foliage). Right: Ground Terrain Image – Synthetic Millimeter Wave (with Bunker and Foliage).

Scene Targeting Analysis for Radar (STAR)

- The Air Force needs advanced software technologies for the accurate synthesis of radar returns from targets and surroundings, obscuring clutter
- Polatin Corporation developed a fast, first-principles radar simulator capable of generating coherent returns from virtually any terrain clutter
- The processing speed is orders of magnitudes faster than currently available simulators, and the run times are achieved using inexpensive, commercial off-the-shelf computers
- This technology could readily be incorporated into sensor simulators for use in training pilots and other key operational personnel as well as for fast radar signature simulation software in the commercial sensor and avionics manufacturing communities

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Air Force Requirement

Current fuze sensors operating at radio frequency (RF) levels are “trained” using a discretized (facet-based) computer model to generate a “scene” from which a radar return is predicted using empirical data. This is problematic in the computational time required to generate a scene, as well as the lengthy training process. The Air Force needs a first-principles, statistics-based model for the sensor signatures of various targets (low-observable, air, surface) in a variety of obscuring environments (weather, ground cover, and terrain).

SBIR Technology

Polatin Corporation’s research was directed toward the development of advanced software technologies for the accurate synthesis of radar returns from targets and surroundings, including clutter obscuration effects. The following tasks were completed:

- Developed a fast, first-principles radar simulator capable of generating coherent returns from virtually any terrain clutter environment.
- Enables coherent siting of user-selected targets in clutter background, including effects such as path loss and obscuration.
- Provides the ability to specify the layout of a scene, define seasonal and environmental factors, and include sensor parameters such as bandwidth, multiple-aperture sensor geometries and waveforms.
- All parameters are available through an intuitive and easy-to-use user-interface.
- The radar simulation software is implemented in a form suitable for use in a distributed computing environment.
- The performance of the simulator has been validated against measured data available in the open literature as well as with millimeter-wave (MMW) terrain data taken at Eglin AFB.

Polatin Corporation optimized the runtime code to produce complex, polarimetric radar simulations for a 16 element beam-forming array with 1024 frequencies and 1024 pulses per coherent processing interval (CPI) in less than five minutes per time step. This processing speed is orders of magnitudes faster than currently available simulators, and the run times are achieved using inexpensive, commercial off-the-shelf (COTS) computers.

Further, the ability to perform RF systems simulations for scenarios occurring anywhere on earth is made possible by using Polatin Corporation’s SGX (Scene Generator eXpress) Powertools software. SGX utilizes optical and hyperspectral

imagery for a scene of interest, classifies terrain features such as trees, grasses, buildings, paved areas, water bodies, bare ground, etc., and generates reflectivity maps based on estimated ground truth information extracted from the imagery. The ability to quickly perform useful systems simulations for arbitrary scenes, under user-specified environmental conditions and sensor configurations will enable the munitions community to develop robust fuzing sensors optimized to operate across a wide range of scenarios.

Potential Air Force Application

The fast, integrated, radar simulation methods and software components are useful for a variety of applications. An important potential use for fast radar signature simulation software is in the sensor and avionics manufacturing communities. The efficient synthesis of realistic sensor data for complex environments and scenarios would be of tremendous use in the design, development and testing of radar systems. In addition, the tools may readily be incorporated into sensor simulators for use in training pilots and other key operational personnel.

Advanced radar simulation technology is also useful to a variety of non-DoD Government agencies (USGS, CIA, NRO, etc.) for the analysis of commercial and non-commercial remote sensing data. The ability to generate synthetic radar imagery for any region of the world will assist various agencies in analyzing a wide variety of real and hypothetical scenarios of interest.

Company Impact

This SBIR project has benefited Polatin Corporation in a number of important ways in that it has: (1) integrated some of our advanced simulation technologies into a high-level application that is useful to the Air Force, (2) enabled us to develop an extremely fast and efficient set of new computational methodologies that can be used for a wide variety of systems simulations, and (3) provided us with an excellent opportunity to bootstrap the next-generation of RF target signature simulators, which are badly needed in the industry.

Founded in 1998 by Dr. Paul Polatin, Polatin Corporation is a small research and development company providing analysis, design and software support to United States government and private commercial concerns.



SBIR/STTR

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