

Innovation

SBIR Topic Number:
AF05-212

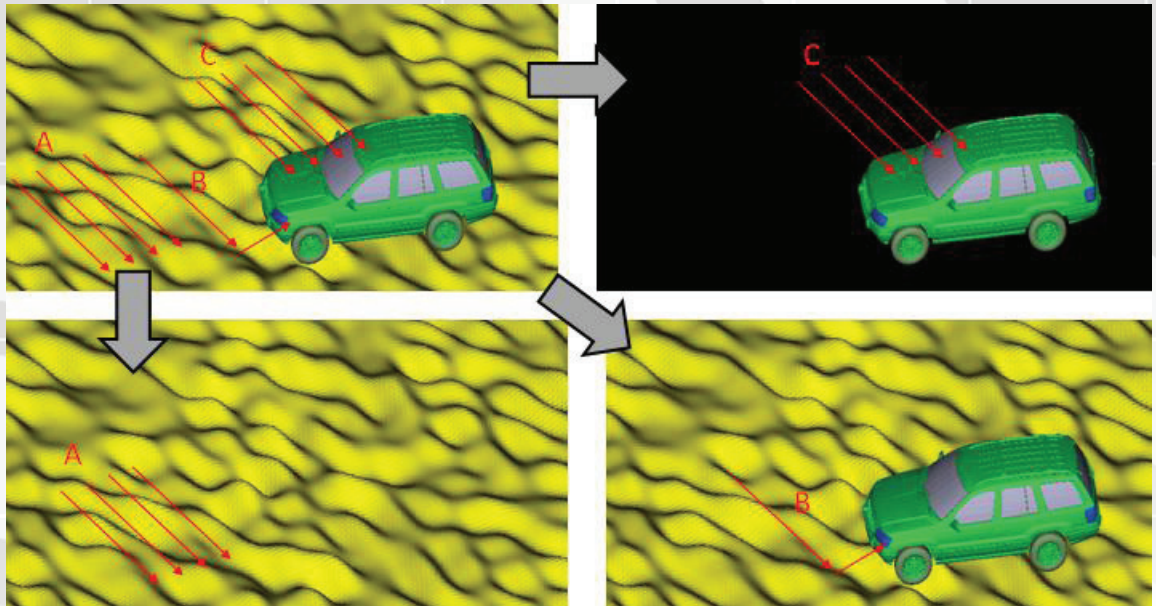
This Air Force SBIR/STTR Innovation Story is an example of Air Force supported SBIR/STTR technology that met topic requirements and has outstanding potential for Air Force and DoD.

SBIR Title:
Air to Ground Signature Database Development Technologies for Combat Identification

Contract Number:
FA8650-06-C-1009

SBIR Company Name:
Etegent Technologies, Ltd.
(formerly Sheet Dynamics, Ltd.), Cincinnati, OH

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



The Electromagnetic (EM) physics model is broken down into three coherently additive components: a) Ground only, b) Ground-Target Interaction, and c) Target only.

Response Function Toolkit for Ground Target Interaction

- There is a need for modeling the ground response for synthetic aperture radar (SAR) and high range resolution (HRR) signatures within a synthetic/simulated database
- This technology provides an enhanced data product which captures the statistics of each pixel/range cell based on assumptions of the known operating conditions
- Models were generated for three ground characteristics: dielectric attenuation, small scale (Rayleigh) roughness, and large scale (Kirchoff) roughness
- This allows consumers of the simulated database to adapt the signatures to multiple operational environments without additional physics models

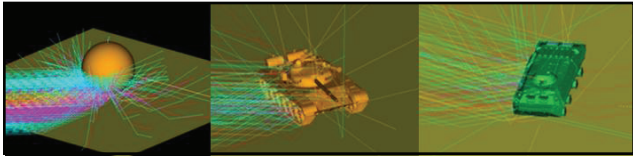
01-10FEB11/AF05-212

A

DISTRIBUTION A:
Approved for public
release; distribution
unlimited.

Air Force Requirement

Populating radar signature databases for ground targets is costly. In addition to representing the target variations, the database must also capture the signature variability introduced by the ground contributions. Simulated radar data is a cost effective addition to the database; however, its inability to efficiently represent the deterministic ground contributions limits its utility.

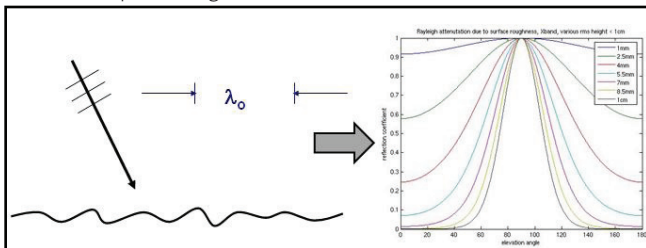


Ground-target interaction during ray trace for three targets.

This SBIR project, which was completed by Etegent Technologies, Ltd. (formerly known as Sheet Dynamics, Ltd.), addresses the need for modeling ground response from synthetic aperture radar (SAR) and high range resolution (HRR) signatures within a synthetic/simulated database. Methods have been developed and tested which incorporate both the effects of surface roughness and varied surface reflectance by modeling the response separately from the target contribution. This allows consumers of the simulated database to adapt the signatures to multiple operational environments without additional physics models.

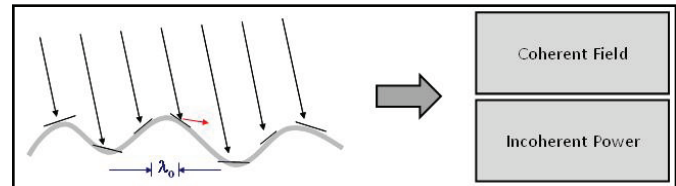
SBIR Technology

Models were generated for three ground characteristics: dielectric attenuation, small scale (Rayleigh) roughness, and large scale (Kirchoff) roughness. The signature prediction is performed by breaking up the contributions due to target only, ground only and target-ground interaction. The effects of the ground characteristics are realized by post processing the decomposed signature to obtain a statistical distribution.



The Rayleigh model is realized as an attenuation of the ground-target component.

There were several things which worked relatively smoothly, namely the dielectric attenuation and application of the small scale roughness as a post process. These two components address the capability to dynamically regenerate data corresponding to arbitrary ground surface (i.e., adapt to concrete versus wet sand) and minor surface perturbations. The remaining piece of the puzzle was the application of large surface roughness (greater than a wavelength), which was successfully implemented.



The Kirchoff model results in the generation of coherent field and incoherent power.

Potential Application

This technology provides an enhanced data product which captures the statistics of each pixel/range cell based on assumptions of the known operating conditions. In order for the full potential of this technology to be realized and integrated into current and future automatic target recognition (ATR) systems, data consumers must be willing to make a paradigm change and begin ingesting data in such a format. This involves a cultural mind shift, but one that AFRL Sensors Directorate leadership has begun to implement under "performance driven sensing."

Company Impact

"This insight and products generated under this SBIR have allowed SDL/Etegent to procure additional funding in the area of signature exploitation performance modeling," states Dr. Adam Nolan, Chief Technology Officer. "This has allowed us to hire two additional full-time staff"

Sheet Dynamics changed its name to Etegent Technologies, Ltd., in May 2010. Etegent is a high-technology, R&D-focused company conducting state-of-the-art research in a range of areas, including automatic target recognition utilizing radar, LADAR, image, vibrometry and other data types; health monitoring of turbine engines and other assets; nondestructive inspection data management and mining; mechatronic product development; and other areas.



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

