



Counter Concealed Target Technologies

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CC&D Tactics Pose A Challenge to U.S. Targeting Systems



The Challenge:



- Camouflage, Concealment and Deception techniques include:
 - Masking: Foliage cover, radar camouflage nets, chaff, weather
 - Tactics: Rapid movements between hide locations during deployment or after firing, emitting or over-flight
 - Decoys: Divert attention, generate false information

DARPA/SPOs objective is to develop technologies that effectively counter an adversary's use of CC&D



DARPA/SPO Is Addressing CC&D Tactics Through a Variety of Approaches



- Foliage Penetration (FOPEN) Synthetic Aperture Radar (SAR)
 - High-resolution, fully polarimetric imaging of stationary targets
- FOPEN Ground Moving Target Indication (GMTI) Radar
 - Moving target detection and tracking from airborne platforms
 - Low-cost, ground-based, bistatic radars to track vehicles and personnel in foliage
- Multi-Sensor Fusion
 - Fusion of FOPEN and microwave (μ W) SAR and GMTI, ESM and spectral sensor data to enhance identification and reduce the false alarm rate
- Target Identification
 - Close-in sensor packages
 - Multi-look 3-D laser radar (LADAR) imaging



FOPEN Radar Denies an Enemy the Ability to Maneuver and Hide Under Foliage

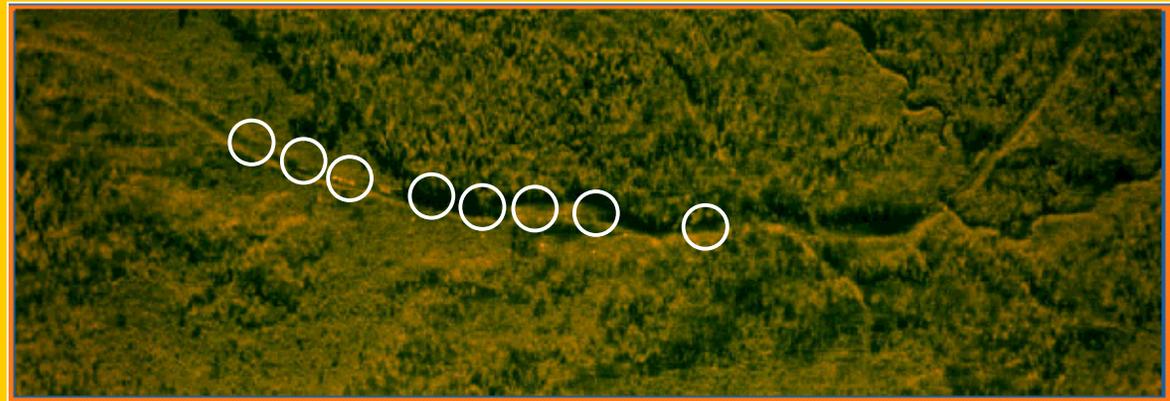


Example of Foliage-Obscured Vehicles

- Depression Angle: 45° , Resolution: 1 m x 1 m
- Vehicles Masked By Trees, Along Logging Road in Maine



Photograph



Conventional SAR Image



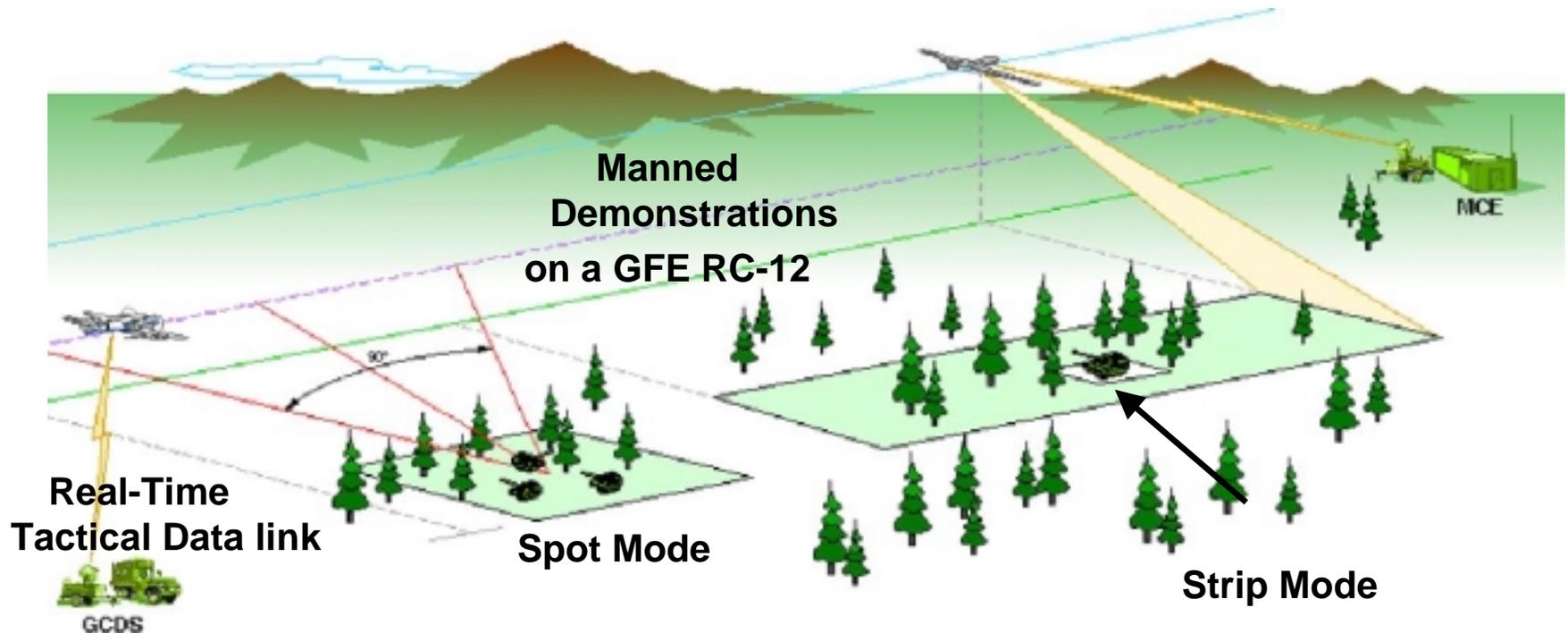
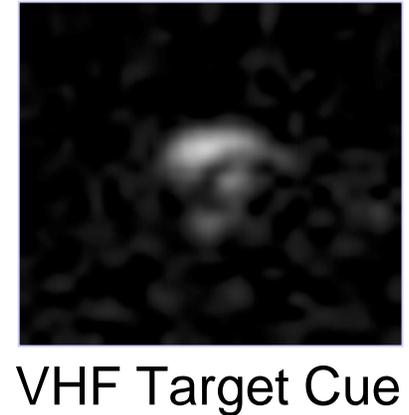
FOPEN SAR Image



DARPA/SPO Is Presently Developing a FOPEN SAR to Detect Stationary Targets



- The FOPEN SAR is a real-time dual-band system
 - Horizontally polarized VHF SAR for target cueing
 - Fully polarimetric UHF SAR for target discrimination and false alarm rejection
 - System being installed and tested on Army RC-12
 - Form, fit and function compatible with Global Hawk UAV

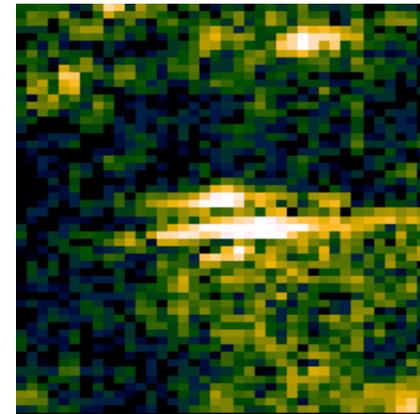




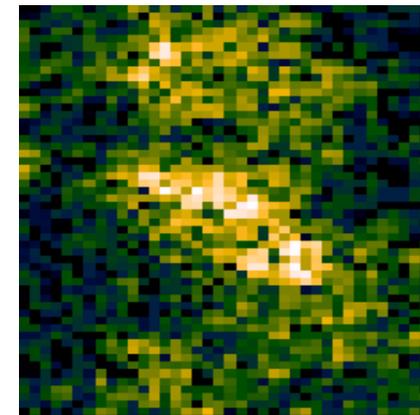
FOPEN SAR: Challenges and Opportunities



- Automatic Target Detection and Cueing (ATD/C) algorithms
 - Enhance target detectability
 - Minimize false alarms
- Advanced processing algorithms
 - RFI suppression
 - Waveform optimization
 - Change detection
 - Target classification
 - Interferometry / stereo / tomography
- FOPEN SAR applications
 - Battle space characterization
 - Environmental monitoring
 - Terrain mapping



UHF Target Chip



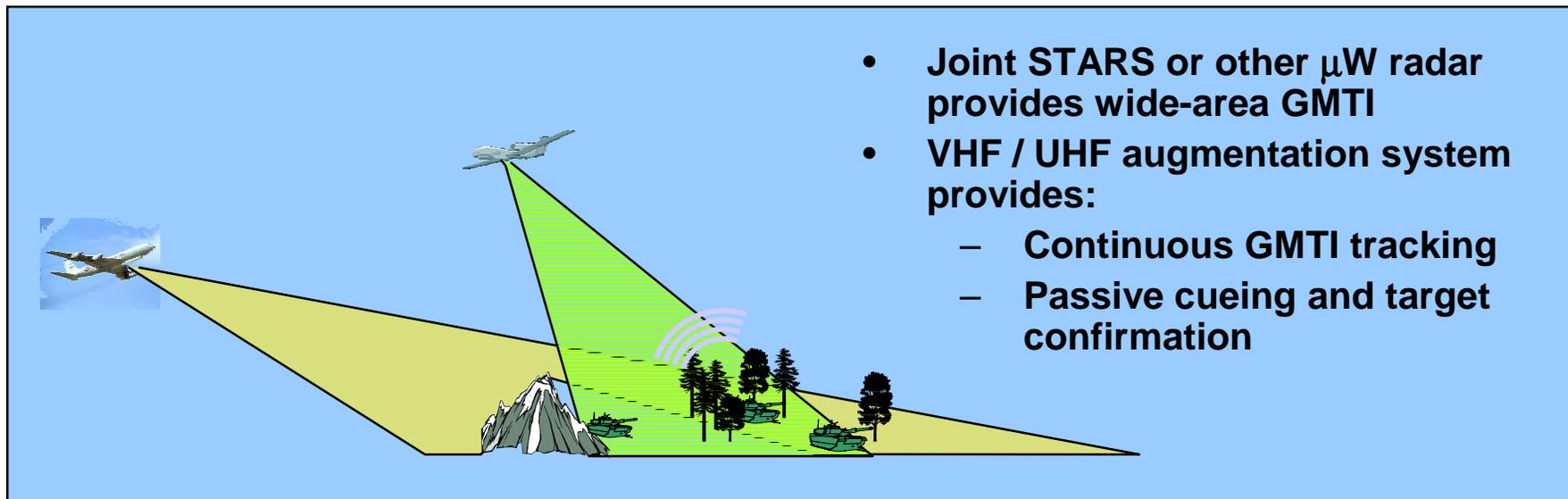
UHF Clutter Chip



DARPA/SPO Is Assessing Integrated VHF / UHF GMTI Radar and ESM Technologies



- VHF / UHF GMTI radar provides all-terrain, all-weather capability
 - Track targets under foliage
 - Provide a high target position update rate
- Bistatic GMTI operation enhances system survivability
- Concurrent ESM uses allocated system resources to identify targets and locate emitters





Integrated VHF/UHF System Technologies: Challenges and Opportunities



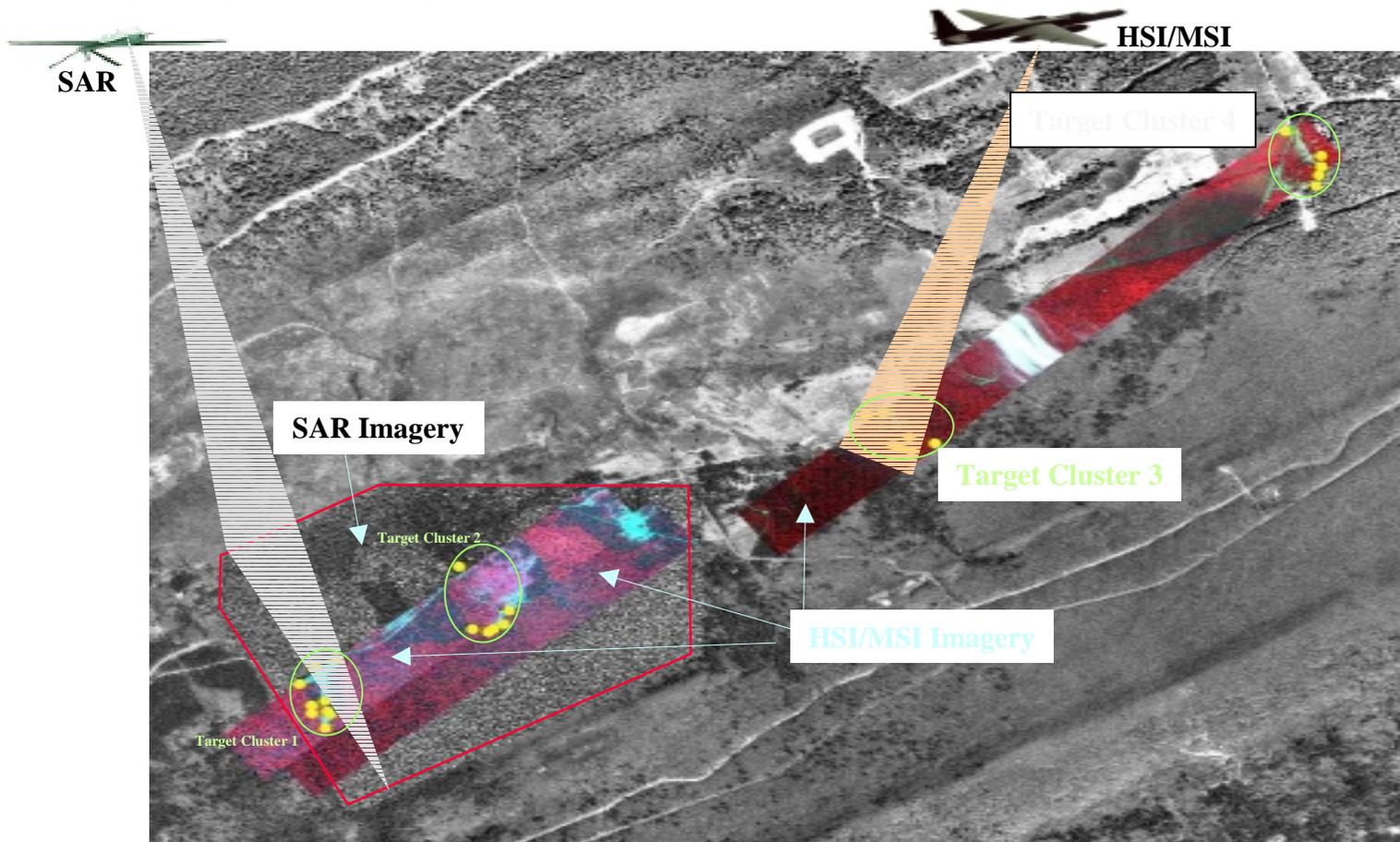
- System architecture
 - Monostatic and bistatic concepts
 - Deployment on UAVs and other suitable platform
 - Integration / utilization of GMTI radar and ESM
- Airborne hardware components
 - Transmitter, antenna, receiver and signal processor
- Adaptive, non-adaptive and ESM processing algorithms
- Concept of Operations (CONOPS)
 - Utilization of GMTI radar and ESM resources
 - Interaction with FOPEN SAR and microwave radars



DARPA/SPO Is Assessing Multi-Sensor Fusion to Counter CC&D Tactics



- **Objectives: Enhance detections, perform target identification and reduce false alarms**



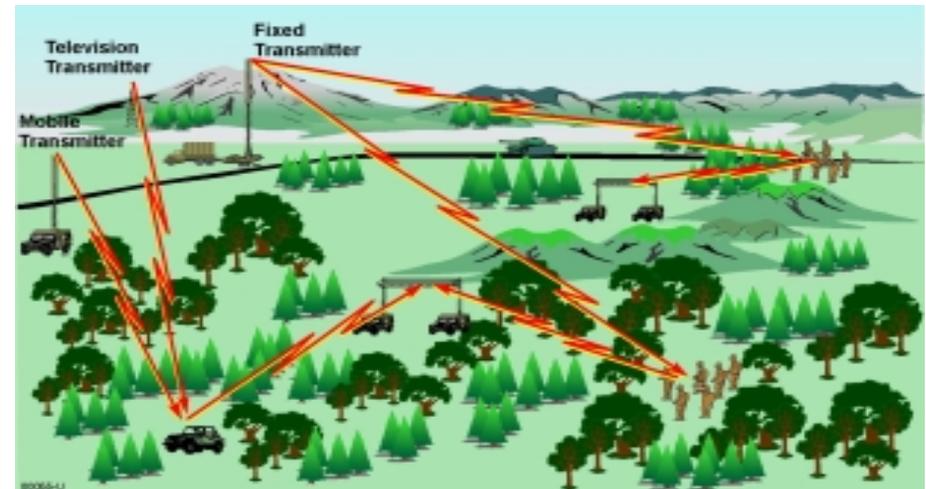


Ground-Based FOPEN GMTI Ground Radar



- Objective: Provide effective, low-cost force protection for ground units
 - Detect personnel / vehicles through foliage
 - Personnel detection to ranges of 4.5 km
 - Vehicle detection to ranges of 7 km
 - Use either cooperative or non-cooperative transmitter
 - Cooperative units could also provide communication / navigation functions
 - HDTV station could serve as non-cooperative illuminator

- Program goals:
 - High performance
 - Rapid deployment
 - Light weight
 - Low cost





Ground-Based FOPEN GMTI Radar Challenges and Opportunities



- Low-cost, light-weight antenna and receiver technologies
 - Wide tunable bandwidth
 - Rapid deployment
- Algorithms
 - Cooperative and non-cooperative illuminators
 - Adaptive processing
 - Tracking
- CONOPS
 - Emitter selection
 - Emitter functions
 - Deployment geometries



Proof-of-Concept System



Foliage



Camouflage

Approaches:

- Close-in sensor package
- LADAR for 3-D sensing
- Multi-mode sensing



Complex Environments
(Urban, Clutter, Proximity)



Decoys



Summary



- DARPA/SPO's goal is to develop and demonstrate viable Counter CC&D technologies and to transition them to the Warfighter
 - Currently addressing the detection of concealed targets through a variety of airborne and ground-based sensor efforts
 - Increasing emphasis is being placed on tracking (GMTI), identification and engagement
- DARPA/SPO welcomes the presentation of new and innovative concepts for surveillance, identification and engagement of stressing surface targets