Three Dimensional (3D) Sensor Exploitation

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Problem

- Non-cooperative target identification systems that produce 2D images of 3D targets often fail to meet both detection and classification performance criteria.
- Existing single 3D imaging technologies and exploitation methods suffer from a variety of performance limiting characteristics:
  - LADAR: Effective range is highly weather dependent
  - Volumetric SAR and IFSAR: Require data collection over large viewing angles in both azimuth and elevation
    - Current image formation algorithms do not utilize scattering models that accurately represent “true” 3D target scattering responses.
  - HSI: Limited spatial resolution
  - Human 3D Data Exploitation Procedures: The amount of data contained in 3D images of dense target scenes can readily saturate even well trained observers, requiring the development of 3D ATR algorithms.

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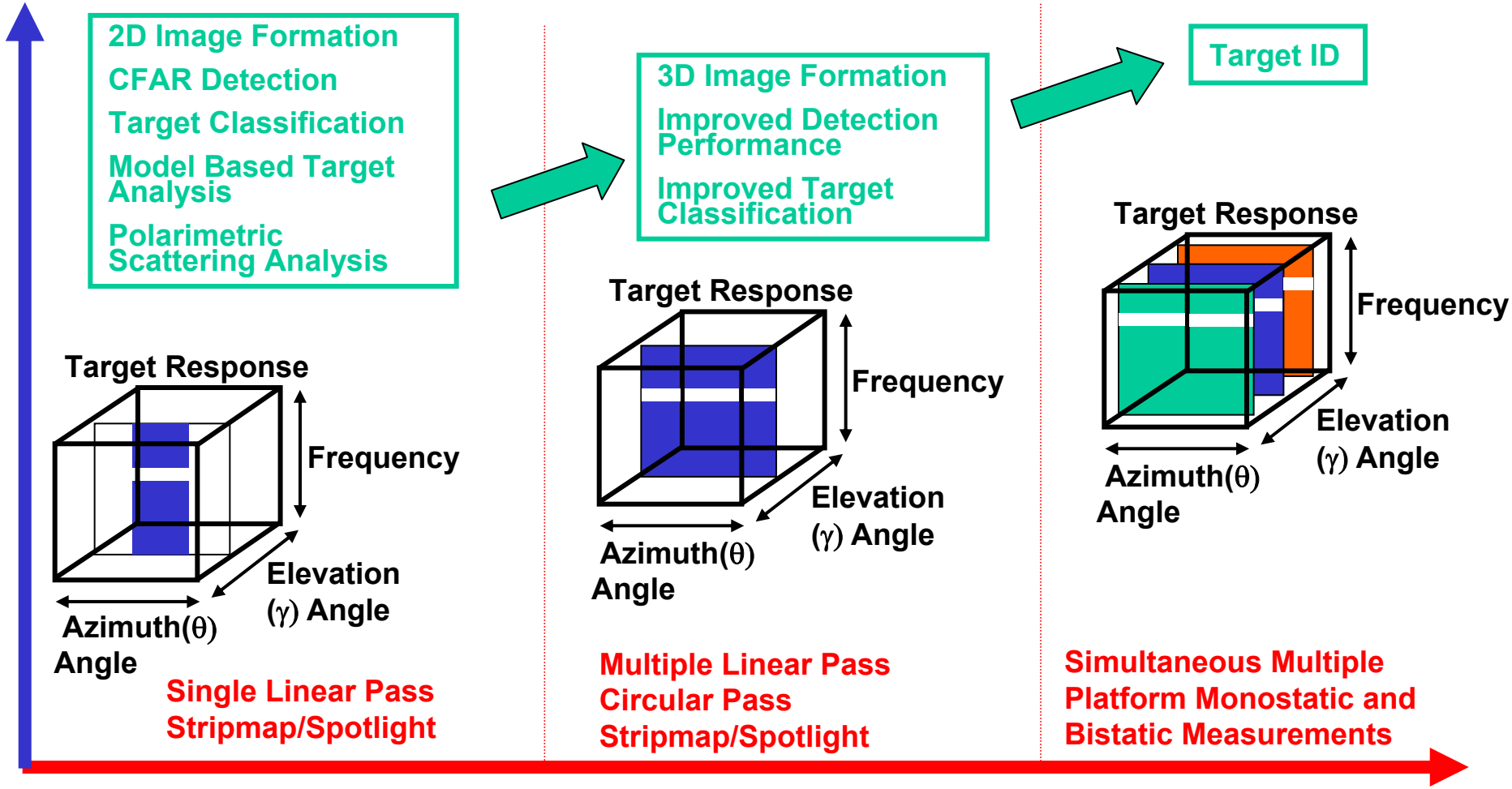
Background

Processing Requirements



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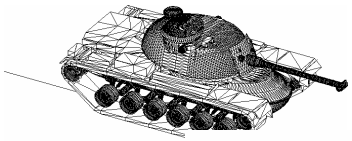
Objective

- Use a systems-level methodology to design, analyze, and implement concepts and algorithms for collaborative 3D sensor target identification and target engagement
  - Develop 3D image formation algorithms that utilize a priori information to produce useful 3D target images over broad ranges of obscuration, configuration variation, and environment complexity
  - Develop optimal sensor tasking algorithms that will allow 3D sensors to quickly collect the data need to form high-resolution 3D images, from the largest possible stand-off distance
  - Develop and demonstrate a prototype 3D Multiple Modality Sensor Information Correlation and Exploitation system

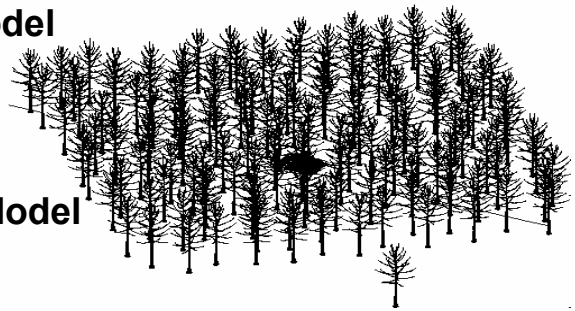
Activities

- Develop 3D image formation algorithms that utilize a priori information to produce 3D images that can be used to reliably recognize targets over broad ranges of obscuration, configuration variation, and environment complexity
- Develop optimal sensor tasking algorithms that will allow 3D sensors to collect the minimum amount of data, from the largest possible stand-off distance and still be able to produce 3D images of a specified spatial resolution
- Develop data level fusion algorithms to improve 3D image quality and 3D image resolution
- Utilize the 3D geometrical information and features produced by the 3DMICE system in combination with HSI (hyperspectral imagery) data to perform enhanced object and material classification and ID

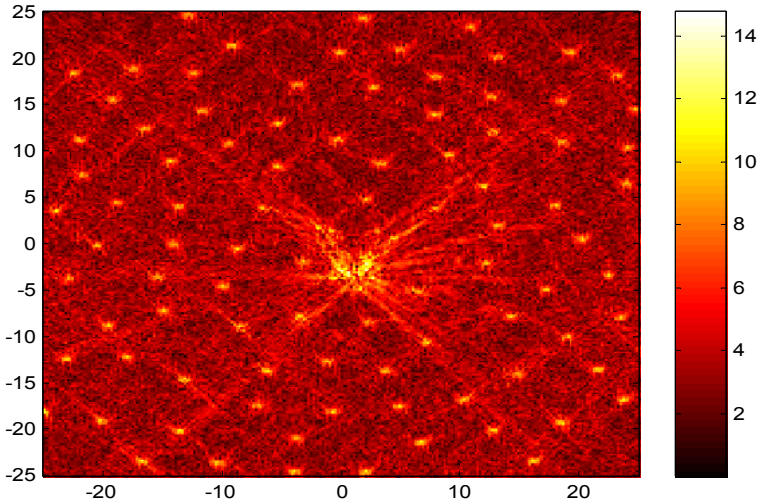
Highlight: Multiple Pass 3D FOPEN SAR Simulation



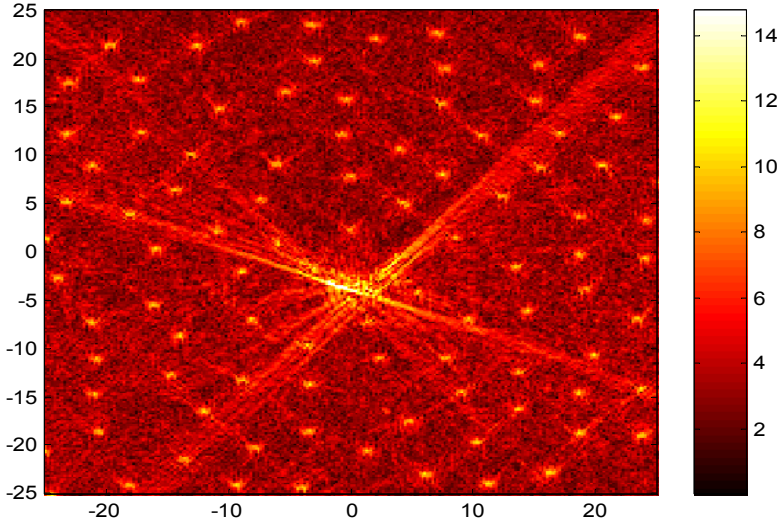
M48 Tank Model



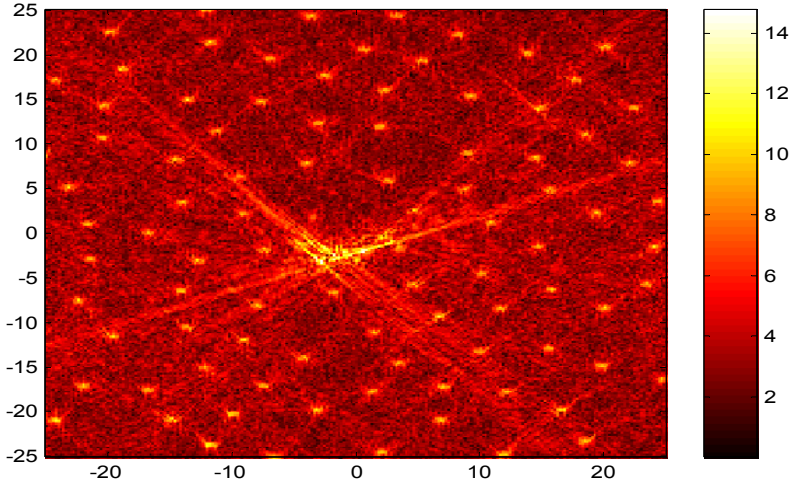
M48 Tank Model in Forest



Azimuth = 0 Degrees



Azimuth = 240 Degrees



Azimuth = 120 Degrees

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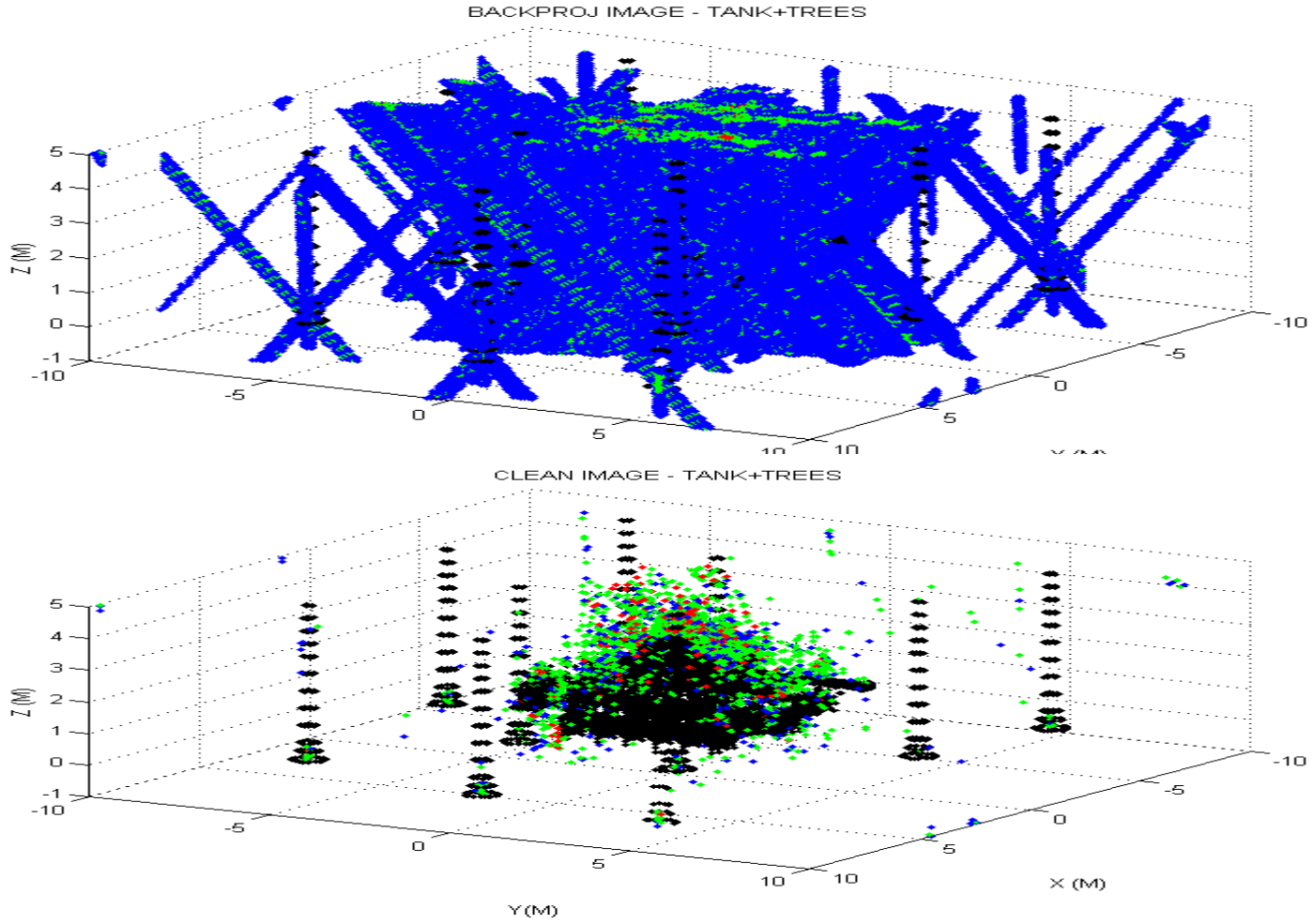
Highlight: Multiple Pass 3D FOPEN SAR Simulation



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Impacts

- Multi-modal 3D sensor exploitation will provide robust all-weather ID capability that is resistant to camouflage, concealment and deception, and jamming.
- This MSR will establish MITRE as a center of excellence in 3D collaborative sensor processing.
- This MSR will advance the state of the art in 3D sensor processing and exploitation.
  - Provide 3D exploitation algorithms that will deliver improved ID information enabling increased combat ID and situation awareness to the warfighter
- The project will establish methods to produce 3D ISR data products in an efficient manner and determine requirements for processing and exploitation of 3D products by the Air Force MC2C, the Army FCS, the Navy ESG, NIMA Vertical Obstruction Mapping, and other national systems.

Future Plans

FY03

- Develop "true" 3D SAR image formation algorithms for non-adaptive data collection scenarios
- Perform initial development and assessment of knowledge-based 3D image formation algorithms
- Develop multi-modality (LADAR, volumetric SAR) 3D fusion and ID algorithms
  - 3D data registration and features extraction
  - ID algorithms that combine hyperspectral features with multi-modality 3D data

FY04

- Develop adaptive multi-sensor tasking algorithms
- Refine 3D image formation techniques to include adaptive data collection scenarios
- Refine knowledge-based 3D SAR image formation algorithm
- Quantify 3D sensor phenomenology and develop 3D image quality metrics

FY05

- Expand and quantify performance of multi-modal fusion and ID techniques using existing field and simulated data sets
- Develop a combined knowledge-based adaptive data collection 3-D image formation algorithm
- Complete performance analysis and demonstration of prototype system using field data (LADAR, volumetric SAR, and other)

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