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DST

Discriminating Sensor Technology

Summary

- Provides a long-range, high-power Range Resolved Doppler Imaging (RRDI) Ladar for use in missile defense target identification
- Integrated active and passive sensor operation to provide new features for corrected threat identification
- Real-time on-board processing for rapid correlation and improved target object mapping
- Demonstrates target handover, interrogation, and cooperative operation of both active and passive sensors for long-range missile threat identification
- Develops processing techniques to produce range-insensitive Doppler images of many targets

The Discriminating Sensor Technology (DST) Program's goal is to demonstrate Range Resolved Doppler Ladar technology that allows enhanced identification of threat objects.

The Discriminating Sensor Technology (DST) program is developing an active Range Resolved Doppler Imaging (RRDI) Ladar system that, when combined with proven passive IR and visible sensors, provides a fully capable sensor suite on current and evolving platforms. In addition, it has the capability to aid in correlation of a ground-based, threat object map and allows fusion of this data with the other sensor data. The DST program integrates an active coherent (Doppler) Ladar into a sensor package containing passive sensors and brings together several complementary technologies that provide a robust capability. The DST critical technologies fuse multi-color passive sensors, a range resolved Doppler Ladar, a common aperture-shared telescope, an integrated electronics suite, and an executive processor for fusing the handover data with the measured feature data needed for missile defense.

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Overview

Evolving ballistic missile threats with their associated countermeasures demand advanced sensors and on-board target identification capabilities to enable destruction of the warhead in midcourse. This has prompted the Missile Defense Agency (MDA) to develop advanced technologies that will provide timely, robust target discrimination and work in concert with the current and future generation of passive sensors as well as ground or forward-based sensors. Higher probability of kill by means of greatly increased probability of valid target identification with minimum a priori knowledge of the threat is the improvement in this technology. All of these critical technologies are now at a state of maturity and readiness to allow them to come together for use in a missile defense role. Their impact to missile defense capability is expected to be very significant by denying the adversary cheap methods to disguise and hide the real threat target.

Benefits to Tomorrow's Defense

Advanced missile threats emerging in the 21st century require development of advanced laser radar (Ladar) sensing capabilities. The goal of this program is to develop a Ladar sensor technology that will augment passive sensors to perform enhanced identification of advanced threat targets. Advanced threats will include re-entry vehicles (RVs) and identically shaped precision Lightweight Replica Decoys (LREPS) with RV-like motion as well as closely spaced objects that are intended to degrade sensor performance of non-imaging passive sensors. The increased traffic in future threat clusters, jammers, clutter, and radar-absorbing materials may degrade the acquisition and tracking coordination between ground-based sensors, airborne sensors, and platforms. However, the presence of a Range Resolved Doppler Imaging sensor on a surveillance platform will substantially reduce coordination and correlation problems.

Technical Concept

A Range Resolved Doppler (RRD) Ladar was selected for technology development on the basis of intense trades that involved all system elements from packaging, optical requirements, technology readiness and cost, systems compatibility / range performance, and features provided for engagement. The RRD Ladar images the target while it is angularly unresolved with passive sensors. The Doppler based synthetic aperture process can rapidly measure target micro-dynamics at extended ranges, even in the presence of closely spaced objects. The RRD process does not require the Ladar to dwell on a single object to derive these kinematic features, thus permitting the system to quickly interrogate many objects in the threat cloud before they leave the field of regard. The RRD Ladar does not rely on external illumination or emitted radiation from the target. The Ladar illuminates each target to measure target range, velocity, and angular rates and forms images that resolve the target in the range and cross-range dimensions.

The DST Ladar utilizes a solid-state laser transmitter to illuminate targets with coherent radiation. The DST receiver optics collects and focuses backscattered Doppler-shifted radiation from the target onto a detector array where it is mixed with a local signal which allows detection of very small changes in signal levels. The method used makes the detection impervious to clutter noise sources. The processed return signal is used to produce 4-D precision track (range, azimuth, elevation, and Doppler) measurements and range resolved Doppler images of each interrogated object in the field-of-view. Very sensitive Doppler measurement properties of the Ladar-received signal magnifies cross range measurement resolution by orders of magnitude beyond what is physically possible with passive sensors sharing the same aperture. The Doppler-measured features are used as identification features to determine real targets from decoys.

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