Sensor Management for Intelligent Sensors

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Overview

- System Objectives
- Illustration of Approach
- Technical Challenges
- Sensor Network Illustration
- General Approach
- Sensor Manager
- Conclusions and Future Work
System Objectives

- **Problem:** As intelligent networks of heterogeneous sensors are created, automatically assessing and optimizing global performance for changing mission requirements easily overwhelms processors and operators.

- **Objectives:**
  - Adapt intelligent sensors for changing mission requirements.
  - Design a mathematical framework based on global performance parameters that adapt to mission changes.
  - Solve the resulting complex optimization problem with computational efficiency.
Geographical Approach
Technical Challenges

- Reduce contention for sensor resources.
- Prevent overwhelming communication network with sensor data.
- Enhance, not hinder, existing sensor adaptability.
- Automatically heal the sensor network for a sensor failure or degradation.
Sensor Network

Observation Space: nature, own resources, threats

Sensor Status

controls

Sensor

Measurements

Data Fusion

Estimates

Sensor Manager

Information Space: target detections, estimates, classifications
General Approach

- Manage objective function, which requires optimization, through a POSet structure.
- Design probabilistic reasoning algorithm mapping situation assessment, threat assessment, and user information into performance goals.
- Optimize performance over the regions using a hybrid Ant System/Particle Swarm Optimization algorithm.
Sensor Management

Situation Assessment → Mission Manager

Threat Assessment → Sensor Manager

Sensor Controls → Sensor Suite

Health/Status → Sensor Models

Operator → Mission Manager
Mission Manager

Features of Partially Ordered Sets (POSETS)

- Provides mathematical framework for organizing parameters
- Supports automatic adaptation to changing mission requirements
- Converts competing performance parameters into single global parameter
Features Swarm Intelligence

- Robust pervasive coverage of optimization problem
- Computationally efficient
- Successful solving difficult combinatorial optimization problems
- Self organized
- Decentralized environment
Conclusions and Future Work

• Sensor Management requires a blending of multiple mathematical techniques.
• The sensor control interface for intelligent sensors must consider the sensor’s adaptability.
• A distributed algorithm leads to scalability.
• In the future, the algorithm will be simulated and tested for a variety of scenarios.