Network Centric Command and Control by means of Picture Compilation and Sensor Management

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Developments

- different functions/tasks
- different controls
- similar and/or complementary information

- implementation of new, complex sensors
- reduction of education/training times
- smaller crews
- shift in mission objectives
Problem Definition

1. Sensor management is becoming increasingly knowledge intensive due to shift in mission objectives and sensor complexity.

2. The available amount of combined operational and technical knowledge necessary for sensor management is decreasing.
Sensor Management Requirements

1. support the compilation of a complete and accurate (timely) picture of the environment

2. provide weapon guidance functions
Operator decisions:

- when to use which sensor and sensor function for picture compilation or weapon assignment while taking into account:
  - Emission Control plans
  - Rules Of Engagement
- how to set a sensor for optimal results with respect to the mission objectives and meteorological/geographical conditions
Required Knowledge

- Knowledge about the Target (Mission)
- Knowledge about the Environment
- Knowledge about the System

Introduction
Knowledge Analysis
Sensor Management
Command and Control
Results
Questions

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Sensor Performance Models

- Knowledge about the system
- Knowledge about the target
- Knowledge about the environment

- Cone of Silence

- No detection due to multipath
- No detection due to Radar horizon

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<tr>
<th>Parameter</th>
<th>Value</th>
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<tr>
<td>Carrier Frequency</td>
<td>3300 MHz</td>
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<tr>
<td>PRF</td>
<td>2 kHz</td>
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<tr>
<td>Peak Power</td>
<td>10 kW</td>
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<tr>
<td>Pulse Length</td>
<td>1 us</td>
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<tr>
<td>Inst. Bandwidth</td>
<td>1 MHz</td>
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<tr>
<td>Transmit Gain</td>
<td>39.0 dBi</td>
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<tr>
<td>Receive Gain</td>
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<tr>
<td>Target RCS</td>
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<td>Target Velocity</td>
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<tr>
<td>Target Altitude</td>
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<td>Swirling Case</td>
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<td>Radar Height</td>
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<td>Sea State</td>
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<td>Doppler Processing</td>
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<td>Pulses per Burst</td>
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<td>False Alarm Prob.</td>
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Environmental Influences
Geografical Information
Shadow Zones
Situation Awareness
Threat Assessment
Decision Making
Direction and Control
Mission

knowledge about the environment
knowledge about the system

Data sources
Deployment

Situation Awareness
Decision Making
Direction and Control

Primary
Secondary
Information transfer

Cognitive Model
Process Model (I)

C2 Process

Mission

Orient

Threat Assessment

Situational Awareness

Observe

Decide

Decision Making

Direction And Control

Act

knowledge About the environment

knowledge about the system

Sensor

Weapon

Crew

Platform
Process Model (II)

Mission

Orient
- Threat Assessment
- Knowledge about the environment

Operational Picture

Decide
- Decision Making
- Knowledge about the system

Act
- Direction and Control
- Act

Observe
- Situational Awareness
- Observe

C2 Process

Sensor

Weapon
- Crew
- Platform
Basic OP object attributes:

- state vector (position, velocity, acceleration)
- type/class
- identity

related uncertainties
Generic Object Model

Vehicle

- Structure
- Payload

- Resource
- Cargo

- Sensor
- C2
- Launcher
- Comms
- Navigation
- Propulsion
- Power Plant
- Manoeuvring
- Crew
Process Model (III)

Picture Compilation Processes

- **Orient**
  - Threat Assessment
  - Situational Awareness

- **Observe**

Resource Management Processes

- **Decide**
  - Decision Making
  - Direction And Control

- **Act**

Mission

- **Weapon**
  - Crew
  - Platform

knowledge About the environment

knowledge about the system

Sensor

Crew

Platform
C2 and Sensor Management

Observe Orient

Picture Compilation Processes

Operational Picture

Act Decide

Sensor Management Processes

Sensor
Picture Compilation processes

- Detect
- Associate/Correlate
- Track
- Fuse
- Classify
- Identify
- Recognise Intent
- Estimate Risk

Increasing Level of Required Operational Knowledge
Sensor Management

Three management stages:

1. construct a sensor task: assign a sensor function to an object
2. assign a sensor to an object - sensor function combination
3. determine required budget and sensor settings
Integrated Model

Picture Compilation

- Detect
- Fuse
- Track
- Classify
- Identify
- Determine Threat
- Recognise Intent

Plans
- Operational Picture
- System Knowledge
- Env. Knowledge
- Mission Knowledge

Plan
- Construct Task (Monitor)
- Select Resource
- Control Resource

Resource Management

- Sensor
- Weapons
- C4I
- Platform
- Crew
Sensor Range
Performance Prediction
Observations
Detection Ranges and Lobing

- **H = 100 m**
  - **R = 26 nm**

- **H = 200 m**
  - **R = 32.5 nm**

- **H = 400 m**
  - **R = 45 nm**
Questions ?
Sensor Range