



Information Fusion for Collaborating Commanders at Different Levels

Position paper intended for discussion

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Overview

- Position paper to stimulate discussions on how information fusion methods and information sharing affect command and control
- Main questions:
 - How is the choice of data/information fusion methods, and the presentation of their result ("Situational picture") affected when information should be shared between different levels of command?
 - Does automated information fusion affect the flexibility of a commander?

Background

- Sensor networks will be used to a greater extent
 - Low level data fusion – results in information about different objects
 - Time critical for fusion and delivery of result to local user
 - Rule based often good since we know what to expect
 - Problem when an ordinary car contains specific people or goods
 - Result is an "intelligence report"
 - Raw data meaningless for external user since data formats are optimised for speed and resource usage

Background

- Information Fusion
 - High level fusion – results in information on how objects are connected, on situations, and threats
 - Longer time-scale
 - Completely rule-based difficult since everything depends on context
 - New methods continuously developed
 - Data-driven methods difficult since not enough data available
 - Results in a "Situational picture"
 - Raw data are sensor fusion results, intelligence reports, information from media, etc.

Collaboration between different command levels

- Different abstraction levels are (obviously) required
 - 1) How can varying abstraction levels be maintained and represented?
 - 2) How to maintain trust for the system and for other users?
- Solutions:
 - Data available at different abstraction levels
 - Representation of ambiguity and noise
 - More important that each user gets relevant information than maintaining a COP

Consequences

- Automated fusion can be used to obtain different abstraction levels
 - We need fusion methods that can use data of different types
 - Methods used in sensor networks NOT suited for high level data
 - Expert systems can use sensor data, but too slow and too resource consuming
 - Data mining techniques useful for high level fusion, but (so far) only used off-line for sensor networks
 - Semantic methods can be used (e.g. attribute fusion)
- The point is: Choice of fusion methods is very important in each subsystem if data/information should be used by users at different levels

Flexibility

- Well-known that information given to humans affect their performance
 - Count passes – see monkey
 - Also valid for military scenarios
 - Spak, U., Lind, M., Submitted to: European Intelligence and Security Informatics Conference (EISIC) 2011, September 12-14, 2011, Athens, Greece.
 - How is C2 affected when information has been fused automatically?
- Traditionally data is handled by intelligence
- Using automated fusion, rules must be set (by experts) beforehand
 - New rules can be generated automatically, but only based on experience from current mission

Flexibility

- Does automated fusion influence the flexibility of a commander?
- What is flexibility?
- Can flexibility be measured?
- If this is a problem, how should data be handled to provide information at different abstraction levels and still not affect the flexibility of the commander?
- Is less flexibility at lower levels desired since it gives high levels commanders better control of their subordinates?

Open questions

- Is it possible to scale simple approaches to semantic fusion to higher-levels?
 - Semantic reasoning does not scale today!
- How construct and maintain/update ontologies that are useful?
 - Low-level ontologies
 - High-level ontologies
- How to construct abstraction methods that reduce the amount of information that needs to be displayed, while retaining everything important?

Discussion

- Thankyou for your interest!