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“Adapting C2 to the 21st Century”

Title of Paper: Concept Map Value Propagation for Tactical Intelligence

Topics: Track 2, Networks and Networking; Track 1, C2 Concepts, Theory, and Policy;
Track 6, C2 Metrics and Assessment

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Abstract

Command and control analysts increasingly apply traditionally unassociated concepts to situation understanding. Techniques are needed to tailor knowledge acquisition resource allocation according to probable value of information, both inferring an answer to a question using knowledge at hand and quickening intelligence efforts to fill in gaps. This paper discusses research into techniques for negotiating and updating Concept Maps, collections of concepts linked by specified relationships, by accounting for both nodal data and links among nodes. Such Maps provide the flexibility to represent contemporary tactical knowledge not lending itself to conventional data structures. In some senses Concept Mapping generalizes the notion of an inference network, a set of propositions organized with rules directing information propagation and combining antecedents to update consequents. We are attempting to develop a mathematical system for organized navigation of a Concept Map, driven by expected variability in the value of a datum and cost to get a new value. We use the CmapTools software associated with the Institute of Human and Machine Cognition as a structural basis for creating and assessing tactical Maps. The paper discusses Map construction, analytical philosophy, and methodology development.

Draft outline

- Concept Maps as meaningful diagrams
 - Relations: Subsumption, differentiation, ...
 - Structures: Cyclical, hierarchical, ...
- Creating tactical knowledge models
 - Concept Mapping procedure
 - CmapTools
- Concept quantification
 - Propositional coherence
 - Description logic
- Propositional grammar
 - Noun, adjective, verb, ...
 - Left concept, link, right concept
- Inference nets
 - Proposition selection
 - Merit propagation
- Extension to dynamic Cmaps
 - Cluster merging
 - Generalized derivatives, chain rule
- Future work
 - Merit indices for combinations of properties
 - Agent-based construction, OWL formalisms