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Evaluation of emergent behavior of Composite Combat Identification in an IABM Systems of Systems Environment

Modeling & Simulation

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An analysis was recently conducted in order to identify unanticipated effects on Composite Combat Identification (CCID) Reasoning Algorithm (CRA) within a distributed system-of-systems (SoS) Integrated Architecture Behavior Model (IABM) environment. An Agent-Based Model (ABM) simulation approach was used to evaluate potential emergent behavior. CRA, based on a Dempster-Shafer evidential reasoning algorithm, was recently introduced in the literature. Studies of its effectiveness have been limited to a single instance of the algorithm.

In investigating distributed CRA effectiveness, we considered the behavior of sensor and CCID information sharing across the network. In particular, network delays deliver distributed sensor information to CRA nodes at different times, skewing CCID recommendations for a given track from individual nodes. Discrepancies must be resolved by some suitable arbitration scheme. We considered four schemes in our study: Weighted Bayesian, Naïve Bayesian, Majority Voting, and Maximum Belief Value.

Distributed SoS architectures famously exhibit “emergent” behavior that is practically impossible to model via fully scripted simulations. We chose to apply ABM to allow us to capture this behavior, to evaluate our distributed SoS architecture from “the bottom up”. In this environment, we were able to study the effects of variations in network delay and arbitration scheme on distributed CRA performance.