

Reliability Assessment and Failure Detection in a Complex Human-Machine System Using Agent-Based and Human Decision-Making Modeling

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Abstract : In a complex aerospace operational environment, identifying failures in a procedure involving multiple human-machine interactions are difficult. These failures could lead to accidents causing loss of hardware or human life. The likelihood of failure further increases if operational procedures are tested for a novel system with multiple human-machine interfaces and with no prior performance data. The existing approach in the literature of reviewing complex operational tasks in a flowchart or tabular form doesn't provide any insight into potential system failures due to human decision-making ability. To address these challenges, this research explores an agent-based simulation approach for reliability assessment and fault detection in complex human-machine systems while utilizing a human decision-making model. The simulation will predict the emergent behavior of the system due to the interaction between humans and their decision-making capability with the varying states of the machine and vice-versa. Overall system reliability will be evaluated based on a defined set of success-criteria conditions and the number of recorded failures over an assigned limit of Monte Carlo runs. The study also aims at identifying high-likelihood failure locations for the system. The research concludes that system reliability and failures can be effectively calculated when individual human and machine agent states are clearly defined. This research is limited to the operations phase of a system lifecycle process in an aerospace environment only. Further exploration of the proposed agent-based and human decision-making model will be required to allow for a greater understanding of this topic for application outside of the operations domain.

Keywords : agent-based model, complex human-machine system, human decision-making model, system reliability assessment

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