ACQUISITION INNOVATION RESEARCH CENTER

INCUBATOR EXECUTIVE SUMMARY | 2022

DIGITAL ENGINEERING ENHANCED T&E OF LEARNING-BASED SYSTEMS

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BACKGROUND AND PURPOSE

The broad objective of this incubator research is to develop approaches to the design of test and evaluation (T&E) programs and the acquisition of data/model rights for learning-based systems. The principal objective is to understand how increasing government access to the models and learning-agents used in designing next-generation military systems might decrease the need and expense of testing and increase confidence in results. Current approaches to test and evaluation (T&E) cannot address the challenges of identifying changes in operating conditions or adversarial actions that might cause the performance of an Artificial Intelligence/Machine Learning (AI/ML) model to deviate from design limits, particularly when considering autonomous functions that may engage in self-learning over the long life cycles of military systems.

The research led by Principal Investigator Dr. Peter Beling (Virginia Tech), Co-Principal Investigators Dr. Laura Freeman (Virginia Tech) and Dr. Jitesh Panchal (Purdue University), posed the principal hypotheses that acquisition costs can be significantly reduced if T&E programs are based on the optimal balance between the cost of acquiring the technical data/algorithm rights of AI/ML systems and the cost of testing those systems.

RESULTS

The work of this project establishes the theory and methods for exploring how T&E requirements can and should change as a function of the test team's knowledge of the technical specifications of AI enabled systems. As a testbed for the methodologies, the team used a hypothetical networked munition system known as Silverfish. The project experimented with two pilot scenarios that demonstrate how multiple phases of testing contribute to the evaluation of AI-enabled systems. The team then presents the Bayesian analytical framework for combining information across the multiple phases of testing and that reflects the changing system configuration and context.

NEXT STEPS

A major challenge in conducting AI-enabled systems research is that physical realizations are needed for T&E research. Future work could leverage the Silverfish testbed directly and expand the testbed into physical implementations, which in addition to Model-based System Engineering (MBSE) representations would enable the direct execution of a T&E program on the Silverfish testbed. Future work should also include purposefully varying the systems knowledge, the complexity of the systems and corresponding operating environments, and determining minimally adequate testing as a function of those variables.

DISCLAIMER

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