Co-evolving Tactics and Strategies for Anti-Terrorism/Force Protection Training and Decision Support

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Project Abstract

The Problem: Live-fire military training exercises are expensive in terms of personnel, ordnance, fuel, and environmental damage. DoD has thus been investing in virtual training technologies for some time and the Navy's family of navigational, tactical, and strategic decision making simulations provides training tools for trainees to plan and execute Anti-Terrorism/Force Protection (ATFP) and other operational plans in a force-on-force environment and through after action review, gain feedback about the effectiveness of their planning and decision making. However, existing training simulations like Virtual Ship (VShip) and Multi-Mission Tactical Trainer (MMTT) still require the participation and coordination of instructors (experts) and many human players because we do not have the capability for automatically controlling a realistic, competent, adaptive opposing force. Furthermore, no one has evaluated the effectiveness of such training simulations compared to live-fire exercises. For example, apart from the cost savings, do realistic simulations impart the lessons that trainees need to learn? Such questions must be empirically answered. Finally, we cannot yet model the cycle of attack and counter-attack tactics and strategies that result from forces adapting their tactics and strategies in response to opponent actions. Thus the inability of current technology to provide a competitive, realistic, opposing force compromises the goal of inexpensive, anytime, anywhere training, especially for strategic training and decision making.

Proposed Solution: We propose to investigate, prototype, and evaluate a revolutionary genetic algorithm based artificial intelligence learning system that uses newly developed technology and learns from subject matter experts to generate realistic, adaptive, appropriately competitive opposing forces and control strategy for decision making simulations. First, a subject matter expert (training instructor) will be able to demonstrate a few courses of action in specific situations and our system will generalize and find a strategy underlying these courses of action and use that strategy in novel scenarios. To simulate a realistic adaptive opponent, the proposed system will evolve counter strategies. Counter-counter strategies are simply one step further. By automating this evolutionary cycle, we can co-evolve new robust offensive and defensive strategies and tactics that model the adaptability of real fighting forces. More specifically, when connected to backend war-gaming simulations like VShip or MMTS, the system uses novel co-evolutionary and spatial representation techniques to provide realistic, adaptive, competent opposing forces without the expense of coordinating and involving multiple students and instructors. Second, this co-evolutionary arms-race also models insurgents' adaptive tactics with Improvised Explosive Devices (IEDs) in the current conflict. When applied in this domain, we therefore expect our system to model and generate novel tactics and strategies for a highly adaptable but weak force confronting our high powered but very slowly adapting ground force. Seeded by the current tactics being used, our system will generate new counter-tactics, counter-counter tactics, and so on, allowing us to identify possible new insurgent tactics and strategies, to preemptively train against and overcome. Finally, trainees learn component skills from traditional classroom methods – these are ultimately tested in simulated scenarios designed to elicit composite responses. We will use behavioral science methods from Psychology to understand and evaluate the composite skill level of trainees that undergo training through simulation. Specifically, we will analyze trainee verbal interaction as an aspect of problem solving behavior in decision simulations and measure the similarity of system generated strategies to strategies generated by subject matter experts in novel scenarios. This will provide the navy with real data on the effectiveness of their training simulations (augmented with our learning system) and suggest methods to improve training, retention, and decision making skills. Better training and decision support saves lives.