Department of the Navy SBIR/STTR Transition Program

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Topic # N171-084

DeepAgent Ph II

Soar Technology, Inc.

WHO

SYSCOM: ONR

Sponsoring Program: Code 34

Transition Target: Virtual training simulations for small unit infantry training.

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Other transition opportunities: This technology can be used anywhere a virtual training environment is part of the infantry training experience. Troop training is a costly effort and when training unit leaders, cost and logistics increase even more. Training can be improved by providing more repetitions at difficultly levels tailored to the students' proficiency level. Virtual training utilizing virtual humans developed using our technology is a cost effective way of reaching that goal.

Notes: Technology developed on this program can also be applied to automatically develop behaviors for autonomous platforms.

Image courtesy of Soar Technology, Inc.

WHAT

Operational Need and Improvement: Training simulations enable warfighters to develop skills without putting their safety at risk or incurring costs typically associated with training such as fuel, munitions, etc. Unfortunately, first person simulations used for infantry training require additional operators to control friendly and enemy units which limits their ability to train unit leaders above the squad level. By replacing operators with artificially intelligent agents (AIs), the cost and logistical challenges of training individual users is reduced and simulation-based training can be focused on higher echelon users, such as small unit leaders.

Specifications Required: DeepAgent requires a virtual training simulation in order to learn behaviors.

Technology Developed: Under the DeepAgent project, SoarTech has developed several algorithms for deep reinforcement learning and adapted them to work with multiple simulations used for small unity infantry training, DeepAgent achieved state-of-the art performance in a prototype version that learned behaviors in the popular computer game, StarCraft. DeepAgent has since been connected to Unity, where it controls fire team members a more complicated first person shooter environment.

Warfighter Value: The value to the warfighter is three-fold. First, this technology will reduce the logistical cost and effort of setting up multiple large-scale training exercises by allowing lower echelon users or opposing teams to be controlled by AI agents. Second, the developers of military simulations will experience a reduced cost in AI behavior development and an increase in AI behavior fidelity. Third, the warfighters, especially those in higher echelon positions, will be more prepared for their posts by receiving more frequent and higher quality repetitions making tactical decisions in training simulations.

WHEN

Contract Number: N68335-18-C-0539 **Ending on:** July 15, 2020

Milestone	Risk Level	Measure of Success	Ending TRL	Date
DRL Algorithms Implemented and Move to Cover Behavior Learned	Low	Score of learned behavior compares to or surpasses hand coded behaviors and human players	4	4th QTR FY19
Exploration and Exploitation Strategies Implemented for Behavior Improvement	Med	Score and qualitative analysis of learned behavior in harder scenarios with infrequent reward is comparable to human players	5	3rd QTR FY20
Learn Additional Strategic Behaviors	Med	Learn behaviors more complicated than move to cover, such as flanking, maneuvering with cover fire, orderly retreat, etc.	6	4th QTR FY20
Transition to Actively Used Simulation	High	Code integrated with simulation and DeepAgent running on on servers with active user base.	7	4th QTR FY21
Imitation Learning Implemented for Behavior Improvement	Med	Collected user data used to improve realism and skill of DeepAgent behaviors.	8	4th QTR FY22

HOW

Projected Business Model: SoarTech plans to sell behaviors learned using DeepAgent to either directly to the Government or prime integrator who provide virtual training simulations. These behaviors will have lower cost, more realism, and higher skill level compared to behaviors manually developed by humans.

Company Objectives: SoarTech is seeking an infantry training simulation to integrate with DeepAgent starting in Q4 2020. SoarTech is also looking to learn behaviors for autonomous platforms in a high fidelity simulation and apply the behaviors learned in simulation to platforms running in the real world.

Potential Commercial Applications: Compared to hand coded methods, our approach to agent behavior development reduces the time, cost, and expertise necessary to develop high-fidelity behavior for simulated agents. Additionally, automatic learning of behaviors has applications for robotic control. SoarTech has developed behavior models to support manned unmanned teaming on a variety of projects (DARPA Squad X, MCWL UTACC). Currently these behaviors are manually coded using Soar agents, but could eventually be automatically learned using DeepAgent. The ability to automatically learn effective and realistic behaviors for agents in a simulation has obvious application to the commercial simulation and gaming industry, but there are also many other applications. Imitation learning could be used for initially training robotic workers in factories using examples of human workers. Similarly, deep reinforcement learning algorithms could be used to learn strategies for maximizing return on investments, suggesting treatments or diagnosis to doctors, etc.

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