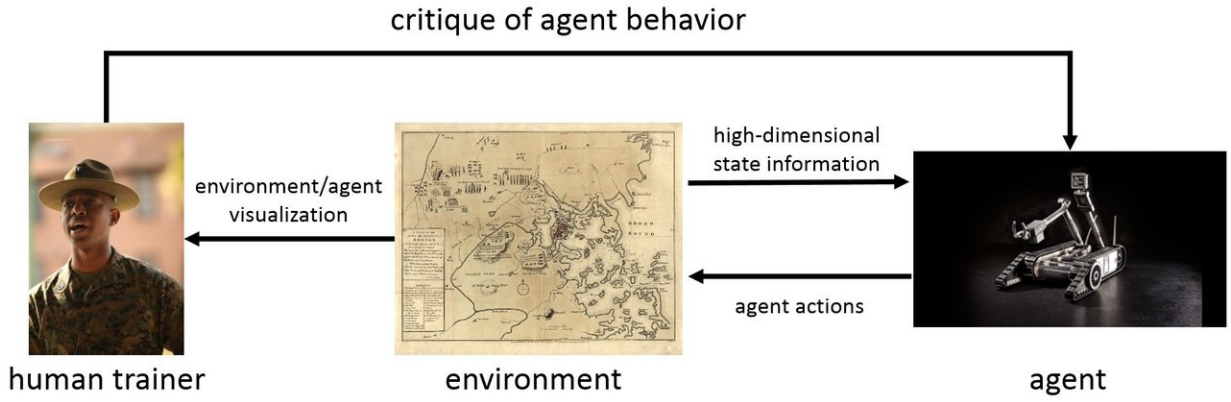
Researchers develop new algorithms to train robots

February 2 2018



The graphic depicts a high-level system diagram of the TAMER framework. Credit: US Army Research Laboratory

Researchers at the U.S. Army Research Laboratory and the University of Texas at Austin have developed new techniques for robots or computer programs to learn how to perform tasks by interacting with a human instructor. The findings of the study will be presented and published at the Association for the Advancement of Artificial Intelligence Conference in New Orleans, Louisiana, Feb. 2-7.

ARL and UT researchers considered a specific case where a human provides real-time feedback in the form of critique. First introduced by collaborator Dr. Peter Stone, a professor at the University of Texas at

Austin, along with his former doctoral student, Brad Knox, as TAMER, or Training an Agent Manually via Evaluative Reinforcement, the ARL/UT team developed a new algorithm called Deep TAMER.

It is an extension of TAMER that uses deep learning - a class of machine learning algorithms that are loosely inspired by the brain to provide a robot the ability to learn how to perform tasks by viewing video streams in a short amount of time with a human trainer.

According to Army researcher Dr. Garrett Warnell, the team considered situations where a human teaches an agent how to behave by observing it and providing critique, for example, "good job" or "bad job" -similar to the way a person might train a dog to do a trick. Warnell said the researchers extended earlier work in this field to enable this type of training for robots or computer programs that currently see the world through images, which is an important first step in designing learning agents that can operate in the real world.

Many current techniques in artificial intelligence require robots to interact with their environment for extended periods of time to learn how to optimally perform a task. During this process, the agent might perform actions that may not only be wrong, like a robot running into a wall for example, but catastrophic like a robot running off the side of a cliff. Warnell said help from humans will speed things up for the agents, and help them avoid potential pitfalls.

As a first step, the researchers demonstrated Deep TAMER's success by using it with 15 minutes of human-provided feedback to train an agent to perform better than humans on the Atari game of bowling - a task that has proven difficult for even state-of-the-art methods in artificial intelligence. Deep-TAMER-trained agents exhibited superhuman performance, besting both their amateur trainers and, on average, an expert human Atari player.

Within the next one to two years, researchers are interested in exploring the applicability of their newest technique in a wider variety of environments: for example, video games other than Atari Bowling and additional simulation environments to better represent the types of agents and environments found when fielding robots in the real world.

Their work will be published in the AAAI 2018 conference proceedings.

ARL Researcher Dr. Garrett Warnell, left and University of Texas Austin Professor Dr. Peter Stone, are part of a team that has developed new techniques for robots or computer programs to learn how to perform tasks by interacting with a human instructor. They are presenting findings of the study at the Association for the Advancement of Artificial Intelligence Conference in New Orleans, Louisiana, Feb. 2-7. Credit: US Army Research Laboratory

"The Army of the future will consist of Soldiers and autonomous teammates working side-by-side," Warnell said. "While both humans and autonomous agents can be trained in advance, the team will inevitably be asked to perform tasks, for example, search and rescue or surveillance, in new environments they have not seen before. In these situations, humans are remarkably good at generalizing their training, but current artificially-intelligent agents are not."

Deep TAMER is the first step in a line of research its researchers envision will enable more successful human-autonomy teams in the Army. Ultimately, they want autonomous agents that can quickly and safely learn from their human teammates in a wide variety of styles such as demonstration, natural language instruction and critique.

Provided by U.S. Army Research Laboratory