Innovation at the Front Lines

How Human-Machine Teams Help DOD Achieve Mission Success

As DOD embeds artificial intelligence and machine learning into its operations, warfighters are beginning to work alongside machines to drive mission success.

At a recent event, defense leaders came together to explain how.

Inside the Defense Department, humans and robots are joining forces.

As DOD and the Defense Industrial Base embed artificial intelligence and machine learning into their operations, warfighters begin to work alongside machines to drive mission success. Today, DOD leaders are working on projects that will enable smart and scalable AI innovation in the future.

But what do these pilots and programs actually look like and how can we apply them to future missions? That's the question DOD research leaders sought to answer at a **recent session** at Nextgov and Defense One's "Genius Machines" event. In case you missed it, here are a few key takeaways from the event.

1. Human Behavior Enables Machine Learning

Cynthia M. Bedell, director of the Computational & Information Sciences Directorate at the Army Research Laboratory, is one defense leader bridging the gap between human and machine intelligence. Her team is working on a number of projects that teach machines to act and respond to specific scenarios.

"We are taking how a human behaves and demonstrating what a human would do based on our mission command and running a robot through that with a joystick. The next time we give that robot that command, it can do it on its own," she said at the event.

Moreover, once these machines learn certain commands and understand how to complete specific tasks, they can train other machines to do the same.

Bedell and her team also leverage natural language processing programs to develop the language necessary to communicate with and train machines.

"We don't have to write it down. We don't have to text it. We don't have to code it. We can talk to the machine and it understands, because we've trained it in a certain mission space," Bedell said.

"**We know that there are really great ideas [and] innovative solutions** out there, and we pose it to the international community to bring [us] their best solutions."

— **Timothy Chung**, Program Manager of the Tactical Technology Office, DARPA

2. Train and Test AI In a Diverse Set of Environments

Teaching a machine to do something is one thing — testing its skills in a real-world environment is another. That's the problem Col. Tucker "Cinco" Hamilton, director of the Department of the Air Force Artificial Intelligence Accelerator at the Massachusetts Institute of Technology, is attempting to solve. His team is using virtual reality and simulations to train AI on how to operate in different types of environments. Of course, machine learning relies on data, which can be problematic.

"If we don't have data from particular environments, it's harder to train AI," Hamilton explained. "What we're realizing now is we need to be able to train these systems, because what if it's just an environment that we're not used to, that we don't have data from? Can we really gather data from all the different environments in [the] Arctic, in a desert, in a mountainous jungle? No, we can't."

Instead, he and his team train small unmanned aircraft systems in different types of virtual environments that adequately prepare them to transition into a real-world environment. Hamilton and his team of researchers are now testing how AI might assist in a rescue mission.

"We're [using] small UAS as deployed in a natural disaster scenario where they're going to go out and they're going to map the land," he explained. "They're going to be able to go into buildings, recognize where survivors are at and then direct the first responders to that location."

Meanwhile, at the Defense Advanced Research Projects Agency, the Tactical Technology Office is working on the "Subterranean Challenge," which seeks to transform how warfighters operate in the underground domain.

It's DARPA's version of a scavenger hunt. Teams of robots search for objects DARPA has placed in the subterranean environment and provide the first look at those settings. That means the robots don't just traverse and navigate through these unknown environments, but they also provide information to their fellow robots and — in some cases — a human supervisor.

"We like to describe the Sub-T Challenge as seeking out actionable situational awareness," said Timothy Chung, program manager of the Tactical Technology Office at DARPA.

The value of this type of grand challenge, Chung said, is that it's open-ended. DARPA isn't looking for a set solution. Instead, it invites innovators to come up with their own, creative answers to complex problems.

"We know that there are really great ideas [and] innovative solutions out there, and we pose it to the international community to bring [us] their best solutions," he said.

One of the key takeaways from the Sub-T Challenge has been what Chung refers to as the "value of heterogeneity," where different capabilities and solutions work together to achieve strategic and tactical applications in challenging and uncertain environments.

3. Humans and Machines Must Work Together

The alliance between humans and machines doesn't have an expiration date. Looking ahead, these entities must continue to work together to drive successful mission outcomes.

One project that could have future implications for how warfighters — and Air Force pilots, in particular — leverage AI is a program underway at the USAF-MIT AI Accelerator.

As part of the experiment, Hamilton explains, MIT undergraduate pilots use AI-powered assistants during simulation tests. Typically, when pilot trainees learn to fly, they participate in a simulation exercise. However, if the trainee fails the test, their simulation instructor will ask them to walk through the process and identify exactly what they did wrong.

"The real benefit of having an AI-powered helper in this scenario is that AI can actually pinpoint very accurately why a student wasn't doing a certain thing because it can monitor many things that are beyond what a usual [simulation] instructor would monitor, primarily biometric data," Hamilton said. "So what we're trying to create is a sim[ulation] instructor that's informed by this type of technology."

The goal of this pilot program — and many of the other projects at the USAF-MIT accelerator — is to prove humans and robots work better together.

"It is all about human-machine teaming," Hamilton said. "It has to be."

Of course, the unlikely partnership between humans and machines also gives the U.S. military a leg up against its adversaries.

"The convergence of lots of different methods of providing human-machine teaming, the methods in which you can enhance that interaction between the different team members, human or otherwise, I think that's going to dramatically accelerate how effective[ly] we might be able to manage complexity and ... uncertainty," Chung said.