Taking human-technology interaction to the next level

April 25 2014, by Joe Kullman

Panagiotis Artemiadis (right) directs the Human-Oriented Robotics and Control Lab, focusing on human-oriented robotics and control systems. He will apply his expertise in the field in new research for the Air Force. Credit: Jessica Hochreiter/ASU

(Phys.org) —Modern military defense planning is already heavily focused on how to gain strategic advantage through brainpower. Another significant step in that direction could result from an Arizona State University engineer's new research on using cognitive abilities to control defense operations in more direct ways than ever.

Panagiotis Artemiadis is exploring the potential for effective control of technology "simply by thinking."

His project serves the growing needs of the U.S. Air Force for more advanced "mixed human-machine decision making," as described by the Air Force Office of Scientific Research.

The agency wants the research to provide methods and models for developing "an actionable knowledge framework between humans and multi-agency systems." For instance, a system enabling direct communication from an individual's brain to a squadron of unmanned semi-autonomous aircraft.

Artemiadis was recently awarded a grant of $360,000 from the Air Force's Young Investigator Research Program, which seeks to put younger scientists and engineers "who show exceptional ability and promise for conducting basic research" to work helping the Air Force solve its technological challenges.

His project was one of only 42 selected from more than 230 proposals for funding from the program.

Artemiadis is an assistant professor of mechanical and aerospace engineering in the School for Engineering of Matter, Transport and Energy, one of ASU's Ira A. Fulton Schools of Engineering.

His expertise is in the field of robotics and control systems, focusing human-oriented robotics, ranging from prosthetics and exoskeletons to rehabilitation and assistive robotic devices.

He is the director of the ASU's Human-Oriented Robotics and Control (HORC) Lab and the editor-in-chief of the research journal Advances in Robotics & Automation.

For his Air Force project, he will explore the brain's perceptive and predictive capacities to assess its ability to perform effectively in "human-swarm closed-loop" communication and control systems.

At a fundamental level, he is seeking to better understand "the mechanisms involved in how the brain perceives information it receives from observing moving multi-agent systems."

In this case, "swarms" and "multi-agent systems" refer to multiple robotic, autonomous vehicles in motion, primarily aircraft.

"We are going to look at people's brain signals while they are watching swarms, and understand how the brain perceives high-level information from these swarms," Artemiadis explains.

The goal is to find out if individuals can reliably maintain a high level of cognitive performance in coordinating the movements and actions of a swarm. The controllers would need to prove themselves capable of effectively strategizing both reactively and proactively in high-pressure, high-risk situations.

Such a closed-loop, brain-machine interface system would integrate the observational capacities of the human and the machines. "It's a mixture of your perception and the machines' perception," he says.

While this mix of perceptions would be accomplished through a system involving human-computer interaction, the computer functions simply as a conduit for communications between machine and an individual's cognitive activity.

"You would not have to send a command by typing on a computer keyboard or by voice command," Artemiadis says. "You literally would just have to think about it."

The idea sounds "a little like science fiction," he adds. "It is beyond the human-technology interaction systems we have at the moment."

Artemiadis will be able to give at least two ASU engineering doctoral students opportunities to assist him in the research.

Provided by Arizona State University