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Advanced Technology Laboratories

TECHBRIEFS

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Technology: Unmanned Vehicle Autonomy and Teaming

Teaming with Robots

Introduction

"The problem with most robots is that they tend to be, well, robotic. They … can do nothing they aren't programmed to do. But for many applications where robots could be useful, they need to be more like humans, able to respond as a cooperative partner rather than as a mindless machine" (*Scientific American Frontiers*, April 2005).

Today, the military and homeland security require a robotic vehicle that possesses intelligent autonomy —the ability to reason in real time and dynamically adjust to changes that affect how it conducts its mission. It must be able to analyze the environment, understand the mission and its own limitations, and be able to coordinate its activities with other robots and human team members.

Today

The military has a broad array of "autonomous" unmanned vehicles in service —from tracked bomb disposal vehicles to highly sophisticated unmanned aircraft and submarine vehicles. But autonomy comes in degrees and, in reality, even the most modern operational systems, on a scale of one to ten, are only approaching an Autonomous Capability Level of four. Such autonomy, for example, would allow an unmanned aircraft to be launched on a pre-programmed route using waypoints for navigation and return safely.

The Next Level

ATL is advancing the levels of unmanned vehicle autonomy through externally and internally funded research, developing technologies that will support Lockheed Martin products and that enable warfighters to effectively exploit current—and enable new—concepts for unmanned vehicles.

A team of robots embark on a role-based team mission from ATL's robotics laboratory. Each robot has a specific role as well as an understanding of the roles of its teammates.

For example, ATL is developing intelligent autonomy technologies that allow multiple unmanned vehicles, often with different individual capabilities, to work effectively as a team to accomplish a mission.

Research Areas

One ATL internally funded program is exploring "implicit coordination" of a team of robots. Implicit coordination allows unmanned vehicles to work with each other—without communication—by inferring the behavior of teammates.

By combining role-based operations and game-theory algorithms, ATL expects to enable a team of robots to determine the best joint action to achieve their mission based strictly on observations of teammate actions, events in the environment, and models of each team member's roles and capabilities.

In 2005, ATL began research into robot-human teaming using natural spoken-language understanding* and dialogue. In the ATL prototype, a person can give a robot an assignment verbally such as "Go tell Captain Smith that the demonstration is ready." Programmed with a map of the building, the robot "knows" only that the Captain's office is in the west wing. It must ask questions of people it encounters, understand the directions given such as "…two doors down on the left," and deliver its message.

Intelligent teaming is just one way in which ATL is expanding the operational capabilities of unmanned systems.

*See Tech Brief Volume 1, Number 1, March 1, 2006.

For More Information:
Lockheed Martin Advanced Technology Laboratories
Hugh Pearce, PhD, Director Business Development
3 Executive Campus • 6th Floor • Cherry Hill, NJ 08002
856.792.9810 • hpearce@atl.lmco.com