ON GUARD
Managing Multiple,
Semi-Autonomous Vehicles

Aiming to radically reduce the workload for human operators of semi-autonomous underwater, ground and aerial vehicles in military and civilian contexts, Professor Christos Cassandras (ECE, SE) and Associate Professor Calin Belta (ME, SE) are developing intelligent single agents—robots, UAVs and other technologies that compute, communicate and control—that can interpret and reason about their environment in changing conditions, as well as networks of multiple agents that can safely and efficiently coordinate their activities with other agents and human operators.

Their efforts are part of a $7.5 million project funded by the Navy that since 2009 has tasked machine learning and control theory experts from BU, MIT, University of California-Berkeley and University of Pennsylvania to engineer more intelligent and autonomous vehicles. Ideally, the technology will enable vehicles to make decisions independent of human interaction except when absolutely necessary—regardless of changes in weather, lighting or other ambient conditions. In the military theater, the ultimate goal is to create teams of persistent surveillance agents to give combat vehicles the edge in detecting and responding to hostile targets.

To maximize single-agent autonomy, Belta has developed a computer language that translates an operator’s simple, structured English instructions into machine code that controls the agent’s motion and communication throughout a mission, from avoiding certain territory to coordinating specific activities with other selected agents.

Meanwhile, Cassandras is developing algorithms that optimize how multiple agents cooperate to solve persistent surveillance problems. He likens the effort to coordinating the movement and communication of multiple PacMan “enemies” tasked to eat up all displayed dots—which collectively mark the region under surveillance—as quickly as possible. Cassandras plans to translate his “dot-eating” algorithms into directions, such as start, stop, wait, or turn around, that robots running on Belta’s computer code can follow, and thus survey a defined space.
A persistent surveillance scenario in which multiple agents coordinate to survey a complex scene with areas weighted by importance and recognize abnormal activity. (Photo courtesy of the Office of Naval Research)