Swarms & Robot-to-Robot Collaboration

How well do your robots coordinate?

Poor coordination among teams of robots performing high-risk tasks—such as casualty extraction, scouting, and explosive device countermeasures—can endanger the personnel they are supposed to protect.

Charles River Analytics provides system components that ensure robots and swarms can leverage collective intelligence and robot-to-robot coordination to safely and efficiently achieve their objectives.

With our components installed, robot swarms can share information, learn and understand human intent, and relay mission-critical information to a human operator with ease, achieving mission-critical tasks otherwise infeasible for a single robot.

Our core technologies fuse real-world experience and cross-validation so robots can work together seamlessly, using biomimetic algorithms and deep machine learning to get the job done.

Are you looking to apply robot-to-robot collaboration technology to your AI components? See how we've advanced these capabilities for our customers.

## Biology-Inspired Algorithms and Robotic Swarms

The DoD, through efforts like DARPA's Offensive Swarm-Enabled Tactics (OFFSET) program, seeks to keep personnel safer with autonomous robots that can perform risky tasks, such as scouting and mine countermeasures. To support OFFSET, Charles River developed capabilities to provide heterogeneous swarms of unlimited size with swarm behaviors that make the swarms resilient to the unforeseen complexities that arise during a mission. Through biology-inspired algorithms and deep machine learning, our robotic swarms can adapt to maintain and achieve mission objectives.

Our Swarm Algorithms and Tactics for Urban Reconnaissance and Isolation (SATURN) effort makes it easier for Warfighters to develop and share swarm tactics in rapidly evolving urban settings, and frees them to perform other critical tasks. In urban missions, unmanned air and ground vehicles provide countless benefits—*for example*, drone swarms can perform risky missions, such as building clearance and reconnaissance.

As one of the "sprinter" teams selected to develop tactics for successful swarm deployment, we created and tested our own novel swarm tactics within the OFFSET testbed, working closely with DARPA, the integrator team, and other sprinters to implement our collective ideas.

Our autonomous swarm systems can offer Warfighters in the field a significant advantage. We fused our swarm tactics, primitives, and algorithms with bio-inspired approaches to create scalable communication between swarm vehicles, decentralized task allocation, and resilience in austere conditions.
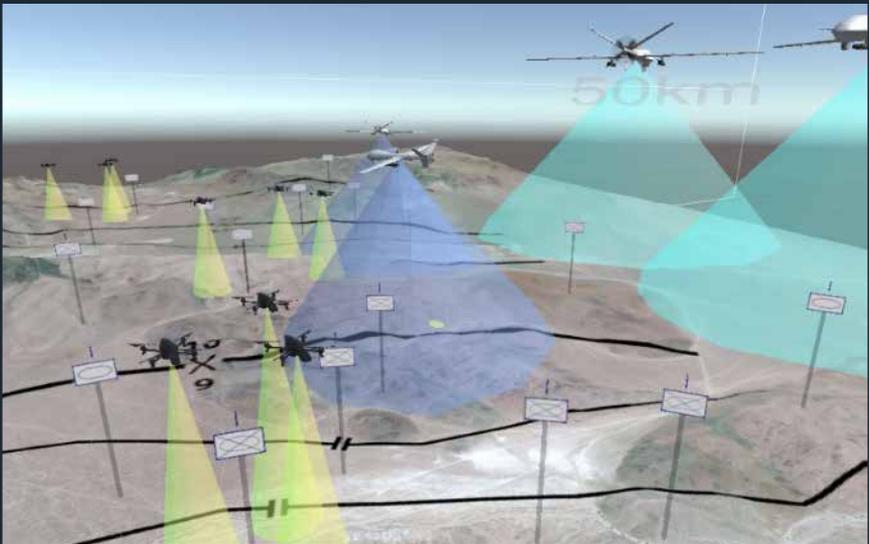
DARPA's OFFSET program aims to make small-unit combat forces operating in urban environments more effective with highly autonomous swarm technologies.

Integrating Sensing Capabilities into Autonomous Robots

Unmanned systems can provide significant operational benefits on dangerous protection tasks, such as casualty extraction and evacuation (CASEVAC). These systems can both remove first responders from harm's way and improve the outcomes of combat casualties by enabling CASEVAC under hostile conditions.

To support unmanned casualty extraction, we are integrating proven sensing and autonomy capabilities into a modular hardware/software Body-Aware Robotic Appliqué for Collaborative Evacuation (BRACE).

A simulation of two BRACE-enabled platforms approaching a casualty before collaboratively lifting and dragging him to a safe position.

BRACE uses state-of-the-art perception technologies to support effective manipulation, navigation, maneuvering, and obstacle avoidance in varied operating conditions. BRACE performs dynamic world modeling, 3D casualty perception, path planning, and localization onboard each vehicle. BRACE also shares relevant information to networked unmanned and manned teammates with a communications manager optimized for constrained-bandwidth networks.

Our envisioned hardware and software kit enables plug-and-play integration with current and future unmanned systems, giving BRACE unprecedented adaptability. Our development and integration of next-generation technology can significantly improve trauma care on the battlefield, increasing safety and saving lives.

About Charles River Analytics

Charles River Analytics has been at the forefront of human-centered AI R&D, implementation, and deployment for decades. We transform our customer's data into mission-relevant tools and solutions to support autonomy and human decision-making. Charles River continues to grow its technology, customer base, and strategic alliances through programs for the NIH, DoD, DHS, NASA, and the Intelligence Community. We address a broad spectrum of mission areas and functional domains, including sensor and image processing, situation assessment and decision aiding, human systems integration, cyber security, human-robot interaction, and robot localization and autonomy. We take on the most challenging problems in the most difficult environments, and deliver insights that lead to action.

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COLLABORATION