Interfaces for Controlling Teams of Wide Area Search Munitions

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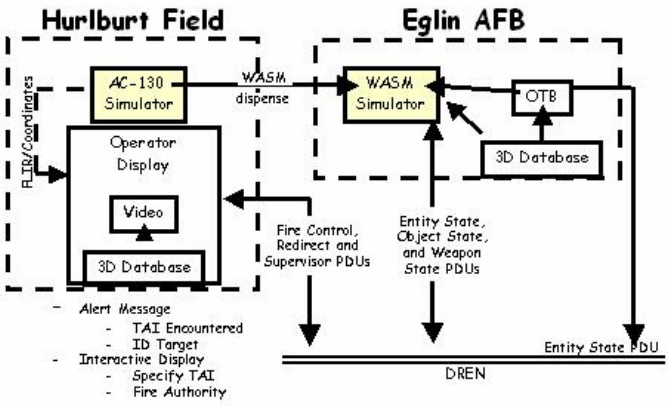
Wide Area Search Munitions (WASMs) are a cross between an unmanned aerial vehicle and a munition. The WASM cannot land; hence it must either end up hitting a target or self-destructing. The sensors on the WASM are focused on the ground and may eventually include video as well as ladar with automatic target recognition (ATR). The Low Cost Autonomous Attack System (LOCAAS) was the first generation of search munitions. Once launched the LOCAAS is fully autonomous and attacks the target recognized by its ATR. When multiple independent WASMs fly in close proximity there are potential problems that may arise including fratricide, strikes against already dead targets, suboptimal coverage of the search region, and absence of battle damage assessment that could be resolved by cooperation among munitions. The WASM concept we are investigating envisions artificially intelligent munitions that communicate and coordinate with one another and human operators to perform their tasks more effectively.

Because cooperating WASMs have not yet been produced, research into strategies for controlling them presents a chicken and the egg problem. We are approaching this problem by simulating WASMs as accurately as possible and evaluating them in human-in-the-loop simulations for a variety of potential applications. The process is a bootstrapping one in which we provide simulated WASMs as a prop to help users identify the most effective concept of operations (conops) for their tasks. The new conops then serve to refine our approaches to cooperation and the user interface. By the end of this process we hope to have searched the space of potential users and uses to find the most appropriate WASM roles and to adapt the user interfaces and behaviors to suit them.

In our first scenario a team of WASMs is launched from an AC-130 aircraft supporting special operations forces on the ground. The WASMs will protect the flight path of the AC-130 into the area of operations, destroying ground based threats as required. Once the AC-130 enters a circling pattern around its targets, the WASMs will set up a perimeter defense, destroying targets of opportunity both to protect the AC-130 and to support the soldiers on the ground. Even under ideal conditions there will be only one human operator on board the AC-130 responsible for monitoring and controlling the group of WASMs. Hence, high levels of autonomous operation and coordination are required of the WASMs themselves.

Initial trials using an AC-130 simulator at Hurlburt Field and a modified Lockheed-Martin LOCAAS simulation are scheduled to begin in February 2004. In these trials the navigator and fire control officer in the rear of the plane will have access to the WASM control interface. As interaction between these stations and the pilots is limited, pre-recorded flight paths will be used for the experimental flights. A parallel set of trials will be conducted at the University of Pittsburgh using MatLab simulations to approximate LOCAAS flight dynamics. In these trials we will begin evaluating more sophisticated coordination protocols using RETSINA (Sycara 1998) agents to supply waypoints to the WASM autopilots.

In this presentation we will describe our simulation infrastructure, the sketching interface we have designed to direct the behavior of teams of search munitions, and our experience in the initial trials for the AC-130 support task.



Simulation configuration for initial trials

WASM control display with targeted area of interest (TAI) sketched out for tank depot (encircled area) with line TAIs following adjacent roads to get any vehicles that try to escape.

Sycara, K.P. 1998. Multi-Agent Systems. AI Magazine, 10(2): 79-93.