FROM SENSING TO MAKING SENSE

Uav-based Optical Standoff Identification Capability

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ABSTRACT:
Collins Aerospace is developing an aerosol chemical detection concept that utilizes an unmanned aerial vehicle (UAV)-based optical standoff capability to enable improved, safe, and time critical identification of aerosol plumes during a battlefield chemical attack. This UAV-based system is designed to safely provide collection and near real-time analytical capability through on-board data mensuration and transmission. The end-state goal is to rapidly inform frontline commanders about the dimensions and composition of a potential aerosol threat without exposing personnel or critical resources to the chemical hazard.

The system approach leverages a single combat UAV platform carrying a chemical analysis payload, and a series of miniature, low-cost, expendable UAVs deployed for sample collection. In a chemical-threat incident, the sample collecting expendable UAVs are deployed near the plume and enter the aerosol cloud to collect aerosol particles on a dedicated external sample collection panel. After collecting, the expendable UAVs maneuver to a standoff position that is near and coordinated with the combat UAV's chemical analysis payload. The chemical analysis payload interrogates the expendable UAV's sample-surface at the standoff position using Ultraviolet (UV) Raman spectroscopy and reports the chemical composition data back to a command center using the combat UAV's data link. Additional expendable UAVs can be deployed to sample and interrogate the aerosol plume, then stand off to the combat UAV in response to dynamic situations. This concept system is designed to operate autonomously as a mission payload using existing military C2 and data architectures.
The logic for this multi-UAV approach addresses three considerations as follows.

Strategy -Having both the sampling and analysis capabilities close to the aerosol threat enables actionable information to be transmitted rapidly and safely to decision makers during a potential chemical attack.

Capability - Optical standoff detection for chemicals is extremely challenging, and more so during dynamic conflict. While UV-laser systems have proven to work well identifying chemicals on solid surfaces (wall, ground, door-handle, etc.), these systems have not demonstrated similar reliability in analyzing aerosol clouds. Both the interrogating laser beam and the return optical signal are diminished by the light scattering effects of the aerosol, making detection difficult and unreliable. By collecting aerosol particles with a direct sampling system on a low-cost, expendable UAV and presenting them to a UV-laser detection system in near real time, the problem is converted from an aerosol problem to a surface problem that leverages proven methods while preserving the capacity for rapid analysis.

Safety – At the end of the mission the contaminated, expendable UAVs can be abandoned or flown to a suitable location for disposal without creating a contamination exposure risk to personnel. The combat UAV with the detection analysis payload, because it was flown at a safe distance from the chemical plume, can be recovered with minimal risk of contamination and subsequent impact to personnel.

This presentation will describe the design concept, performance expectations and anticipated boundary conditions for this multiUAV chemical detection strategy.