

FROM SENSING TO MAKING SENSE

Fully Autonomous Aerial Chemical Plume Mapping

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Fielded CBRN equipment is primarily handheld or vehicle mounted, often requiring the Warfighter to enter a location before being able to know if it contains a CBRN Hazard. Conducting reconnaissance of an area to locate and map these hazards can require a high level of attention and time increasing danger to complete the task. To automate and to expedite broad area chemical (and radiation) threat mapping, Draper has developed CBRN Autonomous Aerial Reconnaissance System (CAARS) funded by Joint Program Executive Office – Chemical, Biological, Radiological and Nuclear Defense (JPEO CBRND) and the CBRN Sensor Integrated on Robotics Platform (CSIRP) effort. The CAARS system, with minimal input to define the area boundary limits, autonomously locates and maps hazards with no further input from an operator once launched. CAARS integrates multiple technologies including Draper's All Domain Execution and Planning Technology (ADEPT) Autonomy Mission Manager, sensor driven mapping/tracking algorithm, COTS unmanned aircraft (UA, drone), Tactical Assault Kit (TAK) Plugin for planning, monitor, control and networking, and modular hot-swappable COTS/GOTS Chemical and Radiation Detectors. With CAARS, the operator can quickly define a search area in TAK, launch the UAV with a button click; the UAV will power up, ascend and transit to search area, initiate initial systemic search to detect, contour map the extent of a chemical plume, return and land safely. The data from the chemical sensor directs the flight path of the UAV to map the moving chemical plume contour with aid of an onboard anemometer. The autonomy and mapping algorithm is onboard the UAV and the system does not require communications with tablet/human to complete the recon/mapping; it is fully autonomous and if comms is lost, contour map information can be retrieved upon return or when comms are reestablished. The second-by-second chemical contour map is displayed real-time on an Android tablet using the TAK CSIRP Plugin. The CAARS data is automatically available on the TAK Network; adjacent units and the chain of command can monitor the real-time display of the chemical plume contour map. Currently, multiple CAARS systems can be launched to cover a much larger area or two UAVs in the same search space to generate a contour map at two different heights which can be later integrated to determine the volume of the plume. For additional flexibility, the search area can be changed/updated to an entirely new area while conducting current recon mapping mission. The program presents the data from multiple chemical mapping flight tests including those executed by recently trained active-duty soldiers from chemical units at several test events and capability demonstrations.

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