

Phase I Project Summary

Firm: Intelligent Automation, Inc.

Contract Number: NNX13CL19P

Project Title: Unmanned Aerial System (UAS) Safety Analysis Model (USAM)

Identification and Significance of Innovation: (Limit 200 words or 2,000 characters whichever is less)

The key innovation of this effort is the development of an integrated, data-driven safety analysis framework to analyze the safety issues resulting from interaction between a piloted aircraft and an *Unmanned Aerial System* (UAS) so that it provides a credible basis to the safety regulators while designing and modifying the operating rules and procedures to facilitate the “safe and efficient” integration of UAS in the NAS. To this end, Intelligent Automation, Inc. (IAI) and its partners, CTSi and LCR, developed a three-step safety analysis approach: **(1)** generating and **selecting conflict scenarios** involving a UAS and a piloted aircraft, **(2)** running CRM (Collision Risk Model) on the identified conflict scenarios to obtain the **conditional probability of collision**, and **(3)** establishing a **causal link** to the conditional collision probability from the second step using ASRM (Aviation Safety Risk Model). It is the synergistic combination of existing models that make this proposed effort unique and valuable. The combination of the IAI-provided encounter geometries along with the existing safety analysis framework and collision probability models allowed the team to provide an in-depth look at the safety issues surrounding the introduction of UAS aircraft in the National Airspace System.

Technical Objectives and Work Plan: (Limit 200 words or 2,000 characters whichever is less)

The primary objective of Phase 1 was to develop an approach for safety analysis of issues that are expected to arise when UAS are integrated in the NAS in the near future. The resulting methodology can be used by the safety regulators and policy makers to facilitate “safe and efficient” integration of UAS in the NAS. The specific objectives of Phase 1 included:

Objective 1. Integrate the screening tool (ACES), CRM, and ASRM into a combined UAS Safety Analysis Model (USAM).

Objective 2. Demonstrate the utility of USAM by actually computing risk probabilities for the identified conflict scenarios.

Technical Accomplishments: (Limit 200 words or 2,000 characters whichever is less)

The primary technical accomplishment of USAM was to demonstrate to NASA that the synergistic combination of the three modeling tools, namely, ACES, CRM, and ASRM, produced the prototype of a comprehensive safety analysis framework that can help identify, analyze, and quantify the safety issues that are expected to result from the integration of UAS in the NAS. The team built a technical framework to exchange data among the three tools and demonstrated that these tools are very complementary in nature. ACES was used as a screening tool to generate and selected specific encounter geometries. CRM was used as a tool to compute the probability of collision. Finally, ASRM was used to establish a causal link for the “effects” identified by CRM.

The team demonstrated this synergistic interaction among these three models by analyzing three specific conflict scenarios that involved UAS and a piloted aircraft.

NASA Application(s): (Limit 100 words or 1,000 characters whichever is less)

USAM will represent a valuable analysis tool that NASA researchers can use to assess the safety component of their proposed future NAS configurations, including future NextGen improvements. We believe that, in the very near future, all safety assessments will have to include a UAS component. The reason that they do not already require a UAS component is that a tool such as USAM does not exist. With the existence of USAM, safety analysis including UAS vehicles will become a possible, and ultimately required, part of all future NextGen analyses. The demand, therefore, by the research community for USAM is expected to be high.

Non-NASA Commercial Application(s): (Limit 200 words or 2,000 characters whichever is less)

Federal Aviation Administration (FAA): The FAA will require a system to methodically compute the probabilities of hull loss, separation violations, collisions, and the risk to the public, before approving any change to the NAS which allows UAS flights. A tool such as USAM plus other extant FAA analysis techniques will be needed to compute such an assessment.

Other government and commercial applications: Any government agency or commercial organization considering using UAS in the civilian airspace for their work—including the Department of Homeland Security, the Department of Defense, local police departments, UAS manufacturers, UAS users, and so forth—will need a tool like USAM to assess the risk of each mission before flying them. With the information provided by USAM, such agencies can modify their flight plans if necessary or modify the parameters of the mission to ensure that the computed safety probabilities are within tolerable limits.

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