This study developed and analyzed the use of a live virtual constructive (LVC) framework capable of simulating ionizing radiation damage to Unmanned Aerial Vehicles (UAV) during a nuclear power plant disaster. UAV response promises greater safety to humans over helicopters as well as provides longer survivability in the presence of irradiated environments. However, electronics in unmanned systems are subject to radiation damage and over time eventual failure. A LVC simulation framework may offer an independent and low-cost assessment of equipment life expectancy. Knowing life expectancy of equipment for operational scenarios is critical for emergency management planners. This research creates an enhanced RASCAL-LVC simulation framework by modeling and simulating NPP disaster radiation release based on the NRC RASCAL simulation and radioactive cloud dispersion in STAGE. The resulting framework enables analysis of length of operational survivability of UAV electronics for three illustrative missions. The three scenarios examined are: (1) an In-And-Out Mission that simulates Parts Delivery, Surveillance, or passenger pickup/delivery; (2) a Fukushima-like Spent Fuel Pool water replenishment mission with radiation hot spot; and (3) an exploratory Chernobyl-magnitude Reactor Fire-extinguishing Mission with an open reactor radiation hot spot. More generally, the enhanced RASCAL-LVC framework is capable of: (1) supporting human-in-the-loop training and mission rehearsal; (2) design and analysis of a broad spectrum of NPP disaster scenarios and mission responses; (3) analysis of various response vehicles within mission-scenario combinations; and (4) system engineering support to each system's life cycle.

Major: Industrial Engineering

Educational Career:
Bachelor’s of Technical Systems Management, BS, 2011, University of Illinois - Urbana Champaign
Master’s of Systems Engineering, MS, 2013, University of Central Florida

Committee in Charge:
Michael Proctor, Chair, IEMS
Adan Vela, IEMS
Ivan Garibay, IEMS
Charles David Sulfredge, Oak Ridge National Laboratory

Approved for distribution by Michael Proctor, Committee Chair, on November 30, 1999.

The public is welcome to attend.