Research Task / Overview

- Swarm systems are being engineered without guidance from swarm doctrine.
- Informal relationship between swarm mission engineering and swarm systems engineering is impeding architecture reusability.
- Swarm system architecture is dominated by bottom-up, behavior-based design.

Swarm Commander must make a cognitively burdensome number of decisions to manage behaviors of each sub-swarm:

- Informal
- Operated at single behavior level
- Different action plans for each mission
- Low flexibility
- Micro-management approach

Goals & Objectives

- Formalize relationship between swarm mission engineering and swarm systems engineering to promote architecture reusability.
- Transfer typical rule-based decisions from the Swarm Commander to the swarm, freeing the human to make rules of engagement related decisions.

Methodology

1. Develop mission scenario
2. Depict swarm behavior at tactic level
3. Develop mission simulation (beginning at phase level)
4. Check for logical errors
5. Review implementation with stakeholders
6. Revise tactics
7. Swarm doctrine & swarm system requirements

System Architecture

- Mission
- Phases
- Plays
- Tactics
- Algorithms
- Missions
- Sub-swarm
- Play
- Sensor
- Maneuver
- Evolve
- Generate

Operational Architecture

Solution Architecture

Future Research

- Support improved graphical user interface for UAV swarm operations.
- Explore additional software tools that allow for easier exhaustive use-case generation directly from finite state machine.
- Incorporate system and operational failure modes into simulation.
- Develop swarm system measures of performance.

Contacts/References

- CDR Katy Giles, USN  kbgiles@nps.edu
- Advisor: Dr. Kristin Giammarco, Ph.D.  kmgiamma@nps.edu