**CASE STUDY**

**A mission-based architecture for swarm unmanned systems**

PART 1

An amalgamation of mission engineering approach with model-based systems engineering has been used in this paper for the swarm unmanned systems. Enabling one individual, which is the swarm commander usually, to control multiple vehicles with a far less cognitive load than that employed using current systems engineering design methods are the aim of this research. The designs already used for the swarm system design have been discussed. Bottom-up swarm system design, top-down swarm system design, and mission-based composable architecture have been discussed to draw an effective understanding. Mission-based architecture for swarm composability (MASC) is the architecture proposed for this research. Attributes inculcated for the research ensure reusability. A group of more than 20 self-organized homogenous UAV has been considered. A streamlined methodology from developing mission scenarios, depicting swarm behavior, developing mission simulation, reviewing implementation to revising tactics and swarming system requirements. Finally, after applying the MASC framework, evaluation for the effectiveness to promote architecture reusability and MASC’s modularity, composability, and doctrine integration are assessed to support the evaluation. Redesigning the tactics level to a higher level of abstraction by providing a greater distinction between tactics and plays is mentioned in the paper as a potential improvement to MASC for future work.

PART 2

Rapid growth and demand in the government and private sectors about unmanned systems is bringing an increasing interest in swarm systems technology. It is interesting how swarm agents that are “unintelligent and ineffective as individuals” interact among agents to “produce beneficial emergent behavior enabling system-level robustness, flexibility, and scalability”. The idea is to produce an operationally suitable product and connect the mission with a detailed design in the process. Swarm commanders would be managing things at the higher level of abstraction. The focus of the mission is to develop an architectural framework that incorporates multiple levels of autonomy. “Decision selection” and “action implementation” from Parasuraman's model have been brought to light. A mission-focused swarm architecture at a higher level of abstraction facilitates operator engagement in the system architecting process.

The research aims at contributing towards the long-term capability for controlling multiple vehicles having far less load as compared to the current system design methods. MASC (mission-based architecture for swarm composability) intends to integrate key attributes for increased reusability across the conceptual-level architecture.

PART 3

There must have been a strong study to support the use of the MASC framework especially when it is relatively less researched which thereby increases the chances of running into a problem even more. A contrast of why MASC has been chosen over other already existing frameworks would have been better. Multiple modifications in the MASC framework during the course and adding the aspect of the phase of it in an intermediate phase could be a challenge in keeping up the promise with providing robustness to the system. In the part of the paper were checking for logical errors has been discussed, the approach could have been much more precise. It is a theoretical approach that has been laid down and understanding the logical errors could have been consolidated with a nice example. Architecture element levels were not properly considered for appropriateness which is a key basis or the structure on which the research has been laid down upon. A need for a graphical interface was already felt for the swarm system and instead of forming it as a part of future implications, it could have had been inculcated in this research itself which would have been a great boost to the performance needed to support the acquisition.

PART 4

As discussed, a graphical interface for the swarm system must be taken care of that leverages the strengths of humans and machines as a team is an important research area for swarm systems. Since the framework has already been worked upon, a small study on the robustness or an experiment to prove it practically must be performed which ensures the scalability of this framework shortly as well. The paper itself mentions that the swarm algorithms reside at the boundary at which the operational architecture and the solution architecture meet and assigning the perfect or most suitable algorithm to each swarm play is a big task on its own. As the study and future research take place in the field, there would be much to say, discuss and critique about swarm systems which would be a healthy way to learn about these systems and ensure a smoother process in the near future.