The increasing need to provide new capabilities, quickly and affordably, in response to continuously changing environments often results in the acquisition of system of systems (SoS) as the preferred solution. Highly utilized by the DoD and NASA, the concept of SoS has gained increased attention in variety of domains including space sciences, where clusters of complex systems are linked in order to cooperatively accomplish commercial, civil, and military missions. The increasing application of SoS calls for innovative approaches that deal with the design, development, integration and management of such complex systems.

Due to the dynamic nature of today’s mission environments, SoS raises unique operational and developmental challenges, including the method for selecting the “right mix” of systems to meet operational capability and program requirements. This talk will present a methodology for selecting the preferred SoS solution to accomplish a specific mission. This methodology starts with SoS capability requirements and mission objectives, and provides decision-makers with a systematic approach that may be repeatedly used to identify and select candidate systems, generate a library of operationally capable SoS solutions, and make trades between various feasible SoS solutions during the early stages of SoS mission planning and acquisition. As an integral part of this methodology, an approach is presented to estimate a lower-bound mission reliability for SoS solutions in which SoS is operating a phased mission and its constituent systems are capable of exchanging data through datalink. Advanced data analysis and machine learning techniques have been implemented to enable the screening of a large number of feasible SoS solutions in a high-dimensional space, in order to present the best solution to stakeholders.

The second part of the talk explores research avenues where the SoS concepts and systems engineering principals and best practices can be used to develop methodologies and models to support decision making in space situational awareness.

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