

SPACE SYSTEMS SYMPOSIUM (D1)
Space Systems Architectures (4)

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EVALUATING SOURCES OF VALUE IN FRACTIONATED SPACE SYSTEMS

Abstract

Fractionated space systems, in which two or more spacecraft function together as a larger more capable system, are of growing interest due to potentially large increases in overall system value. The DARPA F6 (Future Fast Flexible Fractionated Free-Flying Spacecraft united by Information exchange) program has sought to advance this architectural concept for future space systems. This paper first identifies the different sources that potentially contribute, both positively and negatively, to the fractionated system value over its lifecycle. The impact on value of the different sources is then evaluated using monte-carlo simulations of a space system development, launch, and operation scenario. The overall process is modeled using a network of Markovian states for spacecraft and payloads with a series of decision nodes and chance nodes. The decision nodes serve to model the actions taken by an operator in the face of different events that may possibly occur. The chance nodes allow for capturing the different uncertainties that exist in space programs. The sources of value (SOV) that are initially enumerated are lumped together in six main classes that correspond to the six types of uncertainties. Using this approach, the effect of these lumped sources of value is investigated by systematically toggling the chance nodes in the Markov diagram. In each simulation run, the NPV of the system is computed over a time horizon of several years. Using the result of the simulations, Value- At - Risk and Gain curves are constructed that provide probabilistic estimates of the system lifecycle value. The effect on the VARG as a result of toggling different chance nodes (and thus allowing for different uncertainties to impact the system) serves to quantify the impact of different SOVs. The fidelity of the model allows for evaluating the impact of roughly nine SOVs. It is thus a useful means of gaining insight on the contribution of each of the nine sources and identifying the main drivers of value for fractionated architectures.