Paper ID: 45149
oral
student

IAF SPACE SYSTEMS SYMPOSIUM (D1)
Space Systems Engineering - Methods, Processes and Tools (2) (4B)

Author: Mr. William O'Neill
Purdue University, United States, woneill@purdue.edu

Dr. Daniel Delaurentis
Purdue University, United States, ddelaure@purdue.edu
Dr. Navindran Davendralingam
Purdue University, United States, davendra@purdue.edu

ENHANCED ROBUST PORTFOLIO OPTIMIZATION FOR COST, PERFORMANCE RISK AND SCHEDULE ANALYSIS OF A LUNAR MISSION.

Abstract

The space industry is currently characterized by a multitude of different space systems and technologies sourced from different international space programs and commercial space companies with varying cost, performance and risk. While there is a great opportunity for the international space community to collaborate, it comes with several challenges. The vast number and breadth of different systems available produces countless potential architectures. Compounding this is the uncertainty associated with each system and technology in terms of cost, performance and schedule. The traditional monolithic systems engineering approach breaks down when applied to such a large complex mission where the enormous number of potential system combinations makes analysis difficult. A new method to facilitate and simplify the analysis of this problem is necessary. A top down method that can assess the capabilities, requirements and risks associated with the diversity of available space systems and form optimal portfolios of interworking systems is needed.

The aim of this paper is to describe and demonstrate the application of a modified Robust Portfolio Optimize approach that can both design and assess Lunar missions by optimizing the composition of systems and assessing the architecture in terms of cost, performance, schedule and risk. The portfolio optimization technique is used to explore combinations of systems that work cohesively to meet overarching mission objectives and to assess how uncertainty in system performance, cost and schedule affect stakeholder objectives. Combinations are chosen from a library of future and currently operational systems from both international space partners as well as commercial space companies. Scheduling impacts of different systems are modeled as developmental dependencies and included in the mathematical formulation of the RPO problem. The ability to readily incorporate other system engineering methods such as cost models and scheduling tools is an added benefit to this method.

This paper details the results of the application of the RPO approach to a multi-epoch lunar mission with multiple mission participants. Mission participants represent different international space programs and commercial space companies. This framework is used as a strategic decision making tool to help leverage the technologies, hardware and infrastructure of multiple stakeholders across multiple mission time points and evaluate the impact of decisions in terms of cost, performance, risk and schedule. The RPO methodology is a part of larger overall framework and is useful for finding optimal architectures that can then be examined further with other methods.