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QUANTITATIVE TECHNOLOGY ASSESSMENT IN SPACE MISSION ANALYSIS

Abstract

New technologies will need to be developed to create feasible concepts for NASA's ambitious missions of the future, but quantitative assessments of the impacts that technologies have on systems or architectures are sporadic and often inadequate. The Space Mission Analysis Branch at NASA's Langley Research Center is developing a quantitative technology assessment framework to address this issue with a vision of being able to understand the mission and system architecture impacts of technology development activities.

Historically, there have been three types of technology assessment questions:

1. **What are the technology needs for a given system or campaign?** Performance metrics are defined that achieve the mission, and the technology assessment consists of determining what new technologies (along with their cost, schedule, etc.) are required to achieve those metrics. These types of questions require a database of technology information from subject matter experts.
2. **What effect do technologies have on a given system?** These questions are common in many fields where a feasible operational concept can be improved (better cost, safety, etc.) by adding a new technology. These types of questions require a systems analysis capability that can incorporate the improvements of the technology.
3. **What effect do technologies have on a given architecture?** When technologies are added that fundamentally change the operational paradigm, it is difficult to quantitatively assess the impact that technology has on the overall system architecture. These types of questions require architecture trade space exploration and systems analysis.

A phased approach is being pursued to develop the capability to answer all three question types. First, the integration of subject matter experts, data collection, and data analysis techniques across the NASA technology portfolio will ensure that the framework is up to date and accessible for analyses. Second, systems analysis assesses the impact of key technologies from the first phase on systems, architectures, and campaigns.

The analysis capability being developed combines data collection and analysis, systems analysis, and data visualization techniques. These techniques are facilitating data access, improving insights, revealing trends, and improving prioritization. This analysis capability has been applied to a diverse set of space mission concepts, including lunar small satellite and small lander exploration, Mars fast transit architectures, and in-situ resource utilization campaigns.