Risk-Based Analysis and Decision Making in Multi-Disciplinary Environments

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ABSTRACT

A risk-based decision-making process conceived of and developed at JPL and NASA, has been used to help plan and guide novel technology applications for use on spacecraft. These applications exemplify key challenges inherent in multi-disciplinary design of novel technologies deployed in mission-critical settings:

1) Cross-disciplinary concerns are numerous (e.g., spacecraft involve navigation, propulsion, telecommunications). These concerns are cross-coupled and interact in multiple ways (e.g., electromagnetic interference, heat transfer).

2) Time and budget pressures constrain development, operational resources constrain the resulting system (e.g., mass, volume, power).

3) Spacecraft are critical systems that must operate correctly the first time in only partially understood environments, with no chance for repair.

4) Past experience provides only a partial guide: New mission concepts are enhanced and enabled by new technologies, for which past experience is lacking.

The decision-making process rests on quantitative assessments of the relationships between three classes of information – objectives (the things the system is to accomplish and constraints on its operation and development), risks (whose occurrence detracts from objectives), and mitigations (options for reducing the likelihood and/or severity of risks). The process successfully guides experts to pool their knowledge, using custom-built software to support information gathering and decision-making.

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