AUTONOMOUS CONTROL FOR SPACE SOLAR POWER FOR A PLANETARY SCIENCE MISSION. J. Straub\(^1\), \(^1\)Department of Computer Science, University of North Dakota, 3950 Campus Road, Stop 9015, Grand Forks, ND 58202 United States, jeremy.straub@my.und.edu.

In previous work [1, 2], a control system for a space solar power craft, principally designed for use in Earth orbit was presented. This prior work identified a number of key considerations which included:

- Optimization of Service versus Fuel Consumption
- Graceful System Degradation
- Re-Transmission
- Orbital vs. Orbital and Ground Service

A method for assessing these considerations is shown in Figure 1. A methodology based on a cost function which incorporated several key principals:

- The solution isn’t as simple as choosing the solution with the highest value
- Maximizing spacecraft lifetime is highly desirable
- Prediction of the needs and locations of future customers
- Weighting between different factors
- Behaving as a responsible utility

An algorithm derived from these principals and the assessment of the considerations is presented in Figure 2. This paper focuses on the assessment of this algorithm for use in a deep space planetary science mission.

The deep space environment has surprisingly little impact on the decision making process (though, the distance from the sun has a significant impact on the amount of power generated which may impact decision making). If the provider was operating as a utility at a remote planet, most of the same considerations and methodological elements would be as true at a different distance from the sun as they are in low-Earth orbit.

However, the principal change that is relevant to the deep space / planetary science mission is the nature of the mission itself. Instead of focusing on supporting the needs of numerous customers, the system may be supporting the needs of several spacecraft owned and operated by a single entity (or partner entities).

This impacts the methodology slightly. It doesn’t change the list of methodology elements; however, it changes the relative weight of those listed. For example, prediction of future needs – instead of focusing on power-on-demand requests (as might be typical in an Earth-orbiting scenario) may focus on science needs which may be discovery-driven. Spacecraft lifetime maximization may not be as important, as compared to other factors. Also, unlike a terrestrial ‘responsible utility’, one supporting orbital science may have dramatically different profile. It may be able to turn off or starve customers in deference to organizational priorities (making sure to supply the requisite power required for housekeeping and critical activities).

From the foregoing, it appears that the algorithm, presented in Figure 2, is applicable to a planetary science mission without high-level modification. Limited modification is, of course, required to the weightings based on the mission type and mission particulars.


![Figure 1. Considerations Evaluated [1]](image1)

![Figure 2. Proposed Algorithm [1]](image2)