Low Thrust Orbit Transfer Trajectory Optimization

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In recent years, all electric satellites have had a growing presence in the space industry. The 702-SP family developed by Boeing is to be used for telecommunication satellites. This spawns the need for analyzing mission scenarios in order to achieve the most efficient way of deploying such satellites.

The purpose of this poster is to analyze the different approaches to Low Thrust Spacecraft Trajectory optimization. One of the methods, developed by the author uses a feedback control law which allows the user to minimize an arbitrary objective set by mission designers. It also allows for a combination of objectives like minimum fuel and minimum time transfers. Minimizing radiation damage is another objective that is of importance in these kind of scenarios due to the long transfer times. The second method is a direct optimization routine. While this method has been around longer, convergence to a solution is not guaranteed and depends on initial guesses provided by the user. The third method is a combination of the first two methods and allows for multi-objective optimization. Extensive research of existing literature has shown that such a trajectory optimization method does not exist. The advantage of this method is that it will be able to overcome the shortcomings of the individual components and provide a comprehensive framework for mission designers to work with. The author will go over the merits and drawbacks of the different methods as well as compare the performance of all the methods for multiple scenarios. Some of these metrics will include rate of change of inclination, radius and fuel mass.

In addition to this, the author will also introduce new performance objectives that could be of interest to mission designers and will discuss the method of implementing them into all of the mentioned methods.