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# VECTORED THRUST MANEUVER ALGORITHM FOR INTERPLANETARY MISSIONS WITH MULTIPLE CONSTRAINTS

**Abstract**

Interplanetary missions may at times have multiple attitude constraints during maneuvers, which can prevent the pointing of the main thruster in the required delta-V direction. For example, mission constraints might impose the pointing of solar arrays to the sun and simultaneously pointing a high gain antenna to earth for communication. This might be incompatible with pointing of the main thruster in the required delta-v direction. One such example is the ESA mission to Jupiter's icy moons JUICE, where too many attitude constraints prevent the pointing of the main thruster in the required delta-v direction for certain critical maneuvers. In such cases, the delta-v vector can be realized by the use of all available spacecraft thrusters, including dis-similar one. When including multiple thruster constraints, such as minimum and maximum on times, and minimum-off times, the problem becomes a constrained optimization problem with binary constraints that cannot be handled optimally using traditional thruster modulator algorithms. This paper presents a mixed integer programming approach to solve such a constrained thruster on-time allocation optimization problem, which was designed for the vectored thrust maneuvering mode of the JUICE spacecraft. This algorithm allows to perform vectored thrust maneuvers in a fuel optimal manner while respecting all propulsion system constraints, without any residual torques to be compensated by the attitude control system. The algorithm is compared to traditional thruster modulator algorithms to show its advantages.