

ASTRODYNAMICS SYMPOSIUM (C1)
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INCREMENTAL PLANNING OF MULTI-GRAVITY ASSIST TRAJECTORIES

Abstract

The paper presents a novel algorithm for the automatic planning and scheduling of multi-gravity assist trajectories (MGA). The algorithm translates the design of an MGA transfer into a planning and scheduling process in which each planetary encounter is seen as a scheduled task. All possible transfers form a directional graph that is incrementally built and explored simultaneously forward from the departure planet to the arrival one and backward from the arrival planet to the departure one. Nodes in the graph (or tree) represent tasks (or planetary encounters).

Backward and forward generated transfers are then matched during the construction of the tree to improve both convergence and exploration. It can be shown, in fact, that the multi-directional exploration of the tree, allows for better quality solutions for the same computational cost.

Unlike branch and prune algorithms that use a set of deterministic branching and pruning heuristics, the algorithm proposed in this paper progressively builds a probabilistic model over all the possible tasks that form a complete trajectory. No branch is pruned but the probability of selecting one particular task increases as the algorithm progresses in the search for a solution.

The effectiveness of the algorithm is demonstrated on the design optimisation of the trajectory of Marco Polo and JUICE.