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Minimum-Energy trajectories for Earth-Mars transfers

Pilar Romero, Marta M. Sanchez-Garcia, and Gonzalo Barderas
Facultad de Matematicas, Universidad Complutense, Madrid, Spain

The determination of optimal trajectories aiming to lower costs in terms of impulses has become a key factor in mission planning, allowing for more massive payloads to be transported at a minimum energy cost. In this field, the case of low-thrust transfers Earth to Mars is of great interest.

In this work we focus on the determination of optimal interplanetary trajectories from Earth to Mars by minimizing the total required energy in the major mission phases: Earth departure, interplanetary targeting orbit and Mars arrival. We applied a heuristic-based approach to identify optimal Earth-Mars trajectories: 1) To reduce the launch and arrival windows by contour plots analysis of the departure characteristic energy and the hyperbolic arrival velocity, solving the Lambert problem for various combinations of departure and arrival dates; 2) to apply genetic algorithms to these reduced windows to choose an optimal solution; 3) to determine optimal transfer orbital parameters.