

Low-energy tour of the Galilean moons

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Abstract

We present a low-energy spacecraft tour of Europa, Ganymede and Callisto. The work is based on a previously developed method for the design of minimum-cost invariant manifold transfers between libration point orbits of consecutive moons, in particular between Ganymede and Europa. The method uses two-body approximations of the invariant manifold trajectories in the inter-moon space, and varies the relative orbital phase between the moons to find the minimum-cost connections between the resulting arcs of Keplerian ellipses. The cheapest direct transfer of this type between Europa and Ganymede has a duration of 15 days and a ΔV requirement of 1 km/s. In this contribution, the method is extended to consecutive connections through the system of the Galilean moons (with the exception of Io due to implications concerning the plasma environment of Jupiter). The invariant manifolds are replaced with transit orbits, aiming at extending the search space and reducing the overall time of flight. *Ad hoc* criteria are implemented to select the initial conditions at Europa which allow connections with Ganymede, then from here to Callisto and back from Callisto to Europa through Ganymede. The requirement of performing a close loop around each moon is introduced. Several numerical experiments have been performed and tuned with the objective of designing a tour that is both scientifically appealing and feasible with current space technology. The solutions which minimize ΔV budget, time of flight and pericenter distances of the close passages at each moon will be presented.

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