

The design of fuel-efficient trajectories that visit different moons of a planetary system is best handled by breaking the problem up into multiple three-body problems. This approach, called the patched three-body approach, has received considerable attention in recent years and has proved to lead to substantial fuel savings compared with the traditional patched-conic approach. We consider the problem of designing fuel-efficient multimoon orbiter spacecraft trajectories in the Jupiter–Europa–Ganymede spacecraft system with realistic transfer times. First, fuel-optimal (i.e., near-zero-fuel) trajectories without the use of any control are determined, but turn out to be infeasible due to the very long transfer times involved. We then describe a methodology that exploits the underlying structure of the dynamics of the two three-body problems, that is, the Jupiter–Europa spacecraft and Jupiter–Ganymede spacecraft, using the Hamiltonian structure-preserving Keplerian map approximations derived earlier and small control inputs in the form of instantaneous  $\Delta V$  to get trajectories with times of flight on the order of months rather than several years. A typical trajectory constructed using the control algorithm can complete the mission in about 10% of the time of flight of an uncontrolled trajectory.