

2000 Pacific Rim Dynamical Systems Conference
Minisymposium Proposal:
Space Missions and Dynamical Systems Minisymposium

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New space missions are increasingly more complex; demands on exortic orbits to solve engineering problems have grown beyond the conic-centered astrodynamical infrastructure. The delicate heteroclinic dynamics used by the Genesis Mission dramatically illustrates the need for a new paradigm: dynamical systems. Furthermore, it appears this dynamics has much to say about the morphology and transport of materials within the Solar System. The synergistic interplay between the natural dynamics of the Solar System and applications to engineering has produced a number of new applications, such as a “Petit Grand Tour” of Jovian moons and a low energy transfer with lunar ballistic capture.

Shoot the Moon:

Martin W. Lo, Jet Propulsion Laboratory, California Institute of Technology.

We apply similar techniques used for the “Petit Grand Tour” to produce a lunar capture mission which uses less fuel than a Hohmann transfer. We decouple the Sun-Earth-Moon-Spacecraft 4-body problem into two 3-body problems. Using the invariant manifolds of the Lagrange points of the 3-body systems, we construct low energy transfer trajectories from the Earth to the Moon with a ballistic capture at the Moon. This is joint work with W. Koon, J. Marsden, and S. Ross.

Optimal Control and Halo Orbit Mission:

Wang Sang Koon, Control and Dynamical Systems, California Institute of Technology.

We address the computation of the required trajectory correction maneuvers (TCM) for a halo orbit space mission (like Genesis) to compensate for the launch velocity errors introduced by inaccuracies of the launch vehicle. By combining dynamical systems theory with optimal control techniques, we produce parametric studies not available to mission designers a few years ago, such as how the magnitude of the errors and the timing of the first TCM affect the correction ΔV . This is joint work with M. Lo, J. Marsden, L. Petzold, S. Ross, R. Serban, and R. Wilson.

Heteroclinic Connections between Libration Point Orbits:

Josep Masdemont, Applied Mathematics, Polytechnic University of Catalunya

We present a seminormal form of the Hamiltonian equations of the Restricted 3 Body Problem around the collinear equilibrium points, in order to decouple instability and libration, using suitable coordinates. The orbits contained in the center manifold of an extended neighbourhood of the equilibrium points as well as its hyperbolic invariant manifolds can be obtained. Finally, we show how with a combination of seminumerical and numerical algorithms it is possible to compute some heteroclinic connections between 2D tori. This is joint work with G. Gomez.

Flying Formations near Qausihalo Orbits

Kathleen C. Howell, Aeronautics and Astronautics, Purdue University

In recent years, increased numbers of spacecraft missions have been proposed to exploit the dynamics of the regions of space near the libration points in the Sun-Earth/Moon system. One of the latest concepts is to fly multiple spacecraft in specified relative configurations near the collinear points. In this discussion, some fundamental issues of this concept are explored. Beginning with a review of the natural dynamics on the tori that envelope periodic halo orbits in the Circular Restricted 3 Body Problem, similar motions are pursued in the more complex dynamical model using JPL ephemerides. These results are compared to "non-natural" configurations. Strategies to maintain these types of formations are also presented. This is joint work with B. Barden.