ASTRODYNAMICS SYMPOSIUM (C1)
Orbital Dynamics (1) (1)

Author: Dr. Josep-Maria Mondelo
Universitat Autonoma de Barcelona, Spain

Dr. Merce Olle
Universitat Politecnica de Catalunya (UPC), Spain
Dr. Priscilla Sousa Silva
Instituto Tecnológico de Aeronáutica (ITA), Brazil
Dr. Maisa Terra
Instituto Tecnológico de Aeronáutica (ITA), Brazil

FAMILIES OF HETEROCLINIC CONNECTIONS BETWEEN QUASI-PERIODIC LIBRATION POINT TRAJECTORIES

Abstract

Heteroclinic connections (HC) are trajectories that are asymptotic backward and forward in time to different departure and arrival orbits. They can also be thought as zero-cost transfers between their endpoint orbits. HC play a significant role in the design of complex libration point trajectories, since they provide natural channels connecting motions that are otherwise unrelated. The Genesis and ARTEMIS missions have used trajectories following closely HC between L1 and L2 Lissajous of the Sun-Earth and Earth-Moon systems, respectively.

HC are computed by intersecting the stable manifold of the arrival orbit with the unstable manifold of the departure one in a suitable hypersurface of section. When the endpoint orbits are periodic and the overall motion is planar, this leads to the intersection of curves in a plane. In the quasi-periodic (QP), non-planar case, it is geometrically more challenging (the manifold sections are usually 2D objects in 4D space), although special techniques can be developed [1,2]. Families of HC can be described by computing individual connections for several energies.

Continuation strategies simplify largely the computation of families of HC, since the intersection of invariant manifolds needs to be done only once for each family, instead of at each energy level. In the periodic case this has been demonstrated in [3]. Continuation strategies are more necessary in the QP case, because of the increased geometrical complexity and also the fact that families depend on more parameters. In [4] is seen that, for a single energy level, the set of HC between Lissajous of L1 and L2 is already 2-parametric.

The goal of this paper is to build on the continuation strategies of [3] in order to generalize them to the QP case, as a step towards the elaboration of a map of HC between L1 and L2 libration point QP trajectories. Preliminary results will be shown in this direction.

[1] Gomez, Koon, Lo, Marsden, Masdemont, Ross. Connecting orbits and invariant manifolds in the spatial restricted three-body problem. Nonlinearity 17(5) 1571-1606, 2004.

[2] Haapala, Howell. Representations of higher-dimensional Poincare maps with applications to spacecraft trajectory design. Acta Astronautica 96 23-41, 2014.

[3] Barrabés, Mondelo, Ollé. Numerical continuation of families of heteroclinic connections between periodic orbits in a Hamiltonian system. Nonlinearity 26(10) 2747-2765, 2013.

[4] Delshams, Masdemont, Roldan. Computing the scattering map in the spatial Hill's problem. DCDS-B 10(2,3), 2008.