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POINCARÉ: A MULTI-BODY, MULTI-SYSTEM TRAJECTORY DESIGN TOOL

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Poincaré is a modular trajectory design tool based on a catalog of three-body science orbits and a differential corrector to compute connecting transfer arcs between orbits in multi-body systems. Poincaré attempts to offer a unified approach, i.e., an “all-in-one” integrated search within one interface and setup in MONTE (JPL’s signature astrodynamics computing platform) The Science Orbit Design Tool – first module – facilitates rapid and well-informed decisions regarding the selection of periodic orbits for a particular mission and enables the simultaneous study of various orbit alternatives. The second module – the Reference Trajectory Design Tool – allows the user to calculate optimal transfer paths from a departure orbit to a science orbit via dynamical systems structures, resulting in an end-to-end reference trajectory.

In the 1960’s, the application of insight from the circular restricted three-body problem (CR3BP) moved into the ‘space age’ when a mission to the Lagrange points was considered for NASA’s Apollo program. Since then, many of the structures that emerge in the CR3BP have been more actively exploited in trajectory design. Consequently, successful missions to the vicinity of the Lagrange points have since been launched, including the International Sun-Earth Explorer-3 (ISEE-3), the Solar Heliospheric Observatory (SOHO), the Advanced Composition Explorer (ACE), and the Microwave Anisotropy Probe (MAP). Parallel to the development of these mission concepts, the possibility of applying dynamical systems techniques to the design of these types of trajectories was also being considered. In fact, in the 1960’s, Conley had investigated low energy transfer orbits to the Moon using dynamical system techniques. In the 1990’s, the use of invariant manifolds in the design process to construct pathways between the Earth and the Sun-Earth libration points was finally applied in an actual trajectory: the trajectory supporting the Genesis mission.

Summary

Poincaré is a modular trajectory design tool based on a catalog of three-body science orbits and a differential corrector to compute connecting transfer arcs between orbits in multi-body systems. Poincaré attempts to offer a unified approach, i.e., an “all-in-one” integrated search within one interface and setup in MONTE (JPL’s signature astrodynamics computing platform [1].) The Science Orbit Design Tool – first module – facilitates rapid and well-informed decisions regarding the selection of periodic orbits for a particular mission and enables the simultaneous study of various orbit alternatives. The second module – the Reference Trajectory Design Tool – allows the user to calculate optimal transfer paths from a departure orbit to a science orbit via dynamical systems structures, resulting in an end-to-end reference trajectory.

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