NASA SBIR/STTR Technologies

Space Mission Design in the Vicinity of Small Bodies and Libration Points

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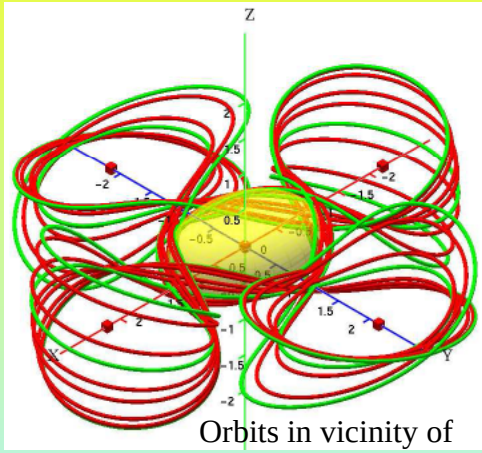
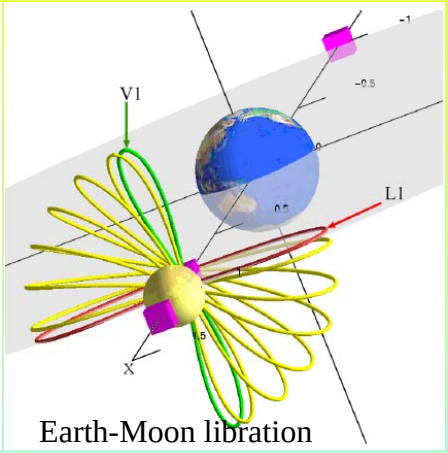
Identification and Significance of Innovation

To address the NASA need for advanced dynamical theories to space mission design and analysis in the vicinity of small bodies and libration points, Physical Optics Corporation (POC) proposes to develop a novel advanced Orbit Dynamic Computation Approach for Space Mission Analysis in the Vicinity of Small Bodies and Libration Points (ODYBOLP), with corresponding computational algorithms and software, based on advanced models of complicated celestial dynamical systems with libration points (LPs) and a pseudo-arc-length continuation method for computation of trajectories used for zero-fuel cost space guidance, navigation, control, and cargo transportation and long-distance passageways through the solar system. The ODYBOLP software will be integrated into standard NASA software packages (GMAT, JAT, etc.). In Phase I, POC will demonstrate the feasibility of ODYBOLP by using its TRL-3 Phase I prototype software.



Orbits in vicinity of small bodies



Earth-Moon libration points orbits

Technical Objectives

1. Development of the dynamical theory describing the motion of an infinitesimal body in vicinity of small celestial bodies.
2. Calculation of the periodic orbit families emanating from the libration points of the small celestial body, secondary, and some tertiary orbit families.
3. Design and development of the basic software for visualization of small celestial body periodic orbits.
4. Definition of the commercial market for the ODYBOLP system.

Work Plan

1. Develop and analyze the dynamical system.
2. Design and development the software for calculations of the small body orbit families.
3. Calculate the periodic orbit families of the dynamical system.
4. Analyze stability of the calculated orbit families.
5. Develop, design, and test the software for visualization of calculated orbit families .
6. Explore the commercial potential and product viability.
7. Prepare and submit reports.

NASA Applications

The proposed ODYBOLP will extend NASA leadership in design and analysis of space missions using unstable orbital trajectories in the vicinity of small bodies and libration points. It will improve libration point dynamical system models associated with the multi-body problem and celestial small bodies and provide methods to use these models in space mission analysis and design. The ODYBOLP makes easier and faster the choice of suitable nominal orbits and near-zero fuel cost transfer trajectories for the mission designer.

Non-NASA Applications

The proposed ODYBOLP approach has significant commercial applications for numerous government agencies and commercial players of the national space and satellite market in effective and robust computations of trajectories of spacecraft used for space guidance, navigation, control, and cargo transportation and long-distance zero-fuel cost passageways through the solar system.

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NON-PROPRIETARY DATA