Trajectory around a binary asteroid in the extended FTBP.

Stage topic Description

Binary asteroids represent from 15% to 20% of the Near Earth Objects (NEO) population. They have been recently subject to attention from the scientific community regarding their formation, composition and dynamics, and also as potential hazardous object to the Earth. Studying a binary asteroid can provide great benefits in understanding their formation. In the case of a NEO mitigation mission, understanding their dynamics is fundamental for an efficient deflection scenario design. Most generally indeed, it is agreed that the best way to study them is to send a spacecraft to their vicinity [1]. Accurate dynamical models would help the mission planning and close-orbit operations. Few studies have been done on binaries either for deflection and mitigation mission [2], or for the dynamical characterisation of the system [3-6]. Obviously, the most important part of the work is the model. One model, which arises naturally and provides so far interesting results, is based on the Full Restricted Three Body Problem (FRTBP) [3]. In particular, there are results on stable and unstable equilibria, stability regions, in-plane orbits, and frozen orbits.
For this stage, we would like to build upon recent results and find if any particular halo-type orbit, potentially good parking orbit or periodic orbit exist. Any results on the libration points would also be helpful, and bring added value to the research.

Candidate's tasks

- Generic Model of the pair in the FTBP, including harmonics till third order.
- Research of Halo and parking orbits. Stability regions. Simulation.

The ideal candidate

Celestial Mechanics and/or Space Mechanics and/or Mathematics.
MATLAB and/or C/C++.

References

1. Bellerose, J., Requirements and Constraints for Exploration of Binary Asteroid Systems: From Didymis to Hektor, 40th Lunar and Planetary Science Conference, 2009
2. Fahnestock, E.G., Broshart, S.B., Dynamical Characterization, Control, and Performance Analysis of Gravity Tractor Operation at Binary Asteroids,
3. Bellerose, J., Scheeres, D.J., Stability of equilibrium points in the restricted full three-body problem, Acta Astronautica, n 60, pp 141-152, 2007.
4. Scheeres, D.J., The Dynamics of NEO Binary Asteroids, proceedings IAU Symposium, No. 236, 2006
5. Gabern, F., Koon, W.S, Marsden, J.E., Parking a Spacecraft near an Asteroid Pair,
6. Gabern, F., Koon, W.S, Marsden, J.E., Scheeres, D.J., Binary Asteroid Observation Orbits from a Global Dynamical Perspective, SIAM J. Applied Dynamical Systems, Vol. 5, No. 2, pp 252-279, 2006.