Gravity-assist trajectories in the CR3BP using a kick function

Stage topic Description

A special class of multiple gravity assists occur outside of the perturbing body's sphere of influence (the Hill sphere) and are derived when the influence of multiple gravitational bodies is taken into account (for example in the circular restricted three-body problem (CR3BP)) These multiple gravity assits can be used to construct low energy transfers between moons in a given planetary system. In the CR3BP, a kick function is used to approximate the effect of the perturbing moon and can predict the change in osculating elements after a moon's flyby. This kick function is an approximation derived from Picard's method. The purpose of this stage is a better understanding of gravity-assists in multi-body regime and how they can be used for the design of a multimoon orbiter mission.

Candidate's tasks

For this stage, we would like to investigate gravity-assits in the CR3BP. The stagiaire will have to first, do an extensive litterature search on what has been done in the past, what is the current methods to approximate fly-bys in multi-body regime and how accurate these methods are (comparison with numerical imtegration). Then, the stagiaire will test this kick function in the Jupiter system for the design of a multimoon orbiter to design some low-energy transfers between Jupiter's moons.

The ideal candidate

Knowledge of the Circular Restricted Three-Body Problem (CR3BP) is required.

Knowledge of fly-bys and mission design is a plus.

Programming skills (MATLAB and/or C/C++ and/or Fortran).

References

Ross, S., Scheeres, D., 'Multiple Gravity Assists, Capture, and Escape in the Restricted Three-Body Problem', Siam J. Applied Dynamical Systems, Vol 6, No 3, p = 576-596

Campagnola, S., Russell, R., 'The Endgame Problem Part B: The Multi-Body Technique and the T-P Graph', 19th AAS/AIAA Space Flight Mechanics Meeting, Savannah, Georgia, February 2009. Paper no AAS 09-227.