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A fast an efficient algorithm for the computation of distant retrograde orbits

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An algorithm for the computation of distant retrograde orbits is presented. It is based on the computation of an approximate analytical solution of the restricted three body problem in the Hill problem approximation that provides accurate estimations of two basic design parameters. Notably, these parameters can be used for the computation of initial conditions of orbits that are periodic on average, and almost periodic in the original problem. Following application of iterative differential corrections results in the initial conditions and period of a true periodic orbit with the characteristics fixed by the design parameters.

The analytical solution consist roughly of a drifting ellipse, whose guiding center moves around the primary with long-period oscillations, and in which the linear growing of the phase of the satellite is modulated with long-period variations. The analytical solution splits in two parts of different nature. The first one provides the periodic corrections needed for converting osculating elements into the mean ones that describe the long-term evolution of the dynamics. The second part of the analytical solution gives the time history of the mean elements in the form of five Lindstedt series, which are needed for describing:
- the time scale in which the Lindstedt series evolve (1 series)
- the time evolution of the guiding center of the reference ellipse (2 series)
- the linear frequency with which the satellite evolves, on average (1 series)
- the long-period modulation of the phase of the satellite (1 series)

The use of the algorithm is illustrated with different examples, ranging from the typical case of 1:1-resonant distant retrograde orbits, in which the satellite remains always far away enough from the primary, to the challenging case of higher order resonances in which the amplitude of the libration of the guiding center of the orbit can take the satellite much closer to the primary.

Summary

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