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# A NOTE ON THE DYNAMICS AROUND THE LAGRANGE POINTS OF THE EARTH–MOON SYSTEM IN A COMPLETE SOLAR SYSTEM MODEL

**Abstract**

In this paper we study of the dynamics of a massless particle around the libration points of the Earth–Moon system in a full Solar System gravitational model (Solar System Restricted n-Body Problem, SSRnBP). The study is based on the analysis of the quasi-periodic solutions around the equilibrium points, whose computation is done using as initial seeds the libration point orbits of the Circular Restricted Three Body Problem (CR3BP), determined by Lindstedt-Poincaré methods. For the unstable collinear libration points, the analysis is done using a novel algorithm capable of refining large time-span orbits in a Solar System model using real ephemeris, which is an iterative combination of a multiple shooting method with a refined Fourier analysis of the orbits computed with the multiple shooting. Using this algorithm, the dynamical substitutes of the collinear points, as well as a large set of surrounding orbits (planar and vertical Lyapunov orbits, halo and quasi-halo orbits, and Lissajous orbits), have been obtained for over 60 years. Special attention has been paid to the 1:2 resonance of some halo and quasi-halo orbits around the $L_2$ point. For the triangular points, due to the appearance of the third intrinsic frequency in the CR3BP model, the behavior is more complex. To tackle the difficulties shown in the Earth-Moon system, triangular points and their surrounding orbits in other three-body systems with different mass ratios have been investigated, which are the Sun–Earth/Moon system and the Sun–Jupiter system. The analysis mainly concerns two aspects: one is the basic frequencies of these orbits; the other is the Poincaré intersections in phase space, both having shown the evidence of strong perturbations from the Sun. However, the structure of the phase space of the SSRnBP is, in general, close to the one of the CR3BP. All the results obtained in this work contribute to provide insights into the dynamical behaviour of these orbits in the real Earth–Moon environment, and will hopefully benefit the future mission design within this realm.