Computing quasi-periodic motions for a particle in the Earth-Moon system: 2,3,4D-tori and their corresponding invariant manifolds*

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Abstract

We are interested in the motion of a particle, such as a spacecraft or an asteroid, in the Earth-Moon System. The simplest model for this problem is the well known Restricted Three Body Problem (RTBP). Here we consider more realistic models that take into account the main perturbations coming from the Sun and the non-circular motion of Earth and Moon. These models are written as quasi-periodic time-dependent perturbations of the RTBP. In our case, depending on the number of effects considered, the perturbation can have 2, 3 or 4 basic frequencies. In the RTBP, there are five equilibrium that here will become tori of dimension 2, 3 or 4, depending on the number of basic frequencies of the perturbation. Our goal is to compute the tori substituting the collinear equilibrium $L_{1,2}$, as well as their invariant unstable and stable manifolds. We will also talk about other quasi-periodic solutions appearing from the centre directions of these tori. In that case the dimension of the tori increase in one or two units.

Due to the strong instability of these points, we use a parallel shooting technique that has the collateral effect of increasing the dimension of the phase space up to 24. We represent these tori and the Floquet transformations by (truncated) Fourier series. Due to the huge amount of computer resources needed, we have modified a previous software of the authors –that was already parallelised and adapted for a Beowulf cluster– to adapt it to the particularities of this problem. In the talk we will discuss some details of this computation and the results obtained.

*oral communication.