Zero-velocity surfaces in the general three-body problem

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The zero velocity surfaces in the form space of the planar three-body problem are considered. Reduction by translations and rotations reduces the dimension of configuration space to 3. If the energy is negative the zero velosity surface has three branches. When angular momentum J equals to zero the available space is located inside the surface except for the origin. As J grows a small surface appears and increases around the origin. Inside this small surface the motion is impossible. The available space is located between two surfaces. As for restricted three body problem there are five different topological types of zero velosity surface depending on the value of J.

Lemaitre regularization is used for the degenerate cases, rectilinear and isosceles motions. In these cases, the configuration space are two-dimensional. The suitable parametrization yields the simple equations of motion in the regularized form space. The zero velocity curve bounds the available space. The properties of rectilinear and isosceles orbits in the regularized form space, including those that lead to chaotic motion, are studied. The number of orbits are calculated by numerical integration. Among them are the Schubart orbits and Brouke orbits, as well as free fall orbits (in rectilinear and isosceles cases).

The figure-eight orbit is considered in the regularized by Lemaitre form space. In this space figure-eight orbit has four pre-images. Clearly these pre-images passes through six pre-images of Euler points. It is interesting, that one of pre-images is approximately unit circle.

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