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Rotopulsators of the curved N -body problem

We consider the N -body problem in spaces of constant curvature and study its rotopulsators, i.e. solutions for which the configuration of the bodies rotates and, usually, changes size during the motion. Rotopulsators fall naturally into five groups: positive elliptic, positive elliptic-elliptic, negative elliptic, negative hyperbolic, and negative elliptic-hyperbolic, depending on the nature and number of their rotations and on whether they occur in spaces of positive or negative curvature. After obtaining existence criteria for each type of rotopulsator, we derive their conservation laws. We further deal with the existence and uniqueness of some classes of rotopulsators in the 3-body case and prove two general results about the qualitative behaviour of these orbits. An interesting finding is that of a class of rotopulsators that behave like relative equilibria, i.e. maintain constant mutual distances during the motion, but cannot be generated from any single element of the underlying subgroup $SO(2) \times SO(2)$ of the Lie group $SO(4)$.