Rotation of a gyrostat. Equilibria and bifurcations

ABSTRACT

A gyrostat G is a mechanical system made of a rigid body P called the platform and other bodies R called the rotors, connected to the platform and in such a way that the motion of the rotors does not modify the distribution of mass of the gyrostat. Due to this double spinning, the gyrostat on the one hand and the rotors on the other, the gyrostat is also known with the name of dual-spin body. For such a body in free rotation, the angular moment is an integral, but the Hamiltonian is not made of the energy. The system has the same symplectic structure as the rigid body, and the problem is shown to be equivalent to a quadratic Hamiltonian on the unit sphere. At difference with the rigid body that has six equilibria on this representation, here, the number of equilibria depends on the shape of the body but also on the number of rotors, which presents a rich variety of bifurcations. Again, the components of the angular moment reveals to be of great utility for handling this problem, since in other representations, like Serret-Andoyer variables, some points cannot be represented and, precisely, these points are good candidates to bifurcate.

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