

GEOMETRICAL ASPECTS IN THE RIGID BODY DYNAMICS WITH THREE QUADRATIC CONTROLS

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Abstract. The dynamics of the rigid body with three quadratic controls is discussed and some of its geometrical and dynamical properties are pointed out.

1. Introduction

The problem of geometrical study of the rigid body dynamics with controls has received a great deal of interest in recent years. We can remind here the papers of Brockett [5], Aeyels [1], Krishnaprasad [11], Crouch [8], Aeyels and Szafranski [2], Bloch and Marsden [3], Bloch, Krishnaprasad and Sanchez de Alvarez [4], Holm and Marsden [9], Byrnes and Isidori [6], Posberg and Zhao [14], Puta [15–20], Puta and Craioveanu [21], Puta and Ivan [22], Puta and Comănescu [23] and Puta and Casu [25].

We shall consider here a class of feedback laws that depends on a parameter matrix W which is nonsingular and symmetric and we shall study its Hamiltonian and Lagrangian picture, its Lax formulation, its numerical integration via Kahan's integrator, its stability via the energy-Casimir method and its geometric prequantization.

2. The Lie Group $SO(3)$ and Its Lie Algebra $so(3)$

The configuration of a rigid body free to rotate about a fixed point in space is described by an element of $SO(3)$, the set of all 3×3 orthogonal and real matrices with determinant one, i. e.

$$SO(3) = \{A \in \mathcal{M}_{3 \times 3}(\mathbb{R}); A^t A = I_3, \det A = 1\}.$$