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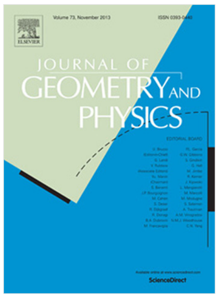

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Abstract

We prove, using Moralès-Ramis theorem, that the minimum-time controlled Kepler problem is not meromorphically integrable in the Liouville sens on the Riemann surface of its Hamiltonian.

Keywords: Hamiltonian systems, integrability, differential Galois theory, optimal control, Kepler problem

1. Introduction

The Kepler problem

$$\ddot{q} + \frac{q}{\|q\|^3} = 0, \quad q \in \mathbb{R}^2 \setminus \{0\}. \tag{1}$$

is a classical reduction of the two-body problem [2]. Here, we think of q as the position of a spacecraft, and of the attraction as the action of the Earth. We are interested in controlling the transfer of the spacecraft from one Keplerian orbit towards another, in the plane. Denoting $v = \dot{q}$ the velocity, and the adjoint variables of q and v by p_q and p_v, the minimum time dynamics is a Hamiltonian system with

$$H(q, v, p_q, p_v) = p_q.v - \frac{p_v.q}{\|q\|^3} + \|p_v\|, \tag{2}$$

as is explained in section 2.1. Prior studies of this problem can be found in [6, 5]. The controlled Kepler problem can be embedded in the two parameter

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