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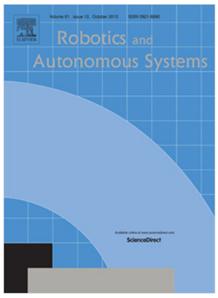

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Juan Carlos Cambera, Vicente Feliu-Batlle

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Input-State Feedback Linearization Control of a Single-Link Flexible Robot Arm moving under Gravity and Joint Friction

Juan Carlos Cambera[a], Vicente Feliu-Batlle[b]

[a] *Instituto de Investigaciones Energéticas y Aplicaciones Industriales (INEI), Campus Universitario de Ciudad Real, 13071 Ciudad Real, Spain. Email: JuanCarlos.Cambera@alu.uclm.es*

[b] *Escuela Técnica Superior de Ingenieros Industriales, University of Castilla-La Mancha, Ciudad Real, 13071 Spain. Email: Vicente.Feliu@uclm.es*

Abstract

In this paper we address the trajectory tracking problem of the end-effector of a single link flexible arm in which the gravity forces and the joint friction forces are taken into account. As an overall approach, a double loop cascade control is used to deal with the joint friction: in its inner loop a two-degree-of-freedom controller is responsible for the joint position in the presence of Coulomb friction disturbances, while in its outer loop an input-state feedback linearization-based controller is implemented to suppress the vibrations and track an end-effector trajectory. To highlight the benefits of the proposed controller in presence of joint friction, the controller was compared with other approaches based on feedback linearization reported in the literature, which considered only a single loop. The results of this comparison showed that our approach provides superior performance in terms of settling time, maximum overshoot and residual vibrations.

The design of the controller presented relies on a non-linear single-lumped mass dynamic model that describes the dynamics of a single link arm with only one significant vibrational mode. The hypothesis of a single lumped mass model could be considered inaccurate given the distributed nature of the link mass, especially in situations in which the link mass is comparable to the payload mass held by the robot. However, for the parameters of our physical platform two studies are presented to demonstrate that the single lumped mass model is a