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Trajectory Tracking of a One-Link Flexible Arm via Iterative Learning Control

Michele Pierallini[1,2], Franco Angelini[1,2,3], Riccardo Mengacci[1,2]
Alessandro Palleschi[1,2], Antonio Bicchi[1,2,3] and Manolo Garabini[1,2]

1 – Centro di Ricerca E. Piaggio – Università di Pisa

2 - Dipartimento di Ingegneria dell'Informazione, Università di Pisa

3 - Soft Robotics for Human Cooperation and Rehabilitation - Fondazione Istituto Italiano di Tecnologia

Robot flexibility underwent a radical change in the last twenty years. Historically, link elasticity was considered as an element jeopardizing the correct execution of the desired task. For this reason, controllers aimed at removing the system compliance by means of high-gain feedback loops, with the result of stiffening the robot. However, with the development of soft robots, physical elasticity became one of the main solutions to obtain safe interactions with unstructured environments, human beings, and other robots. For this reason, the past approaches to tackle classical control problems need to be re-designed. Nowadays, the goal of the controllers moves to approaches which aim to provide good tracking performance, while preserving and exploiting the robot elasticity. Following this idea, we present an iterative learning control algorithm for trajectory tracking with a flexible arm. The proposed method preserves the robot compliant behavior while achieving good tracking performance. We show how the proposed solution can be applied to systems modeled with a generic number of passive joints actuated by one joint, and we provide conditions, based on the system dynamics, that ensure the applicability of the iterative algorithm. Finally, we validate the theoretical results with simulations and experimental tests.

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