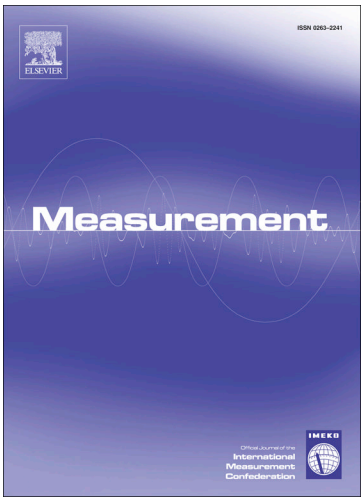

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Reza Gholipour, Mohammad Mehdi Fateh

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Adaptive task-space control of robot manipulators using the Fourier series expansion without task-space velocity measurements

Reza Gholipour[a,*], Mohammad Mehdi Fateh[a]

[a] *Department of Electrical and Robotic Engineering, Shahrood University of Technology, 3619995161 Shahrood, Iran*

Abstract

Many control approaches presented in the field of robotics require velocity signals, which are not usually provided by many commercial robots. The novelty of this paper is designing an adaptive model-free observer for robot manipulators in the task-space without the use of task-space velocity measurements. To compensate for the uncertainties and nonlinearities in the observer and controller, the Fourier series are utilized. Using Lyapunov stability theorem and Barbalat's lemma, it is guaranteed that the tracking error and also the observer estimation error converge to zero. The case study is an articulated robot manipulator driven by permanent magnet DC motors. Simulation results and comparison with an extended state observer and linear observer verify the effectiveness of the proposed algorithm.

Keywords: Task-space control, Adaptive model-free observer, The Fourier series expansion, Robust control, Robot manipulators, Velocity measurements

1. Introduction

During the last decades, we have witnessed an increasing trend towards application of nonlinear control to various industrial systems such as robot manipulators. Among various approaches of nonlinear control, model-based control

*Corresponding author

Email addresses: rezagholipourr@gmail.com (Reza Gholipour), mmfateh@shahroodut.ac.ir (Mohammad Mehdi Fateh)