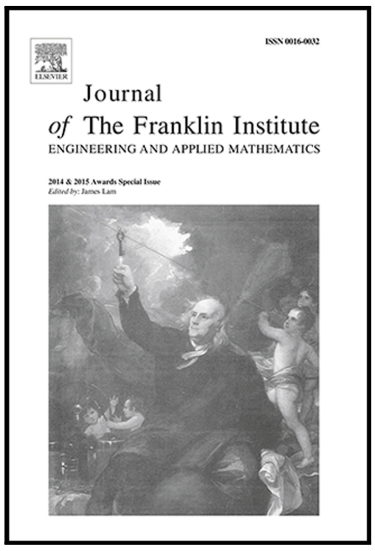

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PII: S0016-0032(17)30120-5
DOI: 10.1016/j.jfranklin.2017.02.034
Reference: FI 2927

To appear in: *Journal of the Franklin Institute*

Received date: 24 January 2015
Revised date: 16 July 2016
Accepted date: 26 February 2017

Please cite this article as: Yuan Chen , Kangling Wang , Longying Zhai , Jun Gao , Feedforward fuzzy trajectory compensator with robust adaptive observer at input trajectory level for uncertain multi-link robot manipulators, *Journal of the Franklin Institute* (2017), doi: 10.1016/j.jfranklin.2017.02.034

Feedforward fuzzy trajectory compensator with robust adaptive observer at input trajectory level for uncertain multi-link robot manipulators

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Abstract: This paper presents an inverse dynamics controller plus feedforward fuzzy trajectory compensator suitable for the trajectory tracking control of uncertain multi-link robot manipulators. To address the issue of unavailable normalization factor, a feedforward fuzzy trajectory compensator is proposed and assembled at the input trajectory level of the inverse dynamics controller rather than at the joint drive torque position. The compensator serving as a low-pass filter is implemented outside the inner control loop by adjusting the desired characteristic trajectory. Due to the nearly unchanged internal control algorithm, the adaptive fuzzy compensator is feasible to implement, and is robust when varying the feedback gain in the inner control loop. Moreover, a robust adaptive fuzzy state observer with loose constraints on the position of uncertain function is designed to assess some unmeasurable state parameters, and a robust term is designed to reduce the influence of the lumped uncertainties. By such design, the observer no longer imposes strict limitations on the position of the nonlinear function and the canonical form of unknown robotic dynamic model. To validate the effectiveness of the proposed controller, simulations and experiments are conducted for a desired characteristic trajectory, and the performance of the proposed controller has been compared with conventional controllers and recently developed controllers to illustrate the usefulness and efficiency of the proposed controller.

Keywords: robot manipulator with uncertainties; feedforward fuzzy trajectory compensator; inverse dynamics controller; robust adaptive fuzzy observer

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