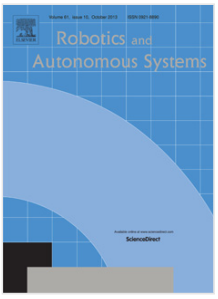
Accepted Manuscript



Proxy-based position control of manipulators with passive compliant actuators: Stability analysis and experiments

Navvab Kashiri, Jinoh Lee, Nikos G. Tsagarakis, Michäel Van Damme, Bram Vanderborght, Darwin G. Caldwell

PII: S0921-8890(15)00191-8
DOI: http://dx.doi.org/10.1016/j.robot.2015.09.003
Reference: ROBOT 2531

To appear in: *Robotics and Autonomous Systems*

Received date: 7 February 2015
Revised date: 10 August 2015
Accepted date: 1 September 2015

Please cite this article as: N. Kashiri, J. Lee, N.G. Tsagarakis, M. Van Damme, B. Vanderborght, D.G. Caldwell, Proxy-based position control of manipulators with passive compliant actuators: Stability analysis and experiments, *Robotics and Autonomous Systems* (2015), http://dx.doi.org/10.1016/j.robot.2015.09.003

Proxy-based Position Control of Manipulators with Passive Compliant Actuators: Stability Analysis and Experiments

Navvab Kashiri[a,*], Jinoh Lee[a], Nikos G. Tsagarakis[a], Michäel Van Damme[b], Bram Vanderborght[b], Darwin G. Caldwell[a]

[a] *Department of Advanced Robotics, Istituto Italiano di Tecnologia, Via Morego 30, 16163 Genova, Italy.*
[b] *Department of Mechanical Engineering, Vrije Universiteit Brussel, Pleinlaan 2, B-1050 Brussels, Belgium.*

Abstract

In this work we introduce a position control scheme which is targeted at the enhancement of the safety of compliant joint robots. In addition to the necessity for accuracy and robustness that both serve as prerequisites for the successful performance of these tasks, the ability to safely handle unexpected events, such as communication failures or unintended interactions which may endanger the robot/human safety, is a paramount requirement. To achieve a smooth motion behaviour of compliant systems under these circumstances, damping control actions are essential. To this end, a novel proxy-based approach for compliant joint robots, integrated into a passivity-guaranteed controller, is proposed. The stability analysis of the proposed scheme is presented and the global asymptotic convergence, as well as the passivity of the control scheme, is analytically proven. The performance of the proposed approach is practically evaluated by means of experiments on a spatial robotic arm with passive compliant actuators, and is compared with that of a classical PD approach. Experimental results validate the ability of the proposed approach to inject damping in order to provide smooth and damped recovery when an interruption in task execution occurs.

☆This work is supported by the European Research Council under EU FP7-ICT projects SAPHARI no. 287513 and WALK-MAN no. 611832.
*Corresponding author, email address: navvab.kashiri@iit.it