

Accepted Manuscript

Hierarchical Learning Control with Physical Human-Exoskeleton Interaction

Rui Huang, Hong Cheng, Hongliang Guo, Xichuan Lin, Jianwei Zhang

PII: S0020-0255(17)30987-8
DOI: [10.1016/j.ins.2017.09.068](https://doi.org/10.1016/j.ins.2017.09.068)
Reference: INS 13172

To appear in: *Information Sciences*

Received date: 15 December 2016
Revised date: 25 September 2017
Accepted date: 29 September 2017

Please cite this article as: Rui Huang, Hong Cheng, Hongliang Guo, Xichuan Lin, Jianwei Zhang, Hierarchical Learning Control with Physical Human-Exoskeleton Interaction, *Information Sciences* (2017), doi: [10.1016/j.ins.2017.09.068](https://doi.org/10.1016/j.ins.2017.09.068)



This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Hierarchical Learning Control with Physical Human-Exoskeleton Interaction

Rui Huang^{a,b}, Hong Cheng^{a,*}, Hongliang Guo^a, Xichuan Lin^a, Jianwei Zhang^b

^a*School of Automation Engineering, University of Electronic Science and Technology, Chengdu 611731, China*

^b*Department of Computer Science, University of Hamburg, Hamburg D-22527, Germany*

Abstract

Learning based control methods have gained considerable interests in human-coupled robot control, since more complex cooperative scenarios have been considered. Most of learning methods are employed to dealing with human-robot interaction (pHRI) in such cooperative tasks. However, the pHRI in lower exoskeleton is changing with different pilots and walking patterns, which make the controller should be learned online to adapt changing pHRI. This paper presents a novel control strategy with Hierarchical Interactive Learning (HIL) framework, which aims to handle varying interaction dynamics. Two learning hierarchies are contained in the proposed HIL control strategy. In high-level motion learning, motion trajectories are modeled with Dynamic Movement Primitives (DMPs) and learned with Locally Weighted Regression (LWR) method. Reinforcement Learning (RL) method is utilized to learn the model-based controller in low-level controller learning hierarchy. The proposed HIL control strategy is demonstrated both on a single DOF platform and a human-powered augmentation lower exoskeleton. Experimental results indicate that the proposed control strategy has the ability to handle varying interaction dynamics and obtain better performance than traditional model-based control algorithms.

Keywords: Hierarchical Interactive Learning, Dynamic Movement Primitives, Reinforcement Learning, Physical Human-Exoskeleton Interaction, Lower Exoskeletons

*Corresponding author
Email address: hcheng@uestc.edu.cn (Hong Cheng)

Download English Version:

<https://daneshyari.com/en/article/6856822>

Download Persian Version:

<https://daneshyari.com/article/6856822>

[Daneshyari.com](https://daneshyari.com)