World Academy of Science, Engineering and Technology
International Journal of Mechanical and Mechatronics Engineering
Vol:10, No:08, 2016

Iterative Estimator-Based Nonlinear Backstepping Control of a Robotic Exoskeleton

Authors : Brahmi Brahim, Mohammad Habibur Rahman, Maarouf Saad, Cristóbal Ochoa Luna

Abstract : A repetitive training movement is an efficient method to improve the ability and movement performance of stroke survivors and help them to recover their lost motor function and acquire new skills. The ETS-MARSE is seven degrees of freedom (DOF) exoskeleton robot developed to be worn on the lateral side of the right upper-extremity to assist and rehabilitate the patients with upper-extremity dysfunction resulting from stroke. Practically, rehabilitation activities are repetitive tasks, which make the assistive/robotic systems to suffer from repetitive/periodic uncertainties and external perturbations induced by the high-order dynamic model (seven DOF) and interaction with human muscle which impact on the tracking performance and even on the stability of the exoskeleton. To ensure the robustness and the stability of the robot, a new nonlinear backstepping control was implemented with designed tests performed by healthy subjects. In order to limit and to reject the periodic/repetitive disturbances, an iterative estimator was integrated into the control of the system. The estimator does not need the precise dynamic model of the exoskeleton. Experimental results confirm the robustness and accuracy of the controller performance to deal with the external perturbation, and the effectiveness of the iterative estimator to reject the repetitive/periodic disturbances.

Keywords : backstepping control, iterative control, Rehabilitation, ETS-MARSE
Conference Title : ICCDSR 2016 : International Conference on Control, Dynamic Systems, and Robotics
Conference Location : Amsterdam, Netherlands
Conference Dates : August 04-05, 2016