Society of Engineering Science 51st Annual Technical Meeting

1–3 October 2014

Purdue University, West Lafayette, Indiana, USA

Human operator modeling, joystick input notch filtering, and safety constraint enforcement for powered wheelchair operation under Parkinson's tremor

Richard T. Meyer; Rick Meyer, rtmeyer@purdue.edu; DeCarlo, Ray; Miloš Žefran

ABSTRACT

This study considers use of a notch filter and enforcement of performance safety limits to mitigate the effects of Parkinson tremors on a battery powered wheelchair directed by a joystick. The wheelchair has regenerative braking to extend range of operation between charges. Regenerative braking transforms the wheelchair model into an autonomously switched hybrid system. The wheelchair is represented as a joystick controlled wheeled mobile robot having two modes of operation per drive wheel, propelling and regenerative braking. In this study, a Parkinson's patient is directed to follow a path that includes moving from a stopped position to a trajectory along a wall that includes a 90˚ corner. A cognitive model of a human operator is incorporated for simulation of an operator with Parkinson's tremor. The human operator model output provides the joystick with noisy velocity, orientation, and position commands. The article delineates a notch filter to remove the main Parkinson's tremor from the joystick input followed by the application of velocity and acceleration performance safety limits. Results show significant feasible advantages for safe wheelchair operation by Parkinson's patients with tremor.