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Assistive Technology

Volume 28, Issue 3, 2 July 2016, Pages 159-174

Integrated modeling and design for realizing a two-wheeled wheelchair for disabled

(Article)

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Abstract

Two-wheeled wheelchairs are considered highly nonlinear and complex systems. The systems mimic a double-inverted pendulum scenario and will provide better maneuverability in confined spaces and also to reach higher level of height for pick and place tasks. The challenge resides in modeling and control of the two-wheeled wheelchair to perform comparably to a normal four-wheeled wheelchair. Most common modeling techniques have been accomplished by researchers utilizing the basic Newton's Laws of motion and some have used 3D tools to model the system where the models are much more theoretical and quite far from the practical implementation. This article is aimed at closing the gap between the conventional mathematical modeling approaches where the integrated 3D modeling approach with validation on the actual hardware implementation was conducted. To achieve this, both nonlinear and a linearized model in terms of state space model were obtained from the mathematical model of the system for analysis and, thereafter, a 3D virtual prototype of the wheelchair was developed, simulated, and analyzed. This has increased the confidence level for the proposed platform and facilitated the actual hardware implementation of the two-wheeled wheelchair. Results show that the prototype developed and tested has successfully worked within the specific requirements established. © 2016 RESNA.

Author keywords

double inverted pendulum; equality; Lagrangian model; mobility; two-wheeled mobile robot; wheelchair

Indexed keywords

Engineering controlled terms: Carrier mobility; Hardware; Lagrange multipliers; Mobile robots; Pendulums; Reconfigurable hardware; State space methods

Double inverted pendulum; equality; Hardware implementations; Integrated modeling; Lagrangian models; Modeling and control; State - space models; Two wheeled mobile robot

Engineering main heading: Wheelchairs

ISSN: 10400435 **CODEN:** ASTEF **Source Type:** Journal **Original language:** English
DOI: 10.1080/10400435.2016.1140688 **Document Type:** Article
Publisher: Taylor and Francis Inc.

View in search results format

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