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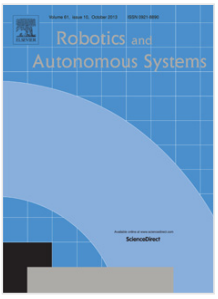

Nonlinear control of mobile inverted pendulum

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Nonlinear Control of Mobile Inverted Pendulum

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Abstract

The mobile inverted pendulum (MIP) is a robotic system with nonholonomic constraint due to no-slip condition imposed on the wheel. In particular, it has four configuration variables to be controlled using only two control inputs. In this paper, we propose a nonlinear control strategy to move the MIP from one point to another point in the configuration space while stabilizing the pendulum. The proposed single level controller is designed using a nonlinear co-ordinate transformation which leads to a simple three step navigation design procedure. The proposed controller stabilizes all four configuration variables without switching between the controllers. Simulation results are presented to validate the proposed technique.

Index Terms

Mobile Inverted Pendulum (MIP), Nonlinear control, Underactuated system.

I. Introduction

Two wheeled self balancing robots are used for mobile applications involving narrow spaces and sloped environment. The laboratory version of this robotic system is called as "mobile inverted pendulum". It has two wheels attached to its chassis and a pendulum which can rotate about its wheel axis. The pendulum is attached to the center of mass of the system in an inverted position. This system has nonholonomic[1] constraints due to no slip condition imposed on the wheels and also underactuated[2]. Yamabico Kurara [1], Segway [2] and Joe [3] are some of the existing models of MIP and in particular Segway is commercially available as a human transporter.

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[1]Nonholonomic constraints are non-integrable and restricts types of motion but not position.

[2]Underactuated systems are defined as system with less number of control inputs than its degrees-of-freedom.