Nonlinear Dynamics and Systems Theory, **11** (4) (2011) 373–382

Application of Passivity Based Control for Partial Stabilization

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Received: January 6, 2011; Revised: September 23, 2011

Abstract: In this paper, the problem of partial stabilization is considered for nonlinear control systems and a general approach for partial stabilization is proposed. In this approach, by introducing the notion of *partially passive systems*, some theorems for partial stabilization are developed. For this purpose, the nonlinear system is divided into two subsystems based on stability properties of system's states. The reduced control input vector (the vector that includes components of input vector appearing in the first subsystem), is designed based on the new passivity based control theorems, in such a way to guarantee asymptotic stability of the nonlinear system with respect to the first part of states vector.

Keywords: *nonlinear systems; partial stability; partial passivity; partial control.*

Mathematics Subject Classification (2000): 34D20, 37N35, 70K99, 74H55, 93C10, 93D15.

1 Introduction

For many of engineering problems, application of Lyapunov stability is required [1]– [3]. However, there are other physical systems like inertial navigation systems, spacecraft stabilization, electromagnetic, adaptive stabilization, guidance, etc. [4]– [12], where partial stability is necessary. In the mentioned applications, while the plant may be unstable in the standard sense, it is partially and not totally asymptotically stable. It means that naturally the plant is stable with respect to just some -and not all- of the state variables. For example, consider the equation of motion for the slider-crank mechanism depicted in Figure 1 [8]:

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