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Composite Control of the *N*-link Chained Mechanical Systems

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Abstract: In this paper, a new control concept for a class of underactuated mechanical system is introduced. Namely, the class of n-link chains, composed of rigid links, non actuated at the pivot point is considered. Underactuated mechanical systems are those having less actuators than degrees of freedom and thereby requiring more sophisticated nonlinear control methods. This class of systems includes among others frequently used for the modeling of walking planar structures. This paper presents the stabilization of the underactuated n-link chain systems with a wide basin of attraction. The equilibrium point to be stabilized is the upright inverted and unstable position.

The basic methodology of the proposed approach consists of various types of partial exact linearization of the model. Based on a suitable exact linearization combined with the so-called "composite principle", the asymptotic stabilization of several underactuated systems is achieved, including a general n-link. The composite principle used herein is a novel idea combining certain fast and slow feedbacks in different coordinate systems to compensate the above mentioned lack of actuation.

Numerous experimental simulation results have been achieved confirming the success of the above design strategy. A proof of stability supports the presented approach.

Keywords: nonlinear systems; exact linearization; underactuated mechanical systems;

AMS Subject Classification: 70E60; 70K42; 70F10; 37C75;

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