



Stabilisation of a Class of Underactuated System with Tree Structure Using Backstepping Approach

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Abstract: In this paper, a method for transforming the structure of a class of underactuated mechanical system from tree to chain structure through a change of coordinates and control law is proposed. The main goal of this transformation is to allow apply control design methodologies suited to the chain structure, namely, the feedback linearization and backstepping. The effectiveness of the proposed transformation is shown via an example of underactuated system that initially possesses a tree structure and to which backstepping control was applied. However, the designed control law presents a singularity that decreases the stability domain. In order to make the latter global, a hybrid control strategy is adopted allowing to switch the control near the singularities. The stability proof and simulation results for using the hybrid switching are given.

Keywords: *underactuated mechanical system; CFD; tree structure; chain structure; systematic backstepping; Tora system; singularity; switching control.*

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