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1 Recursive Decentralized Control for Robotic Manipulators

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Beijing Institute of Technology, Beijing, China 100081 3 Jun ZHANG⁴ 4 5 Beijing Institute of Control Engineering, 100094, Beijing, People's Republic of China 6 Abstract: In the standard centralized motion controllers for trajectory tracking of space 7 manipulators, a precise centralized dynamic model is required, thus demanding high 8 computational cost and large memory for applications. In the decentralized controllers, the 9 space manipulator is viewed as a set of independent second-order subsystems, while the control law only depends on local measurements in each joint. Normally, the decentralized 10 11 control is quite simple to real-time implement and induces a very limited computational 12 burden. However, the control performance would be easily degenerated since the interactions 13 among the subsystems, such as dynamic coupling forces and moments, are neglected. Therefore, this paper presents a compromise between the centralized and decentralized 14 controls — a recursive decentralized strategy. First, the interactions at the joints connecting 15 16 two adjacent links are explicitly modeled by the recursive algorithm for multibody systems dynamics. Then, a decentralized robust control is designed under the assumption that 17 18 communications are allowed in the decentralized controllers. The communicated information 19 includes the relative motion states at the joints, the geometry and mass parameters, and the 20 control torques. These communications enable to recursively construct the nominal part of the 21 physical interactions for compensation. An adaptive robust strategy is further designed in the 22 decentralized control to improve the control performance. Finally, numerical examples are 23 conducted for a space manipulator to verify the effectiveness of the proposed control scheme.

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Key Words: Recursive Dynamics; Decentralized Control; Robust Control; Space Manipulators.

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