The Dynamic Sliding-mode Control of The Robotic Manipulator

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ABSTRACT

A redundant robot for the specific application to contour tracking and singularity problem is considered in this paper. This paper also presents a hybrid path planning approach to improve the disadvantage of the perturbation method and the pseudo-inverse method. The proposed method switches these two algorithms according the cost function of manipulation; it has singularity robustness on the paths with singularity and can minimize the computing cost on the paths without singularity. Traditionally, the selection of the sliding surface is not across the initial condition of the error states. Therefore, it results that the sliding mode control motion has two phases, i.e., the reaching phase and the sliding phase. The invariance of the sliding mode control only applies to the sliding phase on the sliding surface. During the reaching phase, the system is sensitive to parameter uncertainty and disturbance. In this paper, a dynamic sliding mode control with global invariance is studied to solve the above problem. On the other hand, velocity sensors are often omitted to save cost and to avoid the influence of noise. In this paper, the problem of velocity measurements can be solved by using the high-gain observer to estimate joint velocities form position measurements. To avoid the chattering due to the discontinuous switching control that is replaced by the iterative learning control. Different to the conventional ILC approach, the sliding variable of the error dynamics is used to improve tracking performance in the proposed method. The results show that the proposed method is able to achieve good tracking performance without chattering.

Keywords : redundant robot, motion planning, singularity problem, sliding-mode control, high-gain observer, iterative learning control.

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