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INTEGRATION MODEL REFERENCE ADAPTIVE CONTROL AND EXACT LINEARIZATION WITH DISTURBANCE REJECTION FOR CONTROL OF ROBOT MANIPULATORS

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Abstract. *This paper proposes an adaptive global asymptotic stable (adaptive GAS) control scheme for the compensation of friction and disturbance effect to control robot manipulators. This control method integrates both model reference technique and exact linearization. In addition, it employs disturbance compensating mechanics to control the system to follow a linear reference model which has pole placement (on the left of the complex plane), even though modelling error, disturbance and noise exist. The simulation results of the 2DOF planar robot demonstrate the effectiveness of the proposed method.*
Keywords: Model reference, Adaptive control, Exact linearization, Disturbance rejection, Adaptive GAS

1. **Introduction.** During the last decade, the class of robot manipulators as a class have been the subject of intensive research in the various fields of systems and control theory: PID controller, estimated moment controller, adaptive control, variable structure control and fuzzy control. Many controllers that have been researched have already accomplished state measurement of a robot manipulator. In robotic control, we consider location of joints only. The exact location measurement could be made by encoder or analyzer-resolver. On the contrary, speed measurement of joints could be made by tachometer or position error and achieved by encoder or analyzer-resolver. These devices often had an error due to the affect of disturbance. Disturbance disabled the flexible operation of the manipulator and accordingly control quality was almost totally limited by the disturbance element which affected speed measurement. Moreover, the tachometer increased the weight of moving robot parts and accordingly decreased the effectiveness of the robot. Moreover, uncertainties always existed in the system model: external disturbance, parameter uncertainty and sensor errors, modelling errors also existed due to unexplained static and dynamic friction forces at the joints and uncertainty in the link parameters, which caused unstable robotic system performance. In order to improve these limitations, numerous researches were worked to develop the location tracking controller.

First, Nicosia et al. designed the observer-controller structure in which nonlinear observing was added into the feedback loop so as to ensure local asymptotical stabilization in position error [1]. A few years later, Lim et al. repeated this research with a backstepping perspective and achieved similar results [2]. However, their researches all required exact knowledge of the dynamic robot to ensure stable result in local or semiglobal. Regarding compensator for uncertain robot, Canudas de Wit et al. developed the state observer based on the variant structure model in order to design an adaptive controller and a robust controller [3]. Besides, Zhu et al. developed the variant structure controller which