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DIRECT ADAPTIVE NEURAL CONTROL WITH SLIDING MODE METHOD FOR A CLASS OF UNCERTAIN SWITCHED NONLINEAR SYSTEMS

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Abstract. *In this paper, a direct adaptive neural control scheme with sliding mode method is presented for a class of switched nonlinear systems which is in the presence of model uncertainties and external disturbances. A sliding mode controller based on RBF neural networks (RBF NNs) which are utilized to approximate unknown functions and uncertain nonlinear terms is designed to enhance robustness and maintain boundedness. Adaptive neural updated laws are based on switched Lyapunov function approach, and a periodically switching signal is constructed. It is proved that with the proposed control scheme, the resulting closed-loop switched system is robustly stable and uniformly ultimately bounded such that the satisfactory tracking performance and sliding surface are both well achieved. A simulation example is provided to illustrate the effectiveness and the feasibility of the proposed approach.*
Keywords: Switched nonlinear systems, RBF neural networks, Switched Lyapunov function, Direct adaptive sliding mode control

1. **Introduction.** Last decade has witnessed rapidly growing interest in switched systems. There are many results on the control analysis and synthesis of switched linear systems and switched nonlinear systems, and the problems of stability, controllability, observability and stabilization have been mainly focused on [1-10,17,18]. The primary motivation for studying switched systems in control theory comes principally from the fact that switched systems have numerous applications in the control of mechanical systems, automotive industry, process control, power systems, aircraft, traffic control, biology, network and many other practical control fields [3,7,8].

However, in many practical control systems, there often exist nonlinearity and uncertain terms. As a common knowledge, the uncertainty may be due to external uncertainties, internal parameter uncertainties, measurement, noise, system identification error. Also, the model imprecision may arise from the purposeful simplification of mathematical model representation of plant or from insufficient information about the system. If the controller for uncertain switched systems is not well-designed, these may bring about the serious degradation of the system's performance and the decrease in speed of response. So, the factor couldn't be overlooked in analysis of controller design and realization [3,9,10]. On the other hand, there are some controlled systems that are not only characterized by the unstructured uncertainties, but also represented by the terms which cannot be modeled. When the system nonlinearities are not known completely but some bounds on them are known, the nonlinearities can be approximated either by neural networks or by fuzzy