

A Coordinated Adaptive SMC Method for Frequency Regulation Control in Power Systems With Multiple Wind Farms

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The extensive integration of renewable energy resources inevitably gives rise to the complex and uncertain power system, where the somber matter of frequency instability becomes apparent. This article presents a coordinated adaptive radial basis function neural network (RBFNN)-based sliding mode control (CAR-SMC) to reduce the frequency deviation and oscillation of the uncertain power system comprising multiple wind farms. Firstly, the SMC is aimed at establishing the upper layer control law of the frequency regulation controllers. Then, the uncertainties are represented with RBFNN, and an adaptive law is employed to estimate the uncertainties online rapidly and realize the free-chattering of SMC. Furthermore, since a single SMC is only capable of handling a single control input system, a power distribution law based on momentum is proposed to implement the multiple control inputs of the AR-SMC, and also coordinate the frequency regulation abilities of wind turbines and energy storage systems (ESSs). Eventually, the proposed CAR-SMC is validated on a modified IEEE 39-bus system. The simulation results demonstrate that CAR-SMC can enhance the frequency stability in the presence of disturbances and uncertainties during steady-state operation, as well as in under-frequency and over-frequency scenarios.