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Fast Robust Switching Control Scheme for PWR-Type Nuclear Power Plants

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Abstract : In sophisticated and complex systems such as nuclear power plants, maintaining the system's stability in the presence of uncertainties and disturbances and obtaining a fast dynamic response are the most challenging problems. Thus, to ensure the satisfactory and safe operation of nuclear power plants, this work proposes a new fast, robust optimal switching control strategy for pressurized water reactor-type nuclear power plants. The proposed control strategy guarantees a substantial degree of robustness, fast dynamic response over the entire operational envelope, and optimal performance during the nominal operation of the plant. To improve the robustness, obtain a fast dynamic response, and make the system optimal, a bank of controllers is designed. Various controllers, like a baseline proportional-integral-derivative controller, an optimal linear quadratic Gaussian controller, and a robust adaptive L1 controller, are designed to perform distinct tasks in a specific situation. At any instant of time, the most suitable controller from the bank of controllers is selected using the switching logic unit that designates the controller by monitoring the health of the nuclear power plant or transients. The proposed switching control strategy optimizes the overall performance and increases operational safety and efficiency. Simulation studies have been performed considering various uncertainties and disturbances that demonstrate the applicability and effectiveness of the proposed switching control strategy over some conventional control techniques.

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