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A Dual-Mode Infinite Horizon Predictive Control Algorithm for Load Tracking in PUSPATI TRIGA Reactor

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Abstract : The PUSPATI TRIGA Reactor (RTP), Malaysia reached its first criticality on June 28, 1982, with power capacity 1MW thermal. The Feedback Control Algorithm (FCA) which is conventional Proportional-Integral (PI) controller, was used for present power control method to control fission process in RTP. It is important to ensure the core power always stable and follows load tracking within acceptable steady-state error and minimum settling time to reach steady-state power. At this time, the system could be considered not well-posed with power tracking performance. However, there is still potential to improve current performance by developing next generation of a novel design nuclear core power control. In this paper, the dual-mode predictions which are proposed in modelling Optimal Model Predictive Control (OMPC), is presented in a state-space model to control the core power. The model for core power control was based on mathematical models of the reactor core, OMPC, and control rods selection algorithm. The mathematical models of the reactor core were based on neutronic models, thermal hydraulic models, and reactivity models. The dual-mode prediction in OMPC for transient and terminal modes was based on the implementation of a Linear Quadratic Regulator (LQR) in designing the core power control. The combination of dual-mode prediction and Lyapunov which deal with summations in cost function over an infinite horizon is intended to eliminate some of the fundamental weaknesses related to MPC. This paper shows the behaviour of OMPC to deal with tracking, regulation problem, disturbance rejection and caters for parameter uncertainty. The comparison of both tracking and regulating performance is analysed between the conventional controller and OMPC by numerical simulations. In conclusion, the proposed OMPC has shown significant performance in load tracking and regulating core power for nuclear reactor with guarantee stabilising in the closed-loop.

Keywords : core power control, dual-mode prediction, load tracking, optimal model predictive control
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