World Academy of Science, Engineering and Technology
International Journal of Nuclear and Quantum Engineering
Vol:12, No:12, 2018

Transfer Function Model-Based Predictive Control for Nuclear Core Power Control in PUSPATI TRIGA Reactor

Authors : Mohd Sabri Minhat, Nurul Adilla Mohd Subha

Abstract : The 1MWth PUSPATI TRIGA Reactor (RTP) in Malaysia Nuclear Agency has been operating more than 35 years. The existing core power control is using conventional controller known as Feedback Control Algorithm (FCA). It is technically challenging to keep the core power output always stable and operating within acceptable error bands for the safety demand of the RTP. Currently, the system could be considered unsatisfactory with power tracking performance, yet there is still significant room for improvement. Hence, a new design core power control is very important to improve the current performance in tracking and regulating reactor power by controlling the movement of control rods that suit the demand of highly sensitive of nuclear reactor power control. In this paper, the proposed Model Predictive Control (MPC) law was applied to control the core power. The model for core power control was based on mathematical models of the reactor core, MPC, and control rods selection algorithm. The mathematical models of the reactor core were based on point kinetics model, thermal hydraulic models, and reactivity models. The proposed MPC was presented in a transfer function model of the reactor core according to perturbations theory. The transfer function model-based predictive control (TFMPC) was developed to design the core power control with predictions based on a T-filter towards the real-time implementation of MPC on hardware. This paper introduces the sensitivity functions for TFMPC feedback loop to reduce the impact on the input actuation signal and demonstrates the behaviour of TFMPC in term of disturbance and noise rejections. The comparisons of both tracking and regulating performance between the conventional controller and TFMPC were made using MATLAB and analysed. In conclusion, the proposed TFMPC has satisfactory performance in tracking and regulating core power for controlling nuclear reactor with high reliability and safety.

Keywords : core power control, model predictive control, PUSPATI TRIGA reactor, TFMPC
Conference Title : ICNRTRP 2018 : International Conference on Nuclear Reactor Technologies and Radiation Protection
Conference Location : Kuala Lumpur, Malaysia
Conference Dates : December 05-06, 2018