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State Feedback Controller of Robinson Nuclear Plant with States and Control Constraints

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Abstract: This paper deals with the problem of finding a stabilizing feedback controller for nuclear reactor power plant. A mathematical model of the H. B. Robinson pressurized water reactor plant is formulated. The model includes representations for point kinetics, core heat transfer, piping, pressurizer, and the steam generator. The designed linear state feedback controller accounts for constraints on neutron flux level, steam pressure in steam generator, hot leg temperature and constraints on control inputs of reactivity and electric heater to pressurizer. Simulation results show the effectiveness of the proposed design.

Keywords: *H.B. Robinson nuclear plant; stabilization; state feedback controller; state constraints.*

Mathematics Subject Classification (2010): Primary: 34D20, 47H07; Secondary: 34C12, 47A50.

1 Introduction

Currently, there are more than 80 pressurized water reactors (PWRs) operating as important contributors to electricity supply worldwide. But, in this type of reactor, safety margins obstruct the optimal exploitation of the plant because instability may occur under particular operating conditions. The stability of PWR reactor systems has been of a great concern from the safety and the design point of view [1].

Stability problems may only arise during start up or during transients which significantly shift the operating point. Instructions for PWRs contain clear rules on how to

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