

UNIVERSITI TEKNOLOGI MARA

**INTERNAL MODEL CONTROL
USING NEURAL NETWORK FOR
SHELL AND TUBE HEAT
EXCHANGERS**

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ABSTRACT

In this research paper, a nonlinear internal model using neural network (NNIMC) is proposed to the shell and tube heat exchanger system. In past studies, PID controller is implemented in shell and tube heat exchanger, however it is exhibited high overshoot and long settling time. Therefore, NNIMC is introduced to improve the performances of PID controller. The manipulated variable of the controller is the flowrate of the hot fluid in the shell and the controlled variable is the outlet temperature of the cold fluid in the tubes. The addition of the neural network is to compensate time delay and ensures the offset performances. The control structure uses both a forward and an inverse neural network process model. The forward model is placed in parallel to the process model. The inverse neural model (INN) has two input which are previous flowrate and present temperature and one output which is present flowrate. After training for multiple times, one hidden layer INN model with 5 neurons is considered. The forward neural network (FNN) has two inputs which are previous flowrate and previous temperature and one output which is present temperature. After training for multiple times, one hidden layer with 7 neurons is considered. From simulation result, NNIMC outperforms PID controller as it exhibits no overshoot and less settling.

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TABLE OF CONTENT

	Page
SUPERVISOR CERTIFICATION	ii
AUTHOR'S DECLARATION	iv
ABSTRACT	v
ACKNOWLEDGEMENT	vi
TABLE OF CONTENT	vii
LIST OF TABLES	ix
LIST OF FIGURES	x
LIST OF PLATES	xii
LIST OF SYMBOLS	xiii
LIST OF ABBREVIATIONS	xiv
CHAPTER ONE INTRODUCTION	1
1.1 Research Background	1
1.2 Problem statement	3
1.3 Objectives	4
1.4 Scope of Research	4
CHAPTER TWO LITERATURE REVIEW	6
2.1 Introduction	6
2.2 Heat Exchanger and Its Nonlinearity System	6
2.3 Shell and Tube Heat Exchanger	6
2.4 Controller for Shell and Tube Heat Exchangers	8
2.4.1 Classical PID Controller	8
2.4.2 Feedback plus Feedforward Controller	10
2.4.3 Fuzzy Logic Controller	12
2.4.4 Internal Model Controller (IMC)	13
2.5 Neural Network (NN) Estimators	15

CHAPTER ONE

INTRODUCTION

1.1 Research Background

All chemical action is generally involving in creating or absorbing of energy in term of heat. A heat exchanger is used in chemical action in transferring from a hot fluid through a solid wall to a cooler, therefore the temperature of the outlet fluid can be controlled (Sharma, 2016). Open loop systems of heat exchanger are typically manufacture, thus the performance of the heat exchanger is resolute by the structural and mechanical design of the heat exchanger itself. There are many types of heat exchanger and the most common ones is shell and tube heat exchanger. Shell and tube heat exchanger builds up with nonlinear system that consists of uncertainty and robustness that need to be cope with suitable controller to achieve good control performance of system (I. Rivals & Personnaz, 1996).

Nonlinear control design of heat exchanger in process industries has been a complex problem in industries due to uncertainty and disturbances in the systems. Therefore, researchers are implemented several of controller to find the most suitable model for feedback of control design of shell and tube heat exchanger. A control system is consists of to-be-controlled process while, a control device is chosen by the researchers themselves as they will design the controller and any possible other elements that convey the desired behaviour to the control system (I Rivals & Personnaz, 2000).

In designing a good controller for a system is requires many trial and error and comparison between existing controllers since to design controller of modelling dynamic analysis of heat exchanger is not an easy task due to complex process especially nonlinear system that accompanied with uncertainty and disturbances. Therefore, selection of good control algorithm is important since it is depending on the comparison of performances of different possible control technique and results of best control of desired condition. Thus, in the way in finding the most suitable controller for nonlinear system of shell and tube heat exchanger, the controller parameter of dynamic changing process should be perfectly match with parameter of the nonlinear system (S, Nithya, Abhay Singh Gour, N. Sivakumaran, 2007).