UNIVERSITI TEKNIKAL MALAYSIA MELAKA

PREDICTION OF HEAD LOSS IN BORE PIPE USING NEURAL NETWORK MODELLING

This report is submitted in accordance with the requirement of Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Mechanical Engineering Technology (Automotive) with Honours

by

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2018

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

Tajuk: Prediction Of Head Loss In Bore Pipe Using Neural Network Modelling

Sesi Pengajian: 2018/2019 Semester I

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APPROVAL

This report is submitted to the Faculty of Mechanical and Manufacturing Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Mechanical Engineering Technology (Automotive). The member of the supervisory is as follow:

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ABSTRAK

Tujuan penyelidikan ini adalah untuk menentukan kehilangan geseran dalam paip dengan melakukan eksperimen, melakukan pengiraan dengan menggunakan persamaan dan meramalkan hasil pengeluaran data dengan menggunakan pemodelan rangkaian Neural (NNM). Dalam bidang kejuruteraan, ianya adalah kemestian untuk menganggarkan kadar kehilangan turus yang berlaku disebabkan oleh cecair yang mengalir melalui saluran paip dan boleh menyebabkan geseran di sepanjang dinding paip yang dicipta oleh bendalir tersebut. Kaedah yang digunakan dalam eksperimen ini ialah Pemodelan Rangkaian Neural, yang digunakan dalam eksperimen geseran kehilangan turas cecair menggunakan perisian Matlab. Pemodelan Rangkaian Neural adalah komputer atur cara yang direka untuk mengumpul maklumat dengan mengesan pola dan hubungan dalam data dan belajar (atau dilatih) melalui pengalaman. Berdasarkan keputusan dan analisis yang diperolehi, adalah yang terbaik untuk menggunakan Tansig fungsi perpindahan dalam pemodelan rangkaian Neural bagi hasil ramalan eksperimen kerana ia memberikan nombor dan nilai yang paling hampir dan terdekat dengan nilai data pengiraan menggunakan persamaan. Selain itu, pengiraan ralat juga telah dilakukan untuk menentukan prestasi terbaik daripada nilai hasil ramalan daripada permodelan ini. Sebagai kesimpulan, dapat dibuktikan bahawa ini adalah salah satu alternatif yang boleh digunakan untuk menjimatkan wang dan masa.

ABSTRACT

The research of this study is to quantify friction head loss in pipe by doing the experiment, calculated using equation and predicted the output by using Neural Network Modelling (NNM). In engineering practice, it is frequently necessary to estimate the head loss incurred by a fluid as it flows through a pipeline and can cause friction force along the pipe wall that created against the fluid. The method used in this experiment is by applying the Neural Network Modelling in the fluid friction head loss experiment using Matlab Software. Neural Network modelling is a computer programs designed to gather the knowledge by detecting the patterns and relationships in data and learn (or trained) through experience. Based on the result and analysis obtained, it is suggested best to use Tansig transfer function in Neural Network Modelling for prediction output as it give the closest and nearest value to the calculation data. Besides that, an error calculation also were done to determine the best performance of prediction output from the modelling. As conclusion, it is proven that this is one of alternatives that can be used to save money and time.

DEDICATION

I dedicate this thesis to my parents and relatives who have always giving me a great support and love that motivates me on achieving my goals along the way of my study life. In doing so, I would like to dedicate this project to my lecturers Mr Mohd Sulhan Bin Mokhtar, Mr Herdy Rusnandi and Mr Nazri Huzaimi Bin Zakaria who are being my guidance on providing me so much useful knowledge and supports me along the way of my final year project. Besides, I also dedicate this dissertation to my friends who supported me throughout the process.

Last but not least, I would like to dedicate and give special thanks to my lovely supervisor, Madam Ezzatul Farhain Binti Azmi for being patient with all my attitude and keep pushing me with encourage and nice words and belive me to finished this thesis. Thank you.

ACKNOWLEDGEMENT

First and foremost, I would like to express my gratitude to Universiti Teknikal Malaysia Melaka (UTeM) for providing me an opportunity to become a student to gain precious knowledge from both academy and practical in my study life. I would also like to give a great thank to my final year project supervisor, Madam Ezzatul Farhain Binti Azmi for the guidance, inspiration, motivation and patience given all through the advancement of this research. Without her encourage words, this research would not be succesfully finished.

Next, my sincere gratitude to my family who has been so tolerant and keep supporting in each semester so that I can finished the study. Last but not least, thank you to all my friends, my roommate, and my coursemate, for lending me a hand that I can encountered throughout my study life and giving me a great support along the way to finished the thesis. Also not to forget to those who help me direct and indirectly.

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LIST OF SYMBOLS

SYMBOLS		TOPIC
g	:	Gravity
ρ	:	Density
Re	:	Reynold number
V	:	Mean Velocity
D	:	Diameter
L	:	Length
v	:	Average velocity
f	:	Friction force
H	:	Head loss
η	:	Viscosity
K	:	Loss coeficient
t	:	Time

LIST OF ABBREVIATIONS

ANNM	:	Artificial neural network modelling
AI	:	Artificial Intelligence
ANN	:	Artificial Neural Networks
MSE	:	Mean Square Error
MSD	:	Mean Square Deviation
MAE	:	Mean Absolute Error
RMSD	:	Root Mean Squared Deviation
MATLAB	:	Matrix Laboratory
ME	:	Mean Error
RMSE	:	Root Mean Squared Error
Eq	:	Equation

CHAPTER 1

INTRODUCTION

1.1 Background Study

Artificial intelligent Neural Network Modelling (ANNM) are one of the tools that used in machine learning. ANNM are inspired computer programs designed to stimulate the same way like brain human processes. It gather the knowledge by detecting the patterns and relationships in data and learn (or trained) through experience. An ANNM is formed like human brain, with the neuron nodes interconnected like a web. The neurons are connected by links and they interact with each other. Typically, they are organized in layers. Usually, the network is presented via input layer, hidden layer and output layer.

Recently, a deep neural network is a powerful framework for learning representations based approaches that have been widely used to solve structured output prediction. The motivation of this work is to learn the output dependecies that may lie in the output data in order to improve prediction accuracy. This mathematical modelling have been applied in all scopes of operations such a; making cars drive autonomously on the roads, to generating shockingly realistic CGI faces and especially in fluid friction head loss.

In fluid flow, fluid friction is the loss of pressure or head loss friction that occur in pipe due to the effect of the fluid's viscosity near the surface of the pipe. Proffesor Osborne

Reynolds demosntrated that two types of flow may exist in a pipe which are laminar flow and turbulent flow. In laminar flow, head loss, h is directly proportional to flow velocity, u. While in turbulent flow, h is directly proportional to u^n.

By applying the Neural Network Modelling in the fluid friction head loss experiment, this is one of alternatives that can be used to save money and time. Also, it made the experimenter life easier because there is no need to do the experiment again because by using this modelling, it can detected the patterns and learn from it. It just need to run and train the data by using MATLAB software.

1.2 **Objective**

In this study, several objectives will be implemented such as:

a) To study the application of Neural Network Modelling in engineering field.
b) To apply Neural Network Modelling in measuring friction head loss in bore pipes.
c) To compare head loss data between experiment data, calculation using equation formula and by using Neural Network Modelling.

1.3 Problem Statement

Today the researchers have faces so many problems while doing the experiment such as they are wasting too much time and cost. Besides that, there is much complicated to get more data while conduct the experiment. So, with this research, by applying Neural Network Modelling, it can save time and cost also no problem if we want to get more data as many as we can (Haghiabi, 2017)

1.4 Rational of Study

The research of this study is to quantify friction head loss in pipe by doing the experiment, calculated using equation and predicted by utilizing Neural Network Modelling. From that, we can study and understand the distinction between the data obtained from experiment, the data from calculation by utilizing equation and the data forecasting by the Neural Network Modelling.

1.5 Scope of Work

To achieve the objective, a several methods needed to use in this study. Several scopes have been determined:

a) Study and run the dataset using Neural Network Modelling by using MATLAB software.
b) Study and understand the friction head loss in pipe for different water flow rates, pipes diameter and pipe roughness.

1.6 Significance of Study

The significance of the study is it can save a lot of cost and time to us to get the data of friction head loss in pipe. As we can run the data, and train the data in the modelling, so we do not need to do the experiment for another more data that needed. Moreover, the Neural Network modelling can grip more data as many as you can since we already train the data in the modelling. Hence, neural network modelling also is one of the alternatives to get the data other than doing experiments.

1.7 Theory Outline

This research report has four main chapter which are Introduction, Literature Review, Methodology, and Expected Result. For chapter one, it begins with background study, objective, problem statement, scope of work, significance of study, rational of study and theory outline. For the chapter two, the report is telling about the other researchers or other experiment that has been done and followed by chapter three, this chapter explains about on how to conduct this research project.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

In this chapter, the discussion will focus on reports, writing and results of previous studies related to the study that conducted. The highlight of the writing includes a description related to Artificial Intelligence, Fluid Friction in Bore Pipe, Prediction Data, and Error Measurement that occur. The description of the modeling used which is Neural Network Modeling also clarified and discussed based on previous studies.

2.1 Artificial Intelligence

"Artificial Intelligence" (AI) concept was first established at Dartmouth College in the US in 1956 (Crevier D, 1993). Their meaning of AI indicated to the qualification of machines to understand, think, and learn in a similar way to human beings, indicating the possibility of using computers to simulate human intelligence (McCorduck, 2004), (Russell & Norvig, 2003) and (Howe, 1994).

Artificial intelligence techniques and application have recently gained a great deal of attention in many areas since the 1970s. It also including fields of mathematics, neuroscience, economics, engineering, linguistics, gaming, and many others. This is imputable to the spate of innovative and sophisticated AI technique's applications to highly complex problems as well as the powerful new developments in high speed