SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the degree of *Doctor of Philosophy/ Master of Engineering/ Master of Science in .....

(Supervisor's Signature)

Full Name : DR MUHAMMAD @ S.A KHUSHREN SULAIMAN

Position : SENIOR LECTURER.

Date :

(Co-supervisor's Signature)

Full Name :

Position :

Date :

STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

Izah.

(Student's Signature)

Full Name : NURUL IZZAH BINTI OSMANI

ID Number : AA13047

Date : 16 May 2017

FLOOD FORECASTING AT JERANTUT, PAHANG BY USING ARTIFICIAL NEURAL NETWORK (ANN)

NURUL IZZAH BT OSMAN

Thesis submitted in fulfillment of the requirements
for the award of the
Bachelor Degree in Civil Engineering

Faculty of Civil Engineering and Earth Resources

UNIVERSITI MALAYSIA PAHANG

JUNE 2017

ACKNOWLEDGEMENTS

In the name of Allah, the Most Gracious and the Most Merciful

Alhamdulillah, all praises to Allah for the strengths and His blessing in completing this thesis. Special appreciation goes to my supervisor, Dr Muhammad for his supervision and constant support. Through this research, I gained knowledge not only in Artificial Neural Network (ANN), but also in spiritual aspect. His invaluable advices will be remembered for the rest of my life.

Sincere thanks to my friends especially Hafsah Hasmi, Izzah Berhan, Siti Khadijah, Maisarah Abdullah, Hasmira Abd Sahatar and others for their kindness and moral support during my study. Thanks for the friendship and memories.

Last but not least, my deepest gratitude goes to my beloved parents; Osman bin Abu Bakar and Zuliha bt Sarry and also to my siblings for their endless love, prayers and encouragement. To those who indirectly contributed in this research, your kindness means a lot to me. Thank you very much.

ABSTRAK

Membangunkan model bagi meramal aras air merupakan satu keperluan terutama di bahagian pantai timur Malaysia yang mengalami banjir setiap tahun disebabkan angin monsun timur laut. Satu model bagi meramal aras air boleh mengurangkan kesan yang buruk disebabkan oleh banjir. Artificial Neural Network (ANN) mengunakan data terdahulu untuk mengenalpasti data pattern dan menjana hasil dengan ramalan model. Data terdahulu diperlukan untuk menghasilkan result dengan menghasilkan model ramalan. Satu kajian kes telah dilakukan di Sungai Yap, di Sungai Pahang, dimana data bagi setiap jam aras air dari 1985 sehingga 2015 digunapakai untuk ramalam aras air setiap jam. Dalam kajian ini, terdapat tiga jenis sela masa iaitu 1, 3 dan 6 jam dan lima jenis data input iaitu 3, 4, 5, 6 dan 7 telah dianalisis. Hasil menunjukkan kesemua data input adalah berketepatan tinggi dimana nilai bagi NSC ialah 0.9 sehinga 1.

ABSTRACT

Developing flood forecasting is necessity especially for east coast peninsular Malaysia that experienced flood every year due to northeast monsoon. A strong performance of forecasting model to predict water level could be a solution to minimize bad impact of flood. Artificial Neural Network (ANN) use historical data to find data pattern to make data forecasting. Historical data require to generate the result by forecast a model. A case study had been applied at the Sungai Yap at Pahang River where hourly water level data dated from 1985 until 2015 have been used to forecast hourly water level. In this study, three type of time interval 1, 3 and 6 hour and 5 types of data input which are 3, 4, 5, 6 and 7 were analysed. Result showed that all data input successfully achieve high accuracy forecasting result where 0.9 to 1 for NSC value were recorded.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURESERROR! BOOKMARK NOT DEFINED.

LIST OF ABBREVIATIONS

AI	Artificial Intelligent
ANN	Artificial Neural Network
ATF	Activation Transfer Function
DID	Department of Irrigation and Drainage
NSC	Nash-Sutcliffe Coefficient
RMSE	Root Mean Square Error

CHAPTER 1

INTRODUCTION

1.1 Background

The earth is a watery place which 71 percent of the earth's surface is water-covered, and the oceans hold about 96.5 percent of all earth's water. Other than ocean, water also exists in the air as water vapour, in rivers and lakes, in icecaps and glaciers and in the ground as soil moisture. Hydrological cycle is a never ending global process of water circulation from clouds to land, to the ocean, and back to the clouds. Parts of hydrological cycle are precipitation, evaporation, freezing and melting and condensation and this cycling of water is intimately linked with energy exchanges among the atmosphere, ocean and land that determine the earth's climate and cause much of natural climate variability. Changes in the water cycle will give impact to climate change and variability of the human life, as stated in the National Research Council's report on Research Pathways for the Next Decade (NCR. 19990:" Water is at the heart of both the causes and effects of climate change". One of the impact of climate change is amount of rainfall will increase and lead to flood event.

Flood is an overflow of water that submerges land which is usually dry (MSN Encarta Dictionary, 2006). In Malaysia, especially East Coast flood occur every year that lead to damage to both life and property. Without a doubt, flood is one of the most devastating natural disasters. Floods can cause death, devastating damage to properties and adverse economic and environmental impacts. Based on SH Elsafi (2014), although flood cannot be completely eliminated, with flood forecasting model, it can minimize flood damage by provide timely flood warnings with an adequate lead time. The capabilities for prediction had improved during 1970s and 1980s. Now, advance technologies gave a huge impact to forecasting methodologies. For instance, hydrological models use physicals detection system to forecast flood conditions based on predicted

and/or measured parameters (K. James et. al, 2005). In actual flood forecasting scheme, river flow models are used as components, where forecasts are required to issue warning about rising water level. Forecast about the rising water level are obtained in real time, by using the model to transform the input functions into a corresponding rising water level function time.

1.2 Problem Statement

Flood is a natural disaster that gives a major impact to the affected area especially in term of property and life. It has been observed that, the economic repercussions of floods are more severely felt by the low-income dwellers especially in the flood plain area (Chan, 2000). With their minimal level of income, what they can do is only small effort to mitigate the impact of floods (Sulong et al., 2012). A study by Vinet (2008) stated that, as the effects of flooding include damage to home, shops and industries. He point out that, flood victim have problem with the cost of repair and some small shops do not reopen after the disaster.

According to (Napolitano, 2011) hydrological modelling attempts to represent processes within the hydrological cycle in a simplified manner which is to improve understanding of the flow which underlie the system as well as to make forecast of the future, e.g. flood events, occurrence of rainfall, river levels and sediment concentration or volume. There are three types of approaches of hydrological modelling: process-based; conceptual; and empirical or data driven (which include statistical).

Physically-based models (Wilby, 1997), also referred to as deterministic models (Anderson and Burt, 1985), represent the physical characteristics of the catchment. Although these models are the most complex and accurate of the three model types, they require a large amount of data and processing time, which is not always available for all catchments. The second type of approach is referred to as a conceptual, lumped conceptual or geomorphology-based model (Wilby, 1997; Wood and Connell, 1985; ASCE 2000a); these are viewed as the most successful model types for rainfall-runoff simulation and flood modelling. Conceptual models are therefore less demanding compared to physically-based model but require more information than empirical data-driven models. Data driven model tries to find an empirical relationship between a set of inputs (e.g historical data such as rainfall and temperature) and a set of outputs (e.g.

runoff). These models do not use physical equations, catchment characteristics or other physical parameters (Wilby, 1997; ASCE, 2000a; Anderson and Burt, 1985). One major advantage of this approach is that these models are generally very fast to run and much faster to develop than physically-based or conceptual models.

One of the factors that leads to the poor management of flood disaster is lack of preparation. The reasons is authorities cannot predict accurately when flood will happens. Flood forecasting should be establish so flood preparation could be done efficiently. An Artificial Neural Network (ANN) will be used to create flood forecasting due to accuracy of prediction by produce validation dataset that had been obtain from the training dataset.

1.3 Objective of Study

a. To predict flood events at Jerantut, Pahang
b. Produce flood forecasting model by using Artificial Neural Network (ANN).
c. To achieve high accuracy of flood forecasting model

1.4 Scope of Study

The study is based on predicting flood event at Sungai Pahang, Jerantut. Artificial Neural Network (ANN) are used to develop accurate flood forecasting because its simplicity, easy implementation and demonstrated success in forecasting studies. Hourly water level are gained from the Department of Irrigation and Drainage, the department that responsible on recording river water level at Pahang and used as a input data. Flood forecasting developed by three types of intervals: 1, 3 and 6 hours intervals.

1.5 Research Significant

Flood forecasting can contribute for better natural disaster management by providing relevant information of possible impending floods in populated locations. By establish flood forecasting, the safety of the residents can be achieve and economic losses can be minimize. The Artificial Neural Network (ANN) can achieve good performance when used to predict water flow. It will lead to accurate flood forecasting result.

REFERENCES

Ab. Ghani, s., N.A. Zakaria, I. Abustan, R. Abdullah, L. Mohd Sidek and M.S Ahamed, 1999. *The development of HEC-Series Programes to Predict Sediment Movement for River in Malaysia.* In Bengkel Pencapaian Penyelidikan IRPA-RM 7. 31 Ogos 1999-4 September 1999, Kedah.

Abd Jalil Hassan, Aminuddin Abd Ghani, 2006. *Development of flood risk map using Gis for Sg. Selangor Basin* (from http://www.redac.eng.usm.my.html)

Alex Johnson, (N.D*) Flooding*. Retrieved from https://geographyas.info/rivers/flooding/

Azmi, N.A., Hashim, R. and Zamhury, N. (2012*). Flash flood and people preparedness in anticipating disaster in Malaysia.* IEEE Symposium on Humanities, Science and Engineering Research.

Aziz, A. (2015). *Pengaruh Monsun dan Banjir Pada MPSB Kuala Berang*. Retrieved from http://www.mardec.com.my/media/pdf/pengaruhmonsun.pdf

B. Pradhan, (2010*). Flood susceptible and risk area delineation using logistic regression, GIS and remote sensing*. J Spat Hydrol, vol. 9, pp. 1-18.

Bedient, P. and W. Huber, 1988. *Hydrology and floodplain analysis*, Massachusetts: Addison-Wesley

Ching, Y. C., Yatim, B., Toriman, M. E., Lee, Y. H., Surif, S., & Abdullah, M. (2013). Impact, 6(10), 11-17. of Climate Change on Flood Risk in the Muar River Basin of Malaysia. Disaster Advances

Department of Hydrology, 2011. *Yearly Rainfall Data*. Department of Drainage and Irrigation (DID) Malaysia, Kuala Lumpur.

El-Shafie, A. and Noureldin, A.: *Generalized versus non-generalized neural network model for multi-lead inflow forecastinn at Aswan High Dam, Hydrol.* Earth Syst. Sci., 15, 841-858, doi:10.519/hess-15-841-2011, 2011

El-Shafie, A., Noureldin, A. E., Taha, M. R., and Basri, H.: *Neural network model for Nile river inflow forecasting based on correlation analysis of historical inflow data*, J. Appl. Sci., 8, 4487-4499, 2008

Gebeyehu, A., 1989. Regional Flood frequency analysis, Hydraulic laboratory, the royal institute of technology Stockholm, Sweden.

Han, Jung; Morag, Claudio (1995)."*The influence of the sigmoid function parameters on the speed of backpropagation learning*". In Mira, José; Sandoval, Francisco. From Natural to Artificial Neural Computation pp. 195-201.

Lun, P.I., M.B. Gasim, M.E. Toriman and K.A. Kamarudin, 2010. *River flow conditions and dynamic state of Pahang River*. Proceedings of the3rd Indonesia-Malaysia Joint Conference, Oct. 6-8, Universitas Pembangunan Sosial Yogyakarta, Indonesia, pp: 24-25.

Lun, P.I., M.B. Gasim, M.E. Toriman, S.A. Rahim and K.A. Kamarudin, 2011. *Hydrological pattern of pahang river basin and their relation to flood historical event*. J. e-Bangi, 6: 29-37

Noorazuan M.H. 2006.*Urban hydrological changes in the Sankey Brook catchment.* Unpublished PhD thesis. Manchester: University of Manchester.

M.Sulaiman, A. El-Shafie, O. Karim, and H. Basri, 2011. *Real-time flood forecasting by employing artificial neural network based model with zoning matching approach*

McCluskey, J. (2001). *Water supply, health and vulnerability in flood.* Waterlines Vol.19 No.3 January 2001

Mohit, M.A., Sellu, G.M. (2013). *Mitigation of Climate Change Effects through Non-structural Flood Disaster Management in Pekan Town, Malaysia*

Schueler, T., 1994. *The importance of imperviousness, Watershed protection techniques,* 1(3): 100-111

S.K. Sinnakaudan, (2002). *Flood risk mapping for Pari River incorporating sediment transport. Environmental Modelling & Software*, vol. 18, pp. 119-130.

Suparta, W. and Rahman, R (2015). *Spatial interpolation of GPS PWV and meteorological variable over the west coast of Peninsular Malaysia during 2013 Klang Valley Flash Flood.*

Vincent, R.K., 1997. *Fundamentals of geological and environmental remote sensing.* Prentice-Hall, Inc., Upper Saddle River, NJ.