Abstract of thesis presented to the Senate of Universiti Malaysia Terengganu in fulfilment of the requirements for the degree of Doctor of Philosophy

GENETIC ALGORITHM-ARTIFICIAL NEURAL NETWORK (GA-ANN) AND GIS-BASED WIND MAPPING FOR WIND ENERGY EXPLOITATION: CASE STUDY IN MALAYSIA

YONG KIM HWANG

JUNE 2023

Main Supervisor : **Professor Ir. Ts. Mohd Zamri Ibrahim, Ph.D**

Co-Supervisor : **Professor Marzuki Bin Haji Ismail, Ph.D**

Associate Professor Ir. Al Mahfoodh Ali Najah Ahmed, Ph.D

Faculty : **Faculty of Ocean Engineering Technology**

Wind maps are required to determine wind resource over a given areas and they are an important component of wind energy exploration and exploitation. The intermittency of wind, geographical, and temporal variability, as well as the complex relationship between wind and their nature, have made accurate spatial wind speed modelling more difficult. The aim of this study was to contribute a novel and original solution to the problem of developing wind maps for wind energy exploitation in Malaysia. The main inputs of this study were 37 Malaysian Meteorological Department stations' wind data and 3 installed wind masts' data. The Genetic Algorithm-Artificial Neural Network model was applied in the Measure-Correlate-Predict method to substitute and fill missing data. Spatial modelling was conducted to establish wind maps by interpolating point sources of wind data and extrapolating the wind flow at 10-m and 50-m heights. The Genetic Algorithm-Artificial Neural Network model was also applied to training spatial modelling and to generate a nonlinear wind map. The results revealed that nonlinear wind map had addressed the overprediction issue of the wind maps in mountainous areas at the Cameron Highlands site, where the root mean squared error, and the mean absolute error decreased by 60.39% and 64.01% respectively. Overall, the nonlinear wind map improved

simulated wind data by increasing accuracy and decreasing errors, up to 18.39% and 31.42% respectively. In conclusion, the results clearly prove that addressing the complex nonlinear relationship between the input parameters and output wind map decrease errors in the simulation of wind speed.

Abstrak tesis yang dikemukakan kepada Senat Universiti Malaysia Terengganu sebagai memenuhi keperluan untuk Ijazah Doktor Falsafah

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Penyelia : **Profesor Ir. Ts. Mohd Zamri Ibrahim, Ph.D**

Penyelia Bersama : **Profesor Marzuki Bin Haji Ismail, Ph.D**

Profesor Madya Ir. Al Mahfoodh Ali Najah Ahmed, Ph.D

Fakulti : **Fakulti Teknologi Kejuruteraan Kelautan**

Peta angin diperlukan untuk menentukan sumber angin di kawasan tertentu dan ia merupakan komponen penting dalam penerokaan dan eksploitasi tenaga angin. Keterputus-putusan angin, kebolehubahan geografi dan temporal serta hubungan kompleks antara angin dan sifatnya, telah menjadikan pemodelan kelajuan angin spatial yang tepat lebih sukar. Matlamat kajian ini adalah untuk menyumbang penyelesaian novel dan asli kepada masalah pembangunan peta angin untuk eskploitasi tenaga angin di Malaysia. Input utama kajian ini ialah 37 data angin stesen Jabatan Meteorologi Malaysia dan 3 data tiang angin yang dipasang. Model Algorithma Genetik Rangkaian Neural Tiruan telah digunakan dalam kaedah Ukur-Kait-Ramal untuk menggantikan dan mengisi data yang hilang. Pemodelan spatial telah dijalankan untuk mewujudkan peta angin dengan menginterpolasi sumber titik data angin dan mengekstrapolasi aliran angin pada ketinggian 10-m dan 50-m. Model Algorithma Genetik Rangkaian Neural Tiruan juga telah digunakan untuk melatih pemodelan spatial dan untuk menjana peta angin bukan linear. Keputusannya menunjukkan bahawa peta angin bukan linear telah menangani isu ramalan yang berlebihan peta angin di kawasan pergunungan – di tapak Cameron Highlands, di mana ralat punca purata kuasa dua dan purata ralat mutlak masing-masing menurun

sebanyak 60.39% dan 64.01%. Secara keseluruhannya, peta angin bukan linear menambah baik data angin simulasi dengan meningkatkan ketepatan dan mengurangkan ralat, masing-masing sehingga 18.39% dan 31.42%. Keputusannya jelas membuktikan bahawa menangani hubungan bukan linear yang kompleks antara parameter input dan keluaran peta angin mengurangkan ralat dalam simulasi kelajuan angin.