THE BEST INTERPOLATION METHOD FOR WIND SPEED BY USING GIS

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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.

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ABSTRAK

Kelajuan angin telah memainkan peranan yang sangat penting dalam pengaji cuaca kerana kerosakan bahaya angin meningkat setiap tahun. Menganggarkan kelajuan angin adalah penting dengan menggunakan kaedah interpolasi terutamanya lokasi tidak mempunyai pengaji cuaca atau stesen meteorologi. Dalam kajian ini, tiga kaedah interpolasi spatial yang berbeza adalah Weightring Distance Inverse (IDW), Spline dan Kriging dibandingkan dengan menentukan kesesuaian untuk menganggarkan kelajuan angin. Oleh itu, semua kaedah dinilai dengan analisis regresi dan analisis koefisien korelasi. Berdasarkan hasil yang diperoleh, Kriging ditunjukkan lebih sesuai untuk memperkirakan kecepatan angin diikuti kaedah lain yang merupakan IDW dan Spline. Kajian masa depan dengan lebih banyak data yang dikumpulkan, titik sampel yang lebih padat dan kes-kes yang berlainan boleh dijalankan untuk mendapatkan hasil yang lebih tepat.

ABSTRACT

The wind speed had played the very vital role in weather forest because wind hazard damages increased every year. When estimating the wind speed is important to use the interpolation method especially the location do not has a weather forest or meteorological stations. In this research, the three different method of spatial interpolation which was Inverse Distance Weighting (IDW), Spline and Kriging were compared to determine the suitability for estimating wind speed. Therefore, the all methods were evaluated with the regression analysis and correlation coefficient analysis. Based on the results obtained, Kriging was shown the more suitable to estimate the wind speed by followed the other methods which are IDW and Spline. Future studies with more data collected, denser sample points and different cases can be carried out to obtain a more accurate result.

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LIST OF SYMBOLS

S	Standard Error Regression
r	Correlation Coefficient
$\hat{Z}(s_o)$	Predicted and observed value at location s_o
$Z(s_i)$	Predicted and observed value at location s_i,
N	Number of measured sample points used in the prediction
w(d)	Weighting function
d_i	Distance from s_o to s_i
N(h)	Number of pairs of measurement points with distance *h* apart ΣSum
°E	Longitude
°N	Latitude

LIST OF ABBREVIATIONS

GIS	Geographical Information System
IDW	Inverse Distance Weighting
ESRI	Environmental System Research Institute
MMD	Malaysian Meteorological Department

CHAPTER 1

INTRODUCTION

1.1 Background

The wind speed or wind velocity is about the air moving in particular area from high to low pressure that classified as fundamental atmospheric rate usually happen due to changes of temperature. The wind speed and wind directions were characteristics of wind. It is recorded in knots or statute miles per hour or nautical miles per hour that were measured by using a tool that called as anemometer and the data can be collected at meteorology station. A gentle of wind is pleasure but the damages will occur because of strong wind. There are many types of wind such as typhoon, monsoon, tornado, gust, windstorm, whirlwind, breeze and crosswind.

Every year, Malaysian Meteorology Department (MMD) was reported the increasing of wind hazard damages that happen in Malaysia. In the west zone of Peninsular Malaysia, a strong wind that called as tornado was hitting the Kampung Sungai Nonang in Simpang Kuala happen on 12th November 2014 around 2.30 pm. The freak storm was giving the several consequences of damages were shown the results in uprooted trees, blew off the roof panels of several buildings and vehicles. In the same time, the villager'' car was carried away from his porch around 10 m. On the other hand, it is very dangerous because the situation will become worse to surrounding areas and public. Hence, the volume of injuries and accidents were higher.

Besides, torrential rain was coming in afternoon followed by strong winds on 1st October 2018 in Klang. This was wreaked havoc with more than 20 places experienced the damages that were fallen trees and branches. By this cause, the several damages of vehicles were occurred. This is shown in the windscreen car was cracked and the roof car

was dented. This is because the car was getting smashed by the falling branches. Meanwhile, the vehicles were still off-limits becoming the stretch on Jalan Pekan Baru.

Figure 1.1: Damages caused by the tornado in Kampung Sungai Nonang
Source: The Star Online, 13th November 2014

This shows the wind had played a vital role in weather forecast. This is very important to forecast the wind speed at every location, in order to prevent and reduce more wind hazard damages occurred. However, the meteorological stations around Malaysia have in certain locations only. To obtain the wind speed at a location without the meteorological station was required some form of spatial interpolation method. In addition, spatial interpolation methods by using Geographical Information System (GIS) to estimate the value of wind speed for each location. There are variety of interpolation methods are available in GIS. Thus, the accuracy of each method was varying depending on data of spatial attributes.

1.2 Problem Statement

It is very important to determine the wind speed and wind direction for the location before doing the any construction of building or structure. The best wind speed usually was followed Malaysian Meteorological Department (MMD) by using the sampling point method. Nowadays, Geographical Information System (GIS) technic can

analysis the value in the spatial area. Meanwhile, miss interpolate of the value wind speed usually happen when taking the data.

There are several interpolation methods which widely used in Geo Spatial Analysis such as Kriging, Inverse Distance Weighting (IDW), Spline, Trend, Topo for Raster and Natural Neighbour. Every method had different conditions and the results will be showing a different too. Moreover, the wind speed of unknown locations will be estimated by using value of the wind speed data that already required from known locations.

1.3 Objectives

The wind speed of known location with different spatial interpolation methods can determine and estimate the suitability wind speed for the unknown locations. Therefore, there are two objectives in this study which are:

1. To interpolate the wind speed in Peninsular Malaysia
2. To validate and identify the best interpolation method.

1.4 Scope of study

The scope of study will be used to determine the ways to success the objectives of this study. The scopes of this study are:

The five research locations were selected to be unknown locations.

a. Senggarang, Johor (seaside).
b. Rawang, Selangor (town).
c. Gebeng, Pahang (top hill).
d. Teluk Intan, Perak (palm oil).
e. Kuala Perlis, Perlis (paddy field)

There are 15 nearest stations were selected to interpolation the wind speed. The average of maximum wind speed will be used to estimate the annual maximum wind

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