PREDIKSI VISIBILITAS HILAL MODUS PENGAMATAN MATA TELANJANG DI WILAYAH TROPIS BERDASARKAN MODEL KASTNER BERBANTUAN *MACHINE LEARNING*

SKRIPSI

diajukan untuk memenuhi sebagian syarat untuk memperoleh gelar Sarjana Sains

Program Studi Fisika Konsentrasi Fisika Antariksa dan Energi Tinggi

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FPMIPA UPI

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ABSTRAK

Prediksi visibilitas hilal sangat penting untuk menentukan awal bulan *(month)* pada kalender lunar (seperti kalender hijriah) yang digunakan oleh umat Islam. Model Kastner telah terbukti efektif dalam memprediksi visibilitas hilal di wilayah tropis, tetapi prosedur perhitungan visibilitas hilal dengan model Kastner sangat panjang, sehingga kurang efisien. Oleh karena itu, penelitian ini bertujuan mengintegrasikan model Kastner dan *Machine learning* untuk menemukan algoritme *Machine learning* yang mampu memprediksi visibilitas hilal modus pengamatan mata telanjang di wilayah tropis dengan baik, serta mensimulasikan dan mengidentifikasi variabel yang memengaruhi kinerja *Machine learning* tersebut. Tiga algoritme *Machine learning*, yaitu *Linear Regression/Linear Model* (LM), *Generalized Linear Model* (GLM), dan *Support Vector Regression* (SVR), masing-masing di uji dengan empat skenario eksperimen. Data yang digunakan pada penelitian ini, merupakan laporan pengamatan hilal yang bersumber dari KEMENAG RI (Kementerian Agama Republik Indonesia), komunitas RHI (Rukyatul Hilal Indonesia), dan laporan pengamatan hilal Internasional yang dikompilasi oleh Muhammad Odeh. Penelitian ini berhasil melakukan uji coba terhadap algoritme *Machine learning* (LM, GLM, dan SVR) menggunakan *dataset* yang dibangun berdasarkan model Kastner. Berdasarkan eksperimen yang dilakukan, lintang geografis, bujur geografis, waktu visibilitas hilal dihitung, z, h, θ, elongasi, magnitudo visual, r, k, dan elevasi memengaruhi kinerja algoritme SVR yang merupakan model terbaik untuk memprediksi visibilitas hilal, dengan nilai RMSE 0,207, R-squared 0,992, dan MAE 0,158. Algoritme SVR dapat memprediksi visibilitas hilal dengan akurat dan efisien sehingga mampu bersaing dengan algoritme *Machine learning* lainnya.

Kata Kunci: *Visibilitas Hilal, Model Kastner, Linear Regression, Generalized Linear Model, Support Vector Regression*

PREDICTION OF YOUNG LUNAR CRESCENT VISIBILITY MODE NAKED EYE OBSERVATIONS IN THE TROPICS BASED ON THE KASTNER MODEL ASSISTED MACHINE LEARNING

MALA AMANDA

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ABSTRACT

Prediction of hilal visibility is very important to determine the beginning of the month in the lunar calendar (such as the Hijri calendar) used by Muslims. The Kastner model has been proven effective in predicting hilal visibility in the tropics, but the procedure for calculating hilal visibility with the Kastner model is very long, making it less efficient. Therefore, this study aims to integrate the Kastner model and machine learning to find a machine learning algorithm that is able to predict the visibility of the new moon naked-eye observation mode in the tropics well, as well as simulate and identify variables that affect the performance of the machine learning. Three machine learning algorithms, namely Linear Regression/Linear Model (LM), Generalized Linear Model (GLM), and Support Vector Regression (SVR), were each tested with four experimental scenarios. The data used in this study are hilal observation reports sourced from KEMENAG RI (Ministry of Religious Affairs of the Republic of Indonesia), the RHI (Rukyatul Hilal Indonesia) community, and international hilal observation reports compiled by Muhammad Odeh. This research successfully tested machine learning algorithms (LM, GLM, and SVR) using a dataset built on the Kastner model. Based on the experiments conducted, geographical latitude, geographical longitude, calculated hilal visibility time, z, h, θ, elongation, visual magnitude, r, k, and elevation affect the performance of the SVR algorithm which is the best model for predicting hilal visibility, with RMSE values of 0.207, R-squared 0.992, and MAE 0.158. The SVR algorithm can predict hilal visibility accurately and efficiently so that it can compete with other machine learning algorithms.

Keywords: *Young Lunar Crescent Visibility, Kastner Model, Linear Regression, Generalized Linear Model, Support Vector Regression*

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