Multiple Time-Step Predictive Models for Hurricanes in the North Atlantic Basin Based on Machine Learning Algorithms

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The cost of damage caused by hurricanes in 2017 is estimated to be over 200 billion dollars. Quick and accurate prediction of the path of a hurricane and its strength would be very valuable in alleviating these losses. Machine learning based prediction models, in contrast to models based on physics or statistics, have been developed successfully in many problem domains. Rather than explicitly programming the computer with a predefined prediction model, a machine learning system infers the modeling function from a training dataset. This project developed machine learning based prediction models to forecast the path and strength of hurricanes in the North Atlantic basin with greater than .95 accuracy. Feature analysis was performed on the HURDAT2 dataset, which contains paths and strengths of past hurricanes, to obtain the input feature dataset for machine learning algorithms. Generalized Linear Model (GLM) approaches such as Tikhonov regularization were investigated to develop seven hurricane prediction models. Prediction accuracy of these models was compared using a testing dataset, disjoint from the training dataset. The coefficient of determination and the mean squared error were used as performance metrics. Post-processing metrics, such as geodesic error in path prediction and the mean wind speed error, were also used to compare different models. Linear Regression performed the best of out the seven models. However, all models predicted location and strength with greater than .95 coefficient of determination for up to two days. My models predicted hurricane path in under a second with accuracy comparable to that of current models.

Awards Won:

Third Award of $1,000

American Meteorological Society: Certificate of Honorable Mention

National Taiwan Science Education Center: Taiwan International Science Fair Special Award is a trip to participate in the Taiwan International Science Fair