

Predicting Aircraft Landing Time in Extended-TMA using Machine Learning Methods

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Abstract— Accurate prediction of aircraft arrival times is one of the fundamental elements for air traffic controllers to manage an optimal arrival and departure sequencing on the runway, reduce flight delays, and achieve a good collaboration with airports and airlines. In this work, we analyze the feature engineering problem to predict Aircraft Landing Time (LDT) in Extended-TMA with machine learning models. Two main contributions are highlighted in this work. First, the impact of different features in LDT prediction is investigated. Second, a machine learning prediction model is presented to predict LDT. Our case of study is the E-TMA of Singapore Changi Airport (WSSS) with a radius of 100NM. Firstly, data analysis is conducted to check the availability of different resource data, as well as cleaning the raw trajectory data. Then, feature construction and extraction are discussed in details, machine learning prediction models are proposed to address the LDT prediction. The experimental results show that 4 sets of features play a significant impact on LDT prediction for primary runway-in-use, they are: (1) Control intent: traffic demand, current traffic density, and adjacent flow; (2) Weather: surface wind; (3) Trajectory: the position of aircraft; (4) Seasonality: parts of a day and a week. Moreover, comparing three Machine Learning algorithms, in our study case, Extra- Trees is the best prediction algorithm compared with other machine learning models in terms of Root Mean Square Error (RMSE) and Mean Absolute Error (MAE). It is also found that Machine learning models perform much better than the current operational system. In summary, two main conclusions are drawn from the present work. First, predicting the aircraft LDT is strongly correlated with the TMA density at the flight operation time. Second, feature selection with domain knowledge and expert opinions is very important, and with good features, the model is less sensitive to the choice of machine learning algorithm.