LITERATURE SURVEY

1.Yazdi, M.F., Kamel, S.R., Chabok, S.J.M. and Kheirabadi, M., 2020. Flight delay prediction based on deep learning and Levenberg-Marquart algorithm. *Journal of Big Data*, *7*(1), pp.1-28.

Flight delay is inevitable and it plays an important role in both profits and loss of the airlines. An accurate estimation of flight delay is critical for airlines because the results can be applied to increase customer satisfaction and incomes of airline agencies. There have been many researches on modeling and predicting flight delays, where most of them have been trying to predict the delay through extracting important characteristics and most related features. However, most of the proposed methods are not accurate enough because of massive volume data, dependencies and extreme number of parameters. This paper proposes a model for predicting flight delay based on Deep Learning (DL). DL is one of the newest methods employed in solving problems with high level of complexity and massive amount of data. Moreover, DL is capable to automatically extract the important features from data. Furthermore, due to the fact that most of flight delay data are noisy, a technique based on stack denoising auto encoder is designed and added to the proposed model. Also, Levenberg-Marquart algorithm is applied to find weight and bias proper values, and finally the output has been optimized to produce high accurate results. In order to study effect of stack denoising auto encoder and LM algorithm on the model structure, two other structures are also designed. First structure is based on auto encoder and LM algorithm (SAE-LM), and the second structure is based on denoising auto encoder only (SDA). To investigate the three models,

we apply the proposed model on U.S flight dataset that it is imbalanced dataset. In order to create balance dataset, under sampling method are used. We measured precision, accuracy, sensitivity, recall and F-measure of the three models on two cases. Accuracy of the proposed prediction model analyzed and compared to previous prediction method. results of three models on both imbalanced and balanced datasets shows that precision, accuracy, sensitivity, recall and F-measure of SDA-LM model with imbalanced and balanced dataset is improvement than SAE-LM and SDA models. The results also show that accuracy of the proposed model in forecasting flight delay on imbalanced and balanced dataset respectively has greater than previous model called RNN.

1. **Qu, J., Zhao, T., Ye, M., Li, J. and Liu, C., 2020. Flight delay prediction using deep convolutional neural network based on fusion of meteorological data.** ***Neural Processing Letters*****,** ***52*****(2), pp.1461-1484.**

Nowadays, the civil aviation industry has a high precision demand of flight delay prediction. To make full use of the characteristics of flight data and meteorological data, two flight delay prediction models using deep convolution neural network based on fusion of meteorological data are proposed in this paper. One is DCNN (Dual-channel Convolutional Neural Network), which refers to the Res Net network structure. The other is SE-Dense Net (Squeeze and Excitation-Densely Connected Convolutional Network), combining the advantages of Dense Net and SE Net. Firstly, flight data and meteorological data are fused in the model. Then, both DCNN and SE-Dense Net models are used to extract feature automatically based on the fused flight data set. Finally,

the soft max classifier is adopted to predict the flight delay level. For proposed DCNN model, both straight channel and convolution channel are designed to guarantee the lossless transmission of the feature matrix and enhance the patency of the deep network. For proposed SE-Dense Net model, a SE module is added after the convolution layer of each Dense Net block, which can not only enhance the transmission of deep information but also achieve feature recalibration in the feature extraction process. The research results indicate that after considering characteristics of meteorological information, the accuracy of the model can be improved 1% compared with only considering the flight information. The two deep convolutional neural networks proposed in this paper, DCNN and SE-Dense Net, can both effectively improve the prediction accuracies, reaching to 92.1% and 93.19%, respectively.

2. Zoutendijk, M. and Mitici, M., 2021. Probabilistic flight delay predictions using machine learning and applications to the flight-to-gate assignment problem. *Aerospace*, *8*(6), p.152.

Flight delay has been a serious and widespread problem that needs to be solved. One promising solution is the flight delay prediction. Although big data analytics and machine learning have been applied successfully in many domains, their applications in aviation are limited. This paper presents a comprehensive study of flight delay spanning data pre-processing, data visualization and data mining, in which we develop several machine learning models to predict flight arrival delays. Two data sets were used, namely Airline On-Time Performance (AOTP) Data and Quality Controlled Local

Climatological Data (QCLCD). This paper aims to recognize useful patterns of the flight delay from aviation data and perform accurate delay prediction. The best result for flight delay prediction (five classes) using machine learning models is 89.07% (Multilayer Perceptron). A Convolution neural network model is also built which is enlightened by the idea of pattern recognition and success of neural network method, showing a slightly better result with 89.32% prediction accuracy.

3. Esmaeilzadeh, E. and Mokhtarimousavi, S., 2020. Machine learning approach for flight departure delay prediction and analysis. *Transportation Research Record*, *2674*(8), pp.145-159.

The expected growth in air travel demand and the positive correlation with the economic factors highlight the significant contribution of the aviation community to the U.S. economy. On-time operations play a key role in airline performance and passenger satisfaction. Thus, an accurate investigation of the variables that cause delays is of major importance. The application of machine learning techniques in data mining has seen explosive growth in recent years and has garnered interest from a broadening variety of research domains including aviation. This study employed a support vector machine (SVM) model to explore the non-linear relationship between flight delay outcomes. Individual flight data were gathered from 20 days in 2018 to investigate causes and patterns of air traffic delay at three major New York City airports. Considering the black box characteristic of the SVM, a sensitivity analysis was performed to assess the relationship between dependent and explanatory variables. The impacts of various explanatory variables

are examined in relation to delay, weather information, airport ground operation, demand-capacity, and flow management characteristics. The variable impact analysis reveals that factors such as pushback delay, taxi-out delay, ground delay program, and demand-capacity imbalance with the probabilities of 0.506, 0.478, 0.339, and 0.338, respectively, are significantly associated with flight departure delay. These findings provide insight for better understanding of the causes of departure delays and the impacts of various explanatory factors on flight delay patterns.

4. **Lambelho, M., Mitici, M., Pickup, S. and Marsden, A., 2020. Assessing strategic flight schedules at an airport using machine learning-based flight delay and cancellation predictions.** ***Journal of Air Transport Management, 82,*** **p.101737.**

To mitigate air traffic demand-capacity imbalances, large European airports implement strategic flight schedules, where flights are assigned arrival/departure slots several months prior to execution. We propose a generic assessment of such strategic schedules using predictions about arrival/departure flight delays and cancellations. We demonstrate our approach for strategic flight schedules in the period 2013–2018 at London Heathrow Airport. Together with the development of dedicated strategic flight schedule optimization models, our proposed approach supports an integrated strategic flight schedule assessment, where schedules are evaluated with respect to flight delays and cancellations.

5. **Cai, K., Li, Y., Fang, Y.P. and Zhu, Y., 2021. A deep learning approach for flight delay prediction through**

time-evolving graphs. ***IEEE Transactions on Intelligent Transportation Systems*****.**

Flight delay prediction has recently gained growing popularity due to the significant role it plays in efficient airline and airport operation. Most of the previous prediction works consider the single-airport scenario, which overlooks the time-varying spatial interactions hidden in airport networks. In this paper, the flight delay prediction problem is investigated from a network perspective (i.e., multi-airport scenario). To model the time-evolving and periodic graph-structured information in the airport network, a flight delay prediction approach based on the graph convolutional neural network (GCN) is developed in this paper. More specifically, regarding that GCN cannot take both delay time-series and time-evolving graph structures as inputs, a temporal convolutional block based on the Markov property is employed to mine the time-varying patterns of flight delays through a sequence of graph snapshots. Moreover, considering that unknown occasional air routes under emergency may result in incomplete graph-structured inputs for GCN, an adaptive graph convolutional block is embedded into the proposed method to expose spatial interactions hidden in airport networks. Through extensive experiments, it has been shown that the proposed approach outperforms benchmark methods with a satisfying accuracy improvement at the cost of acceptable execution time. The obtained results reveal that deep learning approach based on graph-structured inputs have great potentials in the flight delay prediction problem.