Day 2 (Wednesday, 26 October) 9:30 - 11:00, Hall B
Technical Session 2 Airport 1

T2-1-A

Variable Taxi-Out Time Prediction Based on Machine Learning with Interpretable Attributes

Yixiang Lim, Sameer Alam, Fengji Tan, Pei Ling Toon, Nimrod Lilith (Nanyang Technological University)

This paper presents a machine learning-based approach for predicting the taxi-out time, with the departure process decomposed into two components -- the time taken to travel from the gate to the departure queue, and the time spent in the runway queue. Gradient-Boosted Decision Tree (GBDT) models are trained to predict the two components using different feature sets, and a comparison of both model shows that they can provide better prediction accuracy compared with conventional methods, with a Root Mean Squared Error (RMSE) of 1.79 minutes and 0.92 minutes when predicting the taxiing and queuing times respectively, and 78% and 96% of predictions falling within a +/- 2 minute error margin. Predictions from the GBDT model are analysed and interpreted using SHAP (SHapley Additive exPlanations) values. In particular, the taxiing model identified route features as being the most important feature group, while the queuing model identifies runway queuing features as the most important group. The model explainability provides a pathway towards the certification of machine learning techniques in Air Traffic Controller (ATCO) decision support tools. Finally, a prototype dashboard is presented, providing a visual interface for ATCOs to interpret the model outputs, plan the departure sequence, as well as to analyse the causes of airport delays.

T2-2-A

Synthetic Training of Neural Networks for Semantic Segmentation of LiDAR Point Clouds

Michael Schultz (Universität der Bundeswehr München)

Apron operations must ensure both high utilization of given capacity and safe aircraft operations even under degraded environmental conditions, such as low visibility. An appropriate sensors environment could support controllers, where deep learning models will ensure that the observed objects are classified correctly. The fundamental challenge is that these models require a large amount of data to be trained. Therefore, we have developed a virtual airport to generate the required training and validation data at any time and for any operational scenario (ground truth). We apply our concept of a virtual airport and sensor environment at Singapore Changi Airport implementing a synthetic LiDAR sensor. With the help of different data sources and own models, a multitude of 3D scenes can be generated which correspond to the real operational environment. From these scenes, a point cloud is extracted according to the specifications of the LiDAR sensor, which is already labeled by the underlying model and serves as input for PointNet++ for segmentation and classification. We show that the training of a classifier based on artificial input data is a promising approach, which covers relevant aspects of the real system and can therefore be easily applied in (augmented) tower environments.

T2-3-A

Predicting Passenger Flow at Charles De Gaulle Airport using Dense Neural Networks

Alexis Brun, Daniel Delahaye (Ecole Nationale de l'Aviation Civile), Eric Feron (King Abdullah University of Science and Technology), Sameer Alam (Nanyang Technological University)

Security checking is a major issue in airport operations. Affecting the correct number of security agents is essential to provide a good quality of service to passengers while providing the best security performances. At Paris Charles de Gaulle airport the affectation of security agents is decided at strategical level, more than a month in advance. The key element to determine the number of agents needed is the passenger flow through the security checkpoints. This flow is correlated to the passenger flow in the different boarding rooms. This paper investigates the interest of small dense neural networks to perform passenger flow prediction at strategical level for Paris Charles de Gaulle airport. A dense neural network has been trained to predict the passenger flow for each boarding room of the airport. The network has been compared to a more complex long short-term memory model in terms of mean absolute error and outperformed a mathematical model based on exponentially modified Gaussian distribution.