Day 2 (Wednesday, 26 October) 11:15 - 12:45, Hall B

Technical Session 5 Airport 2

T5-1-A

Air-rail timetable synchronization for a seamless passenger journey

Clara Buire, Daniel Delahaye (Ecole Nationale de l'Aviation Civile), Aude Marzuoli (Georgia Institute of Technology), Eric Féron (King Abdullah University of Science and Technology), Marcel Mongeau (Ecole Nationale de l'Aviation Civile)

This paper proposes a method to generate an integrated air-rail timetable at a hub airport with direct access to a train station. A passenger-oriented metric is introduced to assess the connection time between trains and flights. In order not to impact severely initial flight and train schedules, only small perturbations on the initial timetable are authorized. An integer linear programming formulation is proposed based on this metric. An approached resolution method is implemented to solve the optimization problem. Solution quality and computational time are compared with an exact resolution method. Computational results on the case study of Paris-Charles de Gaulle airport are presented. Results show that a change of an average 11 minutes in schedules could increase passenger comfort by almost 10%.

T5-2-A

Machine Learned Prediction of Runway Configuration Transition Times for Capacity Analysis

Jun Guang Andy Lam, Nimrod Lilith, Imen Dhief, Sameer Alam, Rajesh Piplani (Saab-NTU Joint Research Lab)

The runway system of an airport is a bottleneck resource, limiting the amount of traffic an airport can service. The capacity of a runway system is affected by the runway configuration in use, and by the transition time of runway configuration change. This study introduces a novel data-driven approach to model the transition times between directional runway configuration changes, derived by using computed features from the flight positional data. This study also formulates classification models to assign the magnitude of transition times and their impact on runway capacity, utilizing features known in the literature, as well as engineered features, including weather coefficients and runway complexity. The transition time model is able to identify the instances where the transition times are 'High' 92.2% of the time. Correctly identifying the 'High' transition times is important as such times lead to greater reduction in runway capacity. This is highlighted when the predicted transition time is used as a feature input for the capacity impact model, which correctly identifies periods of unfulfilled demand 88.8% of the time. The predicted transition time is shown to be a more important predictor of capacity impact than weather features, which to date have been considered crucial features in determining capacity. With a better prediction of time periods of unfulfilled demand during runway configuration changes, air traffic controllers can make better decisions by taking into consideration the predicted time to conduct such a change, and minimise air traffic delays.

T5-3-A

Towards Greener Airport Surface Operations: A Reinforcement Learning Approach for Autonomous Taxiing

Thanh-Nam Tran, Duc-Thinh Pham, Sameer Alam (Nanyang Technological University)

This study proposes an autonomous aircraft taxi agent that can be used to recommend the pilot the optimal speed profile to achieve optimal fuel burn and to arrive on time at the target position on the taxiway while considering potential interactions with surrounding traffic. The problem is modeled as a control decision problem which is solved by training the agent under a Deep Reinforcement Learning mechanism, using the Proximal Policy Optimization algorithm. The reward function is designed to consider the fuel burn, taxi time, and delay time. Thus, the trained agent will learn to taxi the aircraft between any pair of locations on the airport surface timely while maintaining safety and efficiency. As the result, in more than 97.8% of the evaluated sessions, the controlled aircraft can reach the target position with a time difference within the range of [-20,5] seconds. Moreover, compared with actual fuel burn, the proposed autonomous taxi agent demonstrated a reduction of 29.5%, equivalent to the reduction of 13.9kg of fuel per aircraft. This benefit in fuel burn reduction can complement the emission reductions achieved by solving other sub-problems, such as pushback control and taxi-route assignments to achieve much higher performance.