Day 3 (Thursday, 27 October) 9:30 - 11:00, Hall C

Technical Session 11 Air Traffic Management 3

T11-1-A

Exploiting spatio-temporal partial separability of large-scale airspaces

Julien Lavandier, Marcel Mongeau (Ecole Nationale de l'Aviation Civile), Supatcha Chaimatanan (Kasetsart University), Daniel Delahaye (Ecole Nationale de l'Aviation Civile)

This paper addresses large-scale flight planning via a divide-and-conquer technique that exploits the partial separability feature of the problem. 4D-interaction between flights is used to cluster the flights, and these clusters are used to improve the optimization process. Preliminary computational experiments on the French airspace demonstrate the natural separability of air traffic and yield promising computational improvement for flight planning thanks to clustering.

T11-2-A

Multi-Aircraft Trajectory Deformation for Uncertain Thunderstorm Avoidance and Conflict Resolution

Eduardo Andrés, Manuel Soler (Universidad Carlos III de Madrid), Tony Wood, Maryam Kamgarpour (Ècole Polytechnique Fédérale de Lausanne), Manuel Sanjurjo-Rivo (Universidad Carlos III de Madrid), Juan Simarro (Agencia Estatal de Meteorologia)

Uncertainties inherent to convective weather represent a major challenge for the Air Traffic Management system, compromising operational safety and increasing costs. In this work, we address the multi-aircraft trajectory planning problem around stochastic storm cells. We implement an Augmented Random Search methodology to deform a nominal set of trajectories and look for a feasible solution. Its main objective is to guarantee minimum separation between vehicles and reduce time in risky regions. Through parallel programming on graphical processing units (GPUs), we reduce computational times to enable near-real time operation. We test the algorithm with two aircraft flying at the same airspeed and flight level; the scenario consists of real weather data given by an ensemble forecast. The influence of the maximum number of iterations is analyzed. Results reveal that our algorithm is able to avoid thunderstorms, solve conflicts between aircraft and reduce flight time in a few seconds.

T11-3-A

A Multi-task Learning Approach for Facilitating Dynamic Airspace Sectorization

Wei Zhou, Qing Cai, Sameer Alam (Nanyang Technological University)

Dynamic Airspace Sectorization (DAS) is a key pathway for enabling advanced demand capacity balancing (DCB) in modernizing Air Traffic Management (ATM). By splitting and merging the sectors, DAS allows airspace to accommodate the evolving air traffic situations for improving the utilization of airspace in response to different air traffic demand, airspace capacity, weather events and other factors. This research aims at facilitating the decision making on when-to-do such DAS from a deep learning perspective. To this end, this paper proposes a multi-task learning (MTL) approach which is able to predict sector traffic flow and airspace capacity simultaneously using a shared neural network architecture. Specifically, the proposed model predicts the demand-capacity imbalance and identifies the opportunity for sector split/merge implementation. To validate the feasibility of the proposed model, a case study has been carried out in Singapore en-route airspace using the Automatic Dependent Surveillance-Broadcast (ADS-B) data and meteorology data in December 2019. Experimental results explicitly show the capability of the proposed MTL model in predicting flow and capacity. Based on predicted results along with a pre-defined rule, the proposed model predicts the demand-capacity imbalance across multiple timescales and explores the potential to facilitate DAS in terms of tactic, pre-tactic and strategic ATM operations.