# Short-Term Trajectory Prediction Using Generative Machine Learning Methods

Thanh-Ha Le[*], Phu N. Tran[*], Duc-Thinh Pham[*], Michael Schultz[†], Sameer Alam[*]
[*]Air Traffic Management Research Institute, Nanyang Technological University, Singapore
fha.le, phutran, dtpham, sameeralamg@ntu.edu.sg
[†]Institute of Logistics and Aviation, Dresden University of Technology, Germany
michael.schultz@tu-dresden.de

Abstract— Aircraft trajectory prediction is at the heart of the air traffic control (ATC) system. An accurate prediction of aircraft's future locations is essential for the air traffic controllers (ATCOs) to maintain the situational awareness of the traffic and to have proper strategies of congest management and separation assurance, which in turn contribute to a safe and efficient operation of the airspace. In this work, we propose a machine learning method for short-term aircraft trajectory prediction on a sector-based basis. Historical trajectories (from ADS-B data) are divided into clusters based on their spatial behaviors in the sector. Then, for each of the trajectory clusters, a predictive model is trained for future location prediction of the aircraft following the corresponding pattern. In the prediction phase, given the information of an aircraft when it is approaching the sector, our model first predicts the general pattern of the aircraft's trajectory in the sector, and based on the predicted pattern, the most appropriate predictive model is chosen to predict the aircraft's future locations. The whole future trajectory of the aircraft within the sector can also be generated. The evaluation shows that our model can achieve an average trajectory-wise error as low as 1.06 NM at 5-minute look-ahead time and 1.69 NM at 10-minute prediction horizon. The mean absolute error of the total travel time in the sector ranges from 9.8 seconds to 26.5 seconds depending on the trajectory pattern.