Department of
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DEPARTMENT OF MECHANICAL ENGINEERING
THE UNIVERSITY OF HONG KONG

# SEMINAR

# Advanced Data-Driven Integrated Arrival Optimisation in the Terminal Manoeuvring Area Leveraging Intelligent Dynamic Wake Separation Prediction

**Date:** 12 December 2024 (Thursday)
**Time:** 11:30 a.m. to 12:30 p.m.
**Venue:** HW 7-34/7-35
Haking Wong Building
The University of Hong Kong

**Speaker:** Dr Kam K.H. Ng
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**Abstract:**

Runway capacity is a crucial determinant of the efficiency of near-ground flight operations, influenced by various operational constraints, particularly aircraft wake separation. Compared to the traditional aircraft wake separation standard set forth by the International Civil Aviation Organisation (ICAO), both the European Union Aviation Safety Agency (EASA) and the Federal Aviation Administration (FAA) have suggested reclassifying aircraft types to reduce wake separation. Additionally, dynamic wake separation that relates to weather and aircraft pairs remains an active area of research. Furthermore, the effect of dynamic wake separation on terminal traffic control deserves to be investigated. This study introduces two deep-learning models designed to predict dynamic aircraft wake separation using Light Detection and Ranging (LiDAR) data and aviation weather reports (METAR) at Hong Kong International Airport (HKIA). We also present two tiers of wind-related wake separation matrices and compare them with the RECAT-EU standards. The impact of dynamic wake separation on terminal arrival flight management is assessed under both high-traffic and low-traffic scenarios. To tackle the optimisation challenge, we propose a Constrained Position Shifting (CPS)-based simulated annealing (SA) approach to optimise the entry time, flight speed and flight path of arrival flights within the Terminal Manoeuvring Area (TMA). Our results indicate that the reduced wake separation, especially dynamic pairwise separation during the final approach, may lead to congestion at the initial approach fix and increase scheduling pressure at this juncture. However, this issue can be alleviated through terminal flight path planning, resulting in enhancements in hourly runway arrival throughput by approximately 10% compared to traditional RECAT-EU standards with subtle increase in average flight delay. This advancement provides a promising strategy for the joint optimisation of terminal arrival control and runway scheduling, thereby mitigating supply-demand imbalance and enhancing operational efficiency for airports with constrained capacity and configuration.

**Keywords:**

**Aircraft wake turbulence, Dynamic wake separation, Terminal manoeuvring area, Arrival flight sequencing and Scheduling**

**Biography:**

**Dr Kam K.H. Ng (Researcher ID: L-7278-2019; ORCID: 0000-0002-4959-0502; Members of IEEE, IET, AIAA, RAeS, RMetS, and FHKMetS) is currently an Assistant Professor in the Department of Aeronautical and Aviation Engineering (AAE), at The Hong Kong Polytechnic University, HKSAR. His research interests include air traffic control, air traffic flow management, data-driven optimisation, operations research, human factors engineering and neuro-ergonomics in pilot training. He received over HK$28 million (approx. $2 million US$) external research grants, including RGC GRF, ECS, NSFC, STF, ITF PRP in his four-year services in PolyU AAE. He has authored and co-authored papers in leading journals, such as *Reliability Engineering & System Safety*; *Transportation Research Part A: Policy and Practice*; *Transportation Research Part C: Emerging Technologies*; *Transportation Research Part E: Logistics and Transportation Review*; *Journal of Air Transport Management*; and *Transport Policy,* etc.**

**ALL INTERESTED ARE WELCOME**

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