Artificial Intelligence for Air Traffic Management: Threats or Opportunities?

Vu Duong
Director, Air Traffic Management Research Institute/
Professor, School of Mechanical & Aerospace Engineering

23 October 2018
Artificial Intelligence as technology that would replace human ...
Fig. 13. Examples of unusual, distorted, and noisy characters correctly recognized by LeNet-5. The grey level of the output label represents the penalty (lighter for higher penalties).
Artificial Intelligence as technology that would replace human ...

Myths and Reality
Machine Learning has been omnipresent in our daily life …

a matter of fact
As a matter of fact

Machine Learning has been omnipresent in our daily life ...
The threats are on **how** we use technologies

Must know WHY and WHAT FOR
The threats are on

How we use technologies …

Must know WHY and WHAT FOR
ATC is a human-centered system and will remain a human-centered system.

AI shall be powered for human, not for AI.
So, WHY do we power AI for ATM?

Because data could tell you **real facts**, not mathematical models
What can WE learn?
Data also tells complexity
Traffic activities and comm. activities (Paris TMA Data)
Discovering the laws that governs chaos..

Wang et al., 2012
Degree distribution vs. weight

Wang et al., 2012
So, what does that mean?

Data as a mean to improve predictability. AI is a tool to perform analytics on data.
To augment human controllers capability
AI and Human can work in a Hybrid mode

WHAT FOR?
Can Artificial Intelligence Assist ATCOs in Handling More Traffic?

The work presented here-after is performed by Assoc. Prof Sameer Alam, Dr.C. Thinh Pham, Dr. Phu Tran, Dr. C. Sim Kuan Goh (2018)
Approach to Learning

- Air Traffic Data
- Neural Signals
- ATCOs Actions
Learning From Traffic Data (Conflict Scenarios)

- En-route Sector
- Complex Routes
Action-Prediction Model using Random Forest
(Best paper award, Human Performance Track, ICRAT 2018)
4D Trajectory Prediction from ATC Actions
(Accuracy > 70% with only 1 month of data)
Machine Learning Complemented with Human Learning

Lateral Resolution

Vertical Resolution
Understanding Psycho-Physiological Model of ATC
Training with Real-Time Neural and Physiological Feedback

1. Unseen scenario
2. Suggested resolution
3. Show scenario & agent’s resolution
4. Decision/action
5. Human’s evaluation & Event triggers
6. EEG signal
7. ErrP?
8. Human’s resolution

Scenarios simulator — Interactive interface — Human — AI agent — ErrP detector

Air Traffic Data — Neural Signals

ATCO Actions
AI Predicted Actions vs ATC Actions

Example scenario

Learning performance

Human Preference Trajectory Change Point for Conflict Resolution

AI Predicted Resolution Trajectory

Air Traffic Data
ATCOs Actions
Neural Signals

Estimated Reward
Real Reward

Reward

#Iteration (x10^3)
Possible Future Applications of AI

- An Agreed Automation Model for Hybrid AI-Human ATC
  - Human-Like Conflict Detection and Resolution
  - AI for ATC Training and Training Gap Identification
- Transparent AI Models for Humans to Understand AI Actions
Thank you for your attention