AI Situational Awareness Foundation for Advancing Automation — AISA

Javier Alberto Pérez Castán

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SESAR JOINT UNDERTAKING

Founding Members

EUROPEAN UNION EUROCONTROL

INTRODUCTION

- AISA concept
- AISA goals
- AISA architecture

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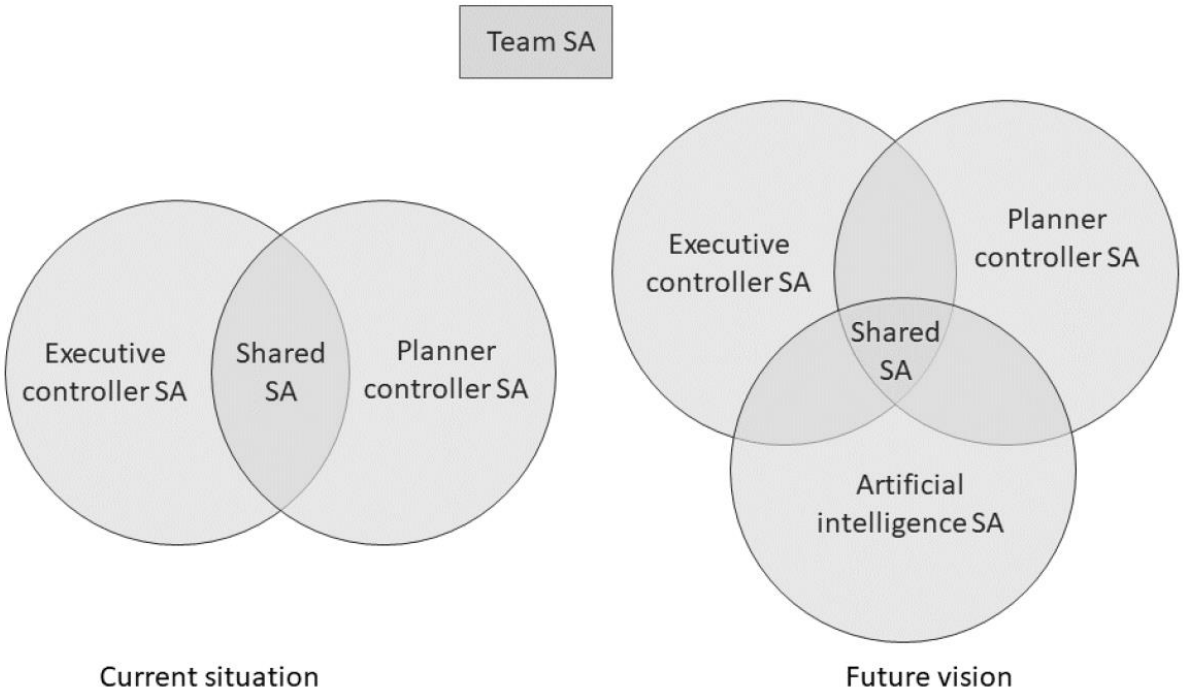
AISA concept



Goal: monitoring tasks in en-route airspace

When complexity ↑ AI performs more tasks

AISA goals

Overall objective:

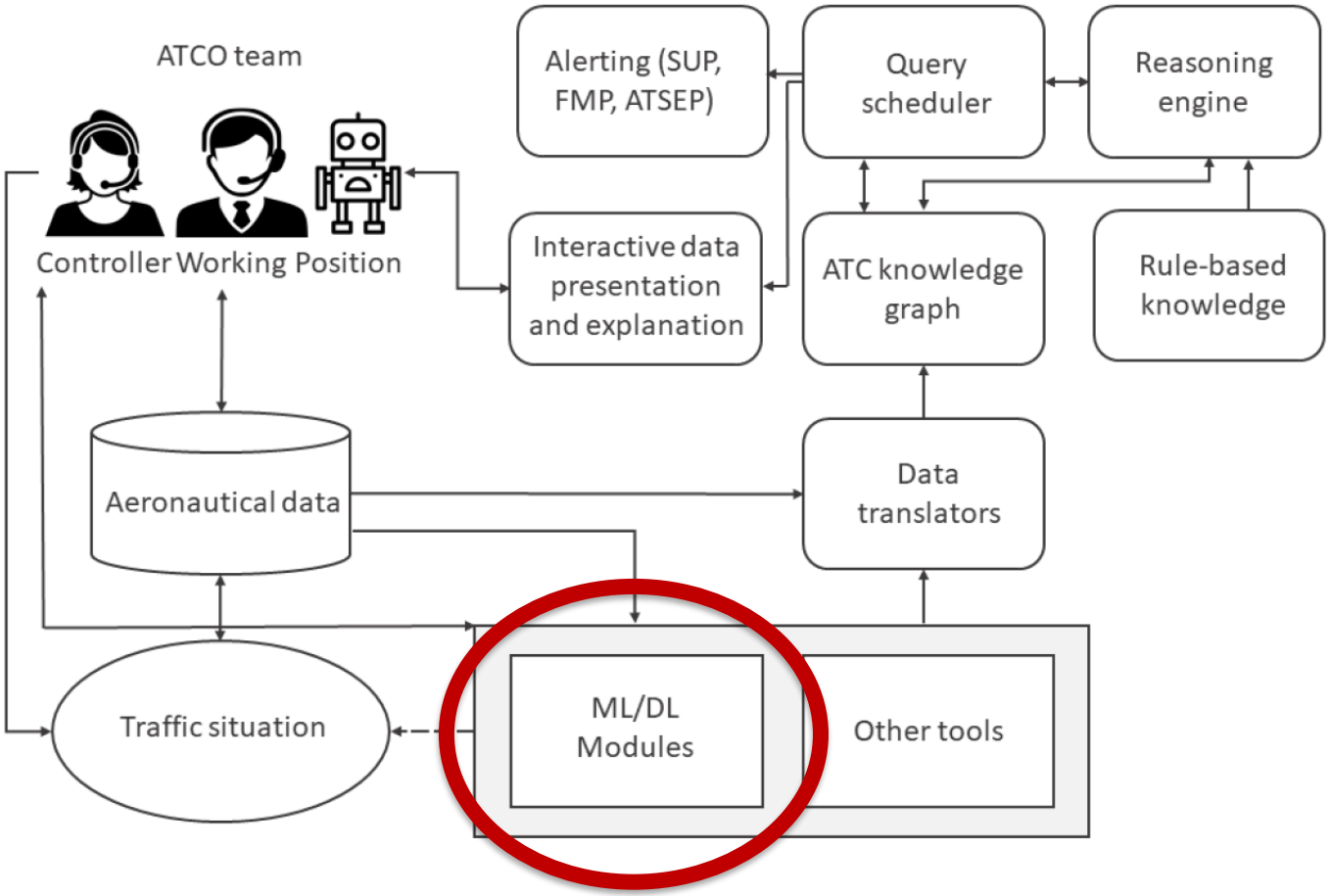
- Increase the possibility for **introduction of automation** in air traffic management (ATM) by researching domain-specific application of transparent and generalizable artificial intelligence methods.

Specific objectives:

- Explore the effects **of human-machine distributed situational awareness** and opportunities for automation of monitoring tasks in en-route operations.

- Identify the **data needed** by air traffic controller (ATCO) to ensure that the proposed solution is correct (transparency).

AISA architecture



Conflict Detection module

- Principles
- Problem statement

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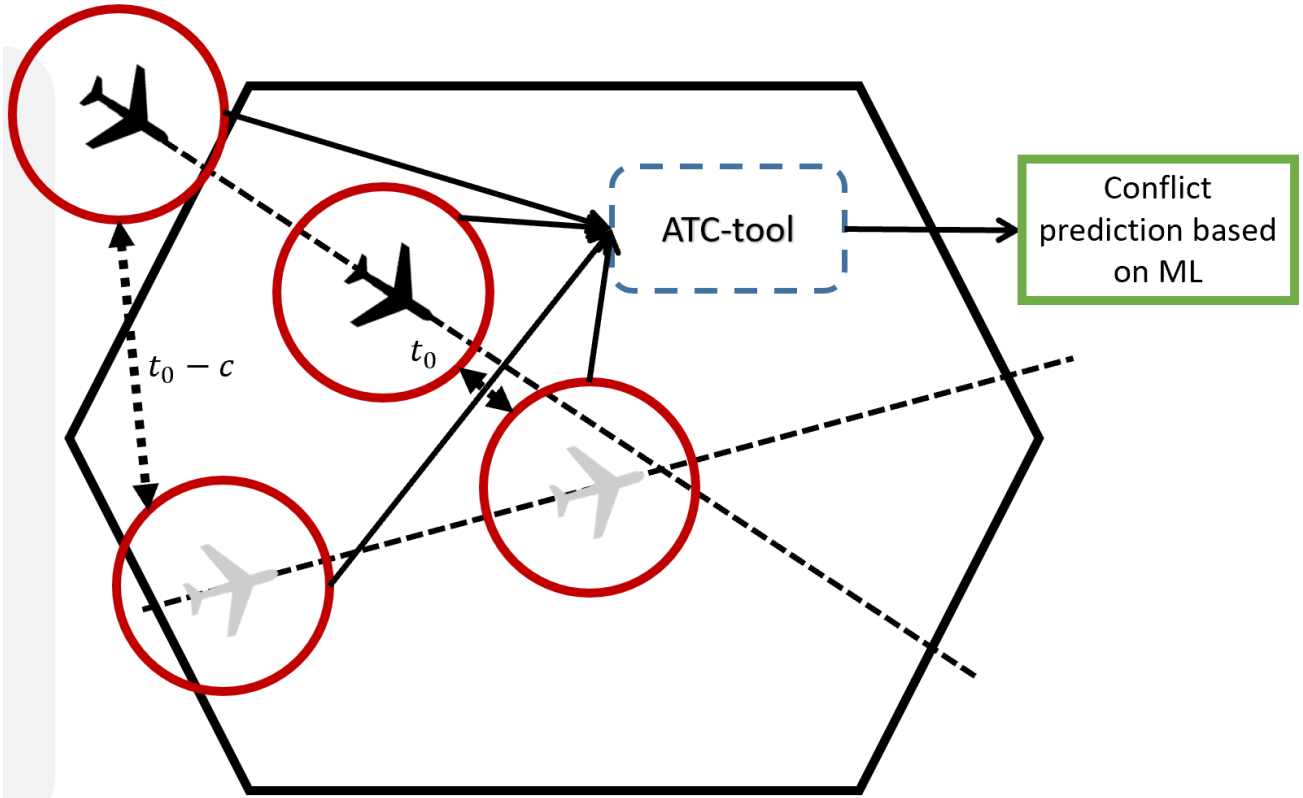
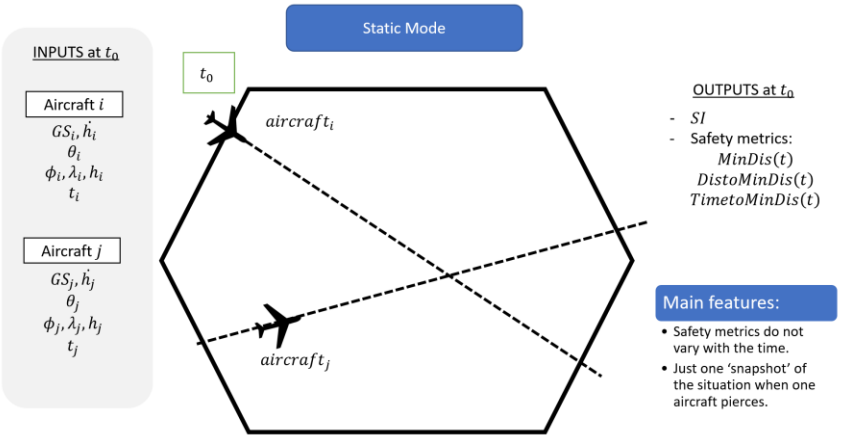
Conflict detection module Principles



ATC roles

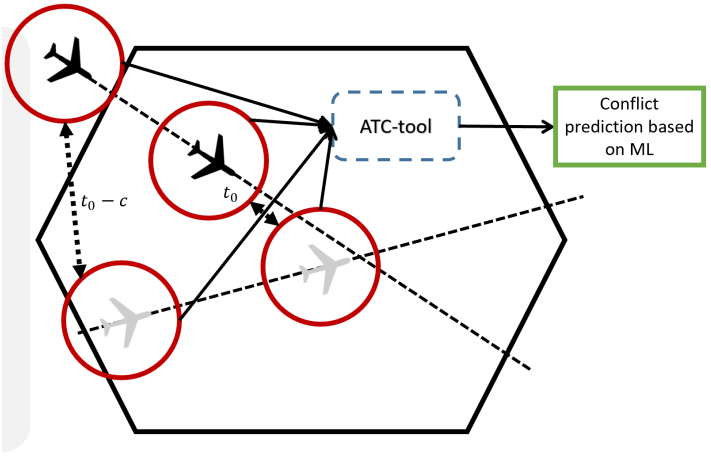
Planner controller role

- Prediction when one aircraft pierces into the airspace: **Fix snapshot**.
- It only evaluates separation infringements with aircraft within the airspace.
- The only information available to perform the prediction is the **state vector** of the aircraft.



Tactical controller role

- Prediction calculation throughout the **evolution** of the aircraft in the airspace
- The system provides a **4DT prediction** for each aircraft based on historical **ADS-B**.
- It focuses on the **tactical** controller's role providing continuous surveillance of the aircraft within the airspace.



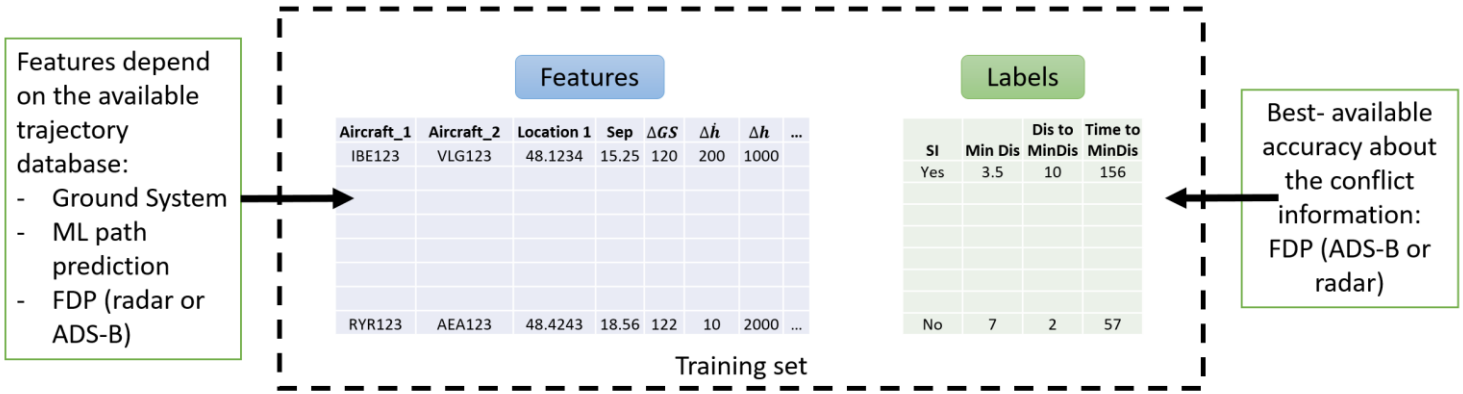
ML techniques

Classification (SI/ No SI)

- SI: aircraft pairs that cross with separation minima lower than specific separation. Herein, the pre-defined separations are longitudinally 10 NM and vertically 1000 ft.

Regression techniques

- Minimum separation,
- time and distance to separation infringement



Database construction

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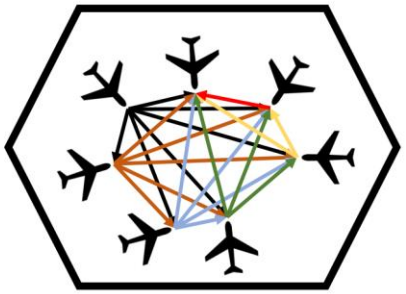
Database Construction

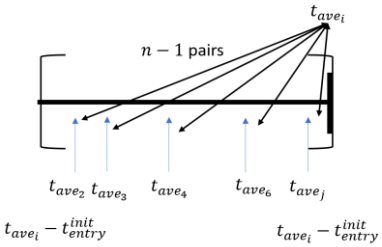


OpenSky ADS-B data

Pre-processing of raw data

Generation of aircraft pairs

Temporary modification in the same time frame.



Results

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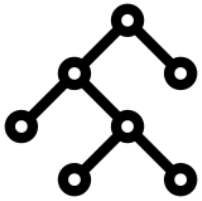
Results

Static

SI rate 75%

MinDis error 3.4 NM

DistoMinDis and TimetoMinDis poor results



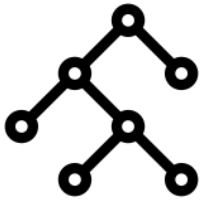
Random Forest

Dynamic

SI rate 99%

MinDis error 1.5 NM

High benefit compared with Static Mode



Random Forest

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CONCLUSIONS

Conclusions

AISA provides a novel solution encompassing different IA techniques

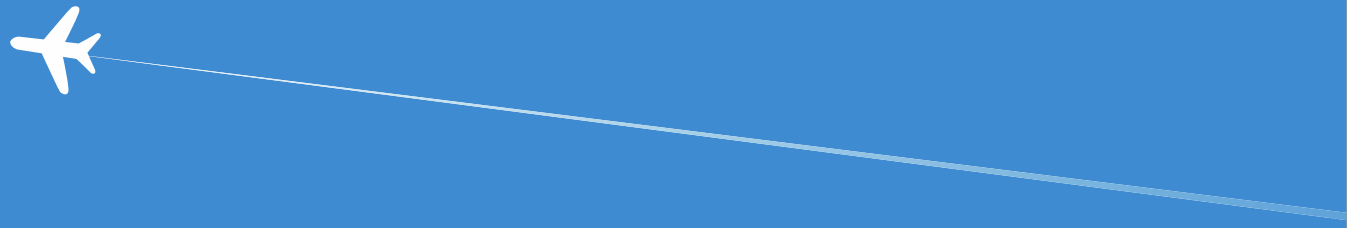
We have identified the information required and the expected outcomes to integrate ML module

Conflict-detection module based on ML can predict separation infringements with very high-rates

Further work

AISA performs the concept assessment based on experiments with ATCos

UPM is performing the risk assessment of the concept



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E-mail: Javier.perez.castan@upm.es

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