Supervised Machine Learning Model to Help Controllers Solving Aircraft Conflicts

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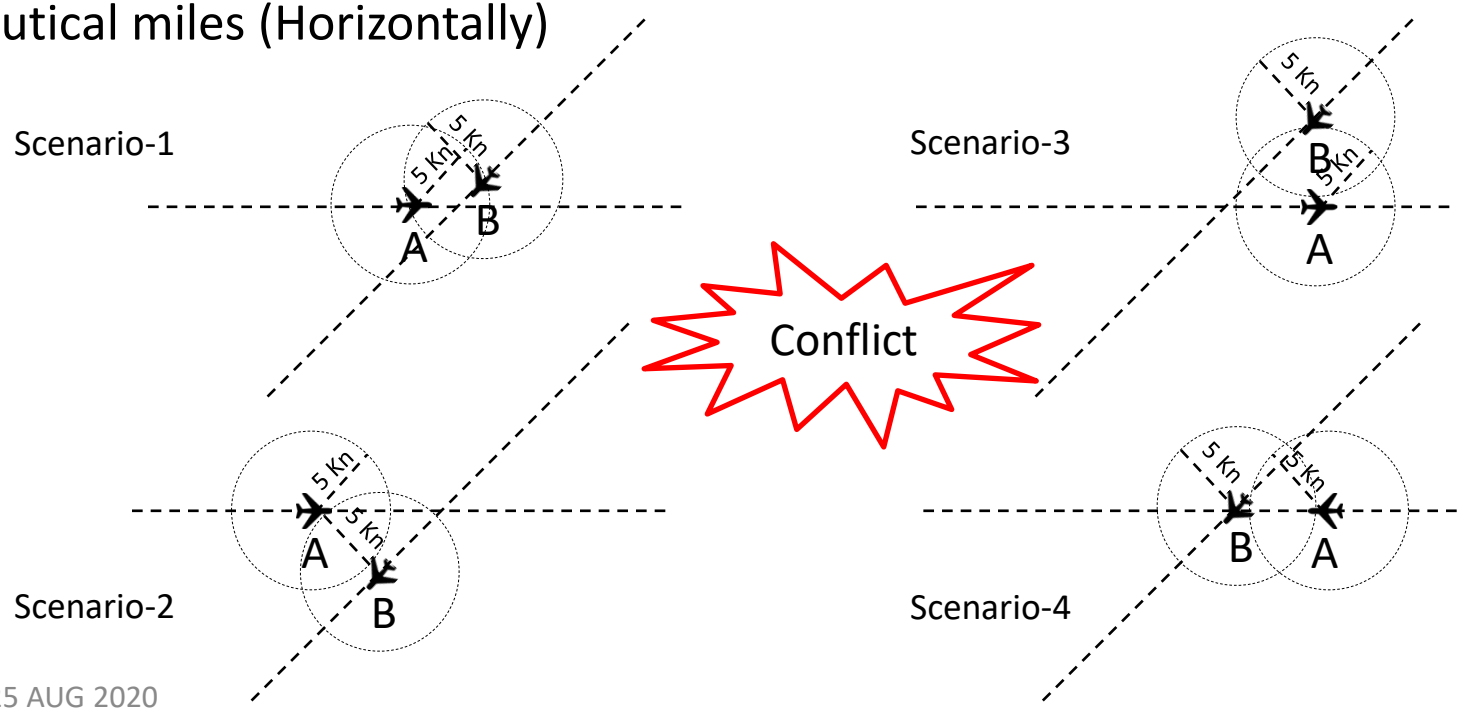
Introduction

Aircraft conflict

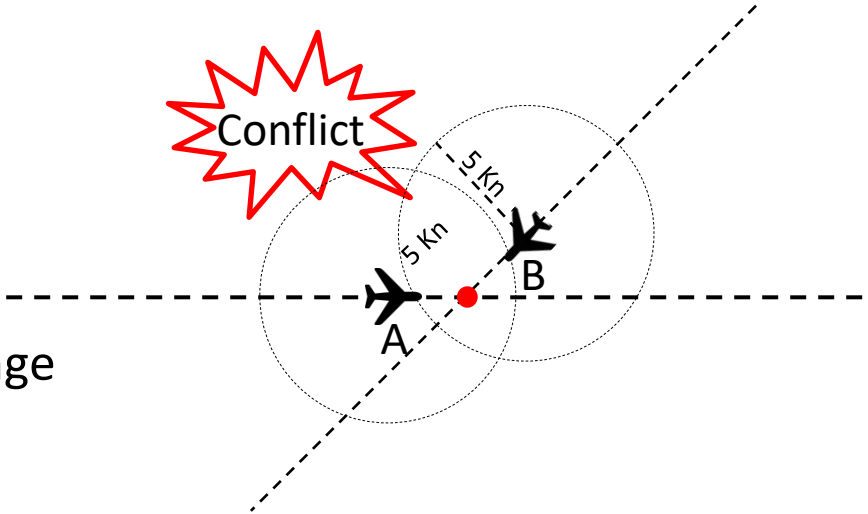
- Fail to maintain minimum distance
- 5 nautical miles (Horizontally)



Introduction

Basic parameters an air traffic controller considers to resolve a conflict.

- Basic parameters
  - Position (Latitude, longitude, altitude)
  - Speed of the involved aircrafts
  - Weather
  - Flight plan
  - Destination
  - Many others
- Aircraft conflict resolve
  - Horizontally heading change
  - Speed change
  - Altitude change



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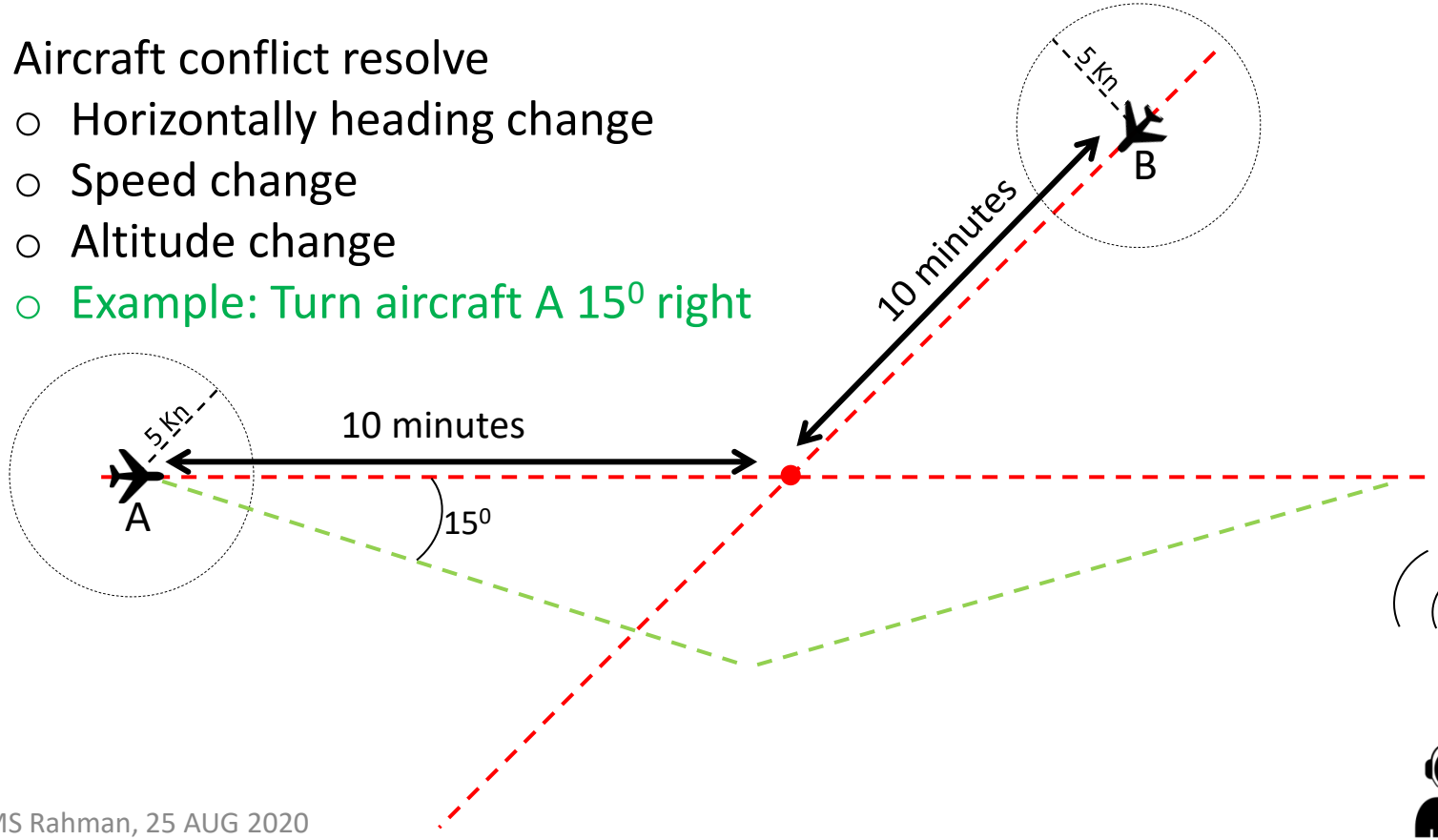
Aircraft conflict resolve

- Horizontally heading change
- Speed change
- Altitude change
- Example: Turn aircraft A 15^0 right



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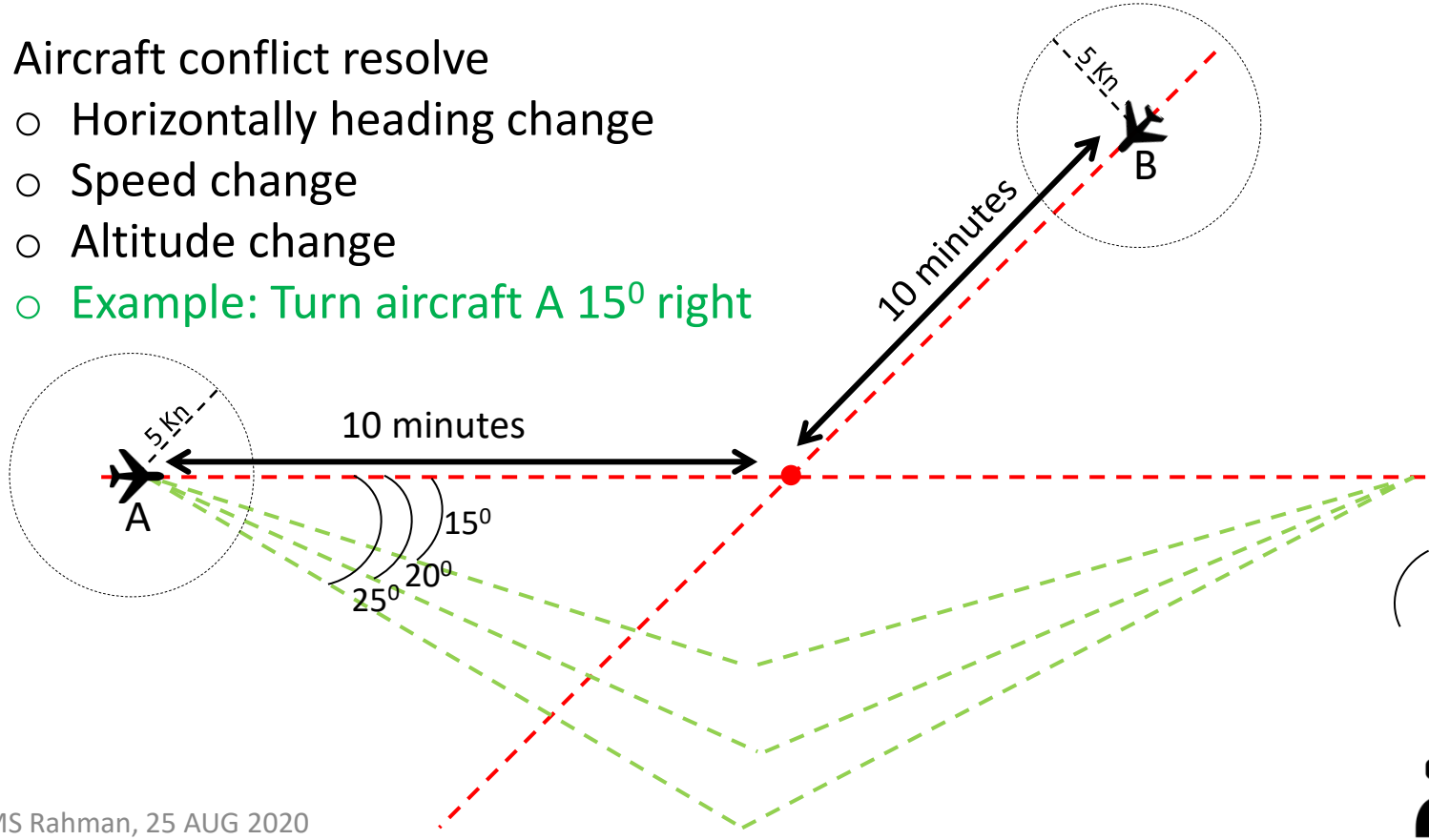
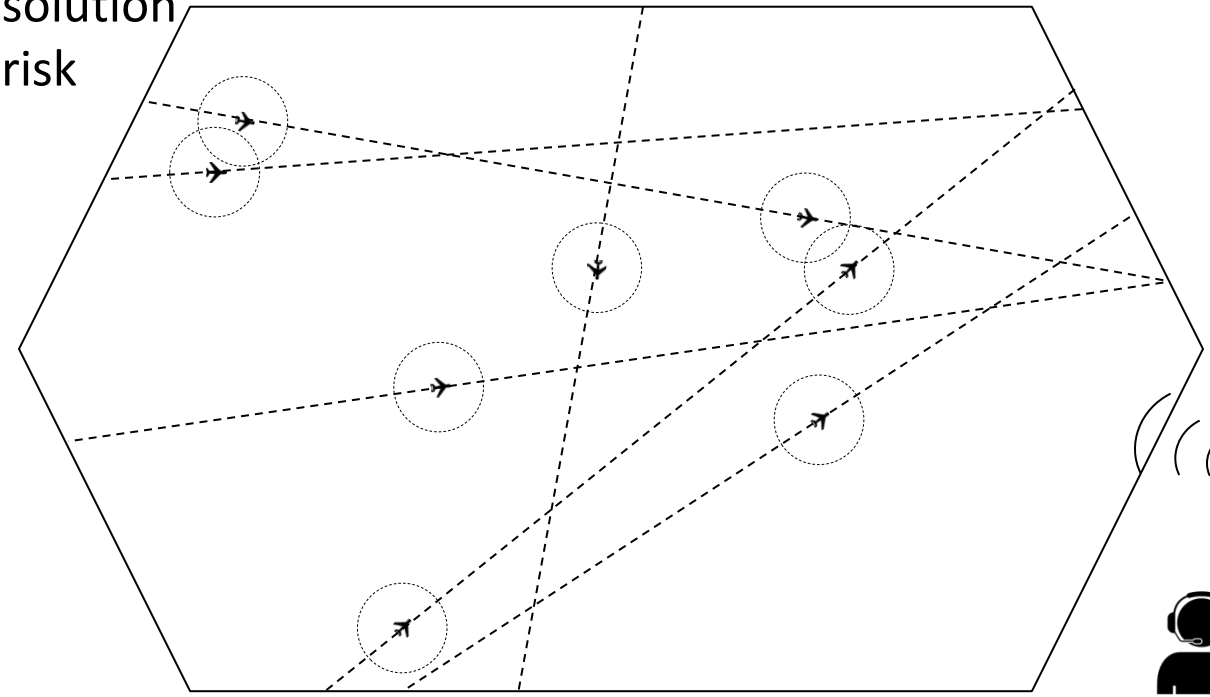


Introduction

Sector with many aircrafts

- Panic situations for the controllers
- Need quick solution
- Sometimes risk



Related works

Related work on aircraft conflict resolution:

- Distributed algorithm for the free flight separation [Eby and Kelly, 1999]
- Mathematical model for conflict detection [Prandini *et at.,* 2000]
- Machine learning model is becoming more popular
  - Supervised classification methods [Kim *et al*., 2016]
  - Semi-supervised machine learning model [Srinivasamurthy *et al.,* 2018]
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Dataset

Commonly used dataset that the air traffic controllers consider to resolve conflicts

- Trajectory data (latitude, longitude, altitude, speed, etc)
- Immediate order (to change the direction) from air traffic controller
- Flight plan
- Weather report

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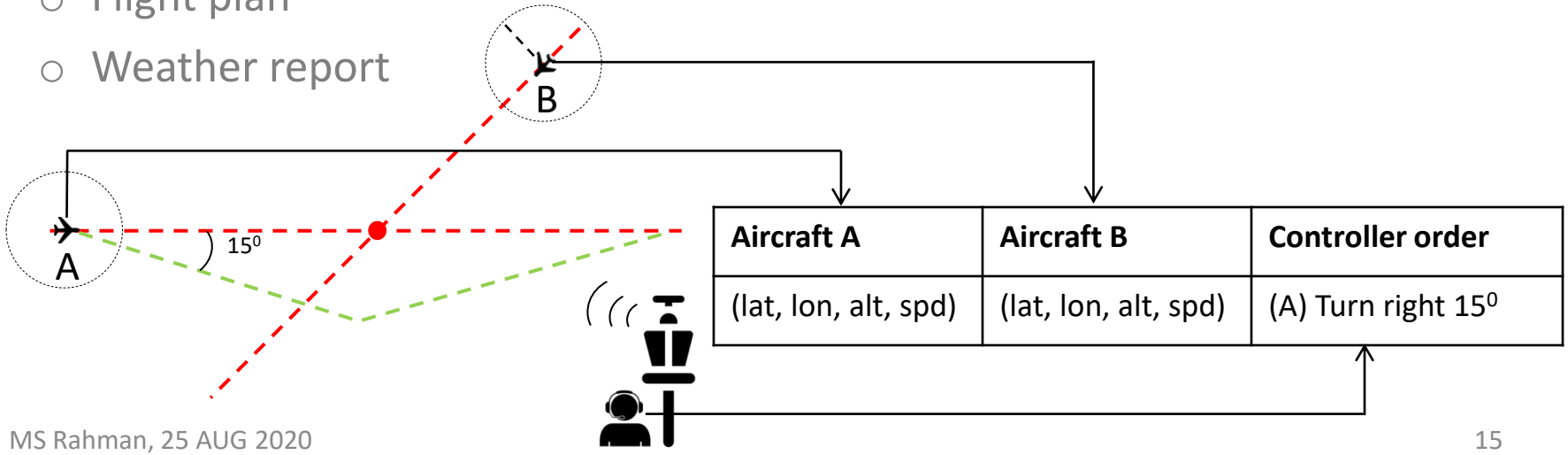
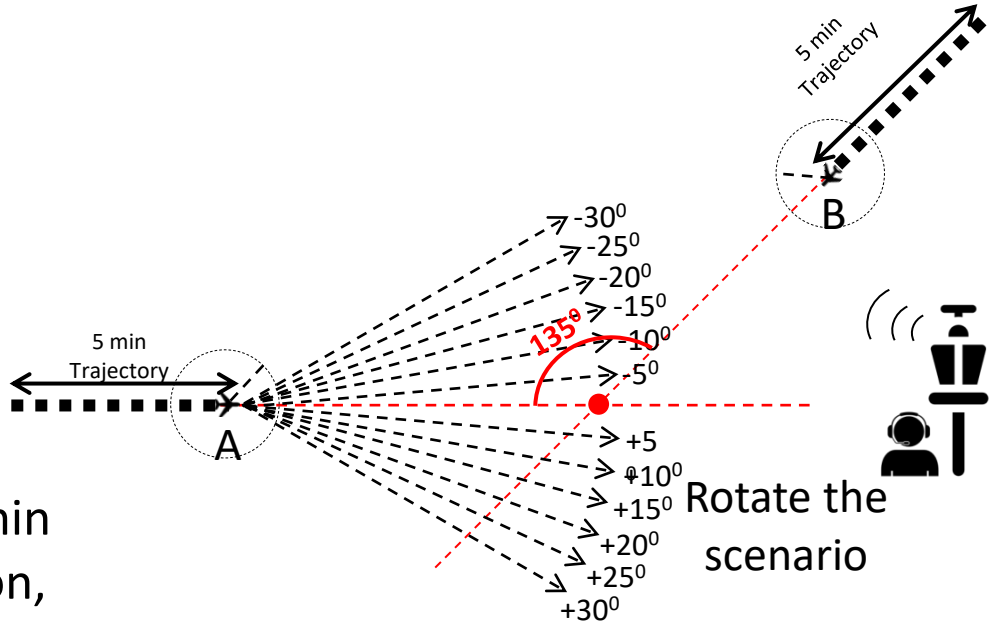


Dataset

Simulated data from the source simulator BlueSky

- Why a simulator?
  - Can generate a lot of data
  - Easy to include variations
- Procedure
  - Updates every 5 secs of 5 min
  - Aircrafts coordinates (lat, lon, alt)
  - Controller action
  - Binary annotation (whether it can solve the conflict).
  - Angles 5^0 to 30^0



Proposed model

Aircraft conflict solving

- 7 input features: 2 * 3 (lat, lon, alt) + 1 (time)
- For 1 min = 7*60 = 420

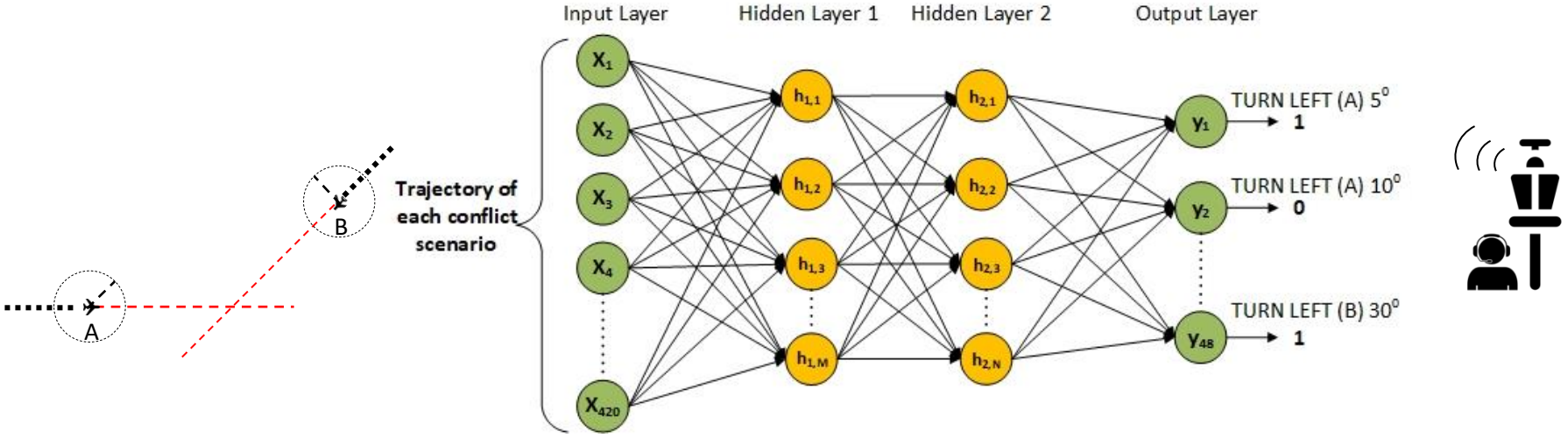
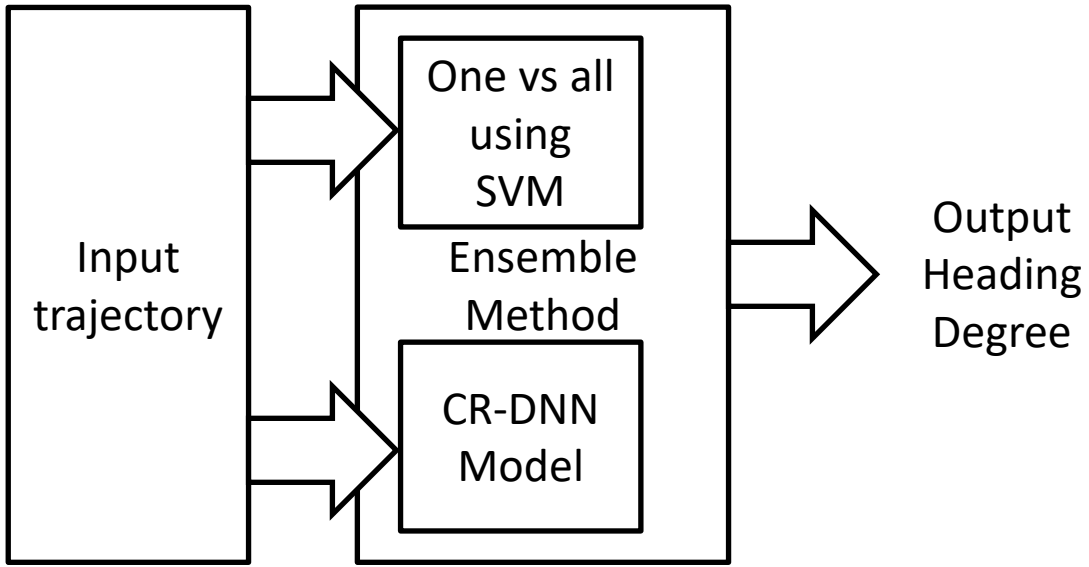


Fig. 1. Conflict Resolution Deep Neural Network (CR-DNN): The model predicts conflict resolution actions with binary decision from the 2 airplanes trajectories.

Proposed model

Future work

- We will use an Ensemble method that will combine the above presented architecture and a model based on other classification methods, such as SVM.



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