Automating Airport Airside Operations through Artificial Air Traffic Control

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Air Traffic Control Today

- Maximize Throughput
- Runway Separation
- Constrain

Short-Term Air Traffic Control Measures

- Airspace Distancing
- Flight Strips
- Voice Commands

Actions

Human ATCs cope with overwhelming constraints that open the opportunity for optimisation [1].

Methodologies & Milestones

This research project creates Artificial Air Traffic Control (ATC) agents that optimise Airport Operations, improving over current ATC human benchmark.

These agents are designed to assist and eventually substitute Human Air Traffic controllers.

- + Airport Efficiency
- + Operational Capacity
- + Customer Satisfaction
- + Airline Revenue
- - Flight Delays
- - Flight Cancellations
- - Air Pollution
- - Airline Expenditures

Most advanced agent consist of AMOA* [2], [3] and a modified version of NSGA-II [4]. The latter creates different scenario candidates, while assessing real world constraints that were previously overlooked, resulting in optimised and feasible solutions. Human Machine Interfaces are also developed for operators to follow the Artificial ATC commands (Fig. 1).

Artificial Air Traffic Control Agent

- Real-time decision making for four ATC operations
- Radar and flight data processing
- Aircraft path calculation
- Graph construction
- Aircraft data

- Optimisation of agents performance
- Real-time and scheduling
- Speed profile generation
- Handling and scheduling
- Human Machine Interface

Results

Our Artificial ATC Agent achieve the following performance under heavy traffic while complying with previously overlooked constraints.

<table>
<thead>
<tr>
<th>Case Study</th>
<th>Taxiing Time [s]</th>
<th>Fuel Spent [kg]</th>
<th>Total Cost [£]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real</td>
<td>3270.00</td>
<td>665.78</td>
<td>2006.33</td>
</tr>
<tr>
<td>Benchmark Algorithm</td>
<td>1538.77</td>
<td>456.24</td>
<td>1045.64</td>
</tr>
<tr>
<td>AMOA* - RS 3 PL &amp; GA 5I</td>
<td>1575.38</td>
<td>410.37</td>
<td>1030.31</td>
</tr>
</tbody>
</table>

Fig. 2 Different agent performance on Stansted Airport from 07-12-2021 07:40:00 to 08:10:00 (UTC)

Conclusions

On average, current agent achieve the following performance over a 1-hour period in busy traffic conditions, without violating any safety regulations:

- 13 Flights prevented from being delayed
- 40% Fuel and taxiing time reduction
- 100% Feasible Solutions

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References