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From Prediction to Decision Support - Strengthening Safe and Scalable ATM Services through Automated Risk Analytics based on Operational Data from Aviation Stakeholders

Results in Brief

Integrating predictive AI into air traffic management workflows

Predictive machine learning could make traffic management systems safer and more efficient. The EU- and industry-funded SafeOps project sought the best way to integrate this information into human operator workflow.

TRANSPORT AND MOBILITY

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Organising the skies above Europe is a delicate operation that depends on the collaborative efforts of airlines and ground authorities. Next-generation air traffic management (ATM) systems are driven by two sometimes conflicting goals: to make ATM processes more efficient, while also increasing safety.

Artificial intelligence (AI) could play a major role in this evolution. AI systems can parse through large volumes of data, bringing enhanced automation and new decision support tools based on predictive information.

For example, air traffic controllers could be advised about potential missed approaches by planes well ahead of time, allowing them to better organise landing traffic, departing traffic and runway capacity. This could mitigate the knock-on effects that result when a plane is forced to loop around the airfield rather than land, known as a go-around event.

Yet while current state-of-the-art air traffic control systems are based on information that is known to be true, AI predictions are based on probabilities, which introduces an element of uncertainty. Safety is paramount in aviation, so controllers will have to trust the information they are receiving.

The SafeOPS project, funded within the framework of the SESAR Joint Undertaking, set out to discover how such predictive technologies can be best integrated into existing human-driven ATM systems, to build trust in AI predictions among controllers.

“Predictive systems must show that they can increase capacity and be cost-efficient, or improve safety and resilience of ATM,” says project coordinator Lukas Beller from the Technical University of Munich in Germany. “Ideally both,” he adds.

Predicting go-around events ahead of time

To investigate the impacts of integrating AI into ATM, the SafeOPS team first ran a series of workshops with experts, tower controllers and other aviation specialists.

“In these workshops, we defined reference scenarios – in which go-arounds are challenging to handle – using the state-of-the-art methods and tools,” Beller explains.

Once these situations had been defined, the team set about designing a prototype system that simulated these reference scenarios using information created through predictive machine learning, a subset of AI. Using this prototype, the team could gather initial quantifiable estimates of how good predictions of go-around events could be. “Go-arounds are very rare events, so quantifying this isn’t trivial,” Beller remarks.

The team then discussed the results of the prototype experiments in further workshops with air traffic controllers, to see if the reference scenarios were still a reasonable reflection of reality, and adapted the results accordingly. This back and forth fine-tuning between human and machine will hopefully lead to better integration into the existing workflow.

At the same time, the SafeOPS team worked to adapt existing risk frameworks within

the ATM industry, taking into account the estimated possible risks of introducing AI predictions.

High confidence predictions for air traffic control

There have been surprising initial results already, says Beller. Initial research shows that air traffic controllers find it acceptable if AI fails to predict every single go-around event, as long as predicted events carry 90 % confidence. This makes sense from an operational perspective, says Beller.

The SafeOPS project is due to conclude at the end of 2022. “I hope that we can show and measure a positive impact of the AI tool on the safety and resilience of ATM,” concludes Beller.

Keywords

SafeOPS | air | traffic | management | AI | safety | resilience | capacity | controller

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