MSc thesis assignment

Evaluation of the Effect of Pilot Input Uncertainty on 4D Air Traffic Control Display Concept

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Background

In the coming decades, global air traffic numbers are projected to rise. To facilitate this increase in air traffic, the Air Traffic Management (ATM) system will need to change [1]. Currently, both EUROCONTROL and the FAA envision an ATM system governed by 4D trajectory-based operations (TBO) (i.e., in time and space) [2,3]. In 4D flight, both the aircraft's position and time are pre-computed, allowing for an airspace in which air traffic flows are optimized and can be de-conflicted before and during operation.

When these pre-planned trajectories are subsequently executed, unforeseen airspace perturbations, such as weather, sequencing and changing airspace constraints, will inevitably require small changes in the trajectories to be made by the air traffic controller. This perturbation management control task will consist of ensuring a safe operation while adhering to the strict time constraints imposed by the 4D flight plan. This will increase the complexity of the air traffic controller work domain, as these constraints (and relations between them) will have to be more strictly adhered to than in the current situation.

A concept 4D trajectory management interface has been designed and initially validated at Delft University of Technology in collaboration with Dutch Air Traffic Control (LVNL) [4] (see also this YouTube playlist). Using the known Required Time of Arrival from the 4D flight plan as a fixed constraint, rerouting possibilities are presented to the air traffic controller, creating so-called “solution spaces”. The idea behind this approach is to leave the air traffic controller in direct control of the actions to take, while supporting him or her in the decision-making process [5].

Although ATC commands are eventually expected to be given using some form of data link, the reality is that radio telephony will still be used in the medium to short term future. Issuing ATC commands that are then manually processed by the pilot will inevitably lead to some sort of time delay (or sometimes even a failure to comply with this instruction altogether). The effect of such a time delay on the display concept is currently still unknown, but is of great interest to its current operational viability.

Project Goal

Thus, in this MSc thesis project, the aim is to investigate different types of time delay and possible input errors to be expected when issuing commands to aircraft (now and in the future). The results from this literature study can be used to set up a human-in-the-loop experiment, where the effect of pilot input delay and errors on the display concept are assessed. This research will be in conducted as part of the Centre of Excellence program at LVNL to improve the quality of the research using the feedback of professional air traffic controllers.

The results of this study will serve as advice for the further development of this display concept.

Details

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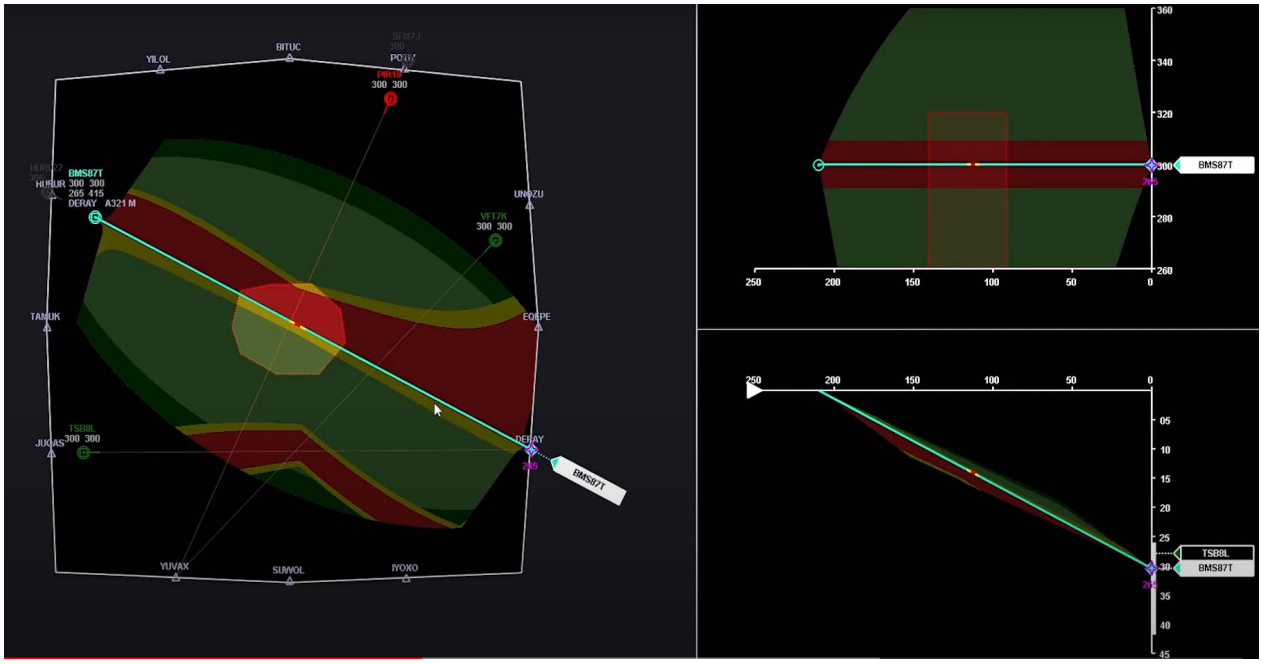

References:

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[4] M.M. Ottenhoff, "Effects of Wind and Trajectory Uncertainty in a 4D Trajectory Management Interface," Master's Thesis, Delft University of Technology, Delft, The Netherlands, 2020. [Online]. Available: http://resolver.tudelft.nl/uuid:87dbd144-d43f-4586-ad6d-a74dbe001389

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