Introduction

This document gives an overview of the activities in 2009 and 2010 for the project “Designing an HMI for ASAS in respect of situation awareness”, which started July 1st 2008. The following section gives a list of publications of this work for the past year, as well as a list of locations and events where this work has been presented, and other work that has been done in support of this project. Section 2 gives an overview of the conference visits, publications, and research planned for 2010/2011. The concluding section illustrates the motivation for the research topics for 2010/2011.
1 Work 2008 – 2009

1.1 Publications

- **Conference paper**

- **Conference paper**

- **Conference paper**

- **Workshop paper**

- **Journal paper**

1.2 Presentations


• “Towards an Ecological Four-Dimensional Self-Separation Assistance Display”, workshop presentation at the 8th Innovative Research Workshop & Exhibition, Brétigny sur Orge, France, December 2, 2009.

1.3 Other work

• Development of a working software implementation of the current 4D-SAI concept. The resulting piece of C++-based software is a simulation using the TU Delft DUECA simulation environment. It can demonstrate a working version of the concept display, using a manually controlled non-linear B747-200 model for ownship motion, and automated traffic generation for (multiple) intruder aircraft.

• EID / WDA / ASAS literature research

2 Work planned for 2010/2011

2.1 Research

• Investigate constraint projections that incorporate the temporal dimension (see below)

• Literature study regarding (traffic) situation awareness, and (existing) SA measurement methods, investigate traffic SA using EID methods (2011)

2.2 Experiments

• Evaluation of a vertical separation assistance display (2010)

• Multi-actor self-separation experiment - An investigation into (implicit) coordination (2010)

• Supporting Self-separation in Three Dimensions Using a Co-planar Display: Evaluation experiment in NLR’s GRACE simulator (2011)

2.3 Conference/workshop visits


• IFAC HMS 2010

• IEEE SMC 2010

• EUROCONTROL Ino workshop 2010

• ISAP 2011
2.4 Publications

- Conference paper: “Design of an Airborne Three-Dimensional Separation Assistance Display”, to be presented at IEEE SMC 2010
- Conference paper: “Supporting Self-separation in Three Dimensions Using a Co-planar Display”

2.5 Other Work

- Scientific seminar: “Designing for Situation Awareness – the Ecological Flight Deck”, to be held by prof. M. Mulder, EUROCONTROL Brussels (As discussed at the last workshop, The Brussels location is preferred.)
- Develop software implementations for the three currently planned experiments.

2.6 Project deliverables 2010

- Year-end progress report
- Annual presentation at the INO workshop

3 Constraint projections and Situation Awareness

As airborne separation systems move towards more automation, it will become more important than ever that automation and instrumentation promote a high level of situation awareness. This is why our group employs Ecological Interface Design to evaluate the requirements for good SA on the flight deck, and to create better displays (and automation) that support it.

Endsley defines three levels of SA: perception, comprehension and projection [3]. The first level relates to perception of the situational elements, such as flight status and the presence of nearby traffic. The second level, comprehension, relates to understanding the meaning of the perceived variables, and their significance with regard to the system goals. The level of projection relates to the ability to project the future actions of the elements in the environment.

Our current ecological separation displays present the affordances of the airspace by showing how they shape the action possibilities for the aircraft state. In other words, the constraints that result from the presence of other traffic are translated into no-go areas in the heading/flight-path angle/velocity action space. This method of visualization has several benefits: it shows a clear picture of how traffic influences the pilot’s maneuvering possibilities (in terms of possible, conflict-free states), and it can be used to create combined visualizations for multiple state dimensions (e.g. the X-ATP display showing combined...
heading/speed affordances, the VSAD FPA/speed, and the current concept presenting combined FPA/heading affordances). These displays support the pilot’s SA on the first two levels, and to a certain extent also on the third level of SA (projecting the current state, or a target state into the (near) future).

When aircraft intent (ownship and intruder) is taken into account, however, projection is no longer a trivial extrapolation of the aircraft state vector into the future. Instead, the affordance space changes as a function of space and time due to trajectory change points (TCPs), and other changes of state or intent. In the next design iteration of the ecological separation assistance interface we therefore want to consider the temporal dimension, and see how traffic intent influences locomotion affordances as a function of time. Previous work already investigated time-heading projections of constraints [1, 2, 4], this work will be used as a starting point.

With such a method it becomes more difficult to relate a constraint visualization simultaneously to more than one state variable in a 2D projection (because time is already employed as the second dimension in this visualization). This will be one of the main challenges for the next concept design. We will therefore also consider combinations with a state display, and/or co-planar presentations.

References


