Eye-Tracking Research in an A330 Full Flight Simulator

Project at the
Berlin University of Technology
Institute of Aeronautics and Astronautics

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Overview

• Environment: Flight simulator with Scientific Research Facility (SRF)

• Method: Measurement of head- and eye-movements

• Flight trials with professional airline pilots: Approach and landing

• Initial results

• Summary / Outlook
Cockpit Setup:

- Headband with mounted eye- and scene-camera
- Head-tracking transmitter and sensor
Subjects

- 16 professional pilots (Lufthansa, LTU and Condor) = 8 crews
- Ø age: 36.7 years, Ø piloting experience: 14.4 years and 7500 flight hours (4500 flight hours in glass cockpits)

Scenario

- 4 destinations in Germany (Düsseldorf, Frankfurt, Munich and Stuttgart)
- Approach and landing
  (Descent from FL200 in managed mode, several altitude clearances, radar vectors (selected mode), ILS approach to touch down or go around)
- Air Traffic Control (ATC) by an instructor inside the simulator cockpit
- Weather: CAT I conditions, medium strong winds

Concept

- 3 – 4 approaches for each crew, Captain as Pilot Flying (PF)
- Crew briefing, pre-flight preparation (charts, weather, …)
- Setup and calibration of the measurement equipment (for PF)
- Measurement of Eye-Point of Gaze (EPoG) data, head-tracking, video-recording and simulator data collection
- Debriefing, questionnaires and rating scales
Scene Video:
- Scene recorded by head-mounted camera
- Eye-Point of Gaze display as cursor overlay in video

Cockpit Video:
- Environment recorded by ceiling-mounted camera
- Pilot actions and events
Visualization of Eye-Point of Gaze (EPoG) Data

Static Cockpit View:
Point of gaze and simulator data

Virtual Cockpit View:
Eye- and head-movements

Scene Video
Eye- and head-movements

Cockpit Video
Events and actions, sound
The A330 Cockpit

Average proportional fixation duration (n=25)

Initial Results I: Areas of Interest (A330 Cockpit)
Attention Allocation to Areas of Interest (Average proportional fixation duration, n=25)

Initial Results II: Areas of Interest (Cockpit & PFD)
Detailed EPoG Data Analysis in the Context of Simulation Data

Simulation Data (Alt-Spd-Hdg, FCU Actions, FMA Changes, Radio Comm.)

Dynamic Attention Allocation (moving average, 40s)

Fixations on Areas of Interests (timeline)
Summary

• Definition of realistic flight scenarios (approach and landing)
• Measurement of eye- and head-Movements of professional airline pilots inside an A330 full flight simulator
• Extensive data recording (EPoG, videos, simulation data, questionnaires)

➔ 25 datasets from 7 crews are available for further analysis

Analysis of the Pilot’s Monitoring Behavior

• Descriptive parameters (attention allocation to areas of interest, fixation duration, transitions, scan-cycles, etc.)
• Dynamic data representation on a timeline
• Simulation context dependent (status, actions, events)
• Mental representation of information (subjective rating)