Applying Pilot Models for Safer Aircraft

A-PiMod
Motivation

Fundamental goal: Improve aviation safety
Human errors cause 60-80% of aviation accidents

"Reduce occurrence and impact of human error… through technologies that support decision making"
A-PiMod Solution for Airliner Cockpit

Assistance should
- know the crew’s state
- adapt to the crew
- interact naturally
Adaptive Multimodal Cockpit

Reduction of Human Error in cockpits

Training Tool

Multimodal Interaction

Pilot Model

Online Risk Assessment

Key technologies of cockpit architecture
Architecture

Mission Level (ML)
Deciding how to reach the goal

Cockpit Level (CL)
Deciding who will do what

Agent Level (AL)
Task Execution

A-PiMod: task management support

typical automation in cockpits
Mission Level: How to reach the goal

Example: thunderstorm at destination airport
ML Risk Assessment

- Online risk assessment during flight
- Based on look-up table defined by company

**Input**
- Aircraft performance
- Environment conditions
- Crew state

**Output**
- List of hazards
- Probability of occurrence
- Severity of consequences

Example: risk of unstabilised landing is high
ML Management Display

Risk of current mission

Alternative missions

Risk of alternative missions

Example: crew requests risk for holding
Multimodal Navigation Display

Example: “hold BEBKU as published“
Cockpit Level: Who should do what?

Cockpit Level

CL Task Determination

CL Task Distribution

CL Risk Assessment

Interaction Manager

Crew State Inference

ML / CL Management Display

Example: lower landing gear
Crew State Inference

Situation Awareness
• Do intentions match the current task distribution?
• Is the Monitoring behaviour adequate?

Intentions
• Which tasks does the crew perform at the moment?

Example: crew did not lower landing gear

Pilot State

Workload
• Is the Crew under- or overloaded?
CL Management Display

Risk Value
Status of Crew and automation
Task Distribution

Example: “lower landing gear” is assigned to crew
Interaction Manager

Ensures that information is perceived

Input
• Task Distribution
• Crew state

Output
• Visual and audio warnings

Example: “lower landing gear” is highlighted
ML/CL Management Display

Mission Level
• Mission
• Flight phase
• Risks

Cockpit Level
• Crew state
• Automation state
• Tasks and distribution
Spin-Off: Training Tool

- Enhance cockpit crew training
- Tool an tablet used by instructor during simulation
- Based on capabilities of the A-PiMod architecture

Monitor flight parameter, automation and crew status

Assess the crew
Validation Method

Start of Project: 09/2013

Initial specification of requirements: 03/2014

Validation cycle 1: individual systems and explorative simulator evaluation: 10/2014

Validation cycle 2, integrated systems and scenario run in simulator: 05/2015

Final validation of safety and operational impact: 08/2016

Community of Practice
Internal + External Stakeholders
A superior crew is the one which uses superior knowledge and experience to avoid situations which require superior knowledge and experiences.

A-PiMod’s multimodal and adaptive cockpit is the third member of a superior crew
Thank you for your attention

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