Presentation Outline

- Introduction
- Mode awareness
- Theory/methodology
- Approach
- Case study 1
- Vertical A/P modes
- Display augmentation
- Means of compensation
The Problem of Display Correctness

Formal Analysis of Human-Automation Interaction

Michael Shafro
David Austin
Michael Heveman
Asaf Degen
• Training
  Irving et al.; Hutchins; Javaux and de-Keyser

• Cognitive studies
  Rogers et al.; Mangold and Eldredge; Vakil et al.

• Incident analysis

• Experimental studies

• Field studies
  Wiener, 1985, 1989; Degani, 1996

Industry/Research contributions
Analysis of Human-Machine Interfaces

- Assumptions:
  - Machine behavior is given
  - Control panel is given
  - Pilot is perfect
  - Task specification and activities are given
  - Information is displayed
  - Focus

- Display correctness aspects
- Qualitative (how this info. is displayed)
- Quantitative (what info.)
Research Objectives

- Develop methodology for evaluation of display correctness
  - consistency with training materials

- Develop methodology for display synthesis
  - correct
  - succinct
  - reliable
Specified activities

Specification driven

Model based

Formal

Systematic

Methodology for evaluation and synthesis

Theory

Analytical

Approach
For every situation, where are we on the list?
- mode
- parameters

For every possible pilot interaction, where will we be on the list?
- mode
- parameters

For every possible pairs of activities, what pilot interaction is necessary to transition between the pair?
- Reverse Engineering
- Simulator behavior

- Confine the investigation
- System under study
- Related events

- Hybrid machine representation
- Discrete
- Continuous
Flight Guidance Project

- Electrical system
- Altitude Interference function
- Vertical A/P modes
- Case studies

Is our theory/method useful?

Problem?

Is display correctness an existing...
Concept of displayed correctness
- Proposed solution
- Climb/descent to an altitude
- ASRS reports
- Field data
- VS, FLCH, ALT, ACQ, ALT-HLD

Existing system

Vertical A/P modes
Figure: Vertical Mode Control Model - Training Manual Version
Range in which reset of GCP altitude behind current aircraft altitude, will result in capture.

Range in which reset of GCP altitude behind current aircraft altitude, will **NOT** result in capture.

Figure : Capture Profile
Figure: Vertical Mode Control Model - Actual
Process of Evaluation

- Profile
  - climb, cruise, descent

- "Altitude Intervene"
  - no MCP contradiction

- "Altitude Intervene"
  - with MCP contradiction

- proposed solution
Hybrid systems are not well understood.

Modeling

- Input events
- State explosion problem

Crew factors

Display format and layout

"Perfect pilot"

Machine is fixed

Entry assumptions

Limitations
A step in the search for a quantitative method of evaluating nutrition interaction in humans.

- Process of evaluating human-nutrient interactions
- Examples
- Methodology
- Theory
- Conclusions