Integrated Intelligent Flight Deck (IIFD)

...a research thrust area within NASA’s Aviation Safety Program (AvSafe)

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Presented to CIBAC
September 25, 2006
Problem Statement

Based on recorded event data...
• Accidents, incidents, and precursors continue to occur wherein the pilot, the automation, or the external environment are causal factors

Based on analysis by industry groups...
• Need for flight deck capabilities that can reduce operational risk with respect to these factors (e.g. CAST, NTSB, NRC, and AOPA)

NGATS vision implies needs for flight deck safety research...
• More automated functions
• Increased flight deck expectations
• Less time to “see-and-avoid”
• Increased system complexity
• Many large uncertainties
Goals and Objectives

Develop technologies to mitigate operator-, automation-, and environment-induced hazards of future operational concepts
• Crew-vehicle interfaces that reduce risk of pilot error
• Monitoring technologies to detect unsafe behaviors
• Fail-safe methods for changing operator/automation roles

Address integration of these capabilities with other AvSafe and ASP (NGATS) products

Foster the development of an improved predictive capability
Our Solution Construct

• Consider the flight deck as a system
  – Recognize pilots serve more than one function in this system
  – Enable roles/responsibilities of elements of system to change dynamically to meet context-specific needs

Adaptive Flight Deck Systems
AFDS Information Flow

- Uncertainty of operator & automation behavior degrades safety margin
- Uncertainty of input set degrades safety margin

- Operator
  - Desired proximity
  - Desired flight plan

- Automation
  - Desired health, PVT, & attitude
  - ATC
  - ATC & other a/c
  - Intent, observations
  - Control system commands

- Avionics Computing Resources
  - ATC

- Vehicle health
  - Operator/automation health

- Position, velocity, time (PVT)
  - Attitude and attitude rates

- Traffic and wake
  - Terrain and airport features
  - Man-made obstacles
  - Atmospheric disturbances
  - Airspace restrictions

- Operator/automation health

- Desired health, PVT, & attitude

- ATC

- ATC & other a/c

- Intent, observations
Comprehensive Approach

- Based upon NASA ARMD’s Three Principles
  - Mastery and intellectual stewardship of core competencies of aeronautics for the nation in all flight regimes
  - Focus our research in areas that are appropriate to NASA’s unique capabilities
  - Directly address the R&D needs of the NGATS in partnership with member agencies of JPDO
Research Framework

Adaptive Flight Deck Systems That Improve Safety

LEVEL 4

Tailored Flexible Operator-Automation Management

Adaptive Displays and Interaction

Decision Associate Technology

Adaptive Intelligent Information Management

Automation Monitoring & Failure Mitigation

Operator State Monitoring & Classification

External Hazard Detection & Classification

LEVEL 3

LEVEL 2

LEVEL 1

Multi-Modal Interfaces

Operator Characterization, Sensing, Interaction Modeling, and Formal Analysis

Information Systems

Remote Sensing, Signal Processing, and External Hazard Characterizations

Methods, Metrics, and Tools

Experimental Capabilities

www.aeronautics.nasa.gov
Status

• Transitioning to project implementation phase to begin Oct 1, 2006

• NRA published, Phase 1 reviews completed
  – Anticipate awards soon (pending negotiations)
  – Plan to issue new topics

• Several IIFD activities have already begun
  – Leveraging FY06 tasking on relevant topics
  – Evolving and new CIBAC tasks
Proposed CIBAC Tasks

- NASA and CIBAC are assessing and developing Speech Recognition technologies, need to develop and validate an "Aviation-specific" speech recognition database

- The primary goal is developing actual in-flight data to represent a “truth” model

- Task 1: Analyze and distribute Ohio Univ. data from the Dallas-Ft. Worth SVS Flight Test back in 2000

- Task 2: Collect several hours of additional speech data in-flight. Ideally, several aircraft and persons would collect a variety of voices and situations, speaking the same aviation phraseology. The flight situation and equipment would be identified, the speech data would be digitally recorded and cataloged, and distributed. Scripts of valid (and non-valid) speech phrases would be developed. Ground and flight ops would be performed with different microphone, acoustic background noise, etc.

- Task 3: Several hours of data collection should also be conducted at a control tower or at a ground facility. Scripts would not be used, but actual ground control, taxi clearance instructions to aircraft and their read-back would be recorded. (Ground ops is probably one of the best SRS applications... particularly at a place like O'Hare, ATL, etc. Someplace really busy.) The data would be cataloged into individual files and distributed for analysis.

- Task 4: Speech analysis by OU should be conducted using their expertise and experience of these data for comparison and contrast of other efforts.