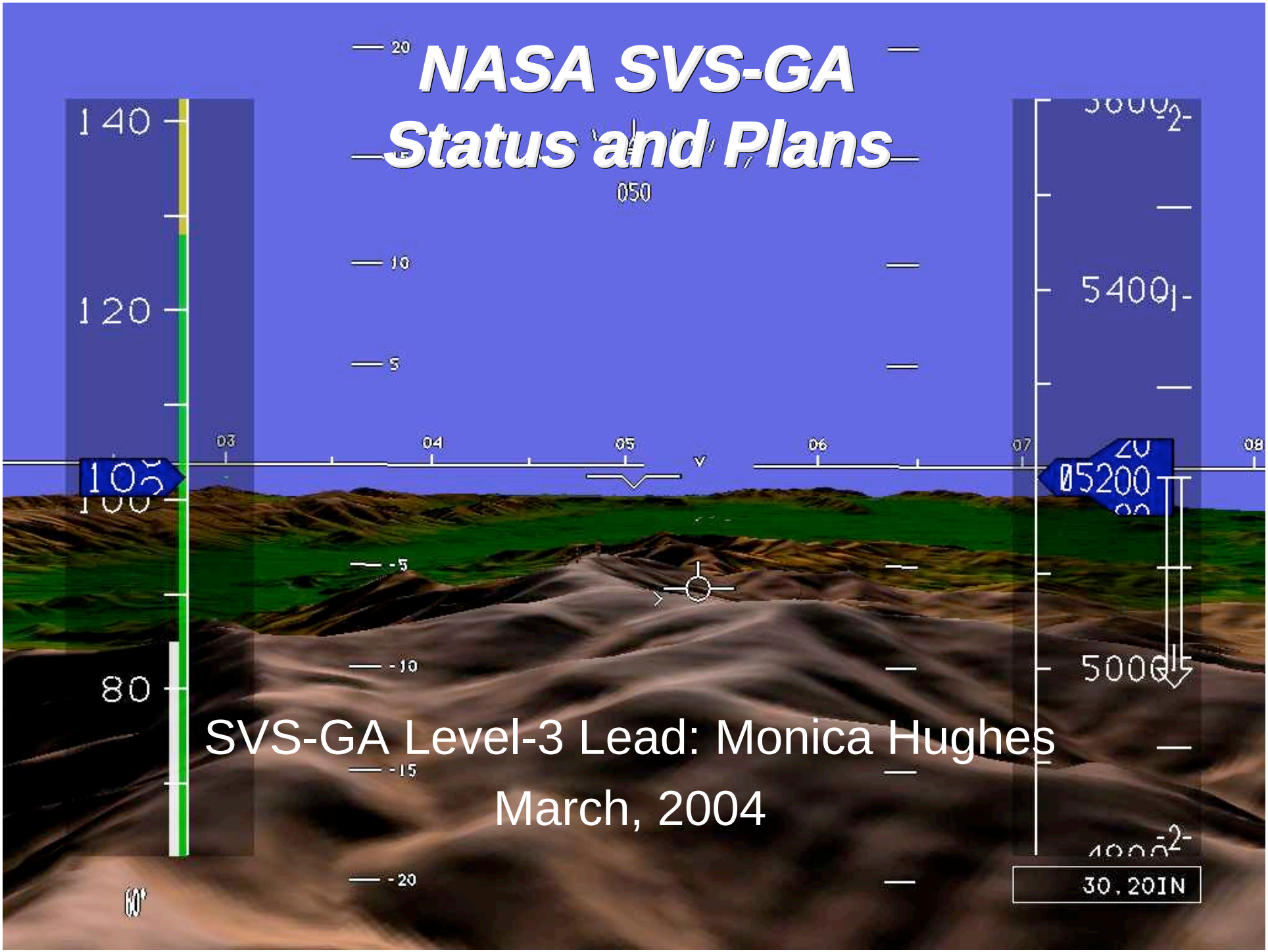
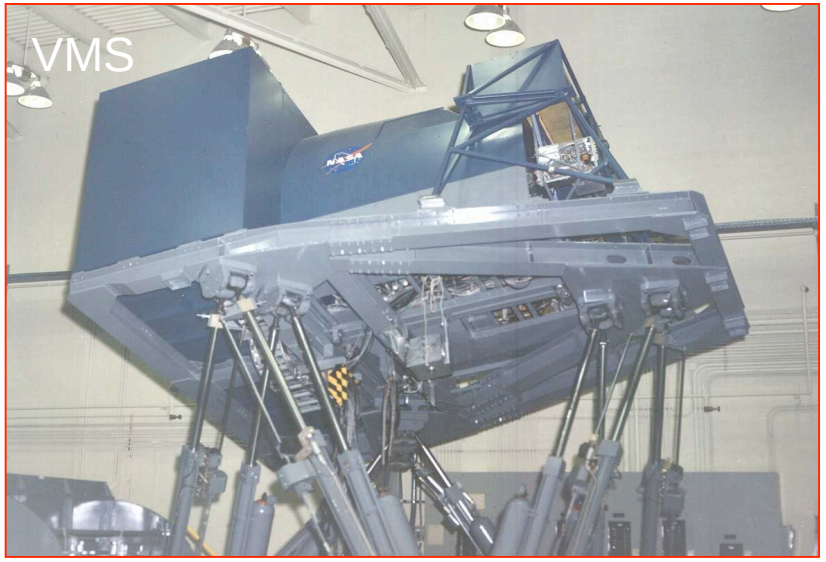

NASA SVS-GA
Status and Plans
SVS-GA Level-3 Lead: Monica Hughes
March, 2004

Outline

- NASA LaRC Facilities
- SVS-GA Element Projected Funding/Workforce
- Current Work
- Future Plans
- Summary

Simulation Research Facilities

- GAWS capabilities
  - Integrated Elite simulation with SVS displays
    - Enhanced data output for research purposes
    - Can simulate several aircraft
  - 40 degree FOV front visual scene
  - Modular instrument panel configuration
  - Physiological data
  - Various audio/video recording
- VMS Capabilities
  - 6-legged hexapod motion base
  - First operational in the 1970s
  - Generic cockpit with sidestick inceptor
  - Limited current use

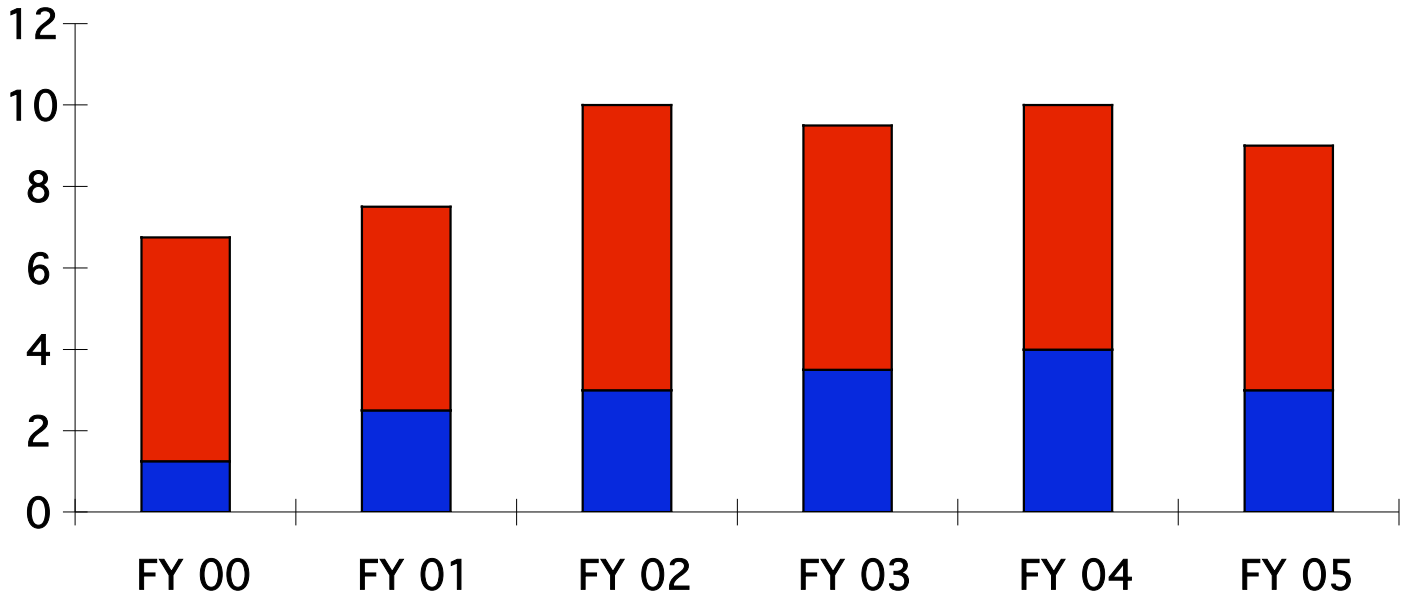


LaRC Flight Research Facilities

- Cessna C-206 capabilities (as flown in first SVS-GA flight test)
  - High-capacity alternator
  - Substantial payload capabilities
  - Seagull GIA-2000 ADAHRS
  - SGI/Intergraph Zx10 research computer
  - Control/position transducers
  - MX-20 installed

NASA LaRC C-206

SVS-GA Element – Workforce/Funding



	FY 00	FY 01	FY 02	FY 03	FY 04	FY 05	Totals
Civil Servants	1.25	2.50	3.00	3.50	4.00	3.00	17.25
In-House Contractors	5.50	5.00	7.00	6.00	6.00	6.00	35.50
Totals	6.75	7.50	10.00	9.50	10.00	9.00	52.75

Budget: FY'04: $1.4M; FY'05: $1M

FY'05 numbers are estimates

SVS-GA Near-Term Plan

- SD-HDD Part C
- SD-HDD Collaborative Flight Test
- Dual-Use Science & Technology Effort
- University of Iowa Grant

SD-HDD Objectives

- Establish interactions between Guidance Symbology and Terrain Portrayal concepts on a Primary Flight Display for:
  - *VMC-like terminal area operations in IMC in a terrain-challenged environment (Approach and Missed Approach)*
  - *Complex mountain pass maneuvers (En Route)*
  - *Over a range of specific minification factors*
- Develop recommendations for SVS-GA PFD symbology and terrain texture
- Demonstrate application of SVS technology to advanced operational procedures
- Evaluate altitude and range estimations for different terrain texturing methods

Part A Part B Part C

SD-HDD Part C and Collaborative Flight Test

- SD-HDD Sim (GAWS): Proposed Part C (En Route, Merrill Pass)
  - Approximately 6 pilots
  - Investigate minification issues specific for GA applications
    - How minified is too minified?
  - Merrill Pass maneuver
  - Evaluate four FOVs
  - Planning in development
  - Hope to start early April
- SD-HDD Flight Collaborative Test 1 (CT1)
  - Collaboration with SATS (RAC Bonanza)
  - Will extend results of SD-HDD sim experiments
  - 12 pilots
  - Includes 2 SVS concepts + terrain baseline series (2 GSCs, 2 TPCs)
  - Approach maneuver
  - Direct stick-to-surface + flight-path-command modes
  - Approximately 90 hours of checkout and flight testing
  - Complements and extends ground based testing
  - Addresses SATS Lower-Landing Minima and Single-Pilot Performance

CT-1 Flight Vehicle

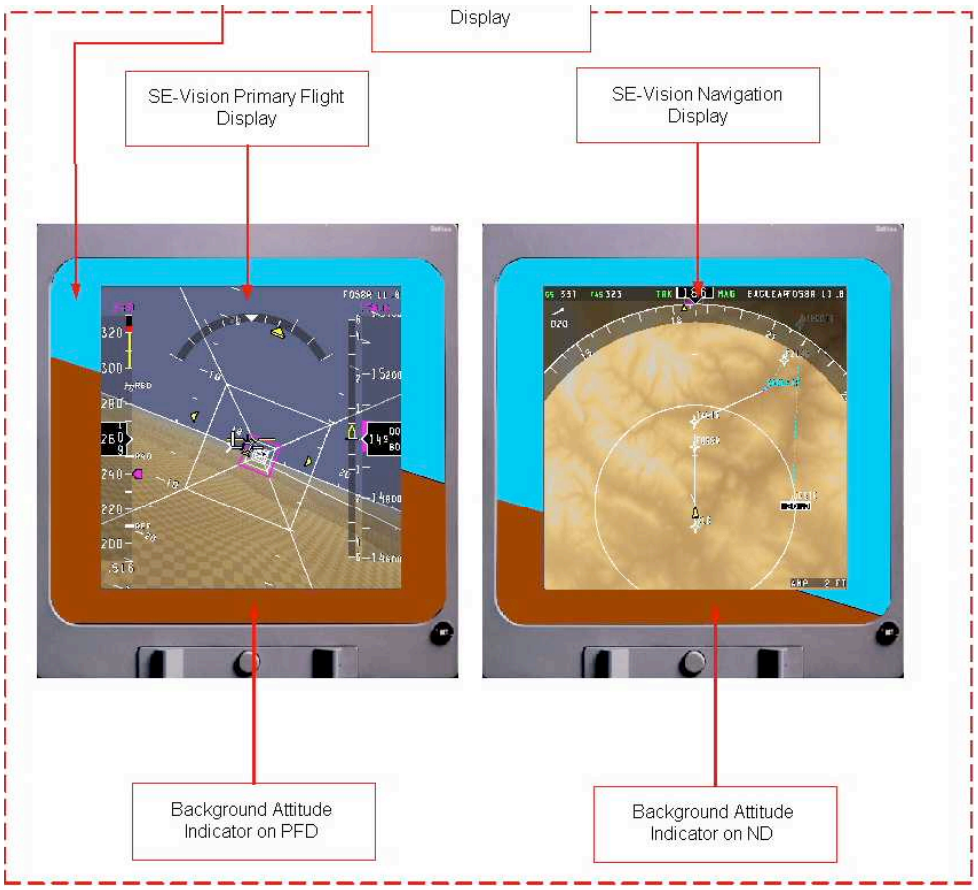
- Raytheon Aircraft Company CJ-144 Bonanza
  - Fly-by-wire control system installed (under AGATE)
  - Direct stick-to-surface or flight-path-command control laws
  - Seagull GIA-2000 ADAHRS
  - SGI/Intergraph Zx10 research computer
  - Two research displays
  - Control/position transducers

DUST Activity

Dual-Use Science and Technology (DUST) Activity:

- Cooperative program with the USAF
- DUST programs need to have:
  - Military Benefit
  - Sound Technical and Management Approach
  - Commercial Viability of Technology
  - Quality of Cost Share
- Pilot Spatial Orientation Enhancements topic
  - Two-year program
  - Substantial NASA support ($$ and technical) (enabling a substantial GA component to the research)
  - Employs SVS display technology (among others, such as tactile cueing) to prevent Spatial Disorientation
  - AFRL/Rockwell Collins/University of Iowa
  - Sim (Gyrolab) and Flight (Harvard Mark IV)
  - Hope for an April 2004 Kick-Off

DUST Activity



Proposed Display Set-Up

USAF Advanced Spatial Disorientation Trainer (ASDT)

NRC (National Research Council Canada) Harvard Mark IV

AM/PM Sim and Flight

Advanced Media/Portable Media

- Grant through University of Iowa
- 2 year effort
- Sim Studies (36 pilots each) – GAWS TOO
  1. Display Size Effects and Requirements
  2. Slant Range, Altitude Estimation (distance estimates to terrain and obstacles)
  3. Full Factorial Extension of Resolution Study
  4. HDD Mounting Location
  5. On vs. Off Axis Viewing, Ego vs. Exocentric PFD
  6. HDD vs. HUD vs HMD
- Flight Test (20 pilots each) – O-2A or Beech Bonanza
  1. VFR pilots and scenarios
  2. IFR pilots and scenarios
- Products
  1. Recommendations, concepts, and requirements to facilitate product development and certification of low-cost SVS implementation concepts.
  2. Evaluation and demonstration of improved safety through the use of AM/PM instrumentation

SVS-GA Element – Future Plan

Future In-house Experiment Option 1:

- Develop integrated system (SVS-PFD + MFD)
- Strategic Display Enhancements and Integration with SVS Tactical Displays
- Integrate traffic, weather and terrain awareness on the strategic display
- Runway incursion work
- Possible collaboration with AWIN and SATS
- Sim
  - GAWS
  - Fall ’04
- Flight testing
  - C206
  - Summer ’05

SVS-GA Element – Future Plan-2

Future In-house Experiment Option-2:

- Feasibility study of prevention of Low-Visibility Loss of Control in NASA LaRC VMS
- Employ “false motion” cues to create visual/vestibular conflict
- Use spirally unstable simulation model
- Evaluate display size, terrain portrayal, and limited symbology to counter SD
- Use similar spectrum of pilots to SD-HDD/TP-HDD

Summary

- NASA SVS-GA experiments have been planned and conducted to address core SVS and SVS GA application technology issues
- Beginning collaboration with USAF: DUST program provides cooperative testing and development of pilot spatial orientation enhancements
  - SVS is one technology to be evaluated
- Where do we go from here?
  - How to prioritize SVS issues?
  - Identify outstanding certification issues and set up experiments to evaluate them?
  - What is next logical research to perform to help transition into Aviation Safety and Security, Phase 2?

Plan: Use feedback from this workshop to help define upcoming simulation and flight experiments.