



# *CFIT Prevention Using Synthetic Vision*

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## Summary of Conclusions

- Synthetic Vision displays
  - Improved pilots ability to detect and avoid CFIT
  - Improved situational awareness
  - Reduced FTE
  - Reduced the pilot's workload
- Statistically validated flight test results



## Background

- NASA Aviation Safety Program project goal: reduce current accident rate by 80%
- Worldwide, most common fatal accident is Controlled Flight into Terrain (CFIT)
- Synthetic Vision System (SVS) program goal: eliminate CFIT
- Research retrofit SVS solutions
  - HUD
  - Head Down: Size A, Size D
- Forward fit solution: Size X (8''x10'')



## Experiment Objectives

- Demonstrate SVS improves the pilot's ability to detect a potential CFIT scenario compared to a baseline 757 EFIS display system with TAWS and a VSD
- Determine pilot usability / acceptability and Situational (Terrain) Awareness provided by a NASA SVDC Head-Up Display (SVDC-HUD) and confirm the potential of the SVDC-HUD as a retrofit display solution for SVS concepts in Non-Glass cockpits (this experimental objective was constrained by the lack of high visual fidelity in simulated HUD presentations).
- Determine pilot usability / acceptability and Situational (Terrain) Awareness provided by various-sized SVDC Head-Down Displays (SVDC-HDD).
- Evaluate pilot usability / acceptability and Situational (Terrain) Awareness provided by photo-textured and generically-textured terrain database SVS concepts within NASA SVS concepts (HUD; Head-down Sizes A/B, X) in support of the retrofit display concept evaluation and SVDC development
- Assess closed-loop performance during manually flown landing approach and departure (go-around) maneuvers in a terrain-challenged operational environment to determine the effect of SVS on performance, and quantify performance with respect to required navigation performance (RNP) procedures

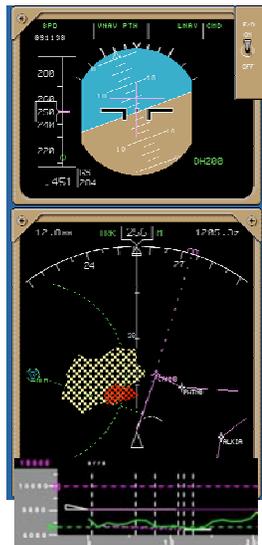
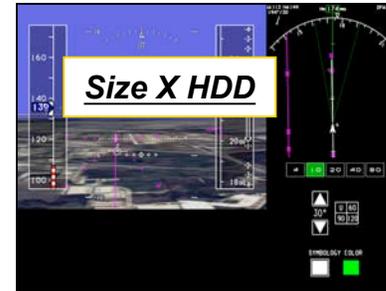
# VISTAS III Part Task Simulator

- Equipment
  - Fixed Based
  - HDD Display
    - 1280x1024 LCD Projector
  - Simulated HUD
    - Beam split glass
  - IMC conditions (no out the window scene on data runs)
  - Boeing 757 model
  - Moderate to light turbulence
- Subject Requirements:
  - 16 subjects
  - HUD-Experience
  - Current airline pilots



# Display Variations

All display variations  
Included TAWS and VSD



# Terrain Texturing Variations

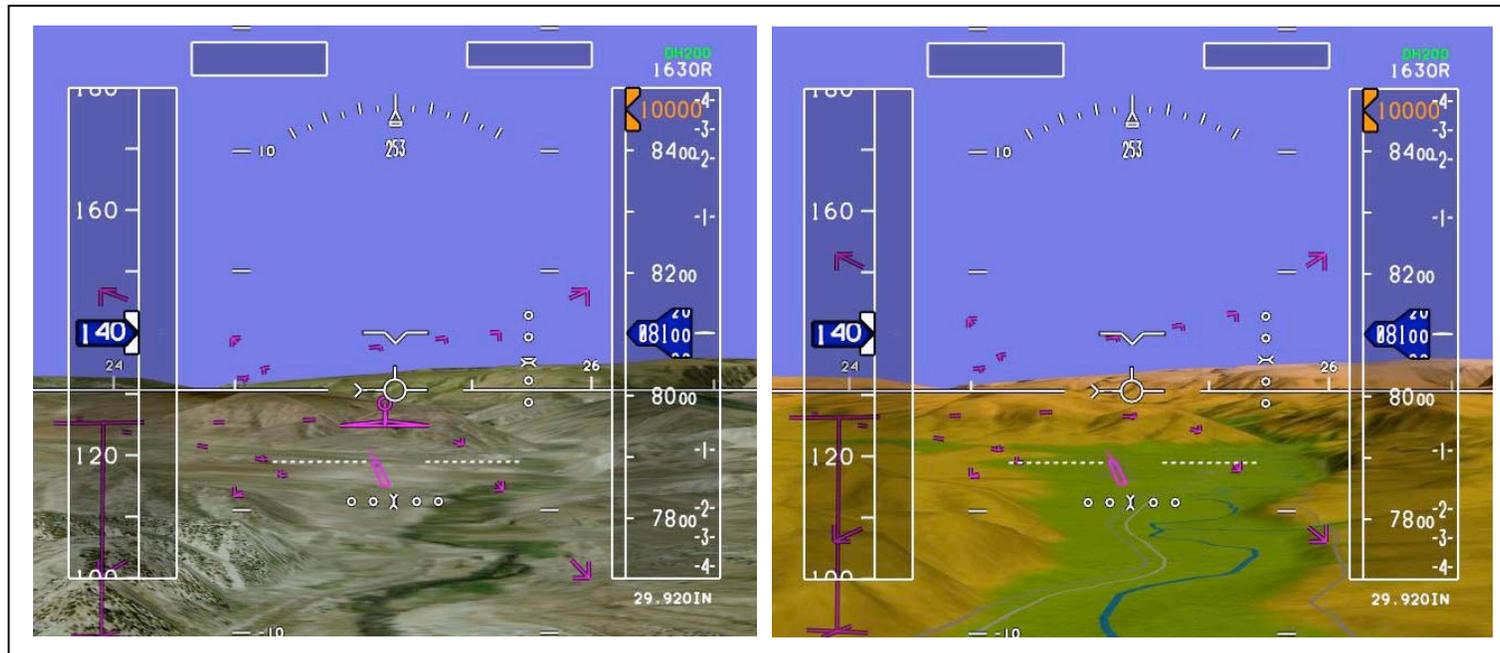


Photo-realistic

Generic Elevation Color Coding



## Experiment Matrix

Reps per pilot	Photo texture	Generic texture
<b>Size X</b>	3 reps	3 reps
<b>Size A</b>	3 reps	3 reps
<b>HUD</b>	3 reps	3 reps

+ 3 reps 757 baseline

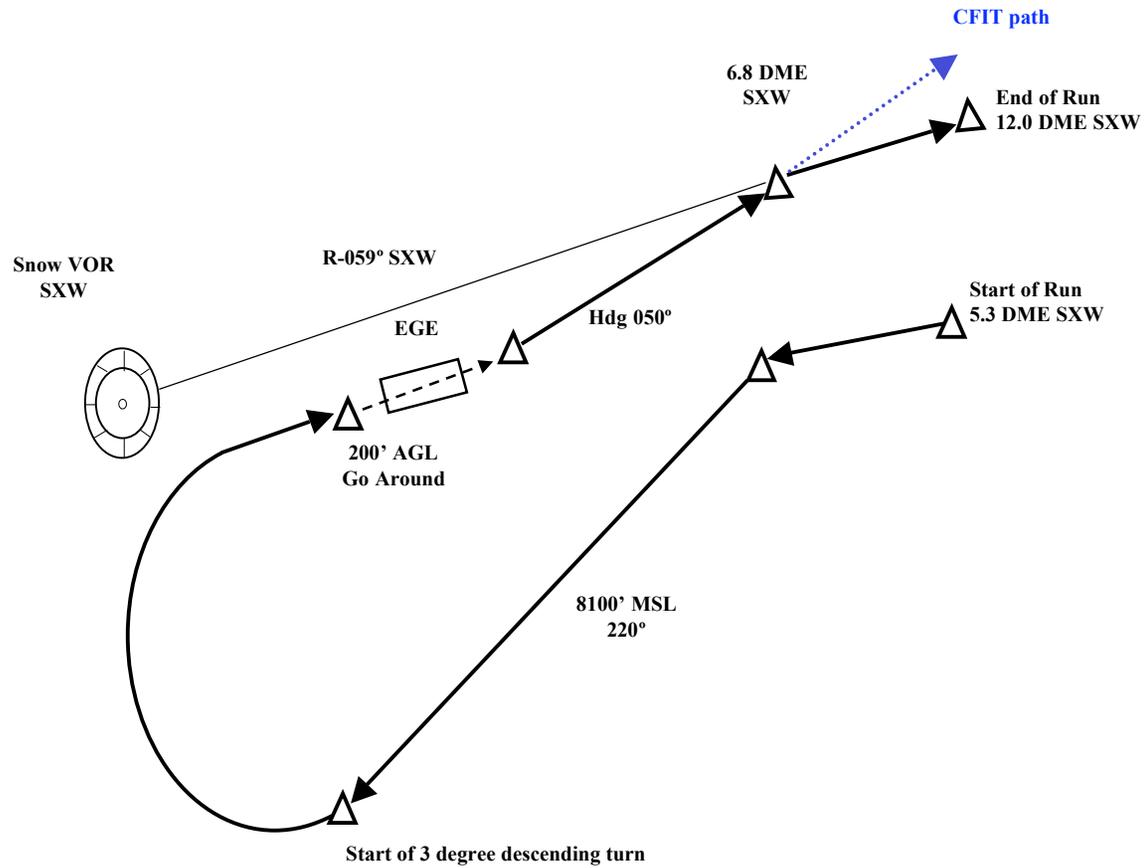
+ 1 CFIT scenario

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**22 Total data runs**



# Subject Task





## CFIT 'Rare Event' Scenario

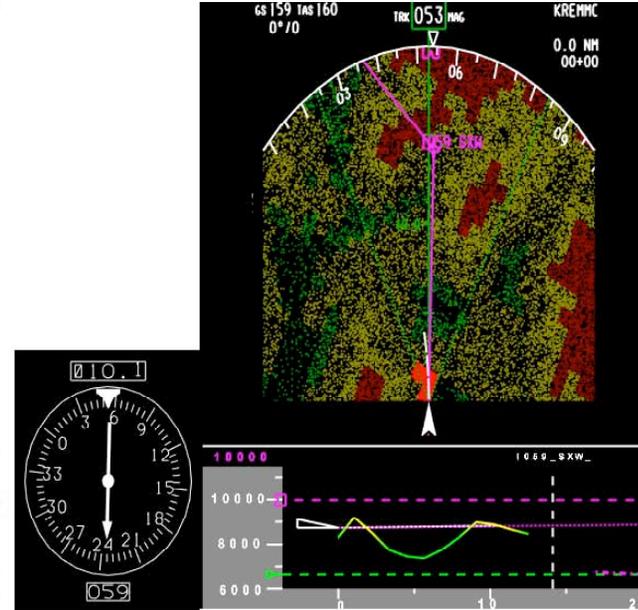
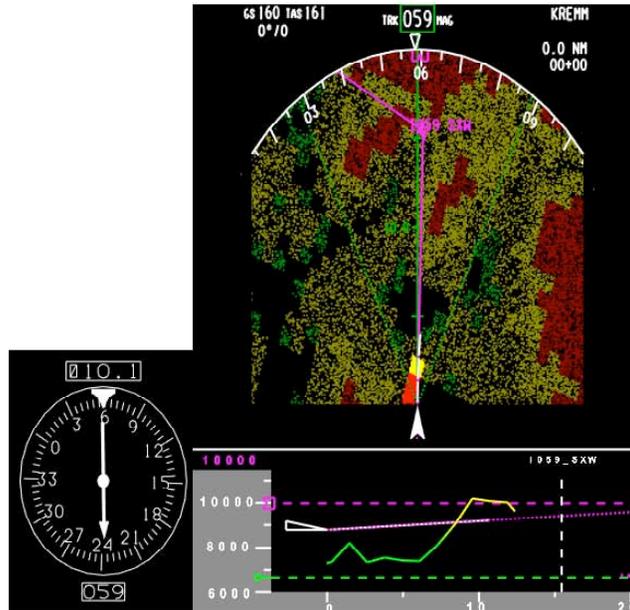
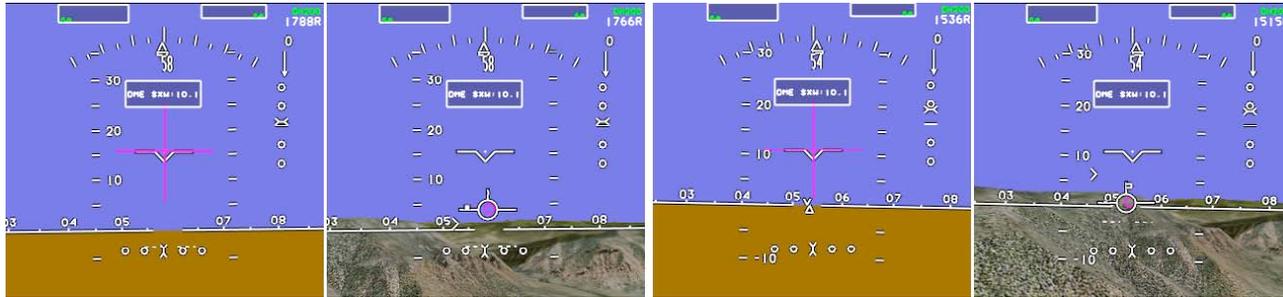
Number of pilots	CFIT display condition
4	Baseline (no synthetic terrain on PFD) TAWS + VSD
4	Photo texture size A
4	Photo texture HUD
4	Photo texture size X

**16 total**

# Results

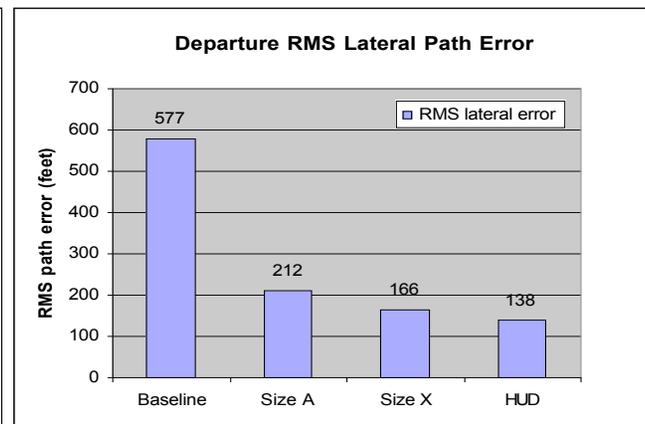
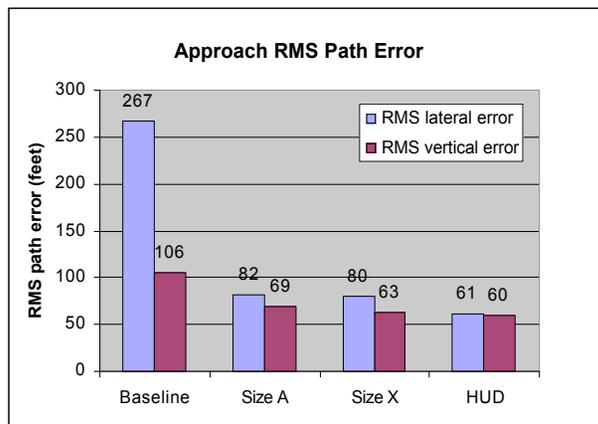
Nominal run

CFIT run



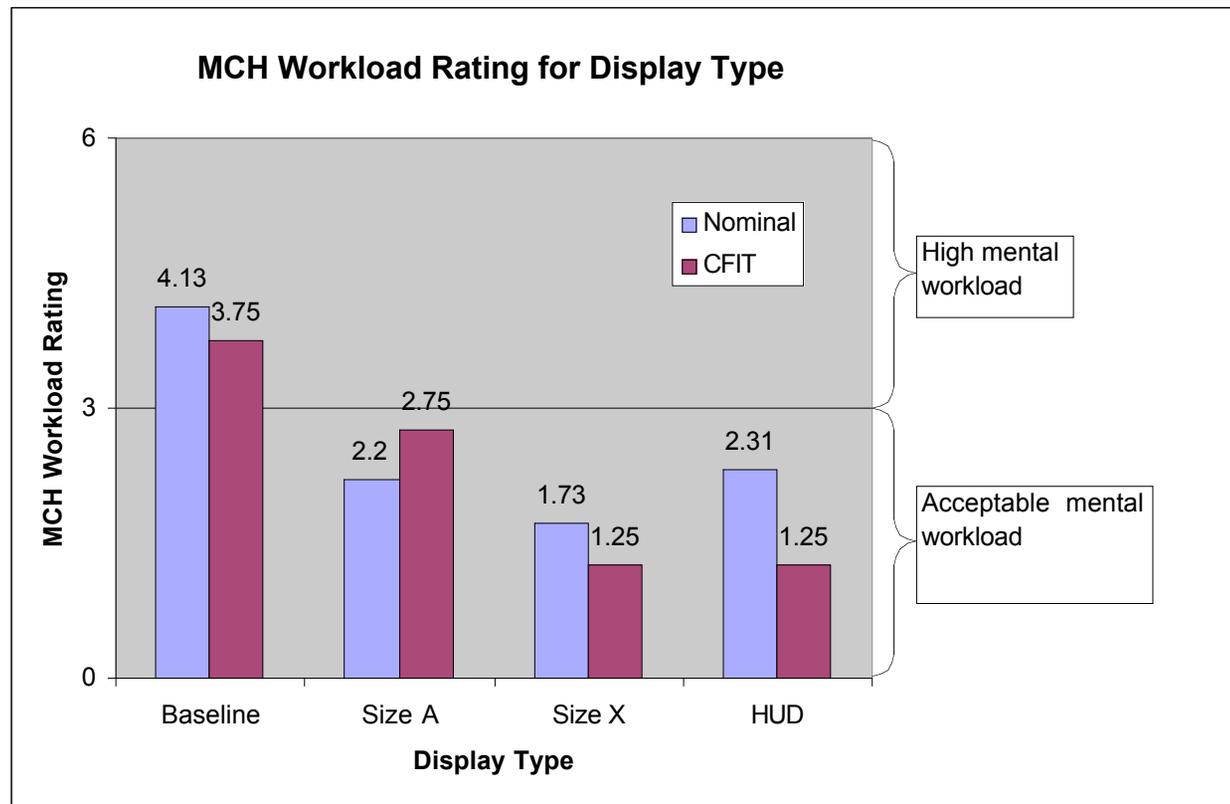
# Results

- For the ‘rare event’, all pilots with the baseline had a CFIT event
- No SVS CFIT’s



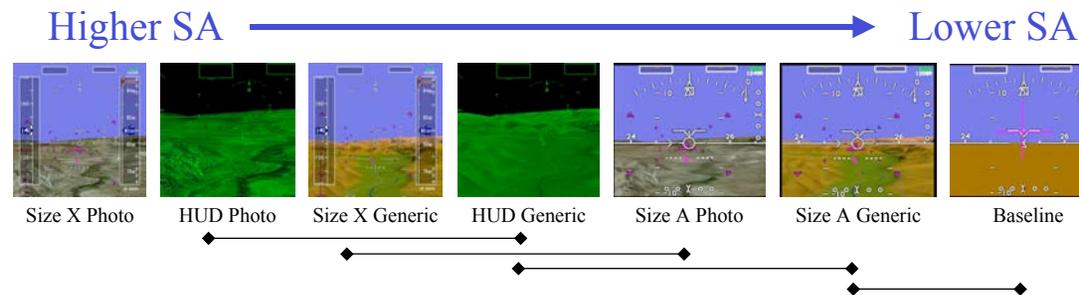
# Results

- Modified Cooper Harper: Baseline required greater mental workload compared to SVS



# Results

- Pilots preferred photo-realistic terrain, but not significant for Flight Technical Error (FTE)
- SA-SWORD results





## Conclusions

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The End

