Introduction

- Objective:
  – Observe the effects of reduced Field of Vision on people through visual manipulation

- Secondary Objective
  – Investigate possible solutions to the Spatial Disorientation of pilots in low visibility conditions

Spatial Disorientation

- “An erroneous sense of one’s position and motion relative to the plane of the earth’s surface”
- “Where the aviator fails to sense correctly the position, motion, or attitude of his aircraft or of himself within the fixed coordinate system provided by the surface of the earth and the gravitational vertical”

Spatial Orientation

- Vision
  – Based on external observation and relating the world to a frame of reference

- Proprioception

- Equilibrium Sense
Vision

- Foveal (Focal)
  - This is where the pilot maintains focus, generally in the center of the field of vision
- Ambient
  - Represents the peripheral field of vision

Assumption: Chances of Spatial Disorientation increased more with a degradation in Ambient than Foveal Vision cont’d.

- Perception dictates motion
  - Vection
    - “Expanding” flow implies forward motion
    - “Rotational” flow implies observer rotation
  - Heading
    - Perception of an observer’s direction
  - Postural Control
    - An observer’s perception of their current location and orientation

Assumption: It is easier to manipulate the visual than it is to manipulate the gravitational when testing for Spatial Disorientation

Testing Apparatus

- Indigo Workstation
  - To generate the simulation
- Three 21-inch monitors
  - To display the visual information
- Height adjustable bench
  - To support the monitors
- Flock of Birds 3D head-tracker
  - To monitor the participant’s head movements

Stimuli and Procedure

- The image would be moved and rotated to simulate actual movement in 3D space at varying speeds to test participant’s response through their head movement
Measurements

Experiment 1

- Full Field of view of 150 degrees horizontal
- Participant put through sequence of accelerations, pitches, and rolls
  - All were non-pilot trained undergraduate students of ages 20 to 41, 12 men and 4 women, and naïve of the experiment
- Results: The results were as expected. Participants swayed and tilted to the stimuli

Experiment 1 (continued)

Experiment 2

- Repeat of Experiment 1 with a reduced FOV from 150 deg. to 105 deg. and 45 deg.
- Results: effects were greater in Y than X dimensions, and reducing the FOV reduced the postural sway
Results

• The visual flow was effective in producing postural motion (sway and XY)
• Translational movements were relatively equal during the two experiments
• Wide-angle display induced higher amounts of sway during forward motion
• Lower roll velocity induced more sway than a higher one

Results (continued)

• In order to produce a more effective instrument flying assistance, it is advantageous to project not only horizon, but moving ground as well
• This projection has a reduction in usefulness in extremely High-G cases when tunnel vision is induced