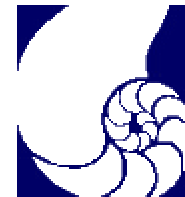
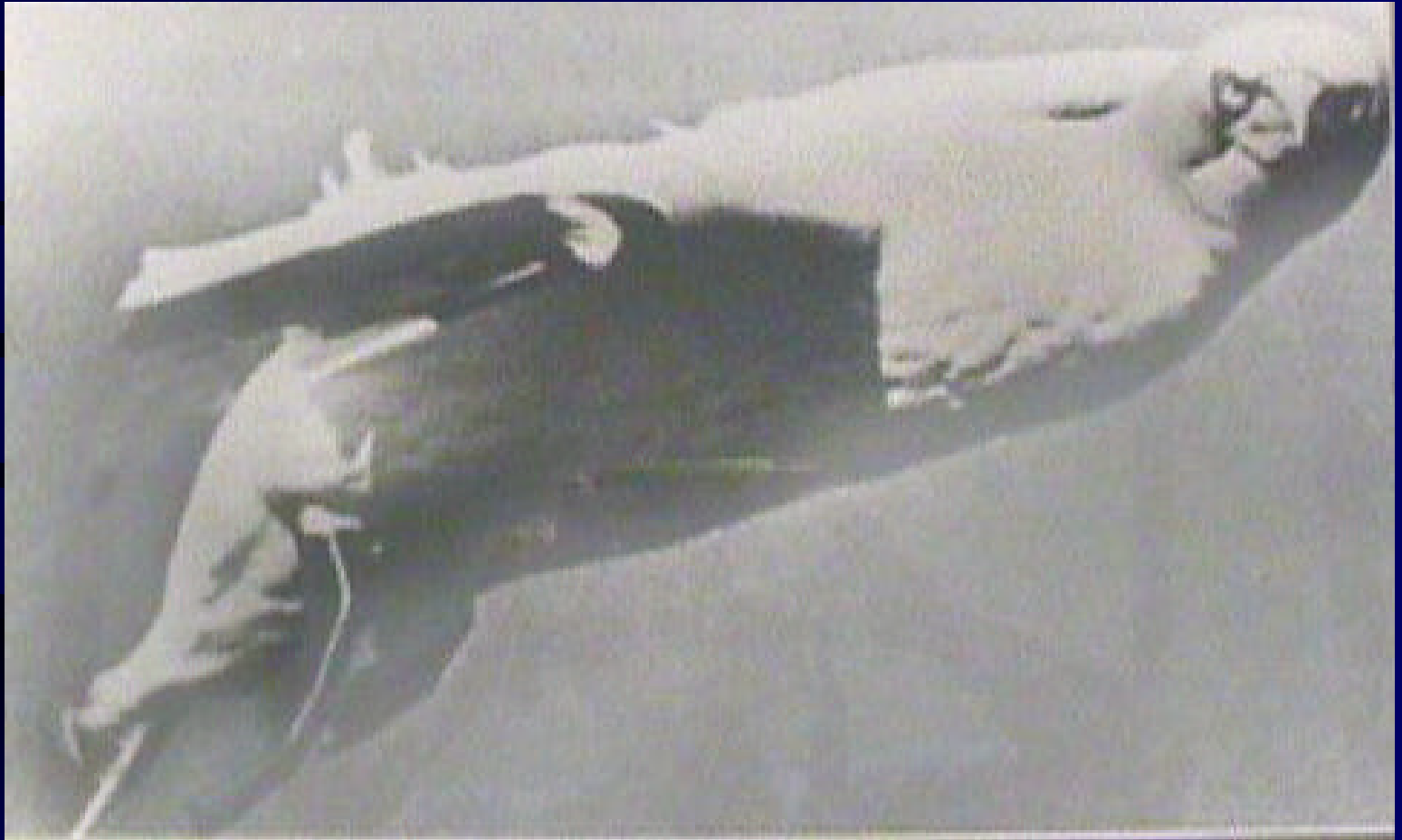


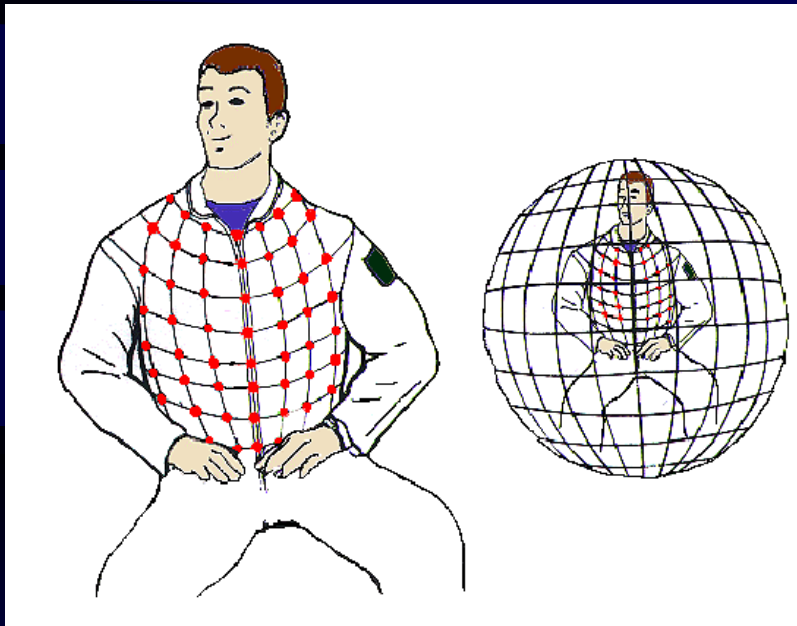


institute for
Human & Machine Cognition





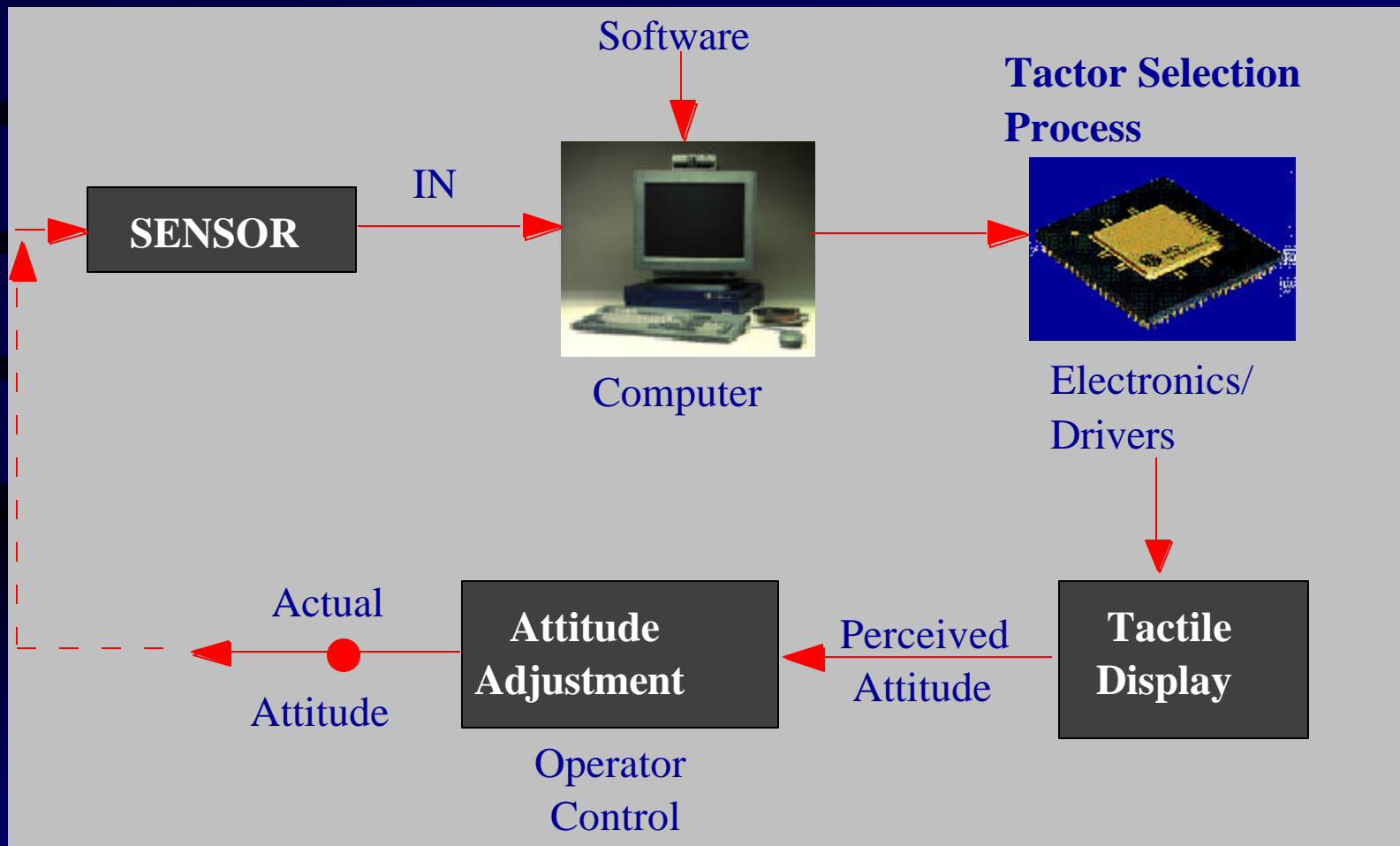
Tactile Situation Awareness System (TSAS)



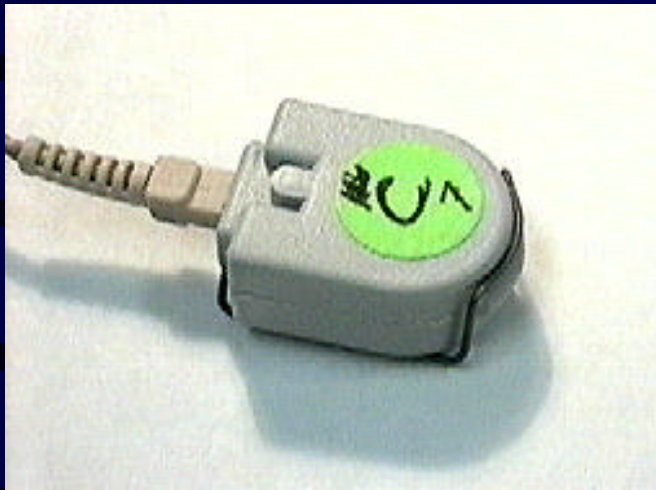
- Maps surrounding space to the torso tactually
- Intuitive in three dimensions
- Non-visual
- Non-competing
- Utilizes “seat of the pants” sense
- Continuous source



Tactile Display System



Tactors



TactAid
Audiological Engineering



Modified Pager Motor
NAMRL



1st Test: Fixed-Wing Flight Demonstration



NAS Patuxent River, MD SEP95



2nd Test: Helicopter Flight Demonstration



Ft. Rucker, AL JAN96



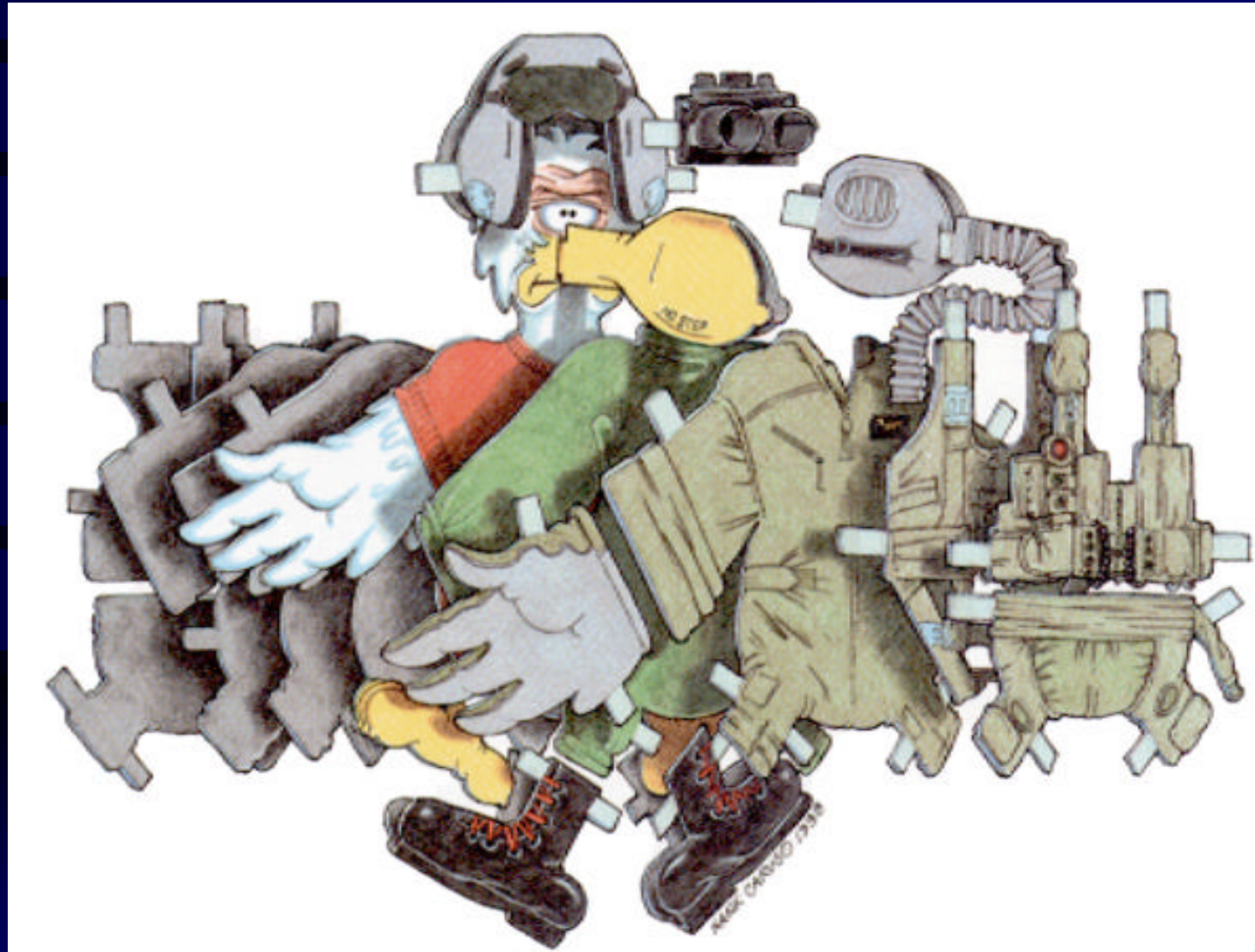
Lessons Learned

- Mode Switching
 - T-34 acrobatic vs fine both worked okay
- Tactile Saturation
 - UH60 pitch, roll, airspeed, heading – too much



Tactor Technology
Tactor Locator System Technology
Aviator Culture “...not another piece of equipment...”

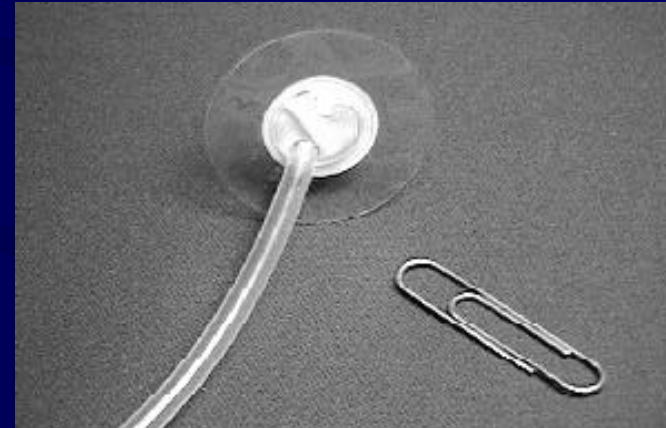




Tactors



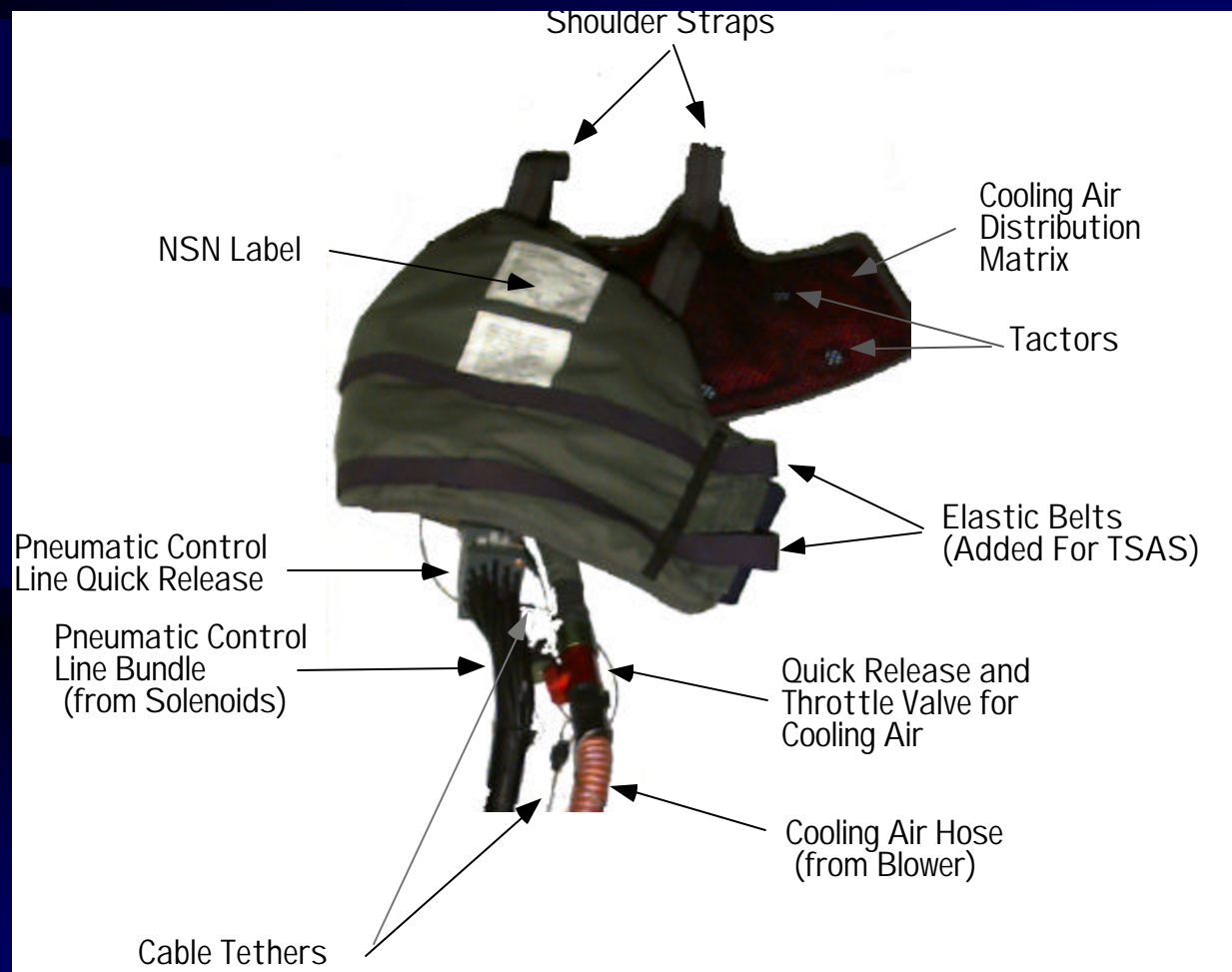
Piezoelectric
Ohio State University



Pneumatic
Carleton Technologies



Tactor Locator System





3rd Test: JSF Flight Demonstration

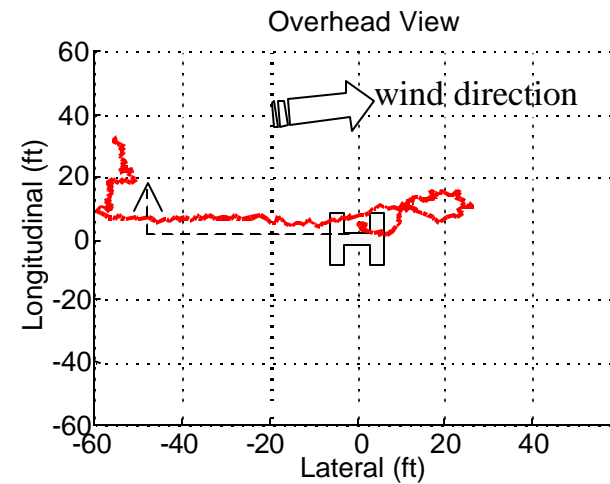
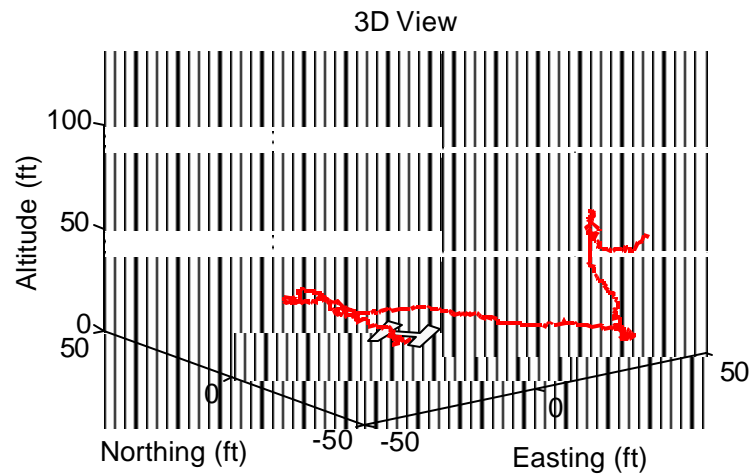


NAS Pensacola, FL. SEP97

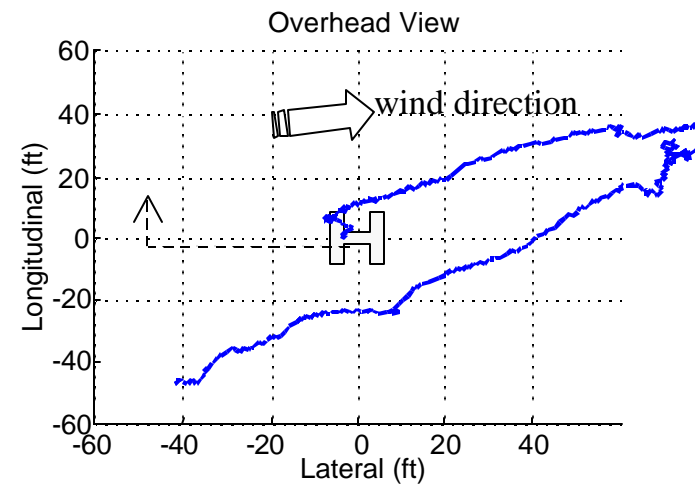
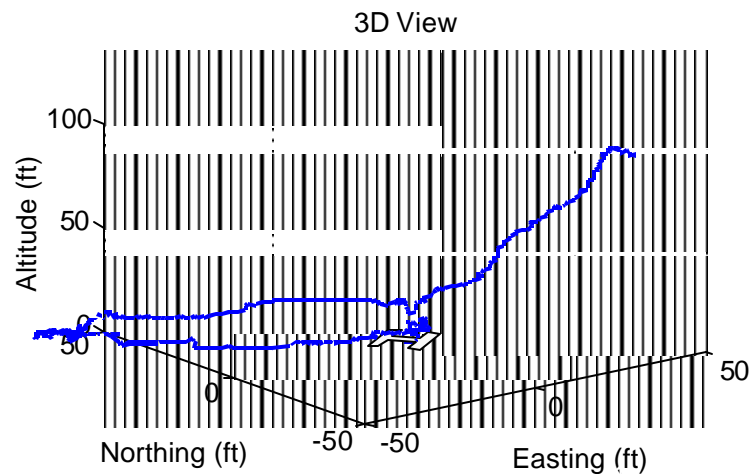


UH-60 Hover Results: “Ship Takeoff”

(1) TSAS ON



(2) TSAS OFF



PROs

- MAINTAINS spatial orientation
- Reduces instrument scan requirements
- Training and Simulation (cost, time, quality)
- Tactical Considerations
 - NVG aid, laser protection, smoke in cockpit
- Possible effects on illusions?

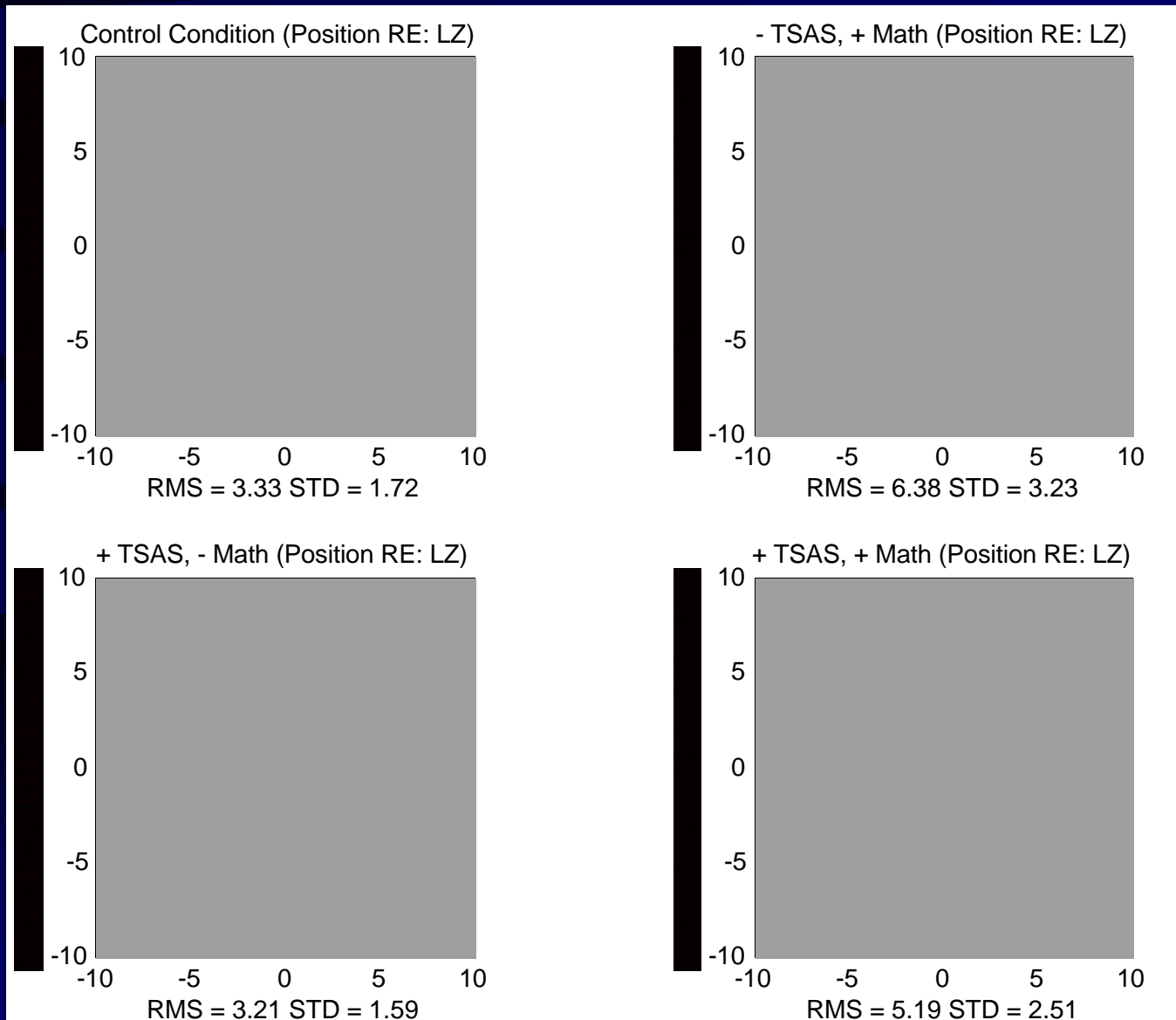


CONs

- System or tactor FAILURE
- Pilot over reliance
- Abnormal pilot reaction
- Inadequate tactors

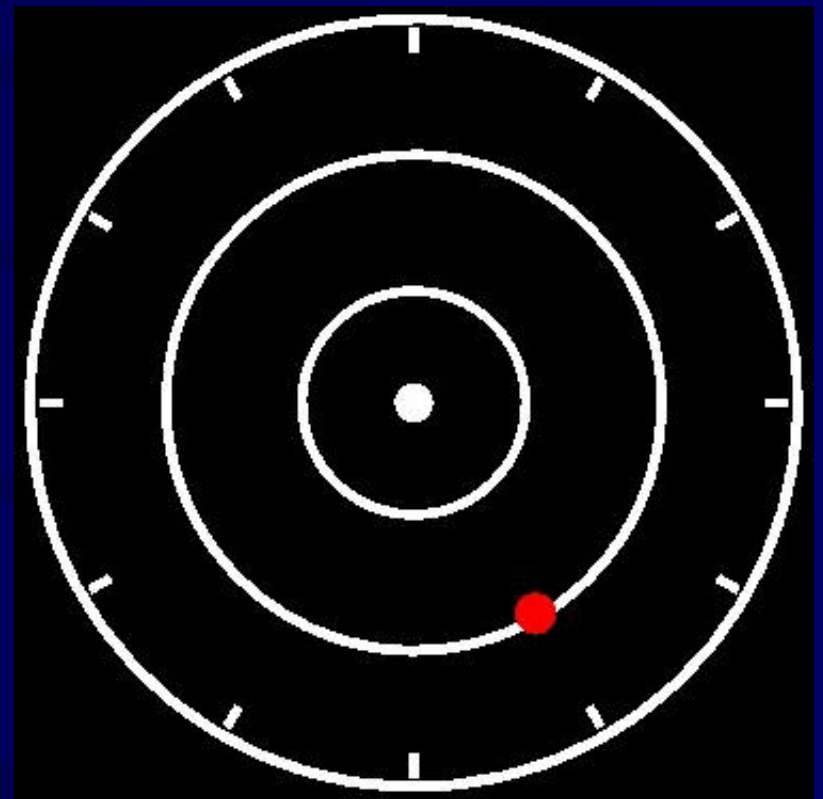


4th Test: Simulated Hover + Distraction



5th Test: Identifying Directions

- Clockface metaphor
- Touchscreen for responses
- Visual cue (red dot)
- Audio cue (“traffic at 5:00 at 2 miles”)
- Tactile cue (different length “chirp” at each distance)



Findings

- Tactile cues can be discriminated even when using the same tactors in the same locations
- Tactile cues can convey directional information faster than audio cues, with some trade off in accuracy
- This was a long test, probably had some fatigue effects

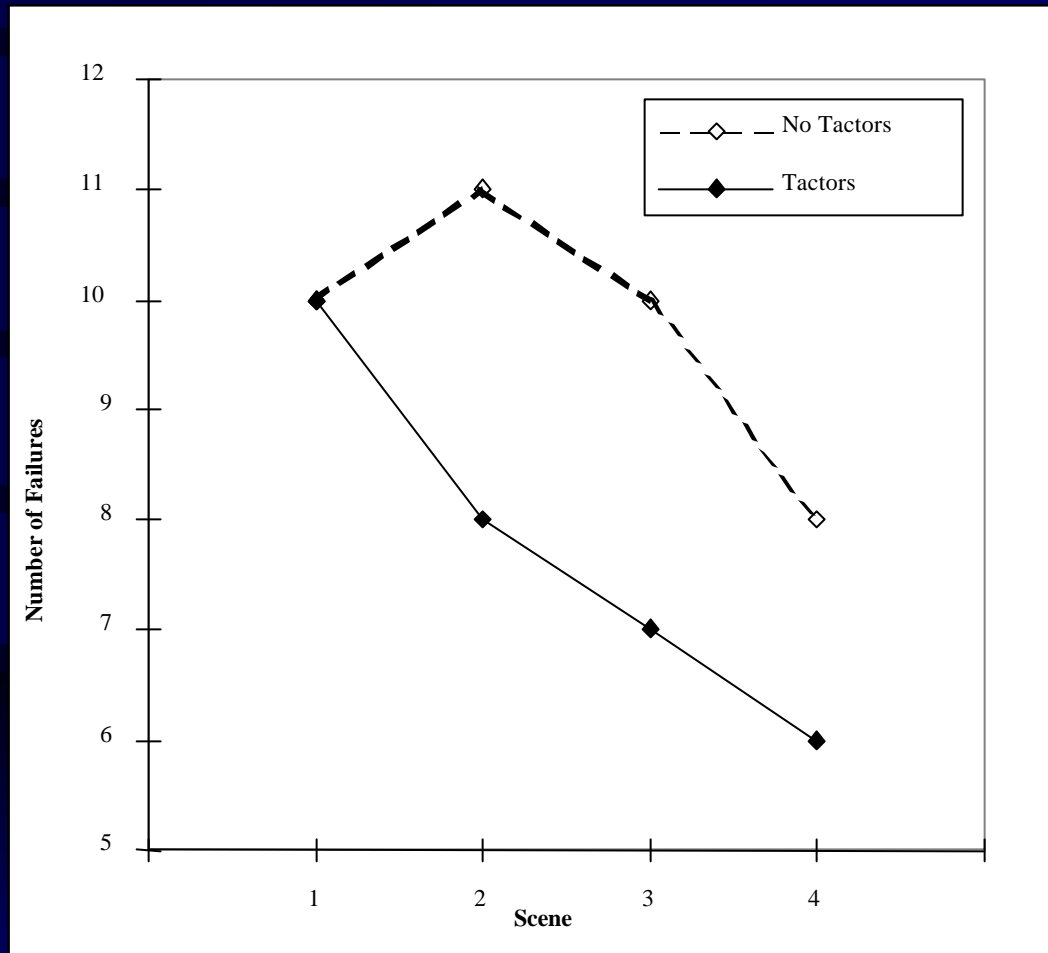




6th Test: Simulated EVA



TSAS Results



7th Test: Standing Balance

- Falling in the elderly





PVTB

Pensacola

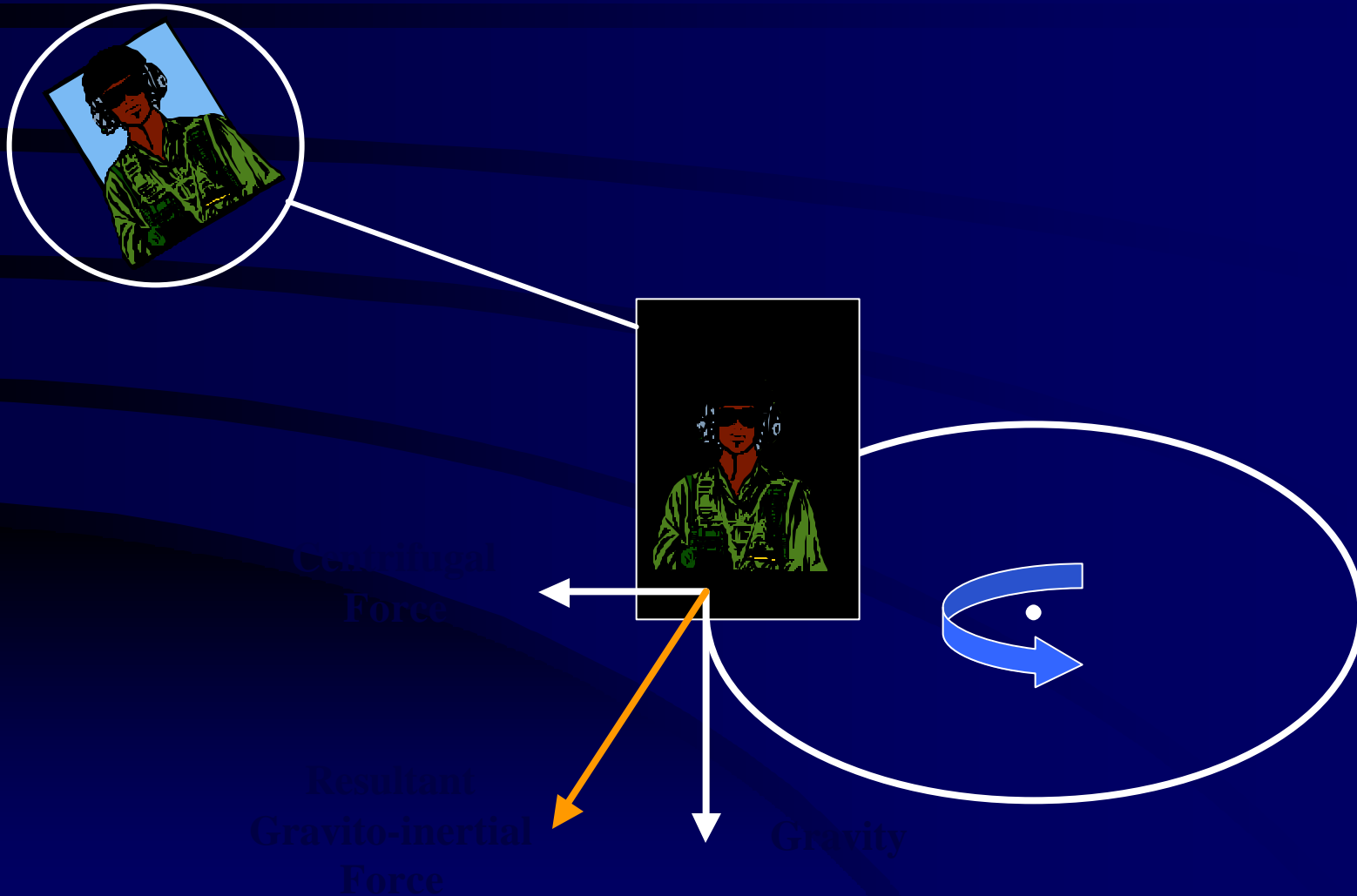
Vestibular

Test

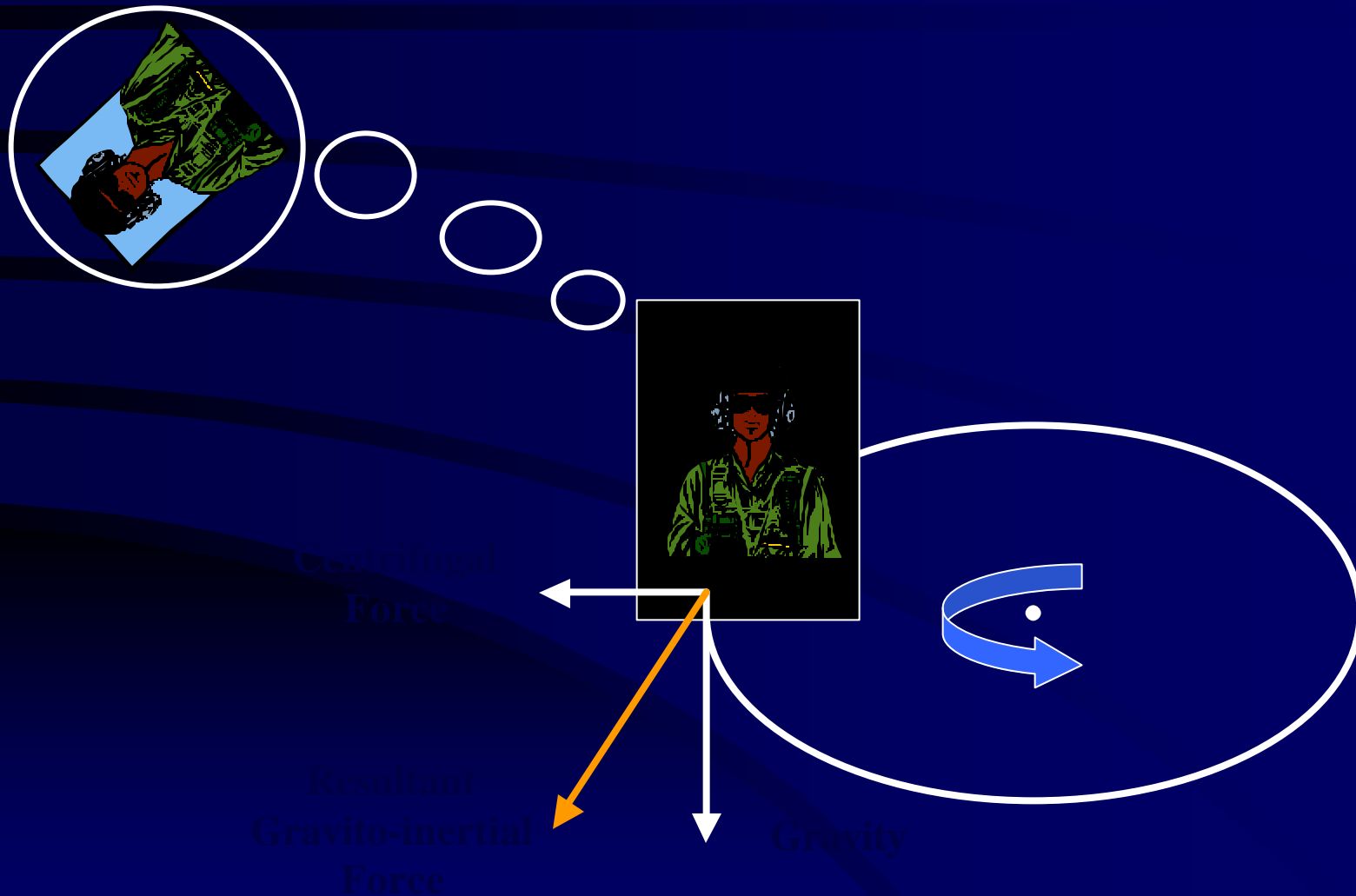
Battery

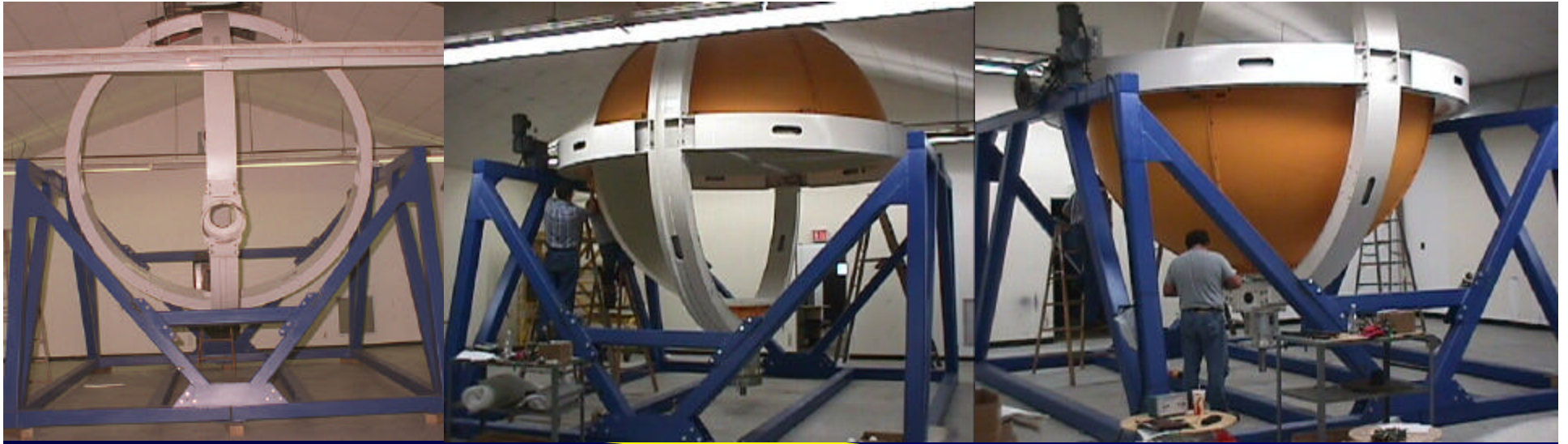


Multiple Station Disorientation Device

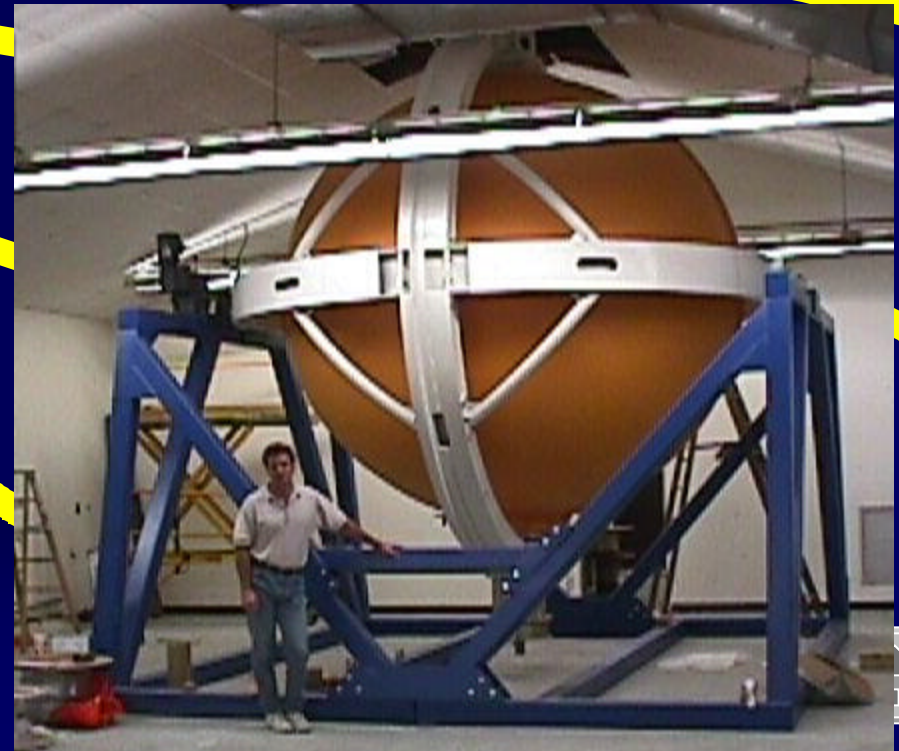


Multiple Station Disorientation Device





VISUAL VESTIBULAR SPHERICAL MOTION



VVSD

