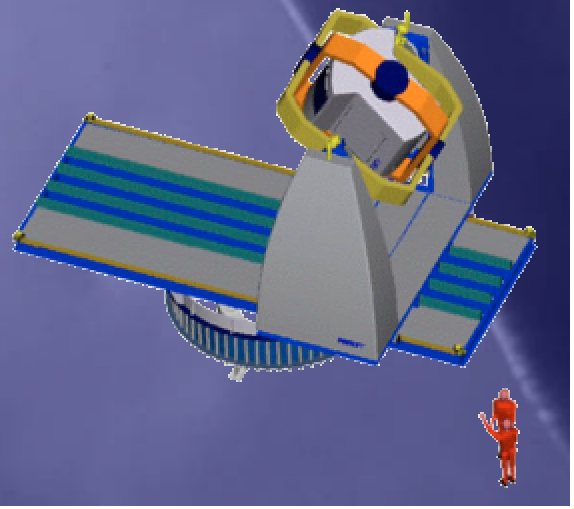
Practical and theoretical developments of countering SD in the Netherlands

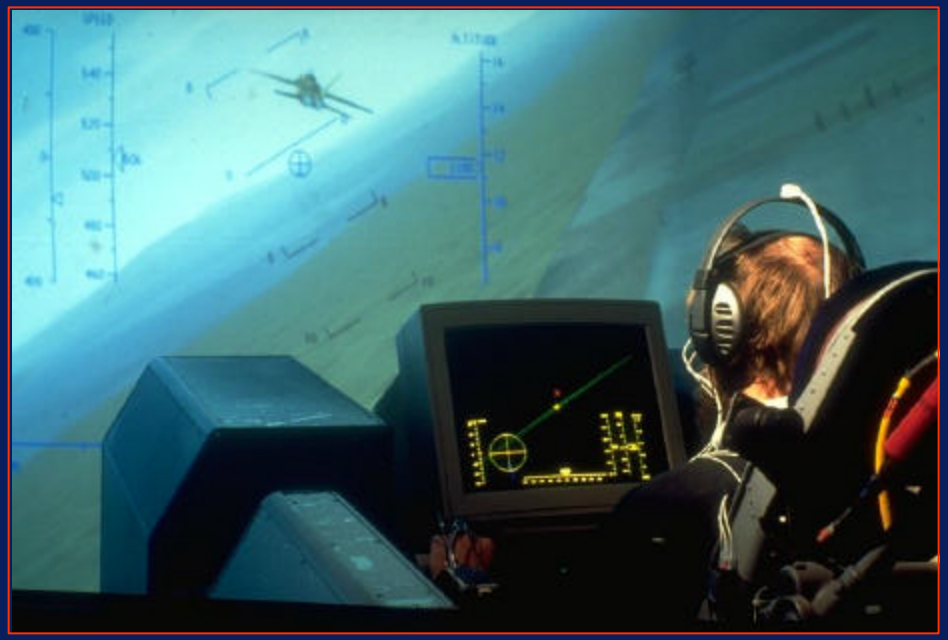
Willem Bles

TNO Human Factors



TNO Human Factors specializes in the knowledge on human factors and its application in the design of human work and adequate technical aids.

Research topics



- Perception
- Information Processing
- Skilled Behavior
- Work Environment
- Training and Instruction
- Group Work

Perception

- Vision and Imaging
- Display
- Hearing
- Speech

Information Processing

- Cognition
- Information Transfer

Skilled Behavior

- Steering and Control
- Traffic Behavior

Work Environment

- Workplace Ergonomics
- Thermal Physiology
- Equilibrium and Orientation

Training and Instruction

- Learning Processes
- Team Training
- Simulation and Modeling

Group Work

- Distributed Decision Making
- Psychosocial Interactions

‘Equilibrium & Orientation’

- **Core business: Human equilibrium system**

• spatial orientation	SD, motion sickness
• postural balance	postural instability
• gaze stabilisation	nystagmus, blur

need for RNLAF to obtain knowledge on:

- SD basic and refresher courses
  - Man in the loop scenario?
- Future Flight Simulation
  - Centrifuge (for high-performance aircraft)?

    Fixed radius, high G-load
    G-loading with angular acceleration
  - G-simulator (for superagile aircraft)?

    Variable radius, moderate G-load
    G-loading with minimum angular acceleration

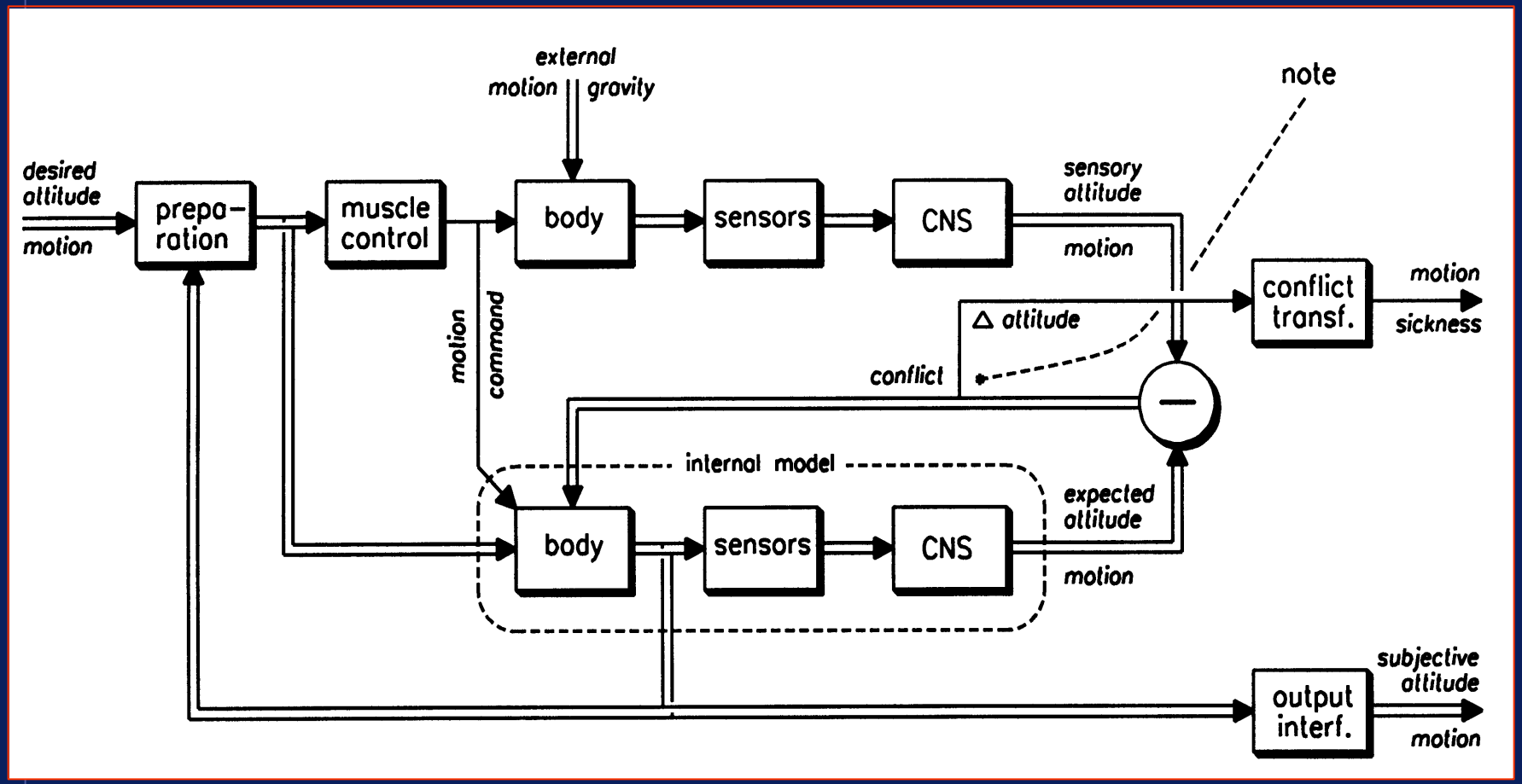
Demo basic

- A one-day course

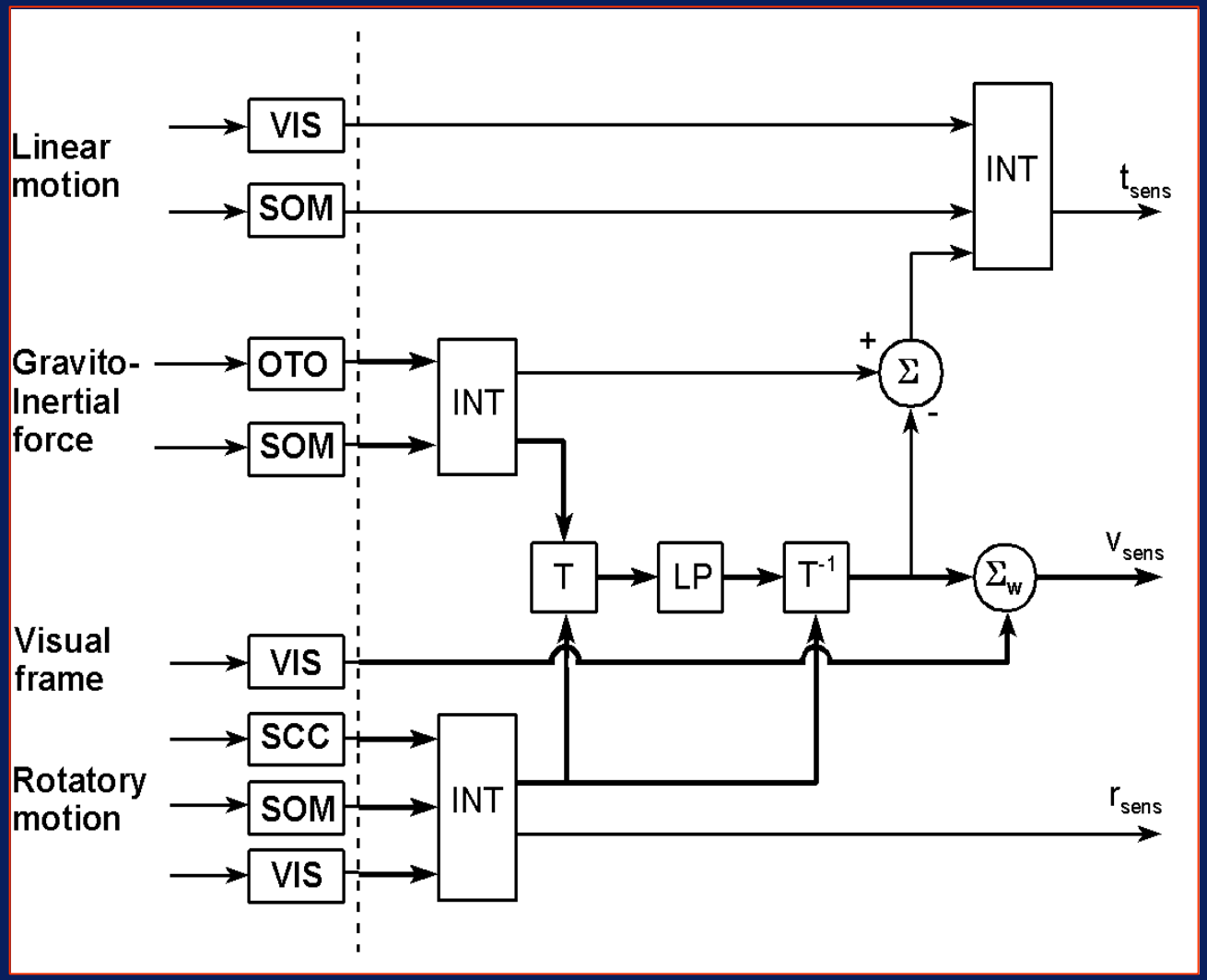
SD in general, definitions, etc.
some physiology
demonstrations, unrelated to flying

important: interaction trainer - trainee
transparency
self-experience

Model concept



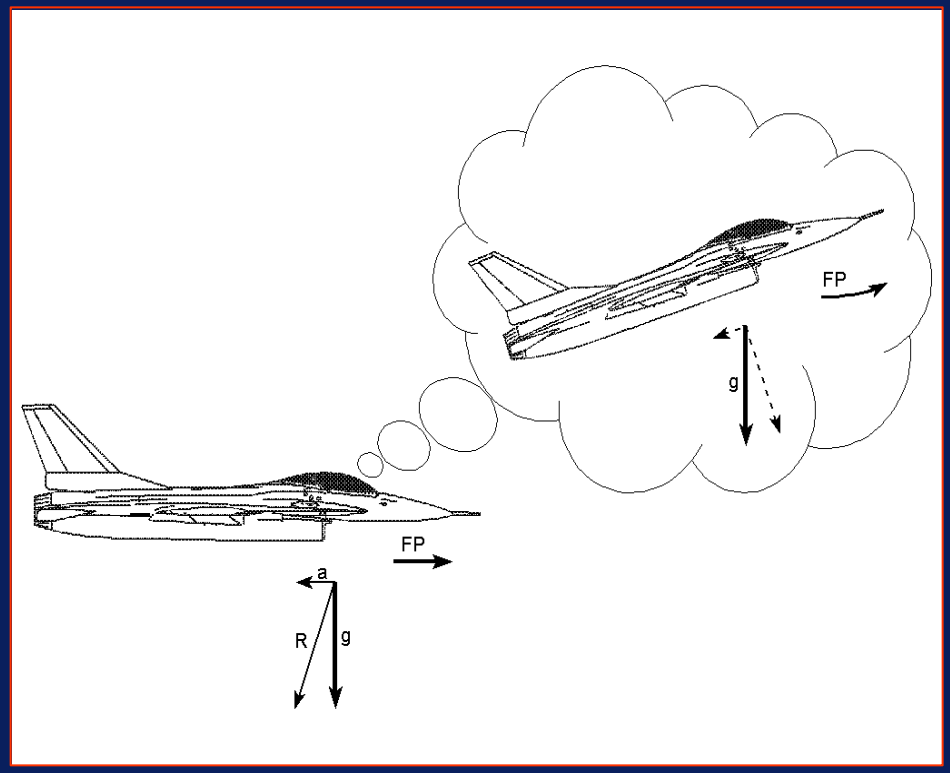
Input and output relations

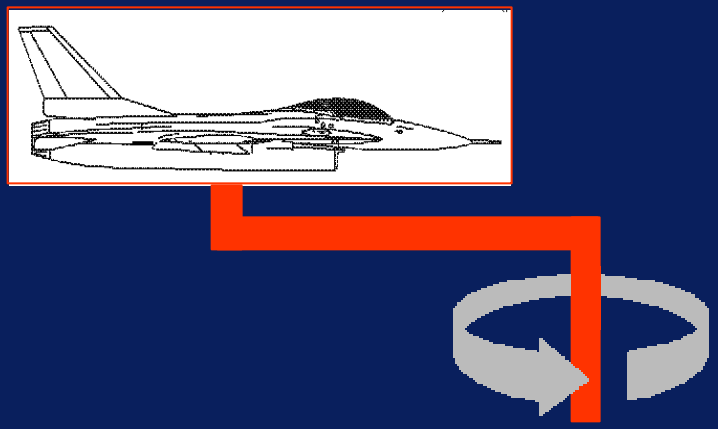


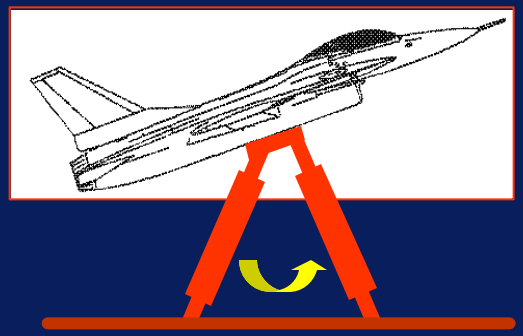
Needs for SD-demonstration:

- **Visual illusions:** Visuals (abstract or realistic)
- **Vestibular illusions:** Move the platform such that the illusion is evoked by the same mechanism as in real flight (no cheated illusions, transparency)

Example:





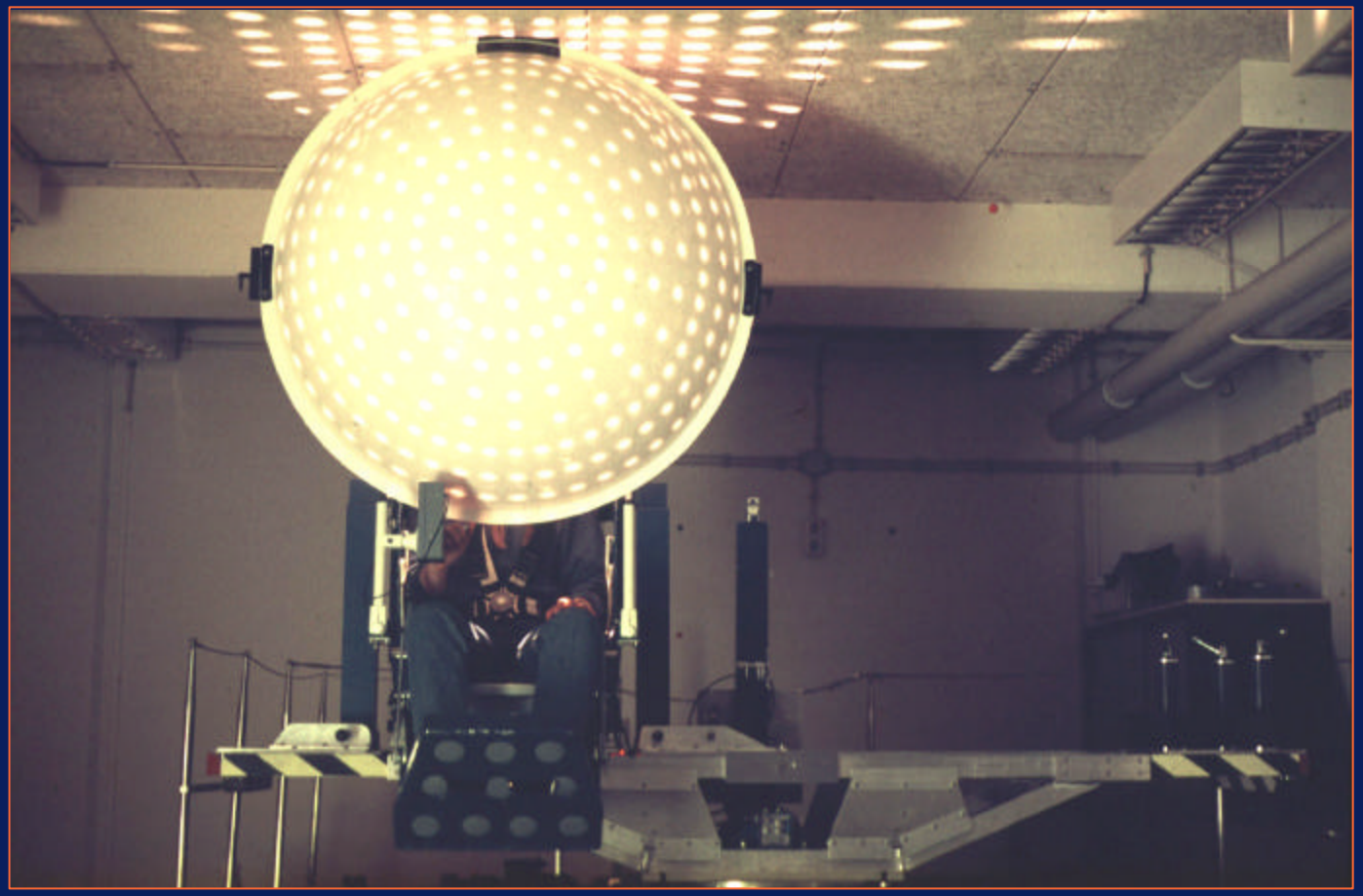


More specific:

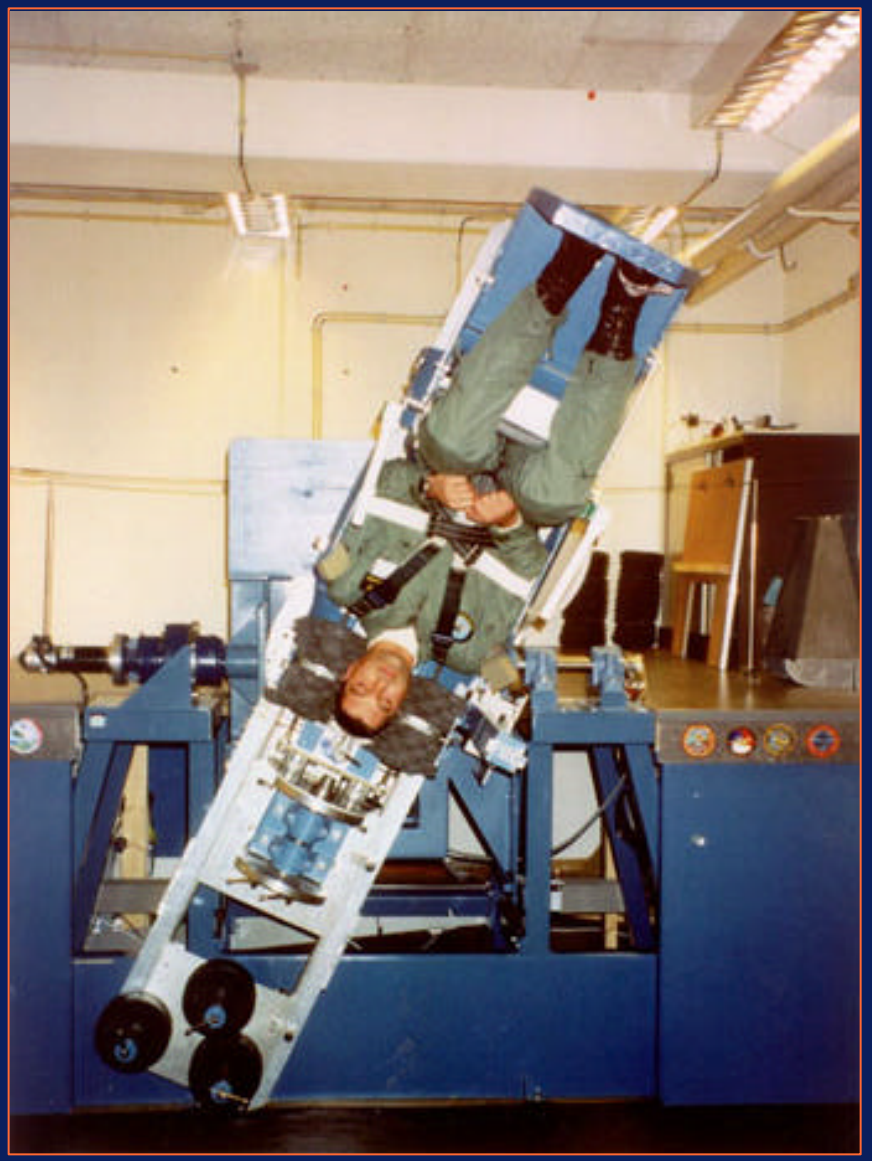
Demonstration of ‘vestibular’ illusions:	Required:
- Erroneous perception of low-frequency turning due to vestibular SCC	unrestrained 3D-rotation
- Erroneous perception of GIF as gravity	sustained G-load

GIF vector as gravity.

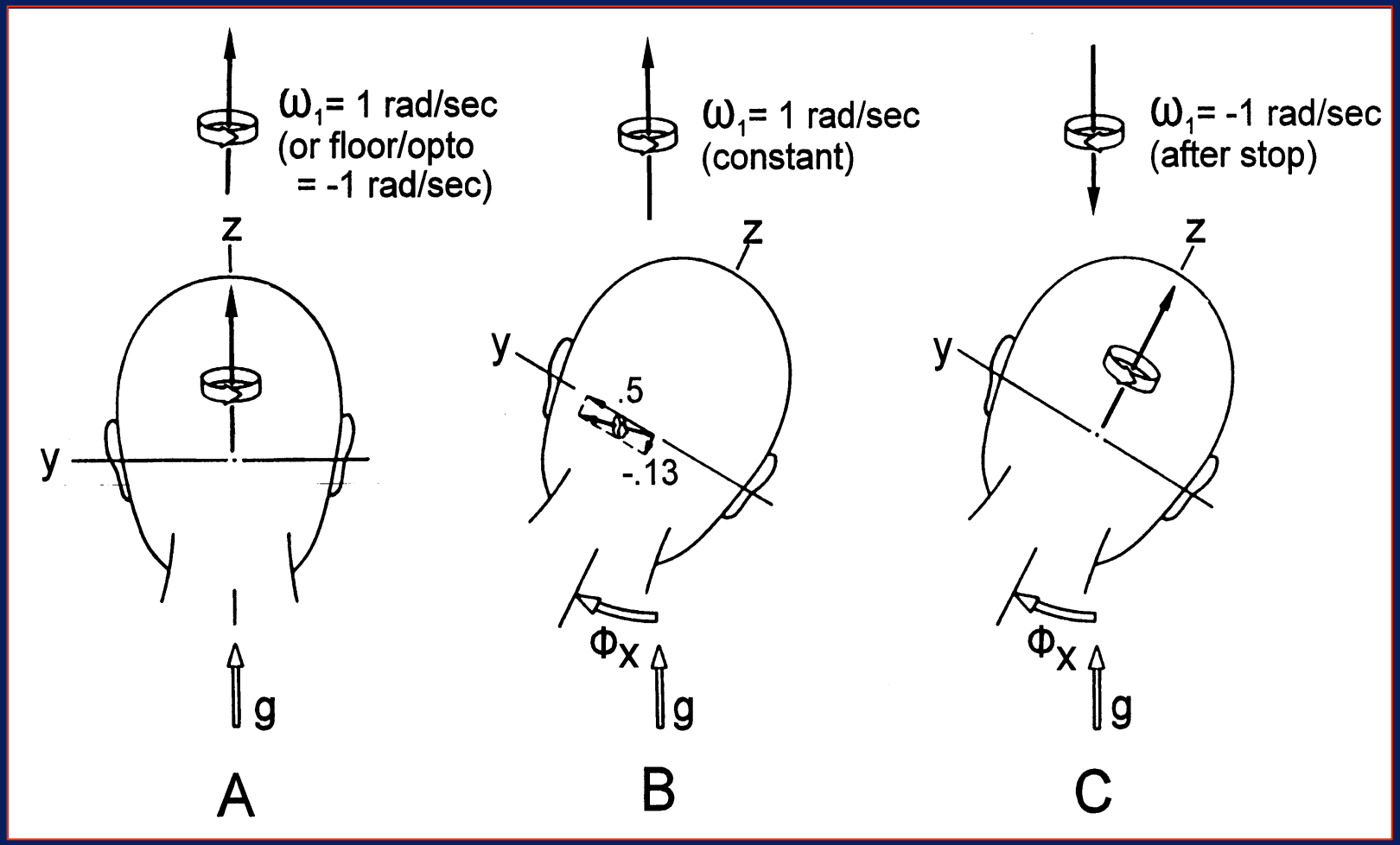
GIF vector as gravity, roll vection



Roll motion



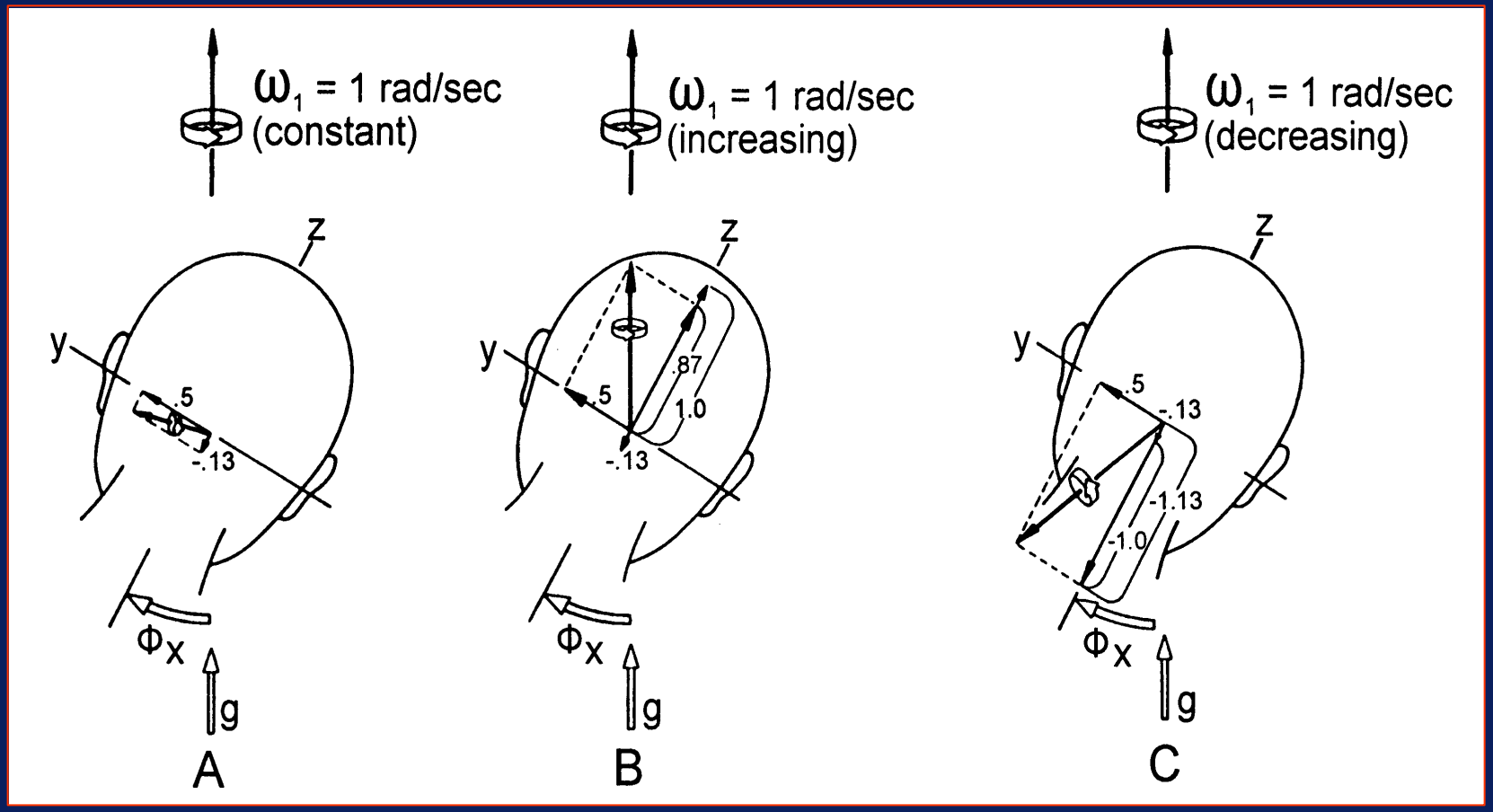
Visual-vestibular interactions in Coriolis effects



A pure yaw rotation

B vestibular Coriolis effect

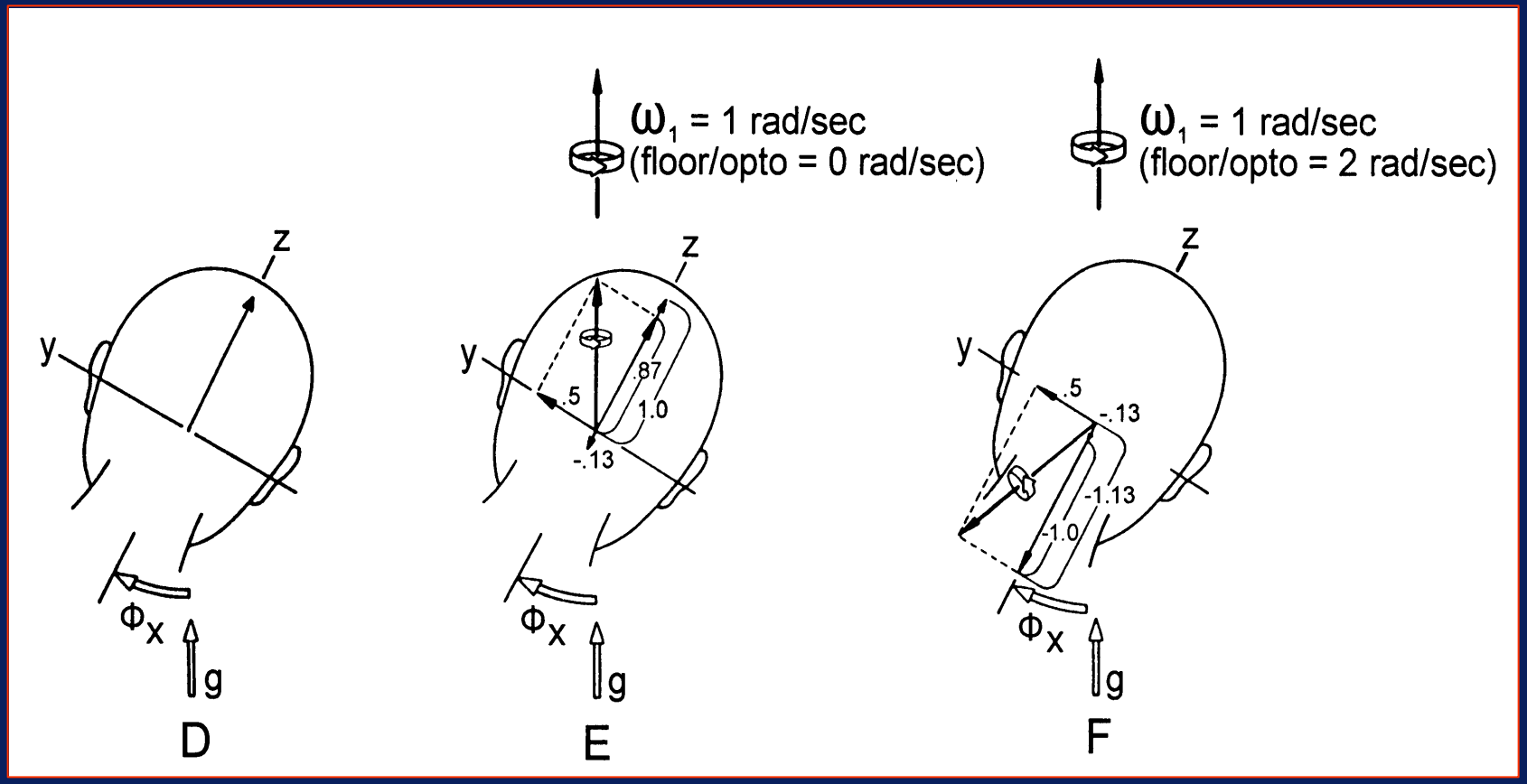
C Purkinje effect



A constant velocity rotation

B during acceleration

C during deceleration

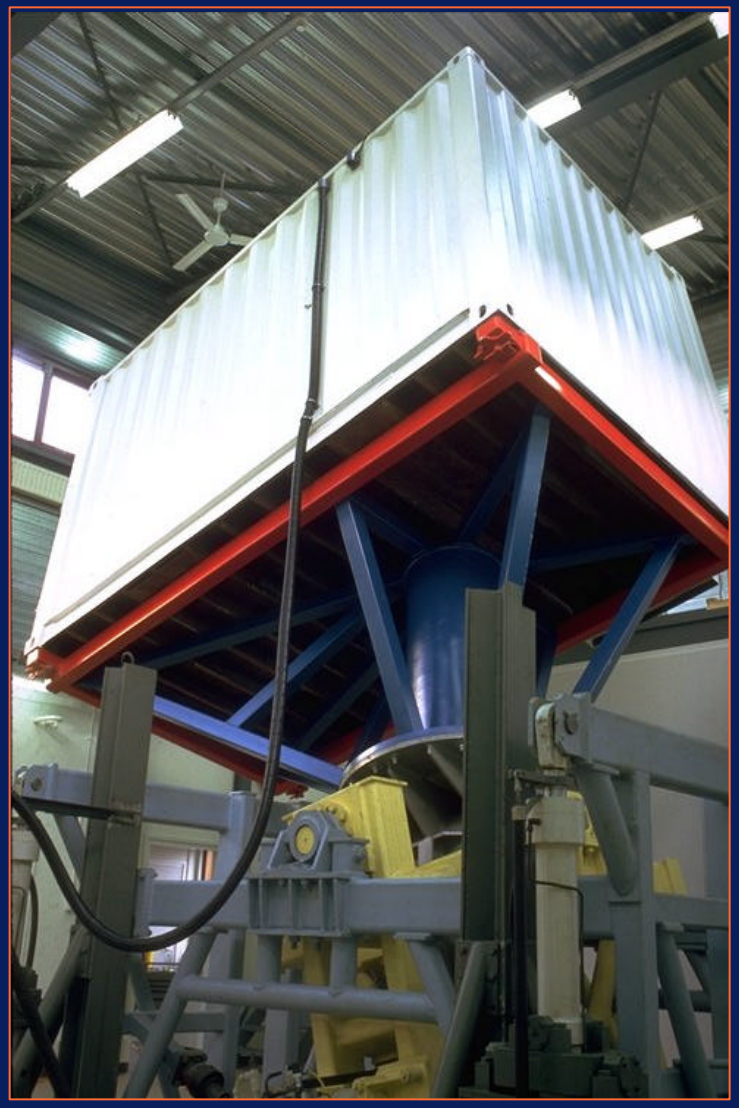


D pure opto/somatosensory stimulation

E congruent motion information

F incongruent motion information

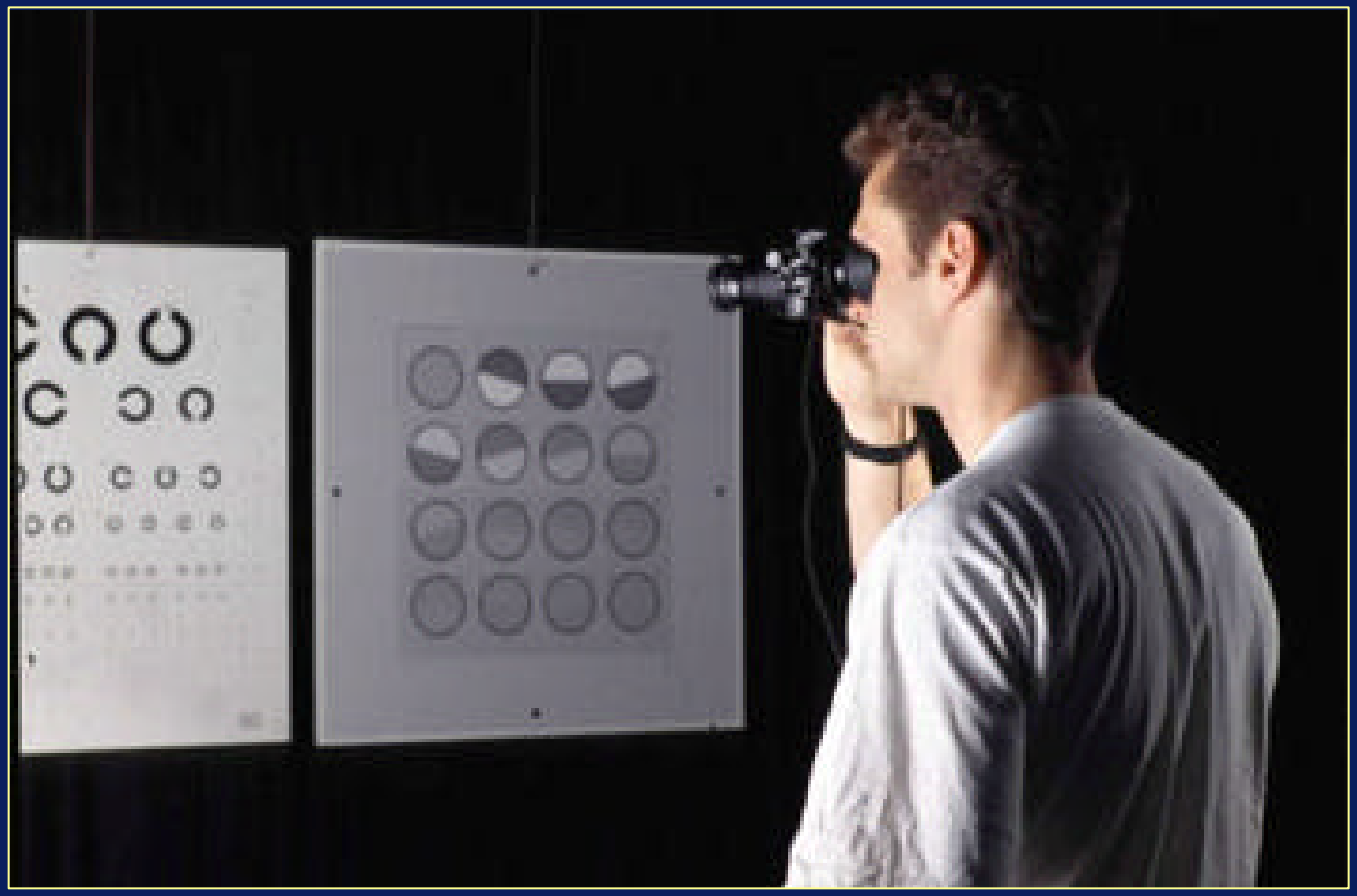
Tilting room



Ship Motion Simulator

not for F-16 pilots !!!

NVG



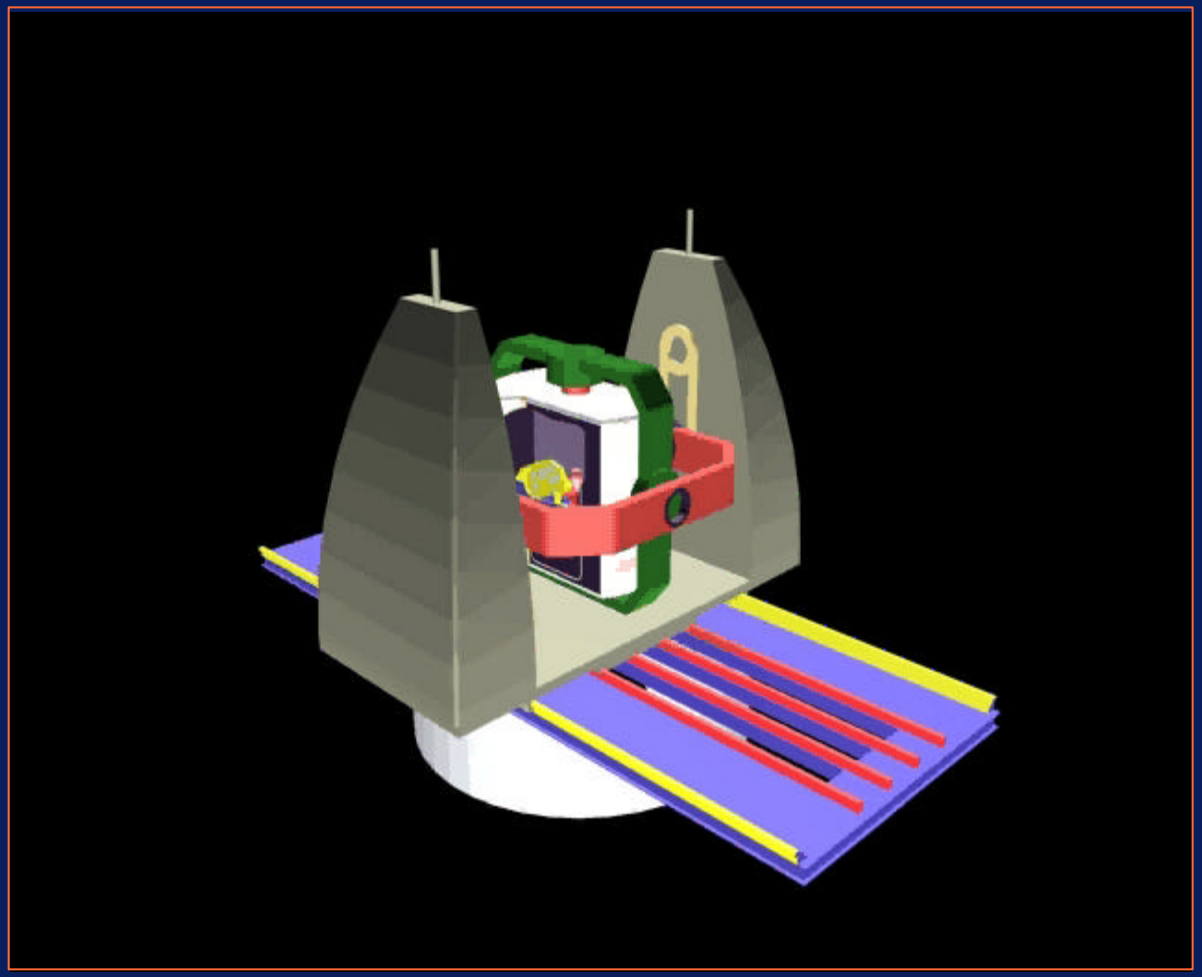
L/R reversing prisms

Refresher course requires realistic flight scenario.

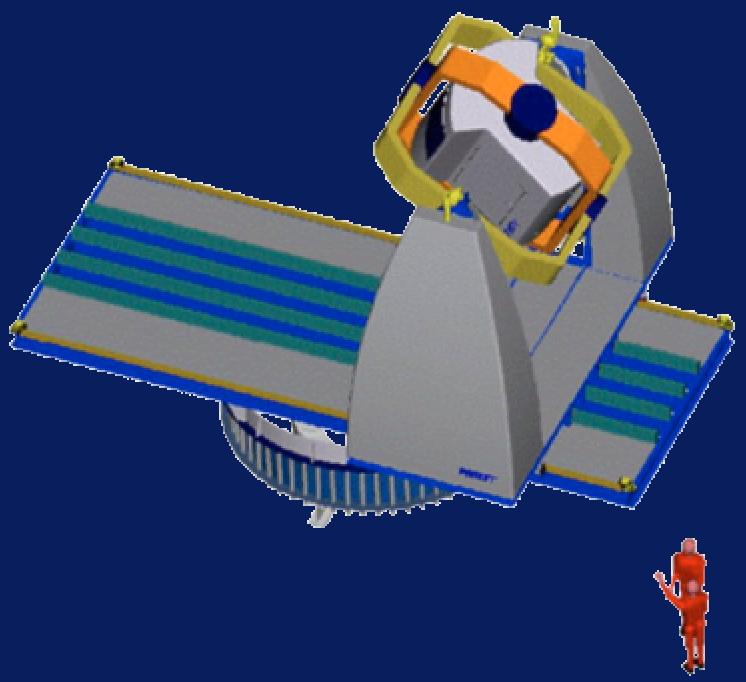
out-the-window visuals
cockpit environment
man-in-the-loop scenario
(tracking target aircraft)

DISO

Desdemona components



Some specifications



- track length 8 m
  - max lin acc. 0.5 g
  - max centr. acc 3 g
- vertical stroke 2 m
  - max. acc. 0.5 g
- pitch, roll and yaw >360 degr
  - rate 90 degr/s
- Out-the-window visuals

Is there a match between the Desdemona concept and the RNLAF need?

yes