

HEAD-UP SYNTHETIC VISION DISPLAYS FOR PREVENTION OF SPATIAL DISORIENTATION

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Head-Up Synthetic Vision



- **Early days of airmail (1918-1927)**

- 40 airmen hired, 31 killed
- Airmail pilot life expectancy four years
- Dean Smith



- **Spatial Disorientation (AFM 11-217)**

“SD is an incorrect perception of one’s linear and angular position and motion relative to the plane of the earth’s surface. ...SD is an erroneous percept of any of the parameters displayed by aircraft control and performance flight instruments.”

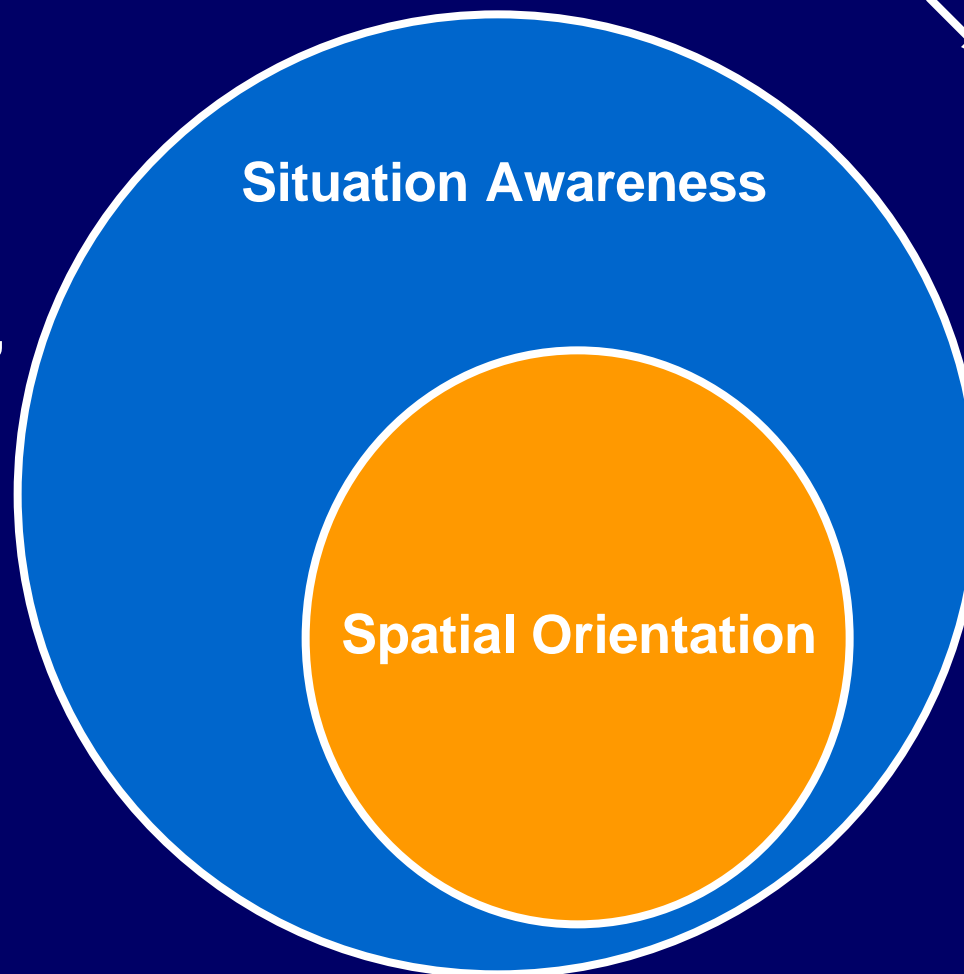


Head-Up Synthetic Vision



- **Situation Awareness vs. Spatial Orientation**

↙
**Awareness of
task-relevant
information,
comprehension,
ability to
forecast.**



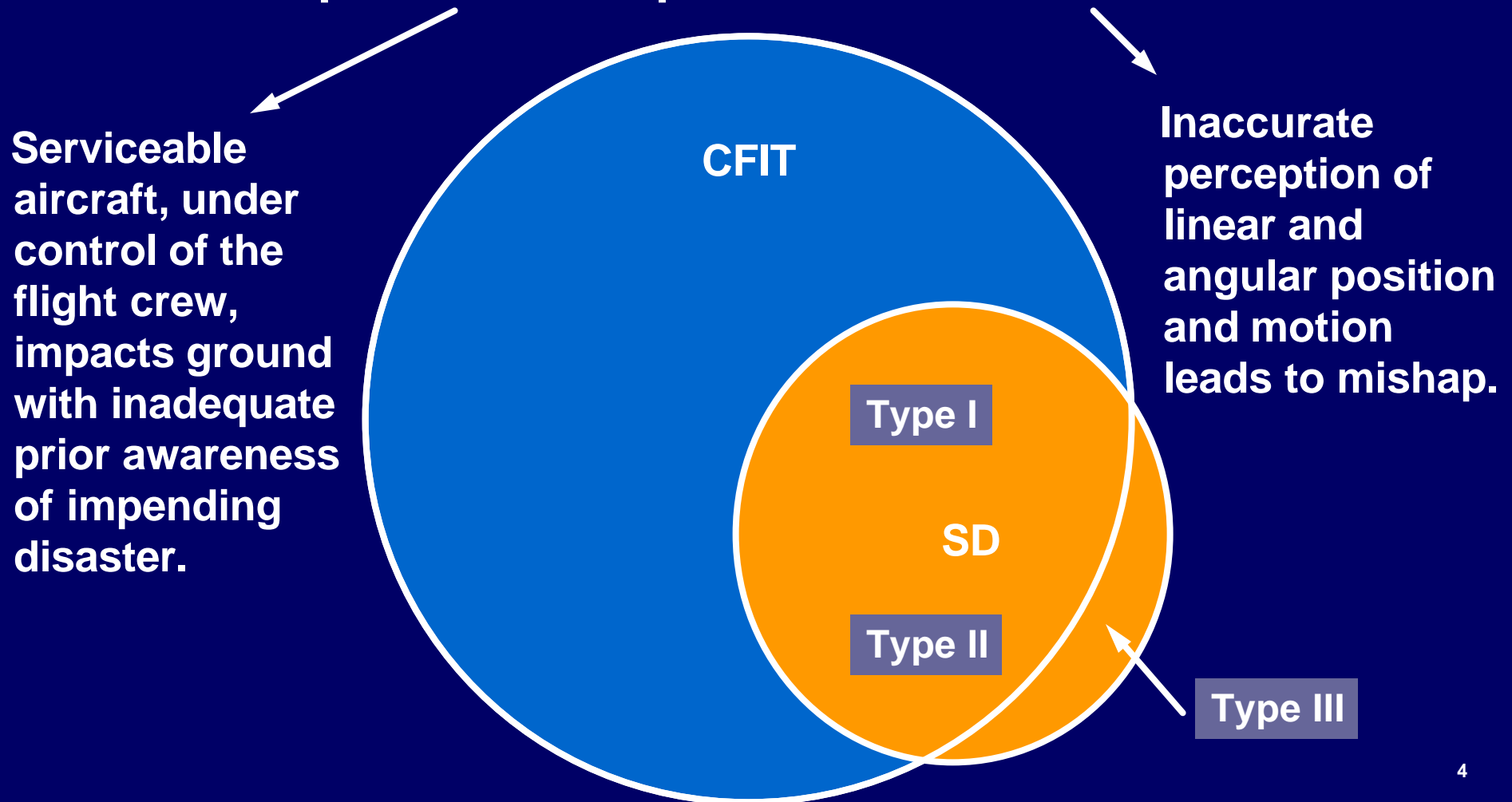
↘
**Accurate
perception of
linear and
angular position
and motion.**



Head-Up Synthetic Vision



- Mishaps: CFIT vs. Spatial Disorientation**





Head-Up Synthetic Vision



- **Mishaps: CFIT vs. Spatial Disorientation**
 - 1996 T-43 Class A: CFIT, not SD
 - 1997 A-10 Class A: CFIT & SD
 - 1999 C-130 Class A: CFIT, not SD





Head-Up Synthetic Vision



- **Visual Dominance**

“Visual dominance exists when the pilot receives through the eyes all the information used to maintain correct orientation.” (AFMAN 11-217)



- **Current instrumentation**

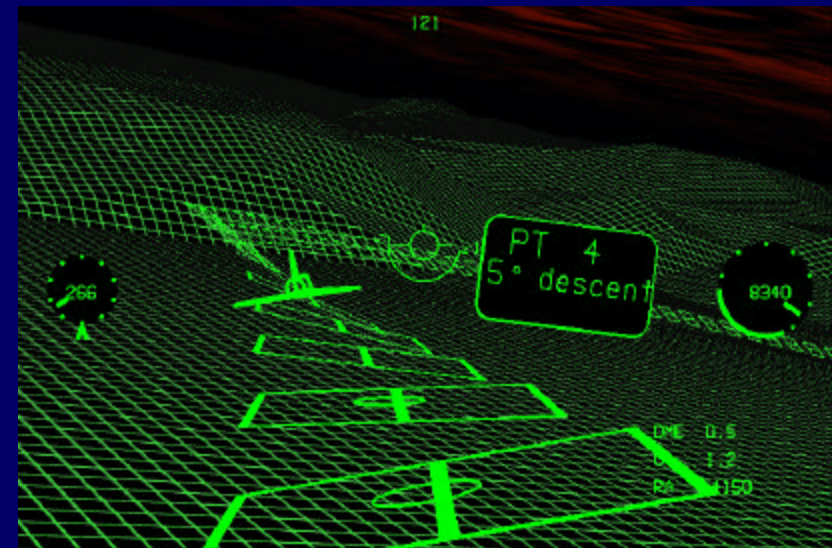
- Orientation requires focal vision, attention, active interpretation, training and long-term memory



Head-Up Synthetic Vision



- **Future instrumentation: Synthetic vision**
 - Orientation does not require focal vision, active interpretation, training and long-term memory; pre-attentive

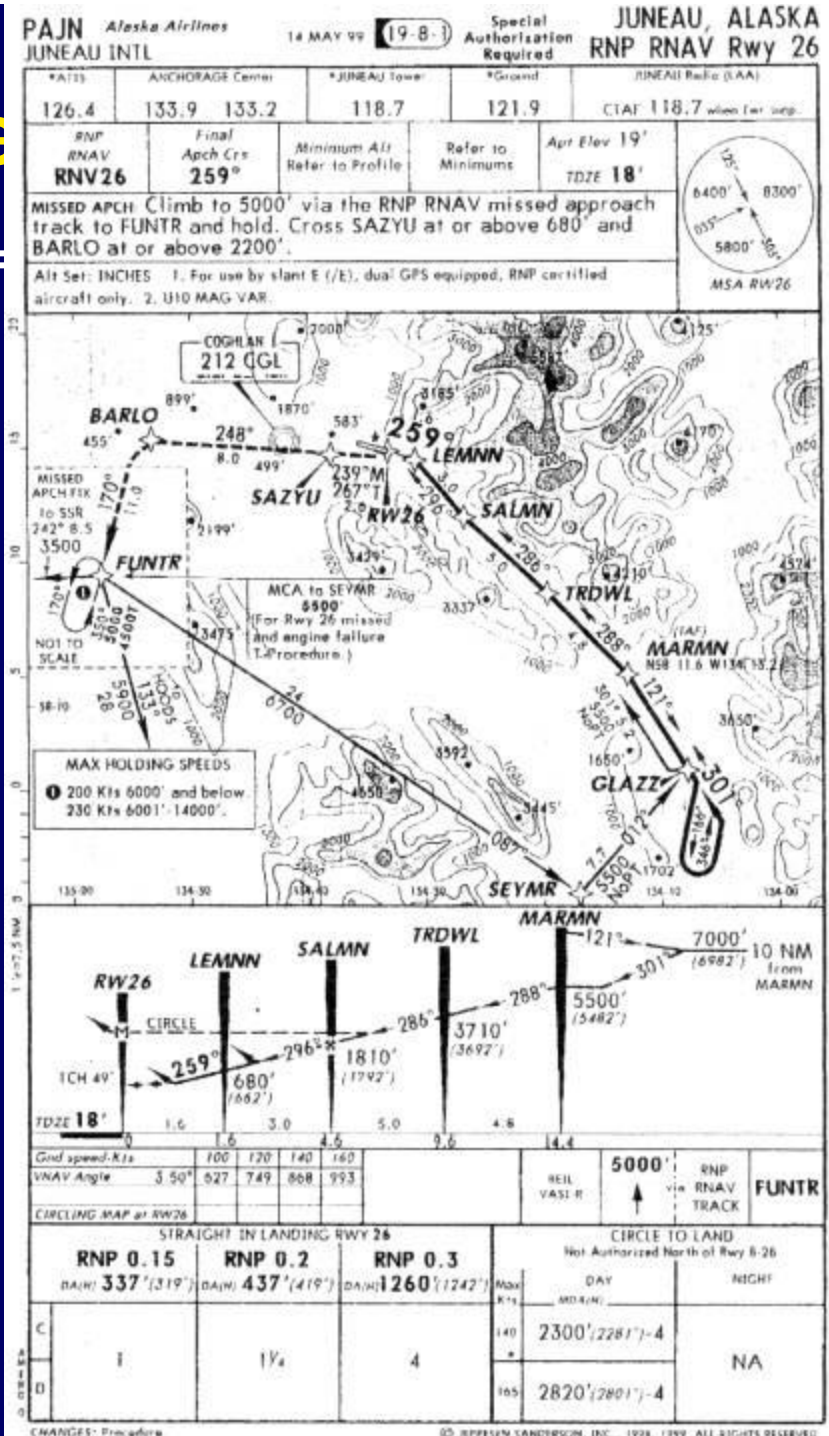
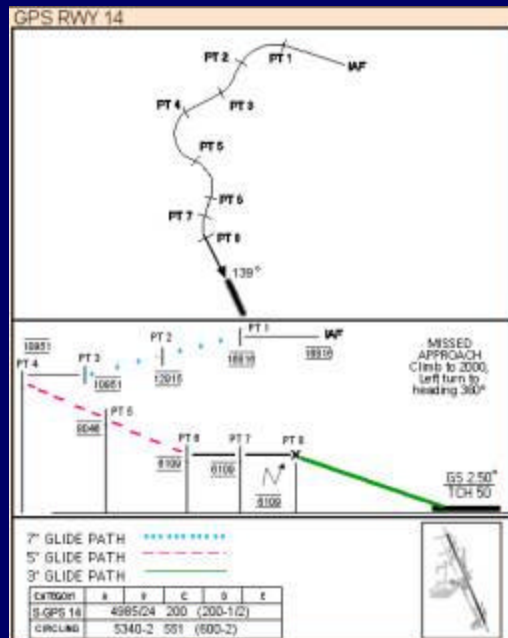


- **Concepts and Terminology**
 - Artificial vision, enhanced vision, synthetic vision



Head-Up Synthe

- Enabling Technologies: Precision Navigation
 - GPS approaches
 - Alaska Airlines
 - AFRL notional





Head-Up Synthetic Vision



- Enabling Technologies: Precision Navigation
 - WAAS: $\pm 7.6\text{m}$, IOC Feb 2003 (as of 8/00)
 - LAAS: $\pm 1\text{m}$, IOC Cat I Fall 2002, Cat III 2005 (as of 3/00)



<http://gps.faa.gov/>

LAAS



Head-Up Synthetic Vision



- **Enabling Technologies**
 - **Head-up or Helmet-Mounted Display**



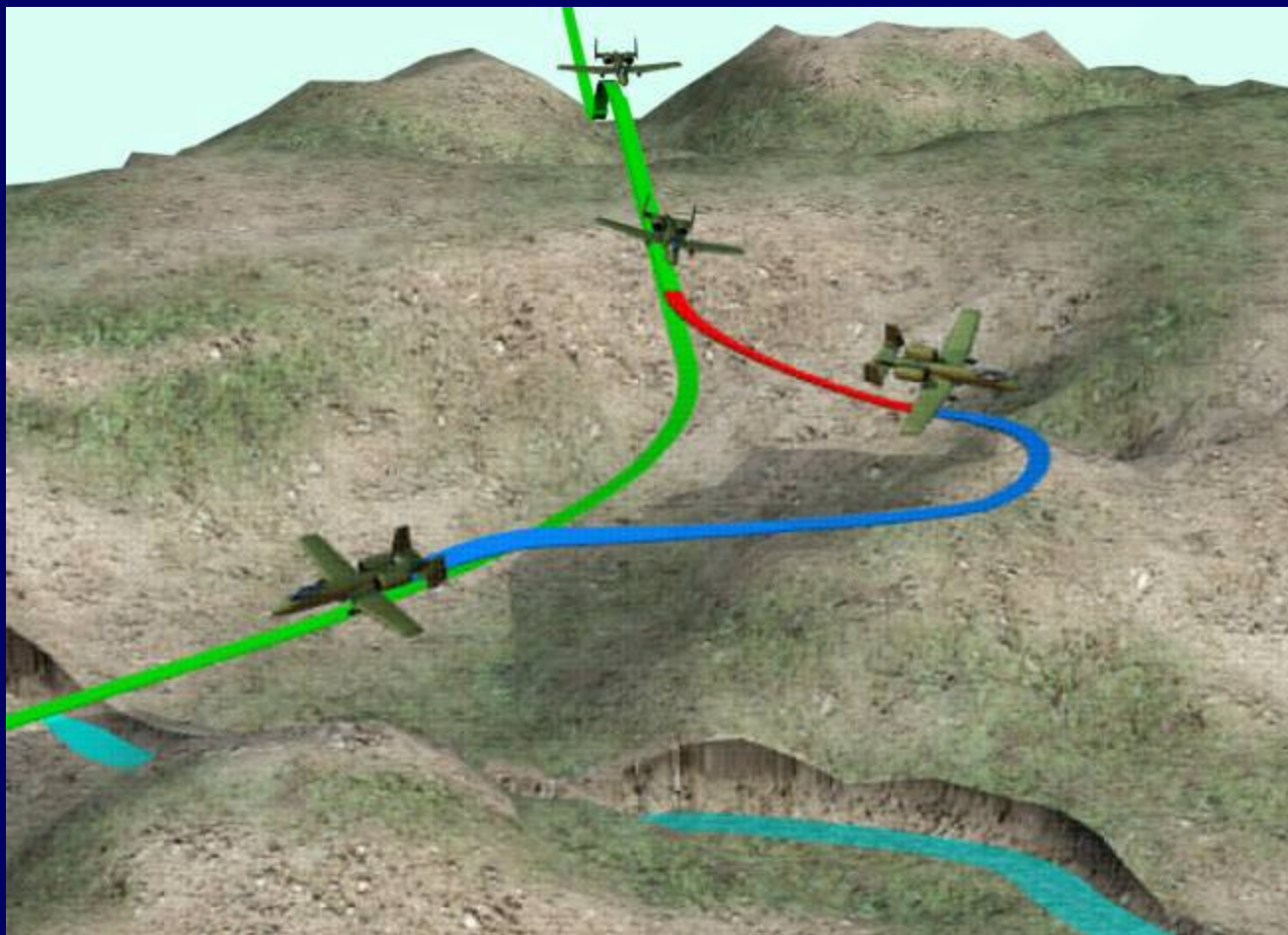
- **Avionics**
- **Databases: Approach, Terrain (SRTM data to USGS Oct 2002), Obstacle, Other**



Head-Up Synthetic Vision



- Pathway-in-the-sky as recovery tool

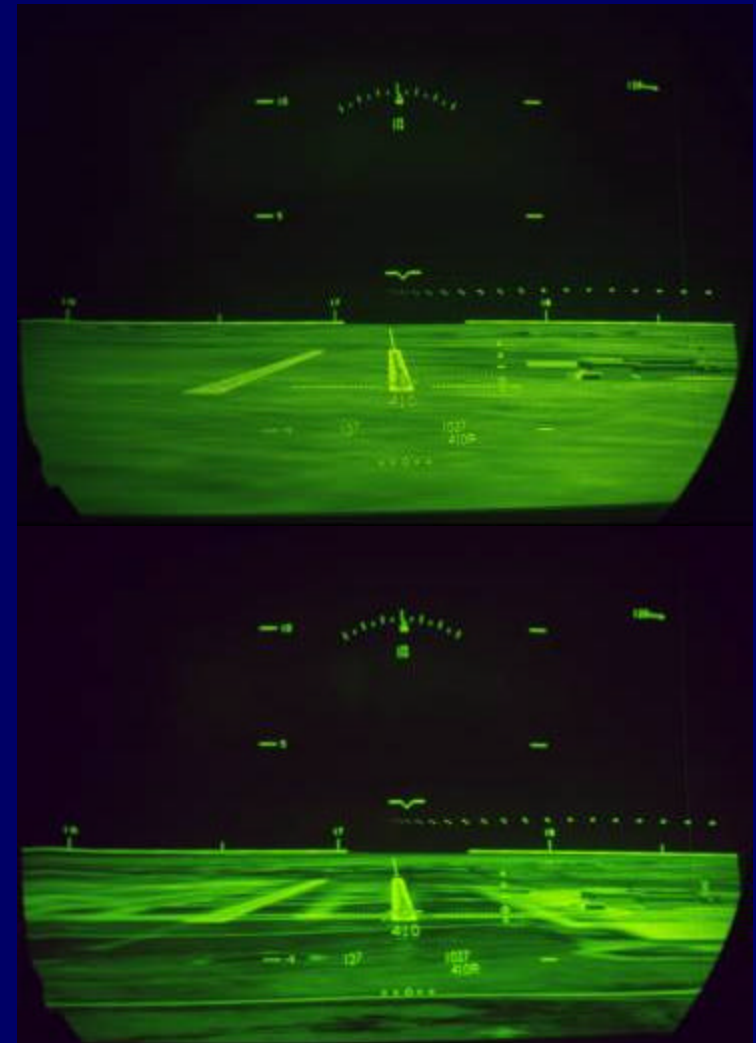




Head-Up Synthetic Vision



- **Current Synthetic Vision efforts**
 - **NASA SVS Program**
 - **Rockwell-Collins**

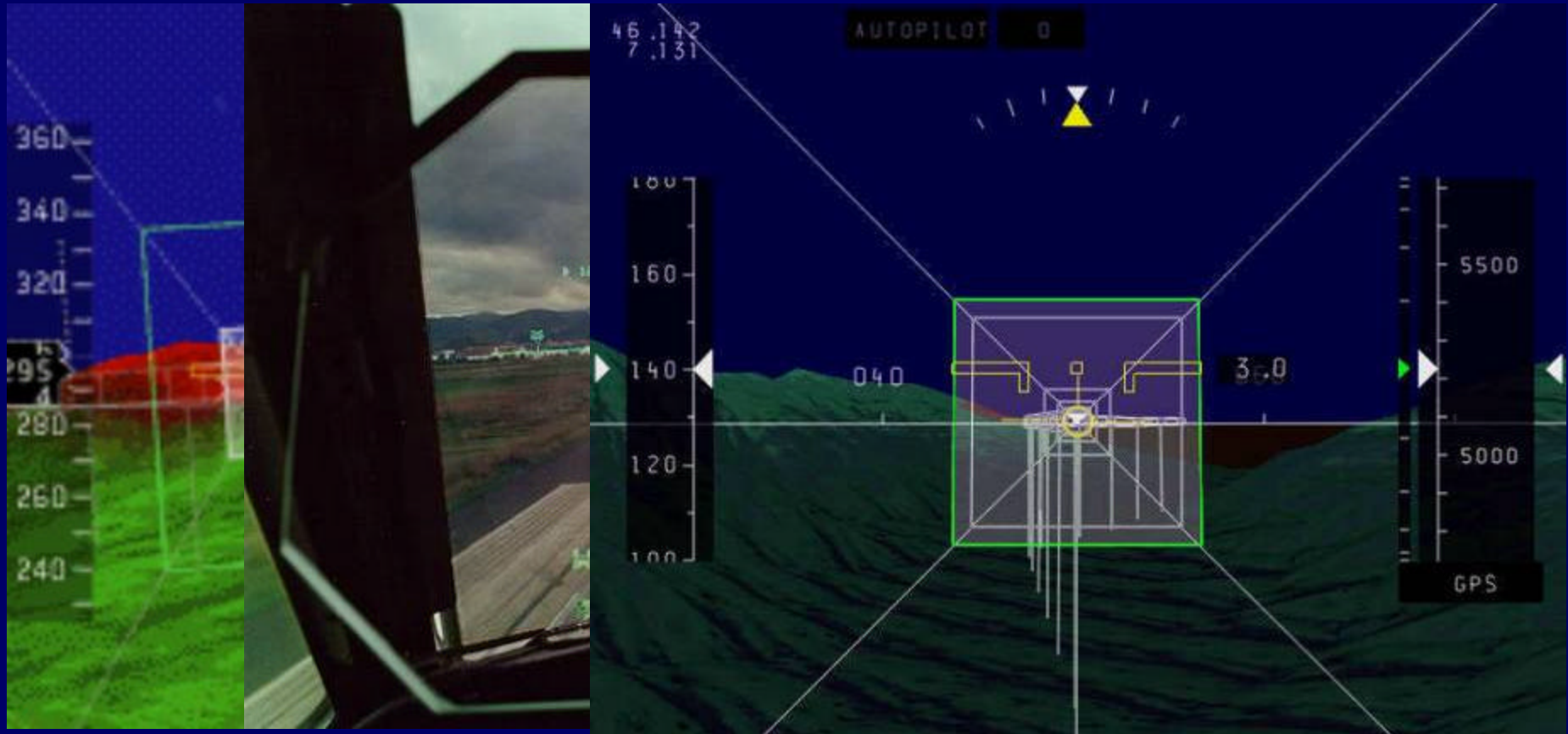




Head-Up Synthetic Vision



- Current Synthetic Vision efforts
 - AFRL, Rockwell-Collins, Flight Dynamics, Delft U.

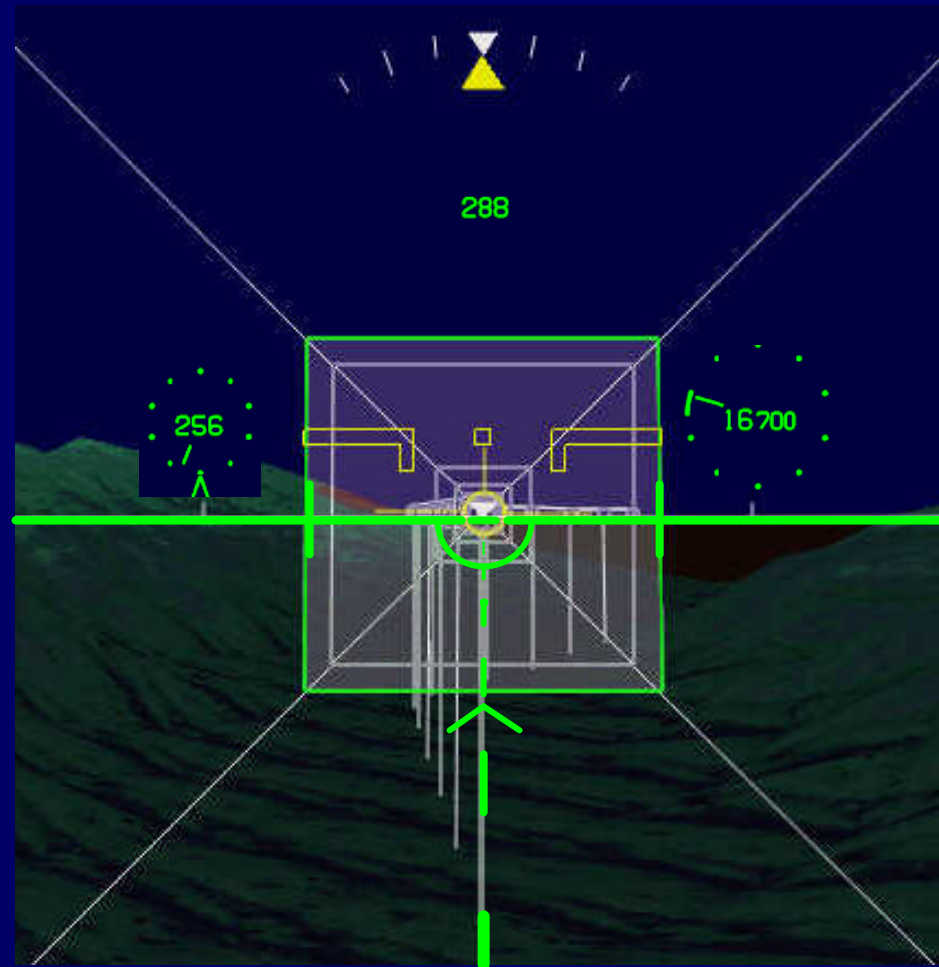
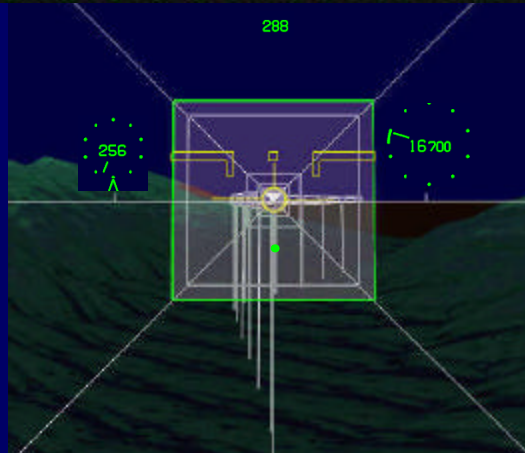
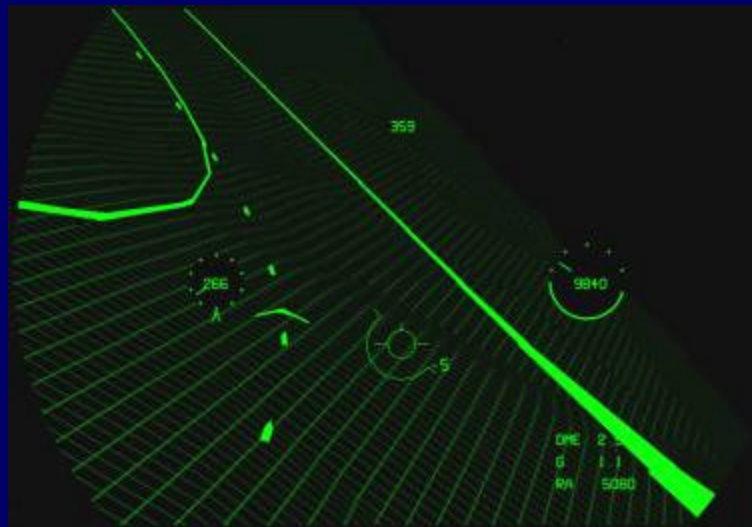




Head-Up Synthetic Vision



- Remaining challenges: Integrating HDD, HUD, HMD





Head-Up Synthetic Vision



- Remaining challenges: Flight worthy products

