Naval aviation flight training is performed using a combination of procedure trainers, flight simulators and live aircraft. While flight simulators and procedure trainers have become very capable and flexible, there are still many skills that Naval aviators need to acquire in live training and fleet aircraft. However, live flight training is very costly and logistically difficult. Designers of virtual environments such as flight simulators are faced with difficult cost-benefit trade-offs that may affect simulator fidelity, training effectiveness, or transfer of training. The construct of fidelity has several dimensions, including physical fidelity, functional fidelity, and cognitive fidelity. Interaction of different fidelity dimensions has an impact on trainee immersion, presence, and buy-in.

The drive to reduce training cost through increased use of flight simulation technology highlighted a knowledge gap in the design of simulators for cueing fidelity requirements. LVC-HPA enables the analysis of physiological data derived from pilots, mission specific data, and aircraft systems state data to derive patterns that are descriptive of the degree of simulator fidelity. The combined human-system state data derived in the real world represents a quantitative fidelity benchmark against which the data derived in simulator environments can be compared.

What LVC/HPA does:

- LVC addresses a capability gap by augmenting live aircraft displays with entities generated with virtual and constructive simulations
- HPA supports safety of flight research in the LVC Live Pillar Virtual and Constructive Representations on Live Avionics Displays (VCR-LAD). HPA quantifies cognitive workload, situational awareness, and decision making in flight.
- HPA supports simulator fidelity assessment in LVC Virtual Pillar Cognitive Fidelity Synthetic Environment (CFSE). Fidelity drives human behavior and HPA captures signatures of behavior as a function of simulator fidelity
- HPA supports capturing of pilot behaviors for use in design of constructive entity behavior in the LVC Tactically-behaving Semi-Automated Forces (TAC SAF).
How it works:

- LVC-HPA uses aircraft sensors to capture aircraft and weapons state in simulator and aircraft.
- Human performance is captured with physiological sensors, including:
  - Eye gaze analysis: Tracking visual information acquisition strategy and visual workload.
  - Electrocardiogram (ECG): Waveform analysis of heart in embedded phase space gives consistent indication of cognitive workload.
  - Respiration: Amplitude and frequency, provides supporting data for ECG.
  - Voice recordings: Communications brevity and accuracy after action analysis.
  - Event flags such as “Fox 3”, “knock-it-off”, “engaged”, etc.
- LVC-HPA assimilates data from an HLA federation.
- Users can insert event tags and markers.
- All data is synchronized with a relational database for use in real-time and during After Action Review (AAR).
- Data can be retrieved and analysis performed on the basis of complex event queries.

What it will achieve:

- Provide design engineers with quantitative human performance data to assess LVC fidelity requirements, quantify safety of flight, and aid in constructive behavior modeling.
- Provide the basis for future training performance assessment system.
- Reduction in R&D life-cycle costs by matching requirements to capabilities.
- Training effectiveness force multiplier for existing virtual and constructive simulations.

LVC-HPA is also used in airborne flight test environments to answer research questions. Measurements of cognitive workload, situation awareness, and pilot behavior support the determination of requirements for safe, effective conduct of live training events with V-C injection. Specifically, LVC-HPA is used to experimentally determine when V-C representations cause a degradation of cognitive functional performance. Safety of flight considerations that are investigated with the aid of LVC-HPA include (but are not limited to) increased pilot workload and information load due to managing V-C entity injection, adverse effects due to unexpected events caused by interaction with V-C entities, separation of nonparticipating live traffic from V-C entities and artificialities that may arise if V-C entities act in unexpected ways due to the difference in situation awareness and separation of sensor information.

For further information on this exhibit, or on business opportunities with the Office of Naval Research, Warfighter Performance Department please feel free to check our website at http://www.onr.navy.mil/Home/Science-Technology/Departments/Code-34.aspx or contact us by mail at: Office of Naval Research, One Liberty Center, Warfighter Performance Department ONR34, 875 N. Randolph St., Arlington VA, 22203.