Head-Up Display (HUD) and Vision Systems

Background

IFALPA believes that the use of HUDs and Vision Systems can significantly contribute to flight safety by increasing pilot's situational awareness, during phases of flight appropriate to their design. Tactical information, previously only available head down on the PFD is available on a HUD in line with the outside view. The outside view can be supported by Enhanced Vision Systems (EVS), Synthetic Vision Systems (SVS) or a combination of both, a Combined Vision System (CVS).

This paper discusses basic design aspects of Head-Up Display (HUD) and Vision Systems. It is not, at present, all encompassing; i.e., it doesn't discuss the required flight crew training nor detailed human factors. It should not be assumed that these systems can simply be installed in the airplane and flight crews can just use them. Specialized training will be necessary in order to reap the full benefits of these systems and ensure safe flight operations while these systems are being used. Information on these aspects will become part of this paper in the future.

Display information

Information displayed on the HUD should include, and is not limited to, the following:

1 - Airspeed

2 - Altitude

3 - Heading/Track

4 - Vertical Speed

5 - Attitude with pitch/bank references

6 - Vertical path / Glidepath where applicable

7 - Flight guidance where applicable

8 - Status indication (e.g. AP, ATHR, nav sensor)

9 - Aircraft Energy State (e.g. Thrust or equivalent energy state display)

10 - Alerts and Warnings (e.g. Windshear, EGPWS, ACAS)

All information displayed on a HUD shall be consistent with the information available head down, i.e. based on the same sensory data.

Special consideration should be given to usability aspects of a HUD: The HUD should be clearly legible at all foreseeable lighting conditions and feature an automatic brightness adaption with a manual correction for each HUD. Field of view should be covering the drift at maximum crosswind during approach laterally or when this is not possible, the crosswind component is limited when HUDs are used. Vertically an angle of 30° should be covered which should be reasonably split above and below the horizon.

Considering the use of Vision Systems, IFALPA believes that operational credit (lower minima) can only be received with enhanced vision systems (EVS) that display electronic real-time images of the actual external scene on a HUD or combined vision systems (CVS). The sole use of synthetic data (SVS) should be restricted for use above MSA or the applicable approach minimum for situational awareness, due to possible inconsistencies between displayed image and actual outside scene.

IFALPA recommendation

▶ IFALPA favors dual-HUD/Vision System installations. For single HUD/Vision System installations, means should be provided to enable the pilot monitoring to fulfill his tasks, e.g. mirrored presentation of the displayed imagery/appropriate symbology from the HUD/Vision System.

▶ Use of the HUD/Vision Systems should be at pilot's discretion, unless required by operating regulation (i.e., to meet

applicable minima).

▶ The use of Vision System information is possible on equivalent displays. If such display is a fixed installation, basically all HUD guidance applies. The device should be continuously available for use during the entire flight, irrespective of weather conditions. Cabling, its size and weight should not restrict pilot access to the instruments and controls needed for phase of flight nor degrade pilot comfort.

▶ If it is a movable solution (e.g. head mounted displays), special considerations have to be taken into account:

- Instrumentation, linked to the directional control of the aircraft (e.g. item 1-7 of the a.m. list), should only be viewable in line with the longitudinal axis of the aircraft, whereas Vision System imagery might be available in the full azimuth. Other information (8-10) should be displayed at all times.

- The device should not increase the risk of spatial disorientation.