POSITION PAPER

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Head-Up Display (HUD) and Vision Systems

NOTE

This paper supersedes 17POS09, of the same name.

BACKGROUND

Head-Up Displays (HUDs) and Vision Systems can increase pilots' situational awareness by the use of the Flight Path Vector (FPV) and the ability to see the outside view and projected infinity image at the same time. IFALPA supports their installation and operational use.

However, the HUD may also obscure the outside view and relevant lighting, traffic, and objects, especially in adverse light conditions such as at night, in low visibility, and with precipitation.

The HUD should be certified and fit for operational use during the entire flight. 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 the basic design, training and operation of Head-Up Display (HUD) and Vision Systems.

IFALPA RECOMMENDATIONS

IFALPA believes that the use of HUDs and vision systems, when used within their limitations and with proper training, can contribute to flight safety but can also introduce risks that have to be mitigated.

Design & Display Information

Information displayed on the HUD should at least include the following:

1. Airspeed
2. Altitude
3. Heading/Track
4. Vertical Speed

5. Attitude with pitch/bank references
6. Vertical path / Glideslope where applicable
7. Flight Path Vector
8. Flight guidance when applicable
9. Status indication (e.g. FMA, navigation sensors)
10. Aircraft Energy State (e.g. Thrust or equivalent energy state display)
11. Alerts and Warnings (e.g. Windshear, EGPWS, ACAS)

All information displayed on a HUD should be consistent with the information available head down:

- The same symbology should be used on the HUD and head down displays, without restricting the usability, e.g. due to clutter effects.
- Flight guidance, whether FPV or attitude-based, should be equal head up and head down.
- The information displayed head up and head down should be based on the same sensory data.

The HUD should cover a lateral field of view to display actual drift at the maximum allowed crosswind for landing. When, during phases of flight other than landing, the drift exceeds the lateral field of view, a means should be provided to indicate that the actual FPV is out of view. Vertically, an angle of 30° should be covered, which should be reasonably split above and below the horizon.

The HUD should be clearly legible at all foreseeable lighting conditions and feature an automatic brightness adjustment and manual brightness control for each HUD.

IFALPA strongly recommends dual-HUD/Vision System installations over single-HUD/Vision System installations. For single HUD/Vision System installations, means should be provided to enable the pilot monitoring to fulfil their tasks, e.g. mirrored presentation of the displayed imagery/appropriate symbology from the HUD/Vision System.

The HUD should be continuously available for use during the entire flight, irrespective of weather conditions. Cabling, size, and weight should not restrict pilot access to instruments and controls, their seat, nor degrade pilot comfort.

Automatic and/or manual declutter modes should be made available to the crew.

Training and Operation

Use of the HUD/Vision Systems should ultimately remain at the pilot's discretion.

Use of HUDs and Vision Systems should be adequately trained, especially when used during take-off, approach and landing. HUDs and Vision systems have visual similarities with head down displays but significant differences in design and operation. In initial and recurrent training, consideration should be given to:

- crosswind operation and any limitations regarding the field of view and extended (projected) horizon line;
- the effect of turbulence on the display and readability of HUD information;
- The difference in angular resolution (distinguishing of details) between conventional and Head-Up displays, leading to more sensitive readings and possibly resulting in overcorrection;
- symbology of the HUD (i.e. clutter, brightness control, infinity projection), specifically for night operations;
- obscuring outside visual details such as lighting, traffic and objects by HUD clutter, especially in adverse light conditions such as at night, in low visibility and with precipitation, leading to loss of positional and traffic awareness, contributing to e.g. runway incursions;
- eye fixation on the HUD instead of seeing through the HUD, and missing out on the overall outside situation;
- attention capture/tunnelling on the HUD display resulting in decreased situational awareness (the HUD may possibly not display weather, EGPWS, engine parameters, traffic or navigational information);
- crew awareness of correct AFDS modes, because of the limited amount of information on the HUD;
- (in)consistency of information displayed head up and head down, possibly leading to confusion between both pilots;
- low visibility operations, when using the HUD for lower take-off and approach minima;
- HUD usage and guidance during dynamic situations, e.g. go around and aircraft upset;
- HUD usage and guidance during alerts and warnings (e.g. Windshear, EGPWS, ACAS); emphasis should be put on the use of the correct eye reference position, especially when using EVS;
- if applicable, difference in pilot technique when flying FPV-based compared to attitude-based. This is especially the case when the head-down guidance is attitude-based, and the HUD is FPV-based;

- if applicable, the difference in FPV or attitude-based guidance during landing, regarding aiming point and flight path;
- developing an effective scan of the HUD, which may require a greater range of eye movement than when using the PFD.

Risks related to the use of the HUD for a specific flight should be considered, mitigated, and mentioned in the crew briefing. Such risks can be, but are not limited to, outside lighting conditions, traffic awareness, crosswind and turbulence.

Pilots should maintain currency in both the use of HUDs and Vision Systems, as well as in the use of head-down indication systems, in all flight phases.

When operating aircraft with and without a HUD as a result of mixed fleet flying, the related risks should be addressed and mitigated; recency requirements should be established for both types of aircraft.

Operational credit for lower approach 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 the displayed image and the actual outside scene.