



Rockwell Collins Head-Up Guidance Systems

Dynamic Analysis Considerations for HUD Certification



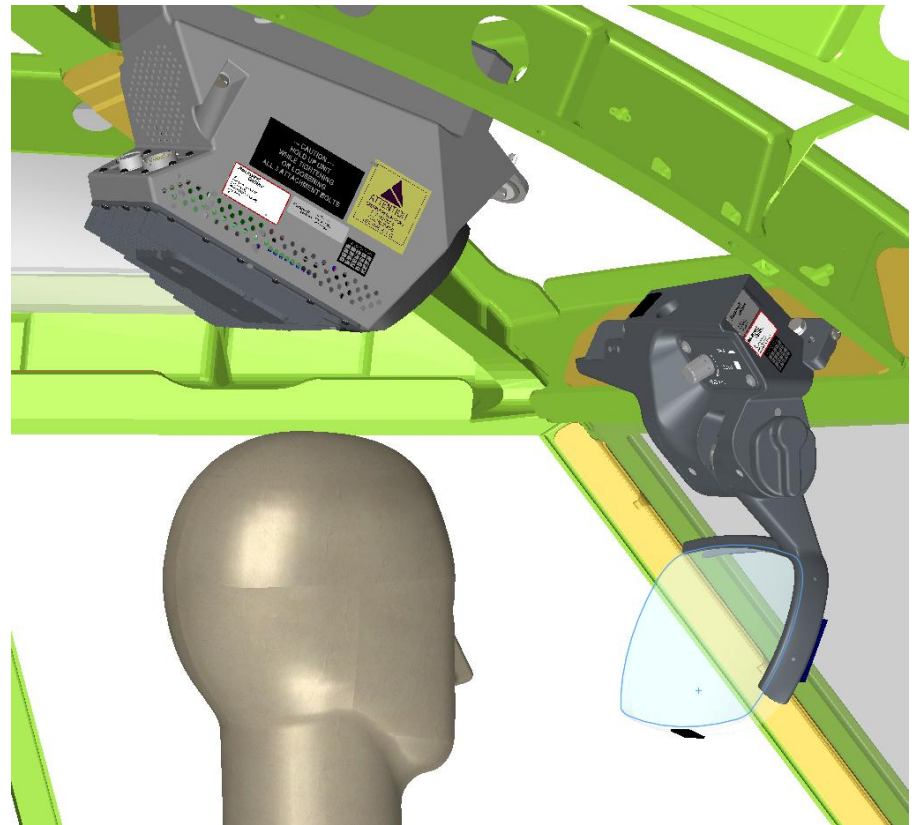
Heads-Up Display (HUD) Overview

- Commercial aircraft Heads-Up Displays are typically comprised of a projector above the pilot's head and a combiner in front of the pilot.
- The combiner contains a transparent but reflective optical element. This allows the image from the projector to be reflected to the pilot and allows the pilot to see the outside world through the combiner.



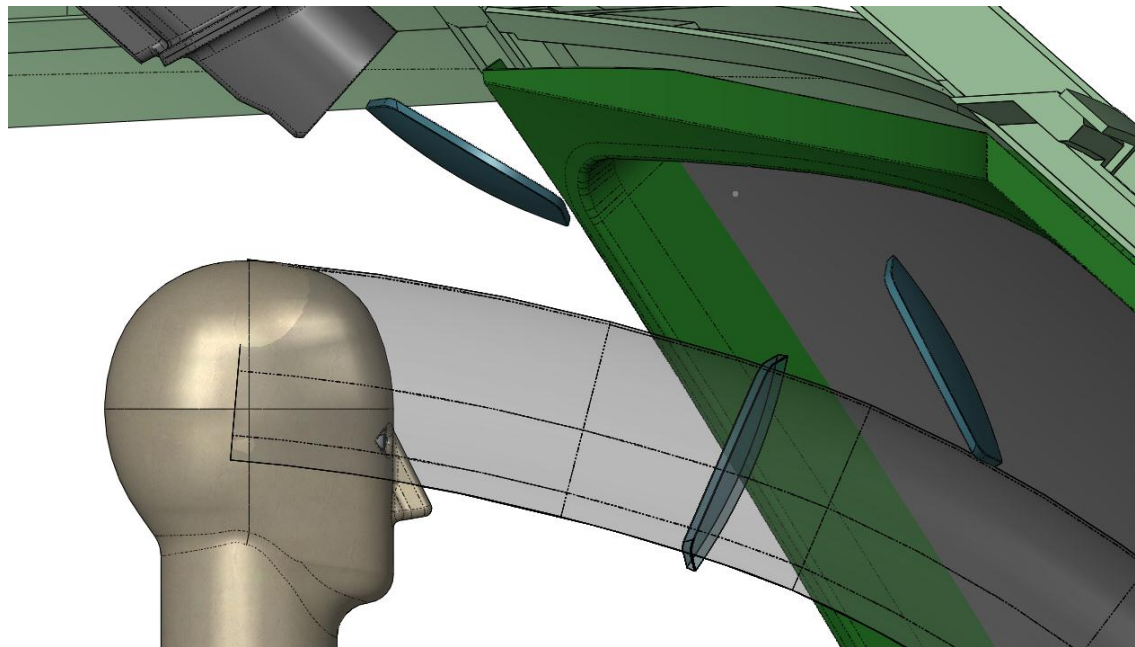
Analysis Considerations

- Due to the proximity of the HUD to the crew, there are many safety considerations that are taken into account when developing and certifying HUD installations.
- Two of these considerations may be relevant to seat analysis
 - Combiner location with respect to head path during HIC scenarios
 - Overhead location with respect to head (head clearance) during gust loading conditions



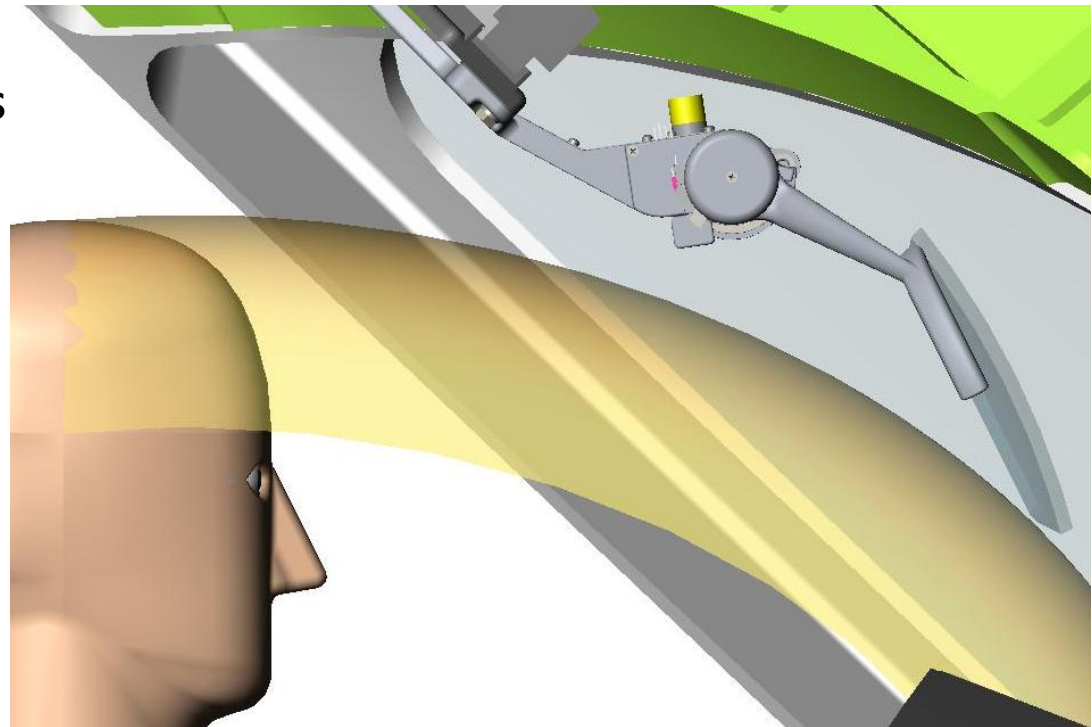
Combiner Design

- Due to the proximity to the pilot the optical element is designed to be rotated into a stow and breakaway position.
 - The stow position is designed to ensure the combiner is out of the way when not in use.
 - The breakaway position is designed to clear the head during a crash safety condition.



Head Path due to HIC Scenario

- A HUD Combiner is typically designed to move out of the way under the inertial load of the event.
- The head path during this event will dictate how the HCU will be designed.
- During the initial design approximations an initial head path is assumed. Once the seat has been tested and a more detailed head path is available the combiner design is adjusted to ensure the combiner optical element is in the optimal position.



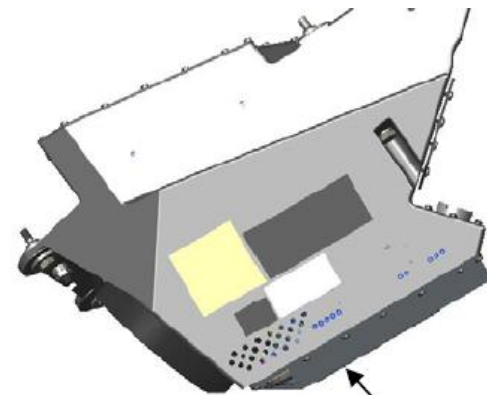
Certification and Compliance

- Depending on the certification basis of the aircraft, the HUD may be required to show compliance to 14 CFR §§ 25.562
- Dynamic seat test
 - The combiner is placed in the correct position with respect to the pilot and verified during the dynamic testing.
- Dynamic time analysis
 - Use test or analysis data of head path and Combiner location over time and compare to show the head misses the combiner during the event.
- Full dynamic analysis
 - Full analysis of seat and Combiner to show HIC values and comparison to previous test results.
 - Used methods described in AC 20-146
 - Worked with NIAR on a HUD installation with existing certified seat.

Vertical Head Strike

- On a specific dual installation, compliance to 14 CFR §§ 25.785 was shown through a similar analysis on the Overhead, ATD and seats.
- An analysis was performed by NIAR to look at the head strike against the bottom of the Overhead.

Combiner



Overhead Unit

