AR/VR TECHNOLOGIES FOR COMMERCIAL AVIATION OPERATIONAL BENEFIT

CURTIS CRAWFORD, SOFTWARE ENGINEER
curtis.crawford@collins.com
JONATHAN HARDMAN, SOFTWARE ENGINEER
jonathan.hardman@collins.com
CARLO TIANA, FELLOW
carlo.tiana@collins.com

HEAD-UP GUIDANCE SYSTEMS
COLLINS AEROSPACE
ABSTRACT

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Augmented Reality (AR) technologies have been utilized in commercial passenger aircraft since the 1970s, in the form of Head-Up Displays. More recently, vision enhancements have been added that deliver operational benefits to pilots. This includes enabling aircraft to land in the worst weather conditions, which, prior to these enhancements, would have been difficult to perform safely. These technologies are evolving to support an era of partially or fully autonomous flight.

We review the key aspects of these technologies and the regulatory framework associated with them that enables one of the few long-term safety and revenue enhancing AR technologies in use today.
OUTLINE

• How do pilots fly in low visibility? Reality needs help.
  • Regulatory Framework and Historical Background
• Head-Up, Helmet-Mounted and Head-Worn Displays
• Symbolic Augmented Reality and Operational Benefits
• Enhanced and Synthetic Vision Augmented Reality and Operational Benefits
• Other Augmented Reality (NVIS and Military Systems)
• The Business Case today
• The Future
APPROACH AND LANDING FLIGHT RULES

- 14 CFR § 91.176: Straight-in landing operations below DA/DH ...
- (a) EFVS Operations to touchdown and rollout
  - Pilot must have …
    - a Head-Up Display and an Enhanced Vision System …
  - and must see …
    - Required Visual References
REQUIRED VISUAL REFERENCES

(ii) From the authorized MDA or DA/DH to 100 feet above the touchdown zone elevation of the runway of intended landing, any approach light system or both the runway threshold and the touchdown zone are distinctly visible and identifiable to the pilot using an EFVS.

(A) The pilot must identify the runway threshold using at least one of the following visual references-
   (1) The beginning of the runway landing surface;
   (2) The threshold lights; or
   (3) The runway end identifier lights.

(B) The pilot must identify the touchdown zone using at least one of the following visual references -
   (1) The runway touchdown zone landing surface;
   (2) The touchdown zone lights;
   (3) The touchdown zone markings; or
   (4) The runway lights.

(iii) At 100 feet above the touchdown zone elevation of the runway of intended landing and below that altitude, the flight visibility must be sufficient for one of the following visual references to be distinctly visible and identifiable to the pilot without reliance on the EFVS -

(A) The runway threshold;

(B) The lights or markings of the threshold;

(C) The runway touchdown zone landing surface; or

(D) The lights or markings of the touchdown zone.
COLLINS WAVEGUIDE HUD MODEL 3500
COLLINS IDVS: INTEGRATED DIGITAL NIGHT VISION SYSTEM

SOLDIER SYSTEM NOT AIRBORNE

Courtesy: https://newatlas.com/rockwell-collins-idvs-hud/45387/
COLLINS AEROSPACE EVS-3XXX

- Multispectral infrared camera
- Fused image stream to HUD
- 2016: Certified for EFVS-I
  - World first
- 2019: Certified for EFVS-II
  - World first
EFVS – “HOW”

- Detect required visual references
EFVS – “HOW”
EFVS – “HOW”
BUSINESS CASE

• Engineering for profit: Vision Systems subject to close scrutiny by commercial customers for near term Return On Investment
  • 14 CFR 91.176 permit EFVS “airline” operations
• System (especially EFVS camera) designed for this case
• Business case accounts for “Saved Landings”, but also
  • Happy passengers at intended destination, not stranded in hotels
  • Route system not disrupted by mis-located directed aircraft
  • Feeder / regional system operations support
  • Customized to airline route structure and historical weather events
THE FUTURE: VISION ALWAYS REQUIRED

• Reliable and Secure links needed to feed vision information to remote consumers
  • Autonomous flights have no pilots but copious ground support
  • Remote towers, remote ops
  • Air Taxi support
  • UAS - Unmanned Aerial Systems
    UAM - Urban Air Mobility
• Some human is always in the loop – look where you fly applies to near-ground operations today and tomorrow
COLLINS AEROSPACE VIDEOS

• EFVS
  • https://www.youtube.com/watch?v=xuGAXgGsQAk

• HUDs and EFVS Operations
  • https://www.youtube.com/watch?v=R6kKdwu6ss0

• Guidance with Synthetic Vision
  • https://www.youtube.com/watch?v=P9N_PFtBUOA

• Combined Vision System
  • https://www.youtube.com/watch?v=0GT0Hic5znS