

## Toward Head-Worn Displays for Equivalent Visual Operations

Lawrence (Lance) J. Prinzel III, Jarvis J. (Trey) Arthur, Randall E. Bailey, Denise R. Jones, Steven P. Williams, Stephanie J. Harrison

NASA Langley Research Center

The Next Generation Air Transportation System represents an envisioned transformation to the U.S. air transportation system that includes an "equivalent visual operations" (EVO) concept, intended to achieve the safety and operational tempos of Visual Flight Rules (VFR) operations independent of visibility conditions. Today, Federal Aviation Administration regulations provide for the use of an Enhanced Flight Visual System (EFVS) as "operational credit" to conduct approach operations below traditional minima otherwise prohibited. An essential element of an EFVS is the Head-Up Display (HUD). NASA has conducted a substantial amount of research investigating the use of HUDs for operational landing "credit", and current efforts are underway to enable manually flown operations as low as 1000 feet Runway Visual Range (RVR). Title 14 CFR 91.175 describes the use of EFVS and the operational credit that may be obtained with airplane equipage of a HUD combined with Enhanced Vision (EV) while also offering the potential use of an "equivalent" display in lieu of the HUD. A Head-Worn Display (HWD) is postulated to provide the same, or better, safety and operational benefits as current HUD-equipped aircraft but for potentially more aircraft and for lower cost. A high-fidelity simulation was conducted that examined the efficacy of HWDs as "equivalent" displays. Twelve airline flight crews conducted 1000 feet RVR approach and 300 feet RVR departure operations using either a HUD or HWD, both with simulated Forward Looking Infra-Red cameras. The paper shall describe (a) quantitative and qualitative results, (b) a comparative evaluation of these findings with prior NASA HUD studies, and (c) describe current research efforts for EFVS to provide for a comprehensive EVO capability.