Rotorcraft Loss of Control In-Flight – The need for research to support increased fidelity in flight training devices, including analogies with upset recovery for fixed-wing aircraft*

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A review of the worldwide commercial jet fleet accident data, 2001 – 2010, showed that the largest single factor leading to fatalities was Loss of Control In-Flight (LOC-I). 20 such accidents occurred during this timeframe with over 1800 fatalities [1], highlighting the need for research to investigate the causes of this problem and to develop new regulations and training programmes to improve flight safety.

For civil helicopter operations, the need to significantly reduce accident rates has been the focus of the International Helicopter Safety Team (IHST), which was formed in 2005 to address factors affecting the "unacceptable" helicopter accident rate. The Team's mission was to facilitate an 80% reduction in accident rates by 2016. From 2006 to 2011, a team completed a review of 523 U.S. helicopter accidents, from which LOC-I was cited as the main factor in accidents; LOC-I was evident in 217 (41%) of the accidents [2].

Addressing LOC-I for fixed-wing aircraft, the Royal Aeronautical Society's Flight Simulation Group (FSG) 2009 Spring Conference was entitled: '*Flight Simulation: Towards the Edge of the Envelope'*, during which Upset Prevention and Recovery Training (UPRT) was highlighted as a major potential contributor to enhanced aviation safety. During the FSG conference, the International Committee for Aviation Training in Extended Envelopes (ICATEE) was formed to deliver a long-term strategy for reducing the rate of LOC-I accidents and incidents through enhanced UPRT [3].

To achieve this, ICATEE created two streams: the Training and Regulations Stream addressing the development of a UPRT training requirements matrix, and the Research and Technology Stream performing a thorough analysis of the technological requirements for UPRT. Key recommendations from the ICATEE work included better use of existing simulators for training, and aerodynamic enhancements to simulators to include stall characteristics.

The impact of the ICATEE work is that their recommendations resulted in a new ICAO publication, "*Manual on Aeroplane Upset Prevention and Recovery Training*" [4]. National Authority regulations have also been impacted, with EASA UPRT requirements expected to be complete by May 2019 and the FAA requiring all Part 121 pilots to be UPRT-trained by March 2020.

For the rotorcraft community, an equivalent safety initiative has recently been established. In 2016, the US Helicopter Safety Team (USHST) began the analysis of 104 fatal helicopter accidents (2009–2013) to develop intervention strategies and produce Helicopter Safety Enhancements (H-SE) that would further reduce rotorcraft accident rates. The USHST analysed accidents where LOC-I occurred during basic manoeuvres (e.g., hover, quick stop) and during unsuccessful attempted recoveries from

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potentially unsafe conditions (e.g., loss of tail rotor effectiveness, settling with insufficient power). Helicopter Safety Enhancement (H-SE) 81 titled, "*Improve Simulator Modeling for Outside-the-Envelope Flight Conditions*" [5] was established to "*improve the accuracy of full flight simulators (FFS)/flight training devices by providing recommendations for developing better mathematical/physics-based models for helicopter flight dynamics*". The goal is to "*achieve more realistic, higher-fidelity simulations of outside-the-envelope flight conditions*" and to examine the "*possible use of simulation for purposes of preventing, recognizing, and recovering from spatial disorientation*".

Complementing the H-SE 81 initiative, a rotorcraft simulation fidelity research activity is underway at the University of Liverpool and Liverpool John Moores University [6]. The goal of this work is to establish a rational and systematic engineering approach to flight simulation fidelity enhancement, using physics-based models, linking in with goals of H-SE 81.

Whilst rotorcraft operations pose different challenges to fixed-wing operations, drawing on the best practices developed by the fixed-wing safety community could benefit the rotorcraft community by reducing the time to implement new safety regulations and develop new training programmes.

The presentation will provide an overview of the critical success factors of the ICATEE work, will report on the rotorcraft fidelity research ongoing in Liverpool, highlighting challenges and opportunities involved in developing simulator-based training for rotorcraft LOC-I scenarios.

References

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[6] https://www.researchgate.net/project/A-Novel-Approach-to-Rotorcraft-Simulation-Fidelity-Enhancement-and-Assessment