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Cockpit Integration and Piloted Assessment of an Upset Detection and Recovery System

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Abstract : The trend of recent accident and incident cases worldwide show that the state-of-the-art automation and operations, for current and future demanding operational environments, does not provide the desired level of operational safety under crew peak workload conditions, specifically in complex situations such as loss-of-control in-flight (LOC-I). Today, the short term focus is on preparing crews to recognise and handle LOC-I situations through upset recovery training. This paper describes the cockpit integration aspects and piloted assessment of both a manually assisted and automatic upset detection and recovery system that has been developed and demonstrated within the European Advanced Cockpit for Reduction Of StreSs and workload (ACROSS) programme. The proposed system is a function that continuously monitors and intervenes when the aircraft enters an upset and provides either manually pilot-assisted guidance or takes over full control of the aircraft to recover from an upset. In order to mitigate the highly physical and psychological impact during aircraft upset events, the system provides new cockpit functionalities to support the pilot in recovering from any upset both manually assisted and automatically. A piloted simulator assessment was made in Oct-Nov 2015 using ten pilots in a representative civil large transport fly-by-wire aircraft in terms of the preference of the tested upset detection and recovery system configurations to reduce pilot workload, increase situational awareness and safe interaction with the manually assisted or automated modes. The piloted simulator evaluation of the upset detection and recovery system showed that the functionalities of the system are able to support pilots during an upset. The experiment showed that pilots are willing to rely on the guidance provided by the system during an upset. Thereby, it is important for pilots to see and understand what the aircraft is doing and trying to do especially in automatic modes. Comparing the manually assisted and the automatic recovery modes, the pilot's opinion was that an automatic recovery reduces the workload so that they could perform a proper screening of the primary flight display. The results further show that the manually assisted recoveries, with recovery guidance cues on the cockpit primary flight display, reduced workload for severe upsets compared to today's situation. The level of situation awareness was improved for automatic upset recoveries where the pilot could monitor what the system was trying to accomplish compared to automatic recovery modes without any guidance. An improvement in situation awareness was also noticeable with the manually assisted upset recovery functionalities as compared to the current non-assisted recovery procedures. This study shows that automatic upset detection and recovery functionalities are likely to positively impact the operational safety by means of reduced workload, improved situation awareness and crew stress reduction. It is thus believed that future developments for upset recovery guidance and loss-of-control prevention should focus on automatic recovery solutions.

Keywords : aircraft accidents, automatic flight control, loss-of-control, upset recovery
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