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Position

18POS11

4 December 2018

Take-Off Performance Monitoring System

BACKGROUND

Take-off performance issues have been a contributing factor in a wide variety of serious incidents and accidents in recent years (1,2). However, there have been very few technological improvements to address the problem, and in particular to validate computed performance data, so that the crew can get confirmation that the calculated Take-off thrust is within a safe range for the actual weight and weather conditions. Real-time take-off acceleration check still relies on the perception of acceleration felt by the crew, which may be very different from one take-off to another.

In a 2012 study (3), NASA outlined six main error families in the field of performance data. All are human errors. Examples include erroneous data entry (wrong weight, fuel, number of passengers, etc.), erroneous copying or reading of data from a computer (EFB, MCDU, etc.), and incorrect flap and trim settings. Most of these errors should have been caught by existing procedures, but many of these procedures can also fail because the checks rely on the same set of data. Initial errors are difficult to catch because procedural checks do not match human performance characteristics and are not adequate to actual flight operations. This study recommends automated data insertion via either computer communication or data scanning, thus limiting the human data input error. It also suggests an on-board weight-and-balance sensing system.

IFALPA's preferred option is the validation of take-off performance computation and related data input via a comparison with live aircraft performance during the take-off roll. The NASA study (3), mentioned this possibility as the "TOPMS" but expresses concerns on the risk of false positive alarms, especially in a high workload phase.

POSITION

Take-off performance monitoring is a complex issue that should be addressed in several steps:

Development of a simple acceleration-based Monitoring System for large errors

In all commercial transport aircraft, there should be a simple system comparing the actual longitudinal acceleration during the take-off roll with a computed value. This computed value could be derived from take-off performance calculation made by the crew or from pilot inputs in the FMS (such as assumed take-off weight and selected thrust rating). The comparison could be done with the acceleration at a specific ground-speed or by averaging the acceleration in a given ground-speed range.

This system should provide an aural warning calling for a stop in case of major discrepancy. The actual ground speed range, when the warning is triggered, should ensure that stopping is always possible on any runway and with any runway contamination, and avoid high-speed rejected take-offs.

Existing aircraft should be retrofitted whenever possible.

Research on an advanced Monitoring System

IFALPA believes that more research should be undertaken to design an advanced take-off monitoring system. All aspects should be studied, such as the ability to call for a stop manoeuvre or for the application of maximum thrust, the estimated error magnitude, the feasibility of either a stop or a continued take-off, and the known and detected environmental and aircraft configuration parameters. The objective is to have the crew take action whenever any possible performance mismatch can be sensed. This is most important in case of an engine failure on the runway or during initial climb.

This system could also be used to advise the crew on the feasibility to stop on the runway in the event of a stop manoeuvre, and on the last moment when such manoeuvre could be performed and still be successful, should it be different from the computed V1.

Special consideration should be given to runway contamination issues, especially by contaminants that can reduce aircraft acceleration.

Non-Hardware Issues related to Take-off Performance

Alongside the development of these devices, crew performance during take-off and the associated training should be considered. Specific training should be given for a systematic application of maximum thrust whenever the crew is in doubt of the aircraft performance during the take-off roll.

REFERENCES

1. ATSB, 2009, "Take-off performance calculation and entry errors: a global perspective"

2. IATA, 2011, "Flight Crew Computer Errors (FMS, EFB), Case Studies"

3. NASA, 2012, "Performance Data Errors in Air Carrier Operations: Causes and Countermeasures"