Aircraft Automatic Control System Failure and Flight Safety

Mareks Slihta¹, Ramachandran Karunanidhi², Vladimirs Sestakovs³

¹,³Institute of Aeronautics, Faculty of Transport and Mechanical Engineering, Riga Technical University
²Hamburg University of Applied Science, Hamburg, Germany

Abstract – This article presents a mathematical model which estimates the probability of successful completion of the aircraft’s flight in case of failure of aviation equipment in flight. This paper shows the relationship between the aircraft’s automatic control system and flight safety. The calculations of probability are made for the successful completion of the flight on Boeing 737 aircraft when the automatic control system has failed.

Keywords – Flight safety, aircraft, probability of failure, automatic control system, negative factors.

I. INTRODUCTION

The aircraft automatic control system was initially designed with the expectation of failure maintaining the main performance functions. For this purpose they are designed to be multi-channel, i.e. two, three or four completely identical control channels running as a parallel steering control circuits, and the failure of one or two channels cannot affect the overall performance of the system. However, even a full pre-flight check of the automatic control system by means of a software-controlled test cannot give an absolute guarantee of system integrity. One of the most important characteristics of the airplane’s successful flight is an adequate position for the angle of bank [1-8].

The aircraft is banked when it is turning around its longitudinal axis. There is a restriction for each roll of the aircraft and it is calculated on the basis of structure, strength, aerodynamics and speed of civil aircraft: 25 degrees – a limit allowed in flight; 30 degrees – a limit allowed when the aircraft has to avoid an obstacle. In critical situations, pilots have permission to exceed the maximum angle of bank with the aim of saving passengers’ lives. The limits of the allowed angle of bank are usually exceeded due to human factors.

It follows:

1. During the maintenance of B-737 aircraft was mixed same type of cable connections which transmit signals from bank angle and direction angle sensors. Maintenance error occurred because both circuits’ connectors had similar sizes. Accordingly, the ailerons tried to reduce fluctuations in direction coordinate plane, but the direction rudder trying to reduce oscillations of bank angle. As a result, volatility increased and exceeded constructive restrictions and aircraft fuselage collapsed under overload.

2. The automatic functional control system on the aircraft is powered by three-phase voltage of 36 V. The maintenance mechanic connected wires “colour to colour”, i.e. yellow to yellow and so on. As a result the automatic functional control system was powered incorrect polarity – in result system gave reverse polarity of pulses and rocked aircraft instead of damping aircraft. This resulted in an accident. This article presents the results of calculating the probability of successful completed flight for B-737 aircraft type with the autopilot failure on the channel which ensures signals of bank angle.