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DOCTORAL THESIS ABSTRACT

The problem of mitigating the effects of atmospheric gusts with consideration of information management in the pilot–commercial aircraft system

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Abstract:

The subject of the dissertation was the problem of mitigating the effects of atmospheric gusts, taking into account information management within the pilot–commercial aircraft system. The issue addressed is particularly important from the perspective of flight safety during critical phases of flight involving sudden wind shear and downdrafts. The introduction highlights the importance of the ability to anticipate wind conditions and respond rapidly to gusts based on perceived load factors. The theoretical part of the dissertation presents statistical data on incidents and accidents associated with atmospheric gusts. Weather phenomena contributing to the formation of wind gusts are described. The dissertation includes analyses of the effects of atmospheric gusts on aircraft flight. Ground-based and airborne systems used for the prediction and detection of atmospheric gusts are characterized. The aim of the dissertation was to develop new methods enabling the detection and estimation of the parameters of gusts affecting commercial aircraft in a three-dimensional context. In this regard, the following hypothesis was formulated: providing pilots with comprehensive, real-time information on three-dimensional wind conditions will facilitate the maintenance of the intended trajectory and flight parameters during the approach by reducing the element of surprise. A simulation test stand adapted for flight-parameter recording and equipped with the capability to communicate with a computational and simulation environment was used to evaluate the developed algorithms for detecting and estimating gust velocity. The algorithms developed in the dissertation demonstrated relatively high fidelity in reproducing the original signal and an acceptable delay. The achieved extension of the functionality of integrated airborne systems enabled the implementation and integration, with a flight simulator, of the

developed concept of flight indications designed to support pilots in mitigating the effects of atmospheric gusts. The research results confirmed the hypothesis proposed in the study. The final chapter of the dissertation presents the conclusions and insights derived from the conducted simulator-based research. It includes proposals for potential solutions that could be the subject of future research. The summary highlights areas and functional limitations of modern onboard systems that require particular attention.