



Chapter 1

Machine Learning and Text Analysis in an Artificial Intelligent System for the Training of Air Traffic Controllers

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ABSTRACT

This chapter presents the application of new information technology in education for the training of air traffic controllers (ATCs). Machine learning, multi-criteria decision analysis, and text analysis as the methods of artificial intelligence for ATCs training have been described. The authors have made an analysis of the International Civil Aviation Organization documents for modern principles of ATCs education. The prototype of the neural network for evaluating the timeliness and correctness of the decision making by ATCs has been developed. The new theoretical and practical tasks for simulation and pre-simulation training have been obtained using expert judgment method. The methodology for sentiment analyzing the airline customers' opinions has been proposed. In addition, the examples of artificial intelligence systems and expert systems by the authors, students and colleagues from National Aviation University, Ukraine and Gdansk University of Technology, Poland have been proposed.

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INTRODUCTION

In recent years we have observed large changes in the education system for training of air traffic controllers and other aviation professionals due using new information technology in aviation. One of the scientific and methodical fields which gained goals as a result of this was Data Analysis and Decision Making (DM) under various names: Statistics, Big Data, Data Mining, Machine Learning, Text Mining, Sentiment Analysis, Intelligence Data Analysis, Artificial Intelligence System, Knowledge Discovery, etc.

The aviation system is a complex system that requires investigation of the human contribution to safety and an understanding of how human performance may be affected by its multiple and interrelated components such as technical, political, physical, social, economic, informational, training culture etc. (International Civil Aviation Organization [ICAO], 2004, 2009, 2016b). The Human Factor (HF) remains a major cause of aviation accidents. That is why the current system of education needs to improve. The HF as a term requires a precise definition because when it is used in everyday life, it often encompasses all aspects of human activity (ICAO, 1998, 2002). People are the most flexible, adaptable and important element in the aviation system and the most vulnerable in terms of opportunities effect on its activity. At the initial stage of development of aviation, many problems have been associated with exposure to human noise, vibration, heat, cold and acceleration forces. But optimization of the human role in complex systems is related to all aspects of human activity, such as DM processes and knowledge; design configuration displays, controls and equipment cockpit and cabin; maintaining communications and software; preparation of plans and maps.

Air traffic controllers (ATCs) – are the experts in Air Traffic Management (ATM) for dynamic, integrated management of air traffic and airspace. The ATM system is a system that provides air traffic management through the collaborative integration of humans, information, technology, facilities and services, supported by air, ground and/or space-based Communications, Navigation and Surveillance (CNS). Statistical data show that human errors account for up to 80% of all causes of aviation accidents (Leychenko, Malishevskiy, & Mikhalic, 2006; Aviation Accident Statistics, 2018). Safety in aviation will continue to be highly dependent on the reliability of Air Traffic Service (ATS). This reliability will be directly linked to the ability of ATS planners and managers to incorporate the many lessons of history regarding the impact of HF on controller performance. According to the list of factors, performance includes quality of selection criteria, initial and recurrent training, and retention programs for ATCs (ICAO, 2008; European Organization for the Safety of Air Navigation [Eurocontrol], 2004a, 2004b). Quality of aviation training is important to decrease the influence of the HF.

BACKGROUND

Pilots and ATCs are working together for ensuring the safely, economically and efficiently flights of aircrafts (ACs). The pilots in crews are in communication with the ATC. ATCs are responsible for the order of movement of different types of ACs (manned and unmanned ACs, helicopters, etc. Control by the dispatcher includes absolutely all stages of the movement of the AC: from taxing it from the parking lot before take-off to taxiing to the parking lot after landing.

That is, in the Air Navigation System (ANS) operates the principle of “dual operator”: the pilot – the ATCs (Figure 1). Actual is the study of the regularities of the activities of both operators and their teams both in the process of fulfilling their professional duties and in social life. The authors present concep-

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