Chapter 1

Artificial Intelligence in Aviation Industries: Methodologies, Education, Applications, and Opportunities

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ABSTRACT

This chapter presents opportunities to use Artificial Intelligence (AI) in aviation and aerospace industries. The AI used an innovative technology for improving the effectiveness of building aviation systems in each stage of the lifecycle for enhancing the security of aviation systems and the characteristic ability to learn, improve, and predict difficult situations. The AI is presented in Air Navigation Sociotechnical system (ANSTS) because the activity of ANSTS, is accompanied by a high degree of risk of causing catastrophic outcomes. The operator’s models of decision making in AI systems are presented such as Expert Systems, Decision Support Systems for pilots of manned and unmanned aircraft, air traffic controllers, engineers, etc. The quality of operator’s decisions depends on the development and use of innovative technology of AI and related fields (Big Data, Data Mining, Multicriteria Decision Analysis, Collaboration Decision Making, Blockchain, Artificial Neural Network, etc.).

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BACKGROUND

The air transport industry plays a major role in world economic activity and to maintain the safe and efficient operation of aviation enterprises maximum use needs to be made of the enhanced capabilities provided by technical advances. Nowadays the International Civil Aviation Organization (ICAO) has added in its documents new approaches for achieving the main goals of the organization, which are: to enhance the effectiveness of global aviation security and to improve the practical and sustainable implementation of preventive aviation security measures. These new approaches include the development of security culture and human capability, the improvement of technological resources to improve oversight and quality assurance, and other directions. (ICAO, 2018). The quality of decisions dependences on the development and the use of innovative technologies in today’s aviation such including Artificial Intelligence and education of aviation operators using modern information technologies and curriculums such as AI, Data Science, Big Data, Data Mining, Multicriteria Decision Analysis, Collaboration DM (CDM), Blockchain, Neural Network, etc.

The aviation systems should be considered as Sociotechnical systems (STS), which tend to have two common features: advanced technologies and high-risk activities (ICAO, 2004; 2013). In addition, large-scale, advanced technology systems such as Air Navigation System (ANS) can be attributed to the STS, in which the distinguishing feature is the presence of the hazardous kinds of activity as well as the use of the high-level technologies in production (Shmelova, Sikirda, Kharchenko, 2016).

Air Navigation System (ANS) is presented as an STS where Artificial Intelligence (AI) can offer significant benefits. The activity of ANS, as well as STS, is accompanied by a high degree risk of causing catastrophic outcomes. Statistical data show that human errors account for up 80% of all causes of aviation accidents (Leychenko, Malishevskiy, & Mikhalic, 2006; Campbell, Bagshaw, 2017). Since operations in STSs generally involve high-risk / high-hazard activities, the consequences of safety breakdowns are often catastrophic in terms of loss of life and property. The more a human-operator (H-O) is trying to control a production process being aided by high-level technologies, especially in case of distant operation, the more non-transparent becomes the result of the operation of a system (ICAO, 2004; 2013a; 2013a; 2017).

The document “White paper” of IATA (International Air Transport Association) presents the results of IATA research and development activities on AI in collaboration with airlines. The new technologies of AI can be clustered in the following capabilities, such as: Machine learning (ML), Natural Language Processing (NLP), Expert Systems, Vision, Speech, Planning, Robotics (IATA, 2016). So, to increase the productivity of work at each stage of the life cycle (LC) of aviation systems, different AI technologies and methods can be effectively applied (Fig. 1).

One of the possible approaches to the solution of these problems is the formalization and mathematical presentation of the ANS operators’ activities in the form of a complex STSs on the base of the systemic analysis and using of AI in each of the LC of modern aerospace and aviation technique: planning, design, production, operation, maintenance / repairs, and modernization of technique. The LC may include all components of AI for improving the effectiveness, safety, and activity of the aviation system and obtains synergetic effect (Fig. 2).

Artificial Intelligence is a system that is able to perform inherent human intellectual activities associated with the perception and processing of knowledge, reasoning and relevant communication (playing chess, making music, poetry, design of complex systems). The development of modern AIS started in the 50’s. The AI is a simulation of human intelligence processes by modeling, computer systems, and
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