


Chapter 6

Artificial Intelligence Methods and Applications in Aviation

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ABSTRACT

The authors make an analysis of the International Civil Aviation Organization documents on applications of new technology for minimizing risk and improving safety in the aviation system. ICAO defined new approaches for effectiveness in aviation – application of artificial intelligence (AI) models for the organization of collaborative decision making (CDM) by all aviation specialists (pilots, air traffic controllers, engineers, etc.) using CDM models based on general information on the flight. The AI is presented in models of decision making (DM) in air navigation system (ANS) as expert systems. The effectiveness of ANS operators' decisions depends on the rational use of intelligent automation at all stages of aircraft flight in the form of intelligent decision support systems (IDSS), with hybrid intelligence (natural intelligence), and AI in DM. Models may be used in the education of aviation specialists and in IDSSs in real flight, especially in emergencies. The chapter presents some examples of CDM models in an emergency “engine failure in flight.”

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INTRODUCTION

Aviation plays a major role in the world. To maintain a safe and efficient operation of aviation enterprises the maximum is using enhanced capabilities provided by new advances in technology. Nowadays one of the goals is applying Artificial Intelligence in aviation for searching for effective solutions and support in difficult situations. Artificial intelligence (AI) is a system that can perform inherent human intellectual activities associated with the perception and processing of knowledge, which is important in aviation, especially for decision-making in emergencies. The aviation system is a complex system that requires investigation of how human performance may be affected by its multiple and interrelated components such as technical, political, physical, social, economic, cultural, etc. The aviation systems such as Air Navigation systems (ANS) can be considered Sociotechnical systems (STS), which tend to have two principal features: high technologies and high-risk activities. Thus, the efficiency and safety of the operation of the systems depend to a high degree on the quality of a human operator's decisions that in its turn are guided by the factors of education, competence, experience, and versatility of application of modern-day information and data processing technologies and others.

The AI is presented in models of decision-making in the Air Navigation Sociotechnical systems (ANSTS) as expert systems, decision support systems (DSS)s, intelligent DSS for operators of ANSTS such as pilots, air traffic controllers, engineers, flight dispatchers, operators of unmanned aircraft, especially in emergencies.

BACKGROUND

To maintain the safe and efficient operation of aviation companies International Civil Aviation Organization (ICAO) in its recent documents extended the existing and defined new approaches to improve the practical and sustainable implementation of preventive aviation security measures based on modern advances in information technology (ICAO, 2018). One approach is using AI systems in aviation. The first AI research was aimed at creating computers with "intelligent" behavior, scientists sought to obtain new artificial systems with abilities to perform work better than the systems with the control of a human operator named Natural Intelligence (NI). Nowadays, the range of AI technologies has expanded considerably with successful applications in many areas (Kashyap, 2019a; Izonin, 2022; Salem, 2020).

For aviation to need the efficient operation of aviation enterprises and aviation services that allows maximum use to be made of enhanced capabilities provided by technical advances to maintain safety. The IATA (International Air Transport Association) also presents the advantages of the application of the modern technologies of AI such as Machine learning (ML), Natural Language Processing (NLP), Expert Systems, Vision, Speech, Planning, and Robotics (IATA, 2018). Developing AI Systems such as Expert Systems, DSS, Intelligent Decision Support Systems (IDSS) considering new concepts in aviation need with using modern information technologies, and modern courses such as Data Science, Big Data, Data Mining, Multi-Criteria Decision Analysis, are relevant now.

Support for the safe functioning of aviation and ANS too is one of the most important scientific and technical problems. Statistical data show that human errors account for up to 80% of all aviation accidents (ICAO, 2004; Leychenko, 2006; National Transportation Safety Board (NTSB), 2022).

Aviation systems cannot be wholly free from dangerous factors and connected with their risks, while the elimination of aviation events and serious incidents continues to be the final goal of human activity in

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