Technische Hochschule Ingolstadt

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The Future of AI in Air Traffic Management: Coordinating Autonomous Airliners and UAM within Busy Airspaces using AI

Seminar Paper

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Affidavit

I certify that I have completed the work without outside help and without using sources other than those specified and that the work has not yet been submitted in the same or a similar form to any other examination authority and has been accepted by them as part of an examination. All statements that have been adopted literally or analogously are marked as such.

Ingolstadt, 23 May 2025

Signature

Acronyms

AI artificial intelligence. 1, 2

ATCO air traffic controller. 1, 2

ATM air traffic management. 1

eVTOL electric VTOL. 1

UAM urban air mobility. 1

UAS unmanned aerial system. 1

UTM UAS traffic management. 1

Abstract

The summary gives the reader a rough overview of the content (brief problem definition, approach, solution approaches and possibly key findings). The scope should be about half a page. This chapter is not mandatory and should only be considered optional.

Contents

1 Introduction

The rapid advancement of aerospace technology and urban infrastructure is driving the emergence of urban air mobility (UAM) and autonomous airliners, reshaping the future of air transportation. UAM refers to the use of electric VTOL (eVTOL) aircraft to provide efficient, low-emission air travel within and around cities, aiming to alleviate ground traffic congestion and reduce travel times [1]. Simultaneously, the development of autonomous airliners (capable of operating with minimal or no human intervention) is gaining momentum, promising increased safety, operational efficiency, and cost-effectiveness in commercial aviation [2]. Together, these innovations mark a significant shift toward smarter, more sustainable air transportation systems, supported by breakthroughs in artificial intelligence (AI), sensor technology, and regulatory evolution.

As the skies grow increasingly crowded with traditional aircraft, drones, and emerging eVTOL vehicles, modernising air traffic management (ATM) systems becomes essential. Traditional ATM frameworks, designed for conventional aviation, are not equipped to handle the complexity and volume introduced by UAM and autonomous operations [3]. To address this, the development of UAS traffic management (UTM) has emerged as a complementary solution, enabling the safe, scalable, and efficient integration of low-altitude, autonomous air traffic into national airspace systems [4]. UTM leverages digital communication, real-time data sharing, and dynamic airspace access. Together, ATM and UTM form the backbone of future-proofed aerial ecosystem, ensuring safety, reliability, and coordination across all types of airborne vehicles.

Integrating UTM into existing ATM infrastructure presents a range of technical, operational, and organisational challenges [4]. Traditional ATM systems are already under pressure, with many countries facing a critical shortage of air traffic controllers (ATCOs): an issue that hampers the capacity to manage even current levels of air traffic safely and efficiently [5]. Adding to this challenge is the rapid growth of unmanned aerial system (UAS) and UAM operations, which introduces unpredictable flight patterns, higher traffic density in low-altitude airspace, and the nead for real-time, automated coordination [6]. These factors demand that UTM systems be not only interoperable with legacy ATM systems, but also highly robust, adaptive, and capable of autonomous decision-making. Ensuring seamless integration while maintaining safety, realiabiity, and trust across both manned and unmanned aviation domains remains a core hurdle in realising the potential of next-generation air mobility.

2 Future of AI in ATM

In this paper, we will be discussing about the AI technologies that directly address the core challenges in airspace management and the increasing workload and staffing shortages faced by ATCOs.

2.1 Efficient Flight Planning

2.2 Maximised Airspace Utilisation

2.3 Dynamic Airspace Sectorisation

2.4 Digital ATCO Assistant

3 Challenges of AI in ATM

4 Conclusion and Outlook

References

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