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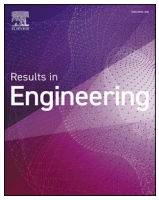

Optimizing UAV performance with IoT and fuzzy linear fractional transportation models

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ABSTRACT

Unmanned aerial vehicles (UAVs) have become indispensable in replacing human pilots for high-risk, high-intensity operations, including search-and-rescue missions, infrastructure inspection, and environmental monitoring. As a key enabler of these operations, UAV task planning systems require advanced trajectory optimization to operate effectively in dynamic, complex environments. This paper presents an innovative model integrating *fully fuzzy linear fractional transportation programming (FTMP)* with Internet of Things (IoT) technologies to enhance UAV performance. Unlike conventional path-planning methods, the proposed model leverages bio-inspired artificial intelligence (AI) algorithms and mixed-integer programming to solve multi-objective optimization problems under uncertainty. A critical feature of this platform is its ability to continuously adjust flight altitude based on real-time data, accounting for varying terrain morphology, fuel constraints, flight restrictions, and threats, thus ensuring optimal 3D trajectory planning. This makes the platform particularly effective in emergency scenarios such as natural disasters, explosions, or fires, where it supports rapid and accurate search-and-rescue efforts. The UAV system not only minimizes human involvement but also reduces the response time by transmitting real-time video, audio, and GPS data to responders over long distances. The proposed solution offers several advantages over traditional aerial platforms, including: (*a*) ***Precision tracking and path optimization*** with a demonstrated accuracy exceeding 88 % across recall, precision, and F-measure metrics. *(b)* ***Cost-effectiveness:*** The UAV is compact, lightweight, and affordable, significantly reducing operational expenses compared to helicopters. (*c*) ***Adaptability:*** Remote sensing allows for seamless control in rugged and obstructed environments. *(d)* ***Scalability:*** IoT integration supports multi-drone coordination for continuous real-time data collection and transmission to smartphones or command centers. This pragmatic UAV model offers transformative potential for emergency response, environmental monitoring, and smart infrastructure management, validating its reliability and efficiency through comprehensive performance metrics.

The Key features of the proposed UAV model include:

- Reduced search time for missing persons.
- Increased accuracy in tracking and locating missing persons, with less human effort required.
- Easy control and direction change through remote sensing.
- Small size, making it suitable for difficult environments.
- Cost-effective compared to traditional aircraft, enabling real-time data collection and transmission to smartphones or computers.

1. Introduction

Intelligent Data Analysis is an indispensable domain in computer science and real-world applications. It involves utilizing AI-based tools to intelligently analyze data and identify patterns that can be used to showcase various techniques for discovery or recovery pattern planning. The results of data evaluation and processing can be applied in practical scenarios [1,2]. Therefore, to address a specific real-world problem, one must evaluate realistic data and select the best logical approach for creating a model that can assess data once it has been discovered. The goal of the analysis is to generate rules, optimize troubleshooting,

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