

A Study on the Development of a Radio Interference Analysis System for UAM Services

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Abstract— This study proposes a radio interference analysis system to support the initial deployment of Urban Air Mobility (UAM) services by enabling evaluation of interference situations with existing wireless communication systems. A UAM-specific interference model is developed as the system's foundation, supporting quantitative analysis of mutual interference through various methodologies. Given UAM's corridor-based operation, interference scenarios involving base station (BS) and flight corridor locations are emphasized. To address these, a terrain-based radio propagation technique is applied to derive optimal corridor routes, BS placement, and antenna configurations that minimize interference. GIS-based visualization further enhances intuitive understanding of interference impacts, providing insights for effective system planning and deployment.

Keywords—Urban Air Mobility, Interference Analysis

I. INTRODUCTION

Urban Air Mobility (UAM), a promising solution to urban traffic congestion, operates along dedicated aerial corridors with predefined flight paths and altitude profiles [1]. In this study, we design a non-terrestrial wireless communication model with fixed-route corridors suitable for Monte Carlo-based interference analysis. Based on this model, we develop an interference analysis system to evaluate potential interference with existing communication networks. We also propose strategies for constructing interference scenarios to support UAM service optimization, along with analytical techniques for precise evaluation under each scenario. The proposed GIS-based analysis method further offers intuitive insights for optimizing UAM operations within geographically constrained service areas.

II. RADIO INTERFERENCE ANALYSIS SYSTEM

To analyze radio interference for UAM services, initial commercial corridors are designed at an altitude of approximately 450 ± 150 m above ground level. An interference model for the UAM system has been developed, as shown in Fig. 1, to evaluate interference effects across various UAM traffic scenarios based on commercial mobile networks. The model includes both downlink and uplink components, reflecting the structure of conventional terrestrial mobile communication systems.

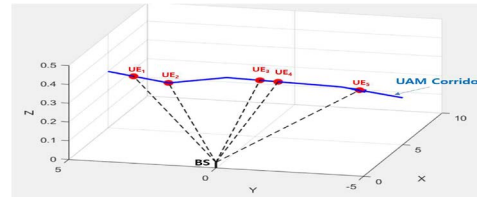


Fig. 1. UAM system interference model

The UAM system interference model is integrated into the overall interference analysis framework, as shown in Fig. 2, and used alongside existing wireless system models to perform Monte Carlo-based radio interference analysis.

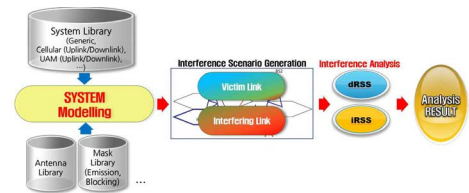


Fig. 2. Radio Interference Analysis System

To conduct Monte Carlo-based interference analysis, the interference and victim systems must first be modeled to reflect realistic scenarios. This includes defining key parameters such as communication schemes, antenna patterns, and filtering characteristics for both transmitter and receiver. After system modeling, the systems are spatially deployed according to the target scenario, and interference analysis is performed based on this configuration.

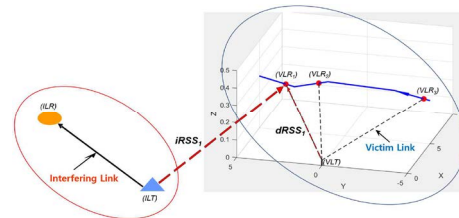
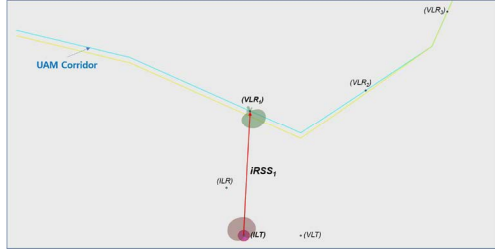
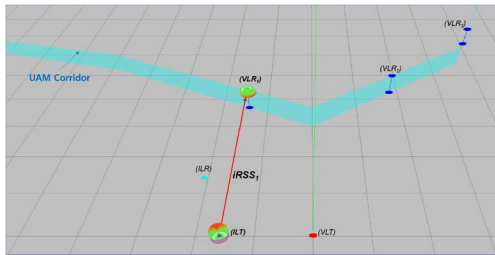


Fig. 3. Interference Scenario Generation for interference analysis

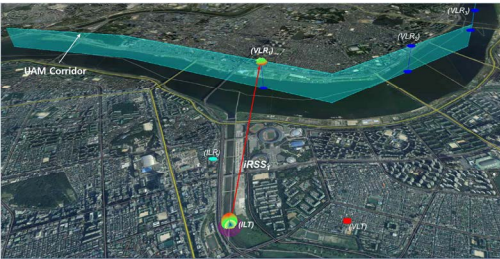
The interference scenario in Fig. 3 assumes that a generic communication system, composed of a transmitter and receiver, interferes with a neighboring UAM downlink system. Based on this scenario, the analysis calculates, for each event, the desired received signal strength (dRSS) at the victim link receiver (VLR) from the victim link transmitter (VLT), and the interfering received signal strength (iRSS) from the interfering link transmitter (ILT). These values are then statistically processed to evaluate the interference impact [2]. The results can be analyzed from multiple perspectives using various analysis modes, as shown in Fig. 4.



(a) 2D mode



(b) 3D mode



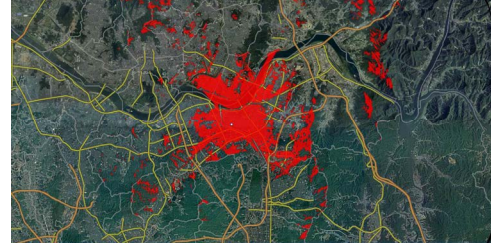
(c) GIS mode

Fig. 4. Various Interference Analysis Modes for iRSS Calculation

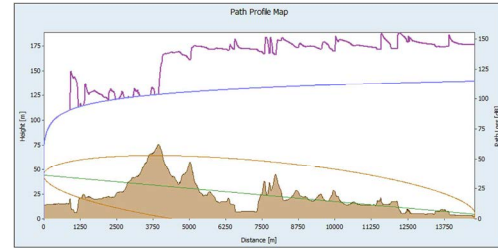
In non-terrestrial mobile services like UAM, interference with terrestrial wireless networks is affected by the spatial arrangement of ground base stations (BSs) and mobile stations within aerial corridors. Thus, combining two-dimensional (2D) and three-dimensional (3D) analysis allows for a more accurate assessment of the interference environment. Given that early-stage UAM services operate within regionally confined corridors, interference impact analysis reliability can be enhanced by applying a radio path loss model incorporating Geographic Information System (GIS) data of the service area [3].

III. ADDITIONAL ANALYSIS METHODS USING GIS

To improve the accuracy of UAM interference analysis, this study proposes a service area analysis method using GIS data and a propagation loss estimation technique based on terrain profiles. These GIS-based approaches enable more realistic modeling by reflecting the actual topography of UAM corridor regions, thereby enhancing the reliability of the analysis results.



(a) service area analysis



(b) propagation loss analysis using terrain profile

Fig. 5. Additional Interference Analysis Methods Using GIS

IV. CONCLUSION

In this study, we proposed the design of a simulator capable of analyzing radio interference between predefined-path(Corridor) wireless communication networks such as the emerging UAM systems and existing terrestrial networks using a Monte Carlo simulation approach. In particular, for scenarios where path and region-specific interference evaluation is critical, such as in UAM communications, it was confirmed that radio propagation analysis incorporating terrain information provides valuable insights for accurately assessing interference conditions.

ACKNOWLEDGMENT

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