

AERIAL COMMUNICATIONS



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Over the past few years, unmanned aerial vehicles (UAVs) and other aerial platforms have become central to several aspects of business and daily life. From remote delivery to acquiring landscape information to providing connectivity in emergency scenarios, drone features are proving to be highly beneficial in places where humans cannot reach or are unable to perform in a timely, efficient, or secure manner, thus paving the way for several disruptive new applications.

Nevertheless, the management and operation of UAVs and other aerial platforms require the study and development of novel solutions in the field of aerial communications. Indeed, one of the most interesting aspects of such aerial platforms is concerned with communications and networking. This includes two complementary areas:

1. The design of proper aerial communication solutions to enable inter-UAV or ground-to-UAV connectivity in a reliable and affordable manner
2. The usage of aerial platforms as mobile network nodes, capable of moving in the 3D space to support communications and service provisioning

Research is still in its early stages to understand how to characterize the aerial communication channel and the challenges and complexity of securing more extended operation and battery life. This Feature Topic (FT) on Aerial Communications aims to address these two challenges with innovative solutions, and received an overwhelming response. All submitted papers have been rigorously peer-reviewed, and the first set of accepted papers are summarized below.

The first article, “THz-Empowered UAVs in 6G: Opportunities, Challenges, and Trade-offs” by M. Mahdi Azari *et al.*, investigates the potential opportunities and application cases of THz-empowered UAVs. The challenges of the corresponding novel designs and their trade-offs are discussed. Furthermore, the article provides an overview of the recent research efforts on UAV deployment regulations, THz standardization, and health aspects of THz bands.

In the second article, “Communication Demands and Performance Metrics for Next Generation Aerial Networks,” Markus Klugel *et al.* provide an overview of the demands from both novel application cases of aerial networks and regulatory bodies of airspace. This article discusses the mismatch and presents an approach to formally transfer required communication performance (RCP) into more “communication-friendly” requirements.

The third article, “High-Mobility Satellite-UAV Communications: Challenges, Solutions, and Future Research Trends” by

Jiawei Wang *et al.*, studies the key challenges and opportunities of high-mobility satellite-UAV communication systems. This article discusses issues including time-varying channel estimation, high-mobility transceiver, and high-mobility multiple access.

In the fourth article, “Aerial Base Station Placement: A Tutorial Introduction,” Pham Q. Viet *et al.* provide an overview of the aerial base station (ABS) placement problem. This article first illustrates the fundamental challenges and trade-offs using a toy application example. Then the article introduces various methods for 2D and 3D ABS placement, such as clustering-based placement, virtual-force-based placement, and placement using terrain or radio maps.

The fifth article, “Charging Techniques for UAV-Assisted Data Collection: Is Laser Power Beaming the Answer?” by M.-A. Lahmeri *et al.*, addresses charging techniques for drone-assisted data collection. It analyzes and compares different wireless and wired charging techniques, including laser beaming, charging stations, and tethered stations. This article presents Monte Carlo simulation results to demonstrate that laser-powered drones outperform tethered and recharged drones in specific scenarios. It also acknowledges the challenges of laser-powered drones and points out possible future research directions.

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BIOGRAPHIES

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