

# Resource Allocation and Trajectory Design for UAV-Enabled ISAC

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How can UAV trajectory and resource allocation be jointly optimized in ISAC systems to enhance power efficiency while maintaining high-quality sensing and communication? What practical considerations are taken into account for UAV-based sensing systems?



*A UAV-enabled ISAC system where a UAV hovers over multiple targets, transmitting sensing and communication signals while optimizing trajectory and resource allocation. The UAV maintains line-of-sight (LoS) to ground users, reducing required sensing power. It adapts trajectory and beamforming to balance sensing accuracy, communication quality, and power consumption while efficiently offloading sensed data via a limited backhaul link.*

## KEY FINDINGS

Optimized UAV Operation: UAV hovers above targets to maximize sensing quality, reducing required power while ensuring effective communication.

- **SIGNIFICANT POWER SAVINGS:** The proposed algorithm achieves substantial energy efficiency compared to heuristic-based trajectories.
- **SENSING-COMMUNICATION TRADEOFF:** Stricter sensing requirements demand longer hovering times, emphasizing the challenge of balancing efficiency and accuracy.
- **RADAR CROSS-SECTION (RCS) IMPACT:** Higher RCS enhances echo strength, reducing radar transmit power needs.
- **BACKHAUL CONSTRAINTS & DATA OFFLOADING:** UAV placement relative to the base station influences data transmission efficiency.

*A. Khalili, A. Rezaei, D. Xu, F. Dressler and R. Schober, "Efficient UAV Hovering, Resource Allocation, and Trajectory Design for ISAC With Limited Backhaul Capacity," in IEEE Transactions on Wireless Communications, vol. 23, no. 11, pp. 17635-17650, Nov. 2024*

*A. Khalili, A. Rezaei, D. Xu and R. Schober, "Energy-Aware Resource Allocation and Trajectory Design for UAV-Enabled ISAC," GLOBECOM 2023 - 2023 IEEE Global Communications Conference, Kuala Lumpur, Malaysia, 2023, pp. 4193-4198*