

Jamming Mitigation for Vehicular-Urban Cloud Architectures Based into a Modal OAM-ISAC Operation

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Abstract

Vehicle-urban-cloud (VUC) architectures, cellular base stations (CBS) and on-board units (OBUs) remain vulnerable to different cyber-attacks threats within the cellular vehicle-to-everything (C-V2X) environments for connected autonomous vehicles (CAVs). Improving the future of cybersecurity in Cloud Computing, requires combining advanced physical-layer defense with dynamic, cloud-native security frameworks. To counter high-power broadband jamming in dynamic, urban vehicular environments (V2X), the primary defense shifts from frequency-agility to spatial and mode-domain isolation. Broadband jammers typically emit traditional plane waves (which correspond to an OAM zero order mode). By exploiting the unique physical properties of OAM vortex waves and the spatial environment awareness of ISAC, you can isolate, nullify, and outmaneuver broadband jamming attacks, through the following 20-30 mitigation strategies:

1. Implement Physical-Layer Anti-Jamming & Mode Hopping: a) Exploit OAM Orthogonality. This naturally isolates data streams and prevents eavesdropping, b) Leverage pre-shared cryptographic keys to constantly hop between different OAM modes at the transmitter and receiver.
2. Deploy AI-Driven Threat Detection & Continuous Sensing: a) Use the "sensing" capability of ISAC to actively monitor the surrounding environment for unauthorized physical devices or jammers, b) Offload sensing data to cloud computing platforms to perform high-resolution to nullify mixed interference.
3. Fortify Cloud Infrastructure: a) Use Reconfigurable Intelligent Surfaces (RIS) antennas and holographic MIMO to dynamically shape and secure transmission beams, b) Network Virtualization: Integrate 6G O-Cloud architectures to logically isolate ISAC services from general communication traffic, allowing for granular security rule deployment.

Keywords

Jamming Mitigation, Vehicular-Urban Cloud Architecture, Orthogonal Angular Momentum (OAM), Integrated Sensing and Communication (ISAC), Intelligent Antennas, V2X.