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INNOVATION HIGHLIGHT

Technology in Support of National Security

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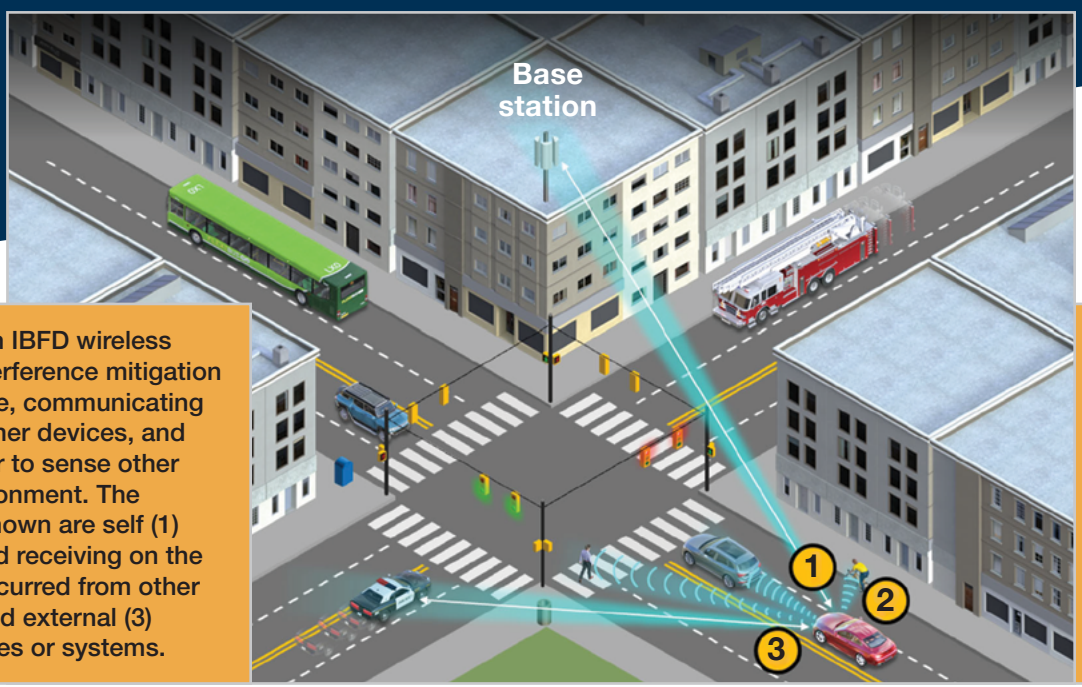
Improving Transportation Communications via Wireless System with Advanced Interference Mitigation



Deployment scenario of an IBFD wireless system with advanced interference mitigation installed on a smart vehicle, communicating with a base station and other devices, and simultaneously using radar to sense other vehicles/users in the environment. The three interference types shown are self (1) caused by transmitting and receiving on the same band; onboard (2) incurred from other systems on the vehicle; and external (3) acquired from other vehicles or systems.

Lincoln Laboratory has developed technology that for the first time enables in-band full-duplex (IBFD) wireless communication systems to mitigate interference from multiple sources. The system increases the number of devices supported (potentially dozens), improves their data rates, and expands their communication range. This novel IBFD system, easily incorporated into vehicles and base stations, can enable an intelligent transportation network that communicates with multiple vehicles and devices to enhance driver safety.

KEY FEATURES

- Mitigation of self, onboard, and external interference below receiver noise floor allows multiple devices to use same frequency
- Tenfold increase in data rate over 4G technology supports data-intensive applications
- Range of 28 miles enables a communication network with fewer base stations and longer-distance communication between users

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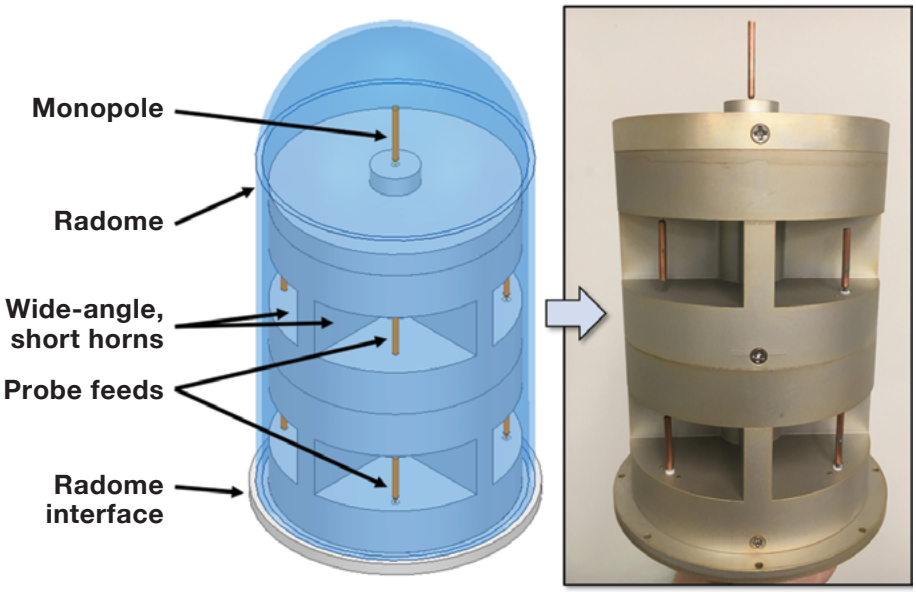
Improving Transportation Communications via Wireless System with Advanced Interference Mitigation

Motivation

Today, more than 18 billion wireless devices are in use worldwide, driving the need for interoperability with more bandwidth and higher data rates. One segment of wireless users, vehicle operators, is predicted by Gartner, a tech research/consulting firm, to become the biggest future market for fifth-generation (5G) wireless capabilities. Solutions for intelligent transportation communications are needed to promote safety on streets and highways. Users will need access to the limited frequency spectrum for radar functions that provide safety and autonomous driving, and new communication channels that allow connectivity between vehicles and the roadway infrastructure.

Wireless systems employing IBFD operation can increase the capacity and number of devices supported by allowing them to transmit and receive simultaneously on the same frequency. However, previous IBFD systems only suppress self-interference and do not mitigate interference from other wireless sources on board and external to the system, leaving them impractical for use in realistic environments.



The left drawing illustrates the parts of the antenna model with a protective cover in blue; at the right is a photograph of the system prototype.

Innovative Solution

Lincoln Laboratory's new wireless system architecture enables IBFD operation in environments containing multiple sources of interference. By uniquely combining antenna nulling to suppress self-interference, RF/digital cancellation to reduce onboard interference, and adaptive beamforming to remove external interference, the architecture addresses the problem faced by vehicles and transportation hubs trying to communicate amidst interference produced by the abundance of wireless devices installed in and surrounding today's vehicles.

Our solution includes a unique antenna that provides omnidirectional coverage and features two distinct capabilities: (1) IBFD for reducing self-interference and (2) receive beamforming for suppressing external interference.

U.S. PATENT #US20240014577A1

More Information

K.E. Kolodziej, P. Dufilie, et al., "Vehicle-Mounted Antenna with Full-Duplex and Beamforming Capabilities," in 2022 IEEE International Symposium on Antennas and Propagation and U.S. National Committee of the International Union of Radio Science (USNC-URSI) Radio Science Meeting, July 2022, pp. 776-777.

This technology is an R&D 100 Award Winner

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