Skysong Innovations
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1475 N. Scottsdale Road, Suite 200
Scottsdale, AZ 85287-3538
Phone: 480 884 1996 Fax: 480 884 1984

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Inventors

Seyedmohammadreza Faghih Imani
Abu Huraira Muhammad Idban

Contact

Physical Sciences Team

Conformal Metasurface Antennas for Angle of Arrival Detection

Detecting angle of arrival (AoA) of electromagnetic (EM) signals is a priority for many civil and military applications including navigation, surveillance, and communication systems. The antenna structures typically used for this purpose are required to conform to nearly arbitrary surfaces including robots, cars, aerial vehicles, and missiles. As a result, the array elements on a conformal surface need to be closely spaced to avoid phase ambiguity. Alternatively, high-gain elements can be utilized to mitigate phase ambiguity and improve detection capabilities. The design of conformal antennas for AoA detection requires navigating a tradeoff between the size of each element (to increase gain) and the spacing of adjacent elements. This process can quickly become complicated, especially if there are other restrictions set by the application (e.g., mechanical, shape, or stealth requirements). This can increase the overall cost and complexity of the design by requiring many receiving units to conduct adequate sensing.

Researchers at Arizona State University have developed a conformal metasurface antenna designed for angle of arrival (AoA) detection that requires only a few receiving units by using compressive sensing techniques. This technology utilizes numerous radiators close together on a conformed surface, which eliminates the need for high-gain antennas and any issues related to phase ambiguity. The use of compressive sensing allows for the deduction of the AoA through only a few receiving units by applying certain features including random multiplexing of information.

Related Publication: Conformal Frequency-Diverse Metasurface for Computational AoA Detection

Potential Applications:

- Navigation (e.g., autonomous vehicles, wearable accessories)
- Surveillance (e.g., aircraft, drones)
- Communication (e.g., ground robots, aircraft)

Benefits and Advantages:

- Removes phase ambiguity (numerous radiators are placed close together on a conformed surface)
- Does not require high-gain antennas, which require a larger footprint
- Easily implemented on any surface of arbitrary curvature
- Can operate with very few receiving units (can be designed to use only a single receiving unit)