



Electrically Small, Super-Directive Antennas Inspired by Insect Anatomy

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WARF: P120184US01

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The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing electrically small antenna arrays with high directional resolution and collected power.

Overview

Antennas that are electrically small, those with dimensions relatively diminutive compared to the size of the wavelengths they radiate, are integral to radio engineering, from wireless garage door openers to cell phones. Conflicts between size, power and resolution have limited the technology's potential in both theory and practice, however, as capabilities diminish with shrinking apparatus size.

To improve directional resolution, researchers have looked to nature for new small-scale designs. One biologically inspired, or biomimetic, antenna array seeks to imitate the ear structures of *Ormia ochracea*, a minute fly acutely able to localize mating calls. Yet the enhanced angular sensitivity of the array has led to a decrease in the system's signal-to-noise output. This inherent tradeoff mimics nature also, where small animals and insects with directional hearing compromise long distance hearing in favor of pinpointing closer sounds. An improved system must overcome such a tradeoff.

The Invention

A UW-Madison researcher has developed an electrically small array that converts super-resolving antennas to super-directive antennas by utilizing a phase shifter. The resolution enhancement increases the total amount of collected power and the overall signal-to-noise output.

The receiver system includes two antennas and a processing circuit with a differential phase shifter (DPS). The second antenna receives a signal, which then is phase shifted as a function of its angle of incidence relative to the array's boresight axis. An output signal can be configured by combining the phase-shifted signal with the first antenna's original signal.

Three distinct DPS methods can achieve the same result. Active DPS can be implemented using a mixer, filters, amplifiers and voltage controlled phase shifter. Direct DPS is another analog process, while digital DPS samples and processes the antenna signals digitally.

Applications

- Consumer wireless communications
- High data rate communication
- High-resolution microwave/mm-wave imaging
- Source tracking

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Key Benefits

- Super-directive, super-gain performance
- Increased total collected power
- Increased overall signal-to-noise
- Increased resolution independent of physical aperture dimensions

Stage of Development

The development of this technology was supported by WARF Accelerator. WARF Accelerator selects WARF's most commercially promising technologies and provides expert assistance and funding to enable achievement of commercially significant milestones. WARF believes that these technologies are especially attractive opportunities for licensing.

Additional Information

Related Technologies

- [For more information about the researcher's electrically small, super-resolving biomimetic antennas, see WARF reference number P110043US01.](#)

Publications

- Behdad N., Al-Joumayly M., and Li M. 2011. Biologically Inspired Electrically Small Antenna Arrays with Enhanced Directional Sensitivity. IEEE Antennas and Wireless Propagation Letters, Vol. 10.

Tech Fields

- [Information Technology : Networking & telecommunications](#)

For current licensing status, please contact Michael Carey at mcarey@warf.org or 608-960-9867

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