Small Beamformer for Simultaneous Spatial and Channel Diversity Communications

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Enhances capacity in mobile wireless network traffic

This technology is a new approach to overcoming the buildup of radio frequency waves across orthogonal frequency division multiple access (OFDMA) networks, often caused by an excess of users jamming network bandwidth. Georgia Tech's technique brings together plural interpenetrating beamformers, each operating and scanning on different channels, onto a common platform. It is designed to contain multiple independent arrays, each capable of simultaneously carrying its own independent radio frequency channel in the same area as a single one-channel legacy antenna array.

The structure—comprised of unit cells of sub-arrays and interpenetrating arrays composed of monopoles from each unit cell—is designed in rows and columns. Each rod monopole measures approximately one-fourth of the radio frequency wavelength in height. The technology aims to: 1) keep the number of users carried by a bandwidth transmitted by a legacy antenna array sufficiently low to generate a manageable error rate and 2) compensate for the reduced throughput by increasing the number of transmitting antenna arrays.

Summary Bullets

- **Scalable**: Improves capacity by increasing the number of arrays and increasing the gain of each interpenetrating array
- **Small formfactor**: Contains nine interpenetrating arrays in the same area as a single legacy array capable of carrying only one bandwidth
- **Efficient**: Demonstrates that each antenna array can spatially scan at least nine independent interpenetrating arrays simultaneously, each carrying its assigned information channel within the assigned bandwidth

Solution Advantages

- **Scalable**: Improves capacity by increasing the number of arrays and increasing the gain of each interpenetrating array
- **Small formfactor**: Contains nine interpenetrating arrays in the same area as a single legacy array capable of carrying only one bandwidth
- **Efficient**: Demonstrates that each antenna array can spatially scan at least nine independent interpenetrating arrays simultaneously, each carrying its assigned information channel within the assigned

bandwidth
- **Cost-saving**: Demonstrates potential to lower costs by minimizing the part duplication used to construct separate beamformer platforms; shared equipment also has the potential to promote energy efficiency

Potential Commercial Applications

This technology could advance a variety of wireless communications applications, including in 5G and future generation network architectures. Specifically, potential applications include:

- Outdoor large base station panels for late 5G and the following 6G era
- Indoor small millimeter-wave base stations that can be used at convention halls, game stadiums, etc.

Background and More Information

As Internet connectivity, smartphones, and social media platforms proliferate, so too do the means of production that sustain an increasingly complex social network. Demand is growing for more and faster communication between people and between machines in factories, fisheries, farms, orbital sensors, and other smart devices. Legacy radio antenna arrays are generally constructed of easily printed, low aspect ratio patch radiators that are designed to operate optimally in a single frequency band or communication channel. Single channels are sometimes overwhelmed by an excess of users, causing transmissions errors and a loss of information.

This invention utilizes radio frequency beamforming, a method in which an array of electrically conducting elements can be directed to transmit radio signals in a targeted area. The propagation of radio waves emanating from an array of electrically conducting structures can be steered in various spatial directions by deliberately designing a set of delays in the path of electrical currents, which alternate at radio frequencies and are supplied to each electrically conducting structure in the array.

While beamforming technology generally has broad applications, this technology is designed to support beamforming arrays for use in mobile wireless networks—specifically 5G networks and future 6G networks. While existing infrastructure serves the needs of 4G and 4G-LTE mobile wireless networks, the networks of the present and near-future are required to provide higher peak data rates, higher spectrum, and energy efficiency, improved mobility, lower latency, higher density of connections, and a significantly advanced ability to move massive peak volumes of data over previous networks.

How It Works

This approach consists of a unit cell sub-array containing N x N high aspect ratio one-fourth wave rod monopole radiators as the basic building unit to construct N x N interpenetrating phased arrays. The arrays each contain (I x J) one-fourth wave rod monopoles within the form factor of a legacy (I x J) patch array unit cells, each consisting of precisely one patch radiator.

Additionally, each interpenetrating array may be spectrally guarded by a narrow bandpass filter. The distribution of the N x N monopoles in a sub-array unit cell and their relative separation is largely inconsequential, barring electrical contact.

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IP Status

<p class="MsoNormal">The following patent application has published<o:p></o:p></p>: WO2023133300A1

Publications

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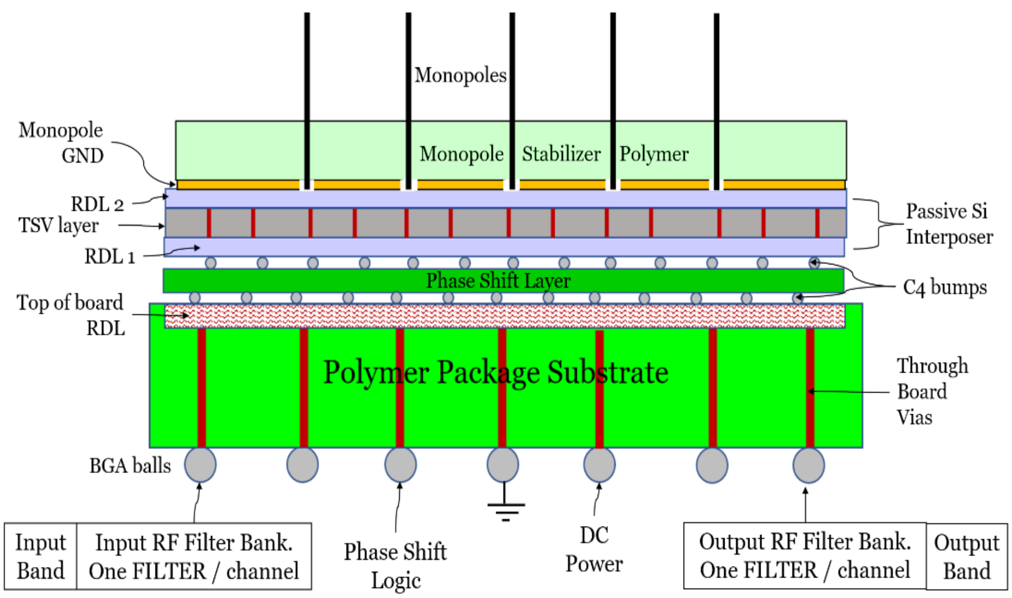
Images



Cross-sectional sketch of a 2.5 D component stack-up process leading to an initial testable prototype

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