Electromagnetic (EM) Metastructures

For structural and electromagnetic uses in radome structures

These multi-use metamaterials can serve both structural and electromagnetic purposes in radome structures. Georgia Tech's innovation replaces the conventional radome inner core dielectric with a 3D frequency selective structure (FSS) metamaterial to provide mechanical rigidity, yet it still provides an EM response by sculpting the transmission, reflection, and absorption response of the impinging EM wave.

Further, electronic components and phase-change materials can be integrated to generate active (e.g. non-Foster circuits) and/or non-linear responses, including but not limited to shuttered or non-reciprocal radomes, frequency tunable spatial filters, wideband reconfigurable planar antennas, and reconfigurable surface wave antennas. The innovation works with traditional printed circuit board (PCB) technologies but also extends to additive manufacturing (3D printing) processes and non-standard PCB materials for more innovative performance requirements. Useful for a wide variety of applications, these EM metastructures can be configured for operation over frequency ranges from DC to the visible regime.

Summary Bullets

- **Multi-use**: Provides structural support in conjunction with static and *in situ* EM performance
- **Efficient**: Reduces size, weight, power, and cost (SWaP-C) parameters
- **Flexible**: Integrates non-standard material systems

Solution Advantages

- **Multi-use**: Provides structural support in conjunction with static and *in situ* EM performance
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Potential Commercial Applications

These materials have the potential to open an avenue to design composites that fulfill both structural and multi-physics and multi-scale performance demands in such a way that they can be made flightworthy, seaworthy, and suitable for high-temperature applications.

- Structural support
  - Reflector-based antenna systems
  - Cassegrain antenna systems

- Electromagnetic response
    - Frequency filtering
    - Electromagnetic field shielding
    - Polarization conversion
    - Signal multiplexing
    - Sub-reflectors
    - Impedance matching to RF sensors

Background and More Information

Radomes are structural weatherproof enclosures that encircle and protect electromagnetic devices—such as RF antennas—to protect them from the operational environment (e.g., rain, wind, snow, ice, sand). Beyond weather elements, radomes also can be used to protect devices from an electromagnetic environment. Ideally, a radome does not degrade the EM performance of the devices concealed. They are traditionally constructed using dielectric material stack-ups composed of two outer dielectrics surrounding an inner dielectric core in a so-called sandwich formation.

Georgia Tech's innovation replaces the core material with 3D FSS metamaterial arrays to provide mechanical rigidity as well as EM response.

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IP Status

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Publications

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