

Tunable Impedance Surfaces for Low-cost Beam Steering and Conformal Antennas

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HRL Laboratories has developed a tunable impedance surface that enables a low-cost electronic beam steering. It consists of a lattice of resonant elements that are interconnected with their neighbors by varactor diodes. The surface provides a frequency dependent phase shift for reflected waves, which depends on the resonance frequency of the resonators. By varying the reverse bias voltage on the varactors, we can locally tune the resonance frequency, creating a programmable phase shifting surface. This is used to steer or focus microwave energy.

The tunable surface can also be used with a conformal feed. In this implementation, we excite surface currents with a small antenna located directly adjacent to the surface. We tune the surface to create a periodic grating structure, and the surface waves leak off at an angle determined by the period of the surface impedance. This implementation eliminates the protruding structure required by a space feed, resulting in a complete antenna structure that is electrically thin. We have shown that this concept can also be used on curved surfaces, so the antenna can be conformal to arbitrary shapes.