Two Port Reconfigurable Metamaterial Leaky Wave Antenna

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**Overview**

Highly reconfigurable two element array with beam steering capabilities in a compact design and with good impedance matching for all its configurations.

Three major benefits are achieved in using this reconfigurable antenna in MIMO communications:

- increased data rate compared to common non-reconfigurable antennas;
- reduced power consumption with respect to standard non-reconfigurable arrays;
- reduced space occupation by the antenna on the communication device.

**Tunable CRLH unit cell**

- Composite Right Left Hand (CRLH) reconfigurable unit cell antenna design
- Composite Right Left Hand (CRLH) unit cell with two independent biasing points to dynamically change the unit cell propagation constant for a fixed frequency of operation.
- The unit cell Bloch impedance is kept close to $50\,\Omega$ for good impedance matching, by tuning the two independent DC bias points.

![Composite Right Left Hand (CRLH) reconfigurable unit cell antenna design](image)

**Reconfigurable leaky wave array**

- 25 cascaded unit cell form a two port pattern reconfigurable leaky wave antenna.
- Electronic beam scanning is a function of the applied bias voltage ("S" and "SH")
  \[ \theta = \sin \left( \frac{\beta(\text{S}, \text{SH})}{k_0} \right) \]
- Radiation patterns excited at the two ports are symmetric with respect to the broadside direction.
- High isolation between the two ports (>10 dB).

**2x2 channel measurements**

- Semi-anechoic chamber with metallic foils for increased multipath.
- RLWA employed at the RX.
- 20 MHz band centered at 2.45 GHz.
- 5 locations and 10 points per location spaced $\lambda/10$ on the y axis.

**RLWA performance**

- Average capacity improvement of 14% with respect to the array of dipoles.
- 18% average capacity improvement with respect to the RLWA most capacity achieving configuration.

**Power saving using the RLWA with respect to dipoles for a target throughput of 300 Mbps.**

**Measured return loss of the two ports of the RLWA for 5 different configurations.**

**Unit cell dispersion diagram for 5 different configurations of applied voltages.**

**Measured radiation patterns (in dB) for 5 different configurations at the two ports of the RLWA. Frequency = 2.45 GHz.**