Time Varying Non-reciprocal Systems: A True Path to Outperform Magnetic Nonreciprocal Devices

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Microwave frequency nonreciprocal devices have long been sought after for a wide range of applications, including full-duplexing radios, network analysis, and quantum computing. Most commonly utilized nonreciprocal devices at microwave frequencies are isolator and circulators. Conventionally, non-reciprocity is obtained by magnetically biasing a ferrite material composed as an EM resonator. They typically lack integration and a compact factor. Even though high performance has been obtained for ferrite devices, the need for more integrated nonreciprocal device has motivated the scientific community to seek alternative technologies for implementing non reciprocity.

Time varying systems have recently been demonstrated with several subtly different flavors, all of which achieve promising performance with drastically different underlying design trades. This talk will first briefly review these promising time varying approaches and their corresponding performance bounds imposed by their mechanisms of obtaining non-reciprocity. Then, discussions will be offered on technology venues where time varying non-reciprocal systems are expected to truly outperform the ferrite circulators. Next, design and implementation of time varying nonreciprocal devices, such as gyrators and circulator, that are based on high performance passives and targeting these venues will be presented with performance comparisons to SOAs. The study on the frequency scalability of the design system will also be shown and the best platforms for different frequency ranges will be suggested. In addition to reporting measured performance, the talk will also discuss the caveats in modeling, measurements, and interpretation of results of of time varying systems.