**Microwave Pulse Compression Devices with Modal Degeneracy**

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Electromagnetic band gap (EBG) structures are widely used in engineering many microwave devices, such as printed antennas, wireless charging, lasers, radars, sensors, as well as others. A specific subset of EBG periodic structures can be designed to exhibit eigenmode degeneracy at the band edge, such as the degenerate band edge (DBE) in special types of coupled mode periodic structures. DBE represents a fourth order degeneracy, i.e., four eigenmodes in a periodic structure coalesce into a single one. These four eigenstates coalesce at the edge of the Brillouin zone, designating a DBE condition which means that current/voltage eigenvectors are no longer independent at the degeneracy point. Waves at frequencies near that of the DBE experience very low group velocity and high field enhancement.

We use these properties of DBE in the design of a pulse compression structure. For the first time, we show that properly designed coupled transmission lines, implemented in microstrip technology with realistic ohmic and radiation losses at RF frequencies, exhibit DBE. The designed microstrip line is tunable by incorporating varactors/switches that detune the DBE condition. We then show how to use this structure in a pulse compression application, building on concepts introduced in (V. A. Tamma, A. Figotin, and F. Capolino, IEEE Trans. Microw. Theory Tech., vol. 64, no. 3, pp. 742–755, 2016). In particular, when operating at the DBE, the waveguide system excited by an external generator accumulates energy over a length of time. By breaking the DBE by means of a change to the state of the varactors, the energy is no longer trapped, and can be coupled to output loads, enabling very short (in time) output pulse with high power pulse compression ratio. We show the performance of the proposed DBE-based pulse compressor by using both circuit simulators and full wave simulations, with losses and non linearities accounted for. The immediate applications are in high power microwave applications, pulse compression in CMOS technology at millimeter waves, radar and communication systems.