Array of Sequentially Phased Antennas with Exceptional Point of Degeneracy

Tarek Mealy, Ahmed F. Abdleshafy, Alireza Nikzamir, and Filippo capolino*
University of California, Irvine, CA 92697, USA, e-mail: f.capolino@uci.edu

We explore the concept of array of antennas arranged periodically and sequentially fed by two coupled transmission lines, under a special condition known as the exceptional point of degeneracy (EPD) at which two or more of the supported eigenmodes of the system coalesce [1,2,3]. When the system is described with its eigenvalues and eigenvectors, at an EPD at least two eigenvalues (i.e., wavenumbers) of the waveguide coalesce, implying that also the eigenvectors (polarization states) coalesce. The number of coalescing eigenmodes determines the order of the degeneracy. We investigate different radiating array structures capable of exhibiting EPDs in their dispersion diagram. In particular we will explores a few kinds of EPDs called, the regular band edge, the stationary inflection point and the degenerate band edge.

Besides the theoretical background, we will also show an experimental verification of the occurrence of EPDs in such periodic structures [2]. We will discuss the effect of CTLs radiative and dissipative losses on EPDs and how introducing gain to the CTLs compensate for such losses restoring the EPD in a fully radiating array, in what we define as the gain and distributed-radiation balance regime. We explore the concept of leaky wave antennas operating at an EPD and how sensitive their radiation pattern is when EPD is perturbed. Finally we show how to design large linear arrays that efficiently generate microwave oscillations [4], and how they are able to generate collimated beams with large radiation intensity by spatial power combining.

References

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