

## **Degeneracies in Electromagnetic Systems and Possible Applications**

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There are various kinds of degeneracies in electromagnetic systems and we discuss here an important class of them: the case when two eigenstates of a system coalesce. We do not discuss the otherwise common concept of two independent modes in a waveguide that have the same wavenumber. In this talk an electromagnetic system can be understood either as a body of finite dimensions supporting electromagnetic (resonant) waves or as a waveguide that support guided modes. In either case the same general concept discussed here can be applied. For the finite-size body problem, electromagnetic fields can be decomposed in terms of resonant modes, whereas in a waveguide an electromagnetic wave can be decomposed in terms of guided modes. In both cases the field is decomposed in terms of modes and in both cases we can discuss the degeneracy when at least two modes become identical in terms of frequency (and wavenumber, for the waveguide case), polarization and energy distribution. We discuss how to classify such degeneracies and how to represent them in mathematical terms. Such degeneracies occur in systems that can be fully passive or in systems that include gain elements; we discuss the common aspects of these two classes. Finally, we discuss possible applications in the area of sensing, oscillators, antennas, amplifiers, etc.

## References

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