Abstracts

General constraints on the propagation of complex waves in closed lossless isotropic waveguides

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Complex propagation in linear time-invariant lossless isotropic closed waveguides is a theoretically intriguing subject. Complex modes are also practically important in the characterization of discontinuities as they contribute in pairs with complex conjugate (c.c.) propagation constants to local power storage. By the systematic application of Lorentz's reciprocity theorem, we derive the constraints linking complex propagation constant, Poynting's integral, and electromagnetic energy storage per unit length. Previously known conditions are recovered, and novel constraints on the exchange power between the two components of the pairs are derived. It is emphasized that existing relationships individually derived by different methods and scattered in the literature, as well as novel ones, are derived from a single fundamental theorem. This set of constraints is believed to pose the tightest necessary conditions so far for the existence of complex waves.

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