Abstracts

Transmission Distortion in Multimode Random Waveguides

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We consider the coupled line equations for two-mode random media in which both modes travel in the same (forward) direction as a model for multimode millimeter waveguides and optical fibers, in which mode conversion at imperfections occurs primarily in the forward direction. Some exact general properties satisfied by the transfer function and the impulse response of such a system are given for an arbitrary coupling coefficient. A random stationary coupling coefficient with statistically independent successive values, and consequently a white spectrum (e.g., a white Gaussian or a Poisson noise), permits exact determination of transmission statistics; we obtain first- and second-order statistics in the time and frequency domains. No perturbation or other approximations are made in any of the above results, which are obtained directly from the coupled line equations. These results are used to study signal distortion in long guides. By straightforward extension of this work more complicated calculations can treat more forward modes, but not backward modes or nonwhite coupling coefficient spectra. In this paper the coupling coefficient is assumed frequency independent, and under certain conditions the signal distortion decreases as the mode conversion increases. In practical cases the coupling coefficients are frequency dependent and the above behavior is modified; the present work is extended to this important case in a companion paper.

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