Ray tracing in a turbulent, shallow-water channel

A ray tracing model can be used to simulate sound (10–100 kHz) transmitted through shallow water. The phase of the ray arrivals, primarily given by travel time, may be mutually independent in such a multipath transmission. Consequently, the transmission loss in a receiving point is randomly valued due to the coherent interference of the multipath arrivals. This problem can be overcome by incoherent summation of the multipath arrivals. However, knowing that nature behaves coherently, this method is not preferred. Instead, the channel can be regarded as dynamic by allowing microfluctuations of the sound speed. Specifically, the channel may be modeled as given by horizontal layers, each assigned with an individual turbulent dissipation rate, and a translation of this is performed into diffraction and phase fluctuation parameters, following Dilorio and Farmer [J. Acoust. Soc. Am. 96, 1056–1069 (1994) and Flatté et al., Sound transmission through a fluctuating ocean (1979)]. Amplitude and phase fluctuations of every ray are realized as samples of a random process. The results for the dynamic channel show a smoother and easier interpretable transmission loss behavior than for the static channel. Furthermore, it is observed that amplitude fluctuations generally exhibit Ricean fading. [Work sponsored by the Danish Technical Research Council.]

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