Simulated performance of an acoustic modem using phase-modulated signals in a time-varying, shallow-water environment

Underwater acoustic modems using coherent modulation, such as phase-shift keying, have proven to efficiently exploit the bandlimited underwater acoustical communication channel. However, the performance of an acoustic modem, given as maximum range and data and error rate, is limited in the complex and dynamic multipath channel. Multipath arrivals at the receiver cause phase distortion and fading of the signal envelope. Yet, for extreme ratios of range to depth, the delays of multipath arrivals decrease, and the channel impulse response coherently contributes energy to the signal at short delays relative to the first arrival, while longer delays give rise to intersymbol interference. Following this, the signal-to-multipath ratio (SMR) is introduced. It is claimed that the SMR determines the performance rather than the signal-to-noise ratio (SNR). Using a ray model including temporal variations of the shallow-water environment, the performance of the acoustic modem may be estimated. Simulations indicate that optimum performance is not necessarily found at receiver depths yielding the maximum total signal level, since the SMR may correspondingly be low due to strong intersymbol interference.

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