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On the Sensitivity of Continuous-Time Noncoherent Fading Channel Capacity

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The noncoherent capacity of stationary discrete-time fading channels is known to be very sensitive to the fine details of the channel model. More specifically, the measure of the support of the fading-process power spectral density (PSD) determines if noncoherent capacity grows logarithmically in SNR or slower than logarithmically. Such a result is unsatisfactory from an engineering point of view, as the support of the PSD cannot be determined through measurements. The aim of this paper is to assess whether, for general continuous-time Rayleigh-fading channels, this sensitivity has a noticeable impact on capacity at SNR values of practical interest.
To this end, we consider the general class of band-limited continuous-time Rayleigh-fading channels that satisfy the wide-sense stationary uncorrelated-scattering (WSSUS) assumption and are, in addition, underspread. We show that, for all SNR values of practical interest, the noncoherent capacity of every channel in this class is close to the capacity of an AWGN channel with the same SNR and bandwidth, independently of the measure of the support of the scattering function (the two-dimensional channel PSD). Our result is based on a lower bound on noncoherent capacity, which is built on a discretization of the channel input-output relation induced by projecting onto Weyl-Heisenberg (WH) sets. This approach is interesting in its own right as it yields a mathematically tractable way of dealing with the mutual information between certain continuous-time random signals.

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