Joint frequency domain equalisation and phase noise estimation for single-carrier modulations in doubly-selective channels

Abstract

In this study the authors propose a novel joint detection and phase noise estimation scheme suited for severely time-dispersive channels. The authors consider single-carrier modulations combined with frequency domain equalisation schemes where the wireless transmission is impaired with phase noise. An iterative frequency-domain equaliser is assumed on the receiver side and the phase noise is estimated and compensated for after the equalisation step and within each iteration of the equaliser. In fact, by exploiting the Gaussianity of the equaliser output the authors are able to track the phase noise using stochastic recursive filtering techniques. These techniques share the same dynamic state-space (DSS) model. The observation equation corresponds to the measurement of the phase noise of a digitally-modulated signal affected by additive white Gaussian noise, and the dynamics equation corresponds to the Wiener–Lévy model for the phase noise. Supported on this DSS model the authors aim at estimating the unknown phase noise value given all observations up to the current time instant. In a Bayesian context this represents estimating recursively in time the filtering and the predictive distributions. From these distributions a minimum mean-squared error estimate of the phase noise is determined.

Keywords: Stochastic processes Iterative methods Modulation Bayes methods Error compensation Signal detection Recursive filters Filtering theory Phase noise AWGN Frequency-domain analysis Wireless channels Equalisers