Noncoherent Short Packet Detection and Decoding for Scatter Radio Sensor Networking

Abstract:

Scatter radio, i.e., communication by means of reflection, has been recently proposed as a promising technology for low-power wireless sensor networks (WSNs). Specifically, this paper offers noncoherent receivers in scatter radio frequency-shift keying, for either channel-coded or uncoded scatter radio reception, in order to eliminate the need for training bits of coherent schemes (for channel estimation) at the packet preamble. Noncoherent symbol-by-symbol and sequence detectors based on hybrid composite hypothesis test (HCHT) and generalized likelihood-ratio test, for the uncoded case and noncoherent decoders based on HCHT, for small block-length channel codes, are derived. Performance comparison under Rician, Rayleigh, or no fading, taking into account fixed energy budget per packet is presented. It is shown that the performance gap between coherent and noncoherent reception depends on whether channel codes are employed, the fading conditions (e.g., Rayleigh versus Rician versus no fading), as well as the utilized coding interleaving depth; the choice of one coding scheme over the other depends on the wireless fading parameters and the design choice for extra diversity versus extra power gain. Finally, experimental outdoor results at 13-dBm transmission power corroborate the practicality of the proposed noncoherent detection and decoding techniques for scatter radio WSNs.