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Lower Bounds on Parameter Modulation–Estimation Under Bandwidth Constraints

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Abstract

We consider the problem of modulating the value of a parameter onto a band-limited signal to be transmitted over a continuous-time, additive white Gaussian noise (AWGN) channel, and estimating this parameter at the receiver. The performance is measured by the mean power-α error (MPαE), which is defined as the worst-case α-th order moment of the absolute estimation error. The optimal exponential decay rate of the MPαE as a function of the transmission time, is investigated. Two upper (converse) bounds on the MPαE exponent are derived, on the basis of known bounds for the AWGN channel of inputs with unlimited bandwidth. The bounds are computed for typical values of the error moment and the signal-to-noise ratio (SNR), and the SNR asymptotics of the different bounds are analyzed. The new bounds are compared to known converse and achievability bounds, which were derived from channel coding considerations.

Index Terms

Parameter estimation, modulation, error exponents, reliability function, additive white Gaussian noise (AWGN), bandwidth constraints.

I. Introduction

The problem of *waveform communication*, as termed in the classic book by Wozencraft and Jacobs [1, Chapter 8], is about conveying the value of a continuous valued parameter to a distant location, via a