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On the Reliability Exponent of the Exponential Telephone Signaling Channel

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Abstract

Abstract—A lower bound on the reliability exponent of the memoryless exponential server timing channel with noiseless feedback is provided. The lower bound depends on whether fixed or random transmission-time, as well as on whether fixed block-length or variable block-length, codes are considered (with block-length denoting the number of recorded departures). On the other hand we show that Arikan's one-way sphere-packing bound for fixed transmission-time codes [8] applies as well to fixed transmission-time codes for the case at hand.

Index Terms – Point process channel, reliability exponent, noiseless feedback, timing channel, telephone signaling channel.

I. Introduction

The exponential-server timing channel is a model for a single-server queue with a first-in first-out service discipline wherein the server's service times are independent and exponentially distributed with mean $1/\mu$ (see [1]-[7] and references therein). Transmission begins at time 0 with the queue containing a possibly non-zero amount u_0 of unfinished work. The model allows u_0 to be a random variable except that it must be independent of the message transmitted. The message to be transmitted is encoded via a codeword $\tilde{\boldsymbol{x}} = (\tilde{x}_1, \tilde{x}_2, \ldots, \tilde{x}_n)$ which consists of n nonnegative components that determine the interarrival times of packets to the queue. The receiver observes the interdeparture times $\boldsymbol{y} = (y_1, y_2, \ldots, y_n)$ of packets from the queue and makes its decision based on this.

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