Towards Simplex-Coded Noisy Feedback Communication on the Gaussian Channel

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Abstract

In this note, the authors present a simplex-coded approach to the noisy feedback communication scheme of [1].

Low-power communication is often needed and simplex codes are known to have lower power consumption for the same error probability obtained as compared to orthogonal signaling and maximum likelihood decoding, at least in the AWGN setting. We next discuss the overall code which uses the simplex configuration for many of its parts and phases.

In Section 8.2 of [2], the author states that simplex codes have the same error probability as orthogonal codes with an energy only $\frac{M-1}{M}$ as great. The error exponent is identical with the Gallager exponent for orthogonal signaling and ML decoding, except that C_∞ is replaced by $C_\infty\sqrt{\frac{M}{M-1}}$throughout. Here M is the size of the message set. This simplex code is to be used for phase 1 transmission.

For phase 2 transmission, if we use a deterministic ID code with the energy upper bounded by AT, then the corresponding simplex signal set will only have a fraction of this energy given by $(\frac{M-1}{M}) \cdot AT$. It turns out that the slight reduction in energy yields a marginally better error exponent (Figure 1).

In phase 3 we can employ on-off keying as opposed to antipodal signaling and in phase 4 we can employ anytime coding but with a simplex style anytime code. In future work, we would like to compare the performance of this setup with that presented in [1]. Since anytime codes are meant for streaming data transmission, it would also be interesting to do an actual streaming transmission or simulation thereof for performance comparison.

References

[1] Aman Chawla. Reliability of a gaussian channel in the presence of gaussian feedback. *S.M. Thesis*, 2006.

[2] Robert G Gallager. *Information theory and reliable communication*, volume 588. New York: Wiley, 1968.

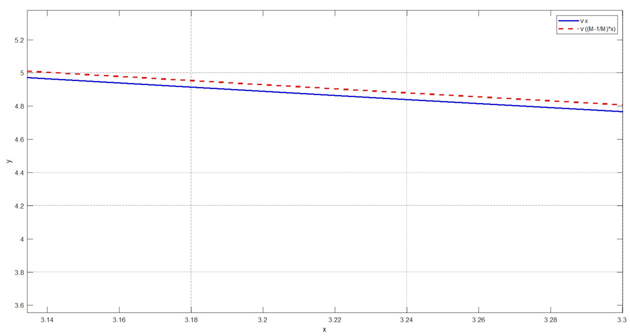

Figure 1: Simplex error exponent. The red dashed line represents the exponent derived from the upper bound on the false alarm probability in deterministic identification when the simplex signals replace the orthogonal signal set signals (blue). The message set size is 100. The horizontal axis is the rate and the vertical axis compares the two exponents, simplex and orthogonal, which are expressed in terms of the rate.