Sequence MAP Decoding Of Trellis Codes For Gaussian And Rayleighchannels

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Summary

This paper considers the use of sequence maximum a posteriori (MAP) decoding of trellis codes. A MAP receiver can exploit any residual redundancy that may exist in the channel encoded signal in the form of memory and/or a nonuniform distribution, thereby providing enhanced performance over very noisy channels, relative to maximum likelihood (ML) decoding. The paper begins with a first-order two-state Markov model for the channel encoder input. A variety of different systems with different source parameters, different modulation schemes, and different encoder complexities are simulated. Sequence MAP decoding is shown to substantially improve performance under very noisy channel conditions for systems with low-to-moderate redundancy, with relative gain increasing as the rate increases. As a result, coding schemes with multidimensional constellations are shown to have higher MAP gains than comparable schemes with two-dimensional (2-D) constellations. The second part of the paper considers trellis encoding of the code-excited linear predictive (CELP) speech coder's line spectral parameters (LSPs) with four-dimensional (4-D) QPSK modulation. Two source LSP models are used. One assumes only intraframe correlation of LSPs while the second one models both intraframe and interframe correlation. MAP decoding gains (over ML decoding) as much as 4 dB are achieved. Also, a comparison between the conventionally designed codes and an I-Q QPSK scheme shows that the I-Q scheme achieves better performance even though the first (sampler) LSP model is used