SESSION MA1

MULTIPLE-ACCESS CHANNELS: CAPACITY

SYMBOL-ASYNCHRONOUS GAUSSIAN MULTIPLE ACCESS CHANNELS,

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Frame-asynchronism has no effect on the capacity region of the Gaussian multiple-access channel (MAC). This is the only type of asynchronism under which the MAC has been analyzed. We show that symbol-asynchronism, which represents the case where transmitters are completely asynchronous and their symbol-epochs do not coincide, affects channel capacity in a fundamental way. Symbol-asynchronism arises when users transmit each codeword symbol by modulating an assigned waveform and they do not cooperate in order that the beginning of each symbol transmission coincides. To encompass multi-user communication systems where each user is not assigned the same waveform a more general model than the scalar Gaussian MAC has to be adopted by modeling the sufficient statistics observed by the decoder as a K-vector discrete-time process. The symbol-asynchronous channel has finite memory because each transmitted symbol affects two consecutive observed vectors; also, it is a decoder-informed compound channel since the encoders do not know the timing of the other users, and hence they ignore the waveform crosscorrelations which determine the degree of interference among them. The derivation of the symbol-asynchronous capacity region shows several interesting features. Unlike the conventional Gaussian MAC there is no input distribution maximizing all mutual information constraints on the rate-sums, and in the two-user case the capacity region is no longer a pentagon. For high SNR there are simple closed-form expressions which quantify the fundamental limitation on the speed of reliable transmission imposed by the existence of other asynchronous users. [This work was partially supported by the National Science Foundation under Grant ECS-8504752.]

SEQUENTIAL DECODING FOR MULTIPLE ACCESS CHANNELS,

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Application of sequential decoding to multiple access channels is considered. The main contribution is the introduction of a new metric (a measure of statistical correlation that the algorithm uses to find the correct message), and the finding of an inner bound to the rate region where this metric can be used. The results indicate that the achievable rate region of sequential decoding is larger than the achievable rate regions of such common techniques as time-division multiplexing, frequency division multiplexing, and Aloha-like schemes. [The research was conducted at M.I.T. Laboratory for Information and Decision Systems with support provided by Defense Advanced Research Projects Agency under Contract N000 14-84-K-0357.]