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Editorial

Special issue on control methods for communication networks — introduction

The papers in this special issue cover a wide range of problems of current interest in communications networking with the common thread being a focus on control and optimization issues. Most of the papers have a tutorial flavor. The problem areas covered include

(1) the tradeoff between fidelity of communicated information and the required bit rate;
(2) admission control to decide when a request to set up a session demanding a particular QoS (quality of service) can be honored;
(3) congestion control to ensure the QoS guarantees are met or that fairness is maintained among the admitted sessions; and
(4) methods to achieve QoS through scheduling and resource allocation.

For (1) we have the paper of Francis and Dasgupta. This paper starts with a review of subband coding and then discusses the optimal design of the subband filters subject to an overall bit rate constraint to maximize overall signal to noise ratio.

For (2) we have the paper of Hanly and Tse in a wireless context and the paper of Paschalidis in the context of a link handling multiclass traffic. The latter paper also covers topic (4) and is discussed later. The paper of Hanly and Tse introduces a concept of effective interference faced by a user due to competing users in a DS-CDMA (direct sequence code division multiple access) system and a related concept of effective bandwidth of each user which can be used to greatly simplify admission control decisions and to determine the carrying capacity of a multiaccess system.

For (3) we have the papers of Mascolo, of Gibbens and Kelly, and of Altman, Basar and Srikant. The paper of Gibbens and Kelly discusses a packet marking scheme by which routers in a network can provide feedback to the sources to enable them to control their flows so as to share the network resources fairly.

The paper of Mascolo adopts a classical control theoretic view of the problem of congestion control as control with delayed observations and relates TCP (transmission control protocol) to the Smith regulator. The paper of Altman et al. adopts a certainty equivalent control paradigm for the congestion control problem with the available link rate modelled as an autoregressive process and discusses the performance of two such schemes.

For (4) we have the paper of Prabhakar and Mckeown, in addition to the paper of Paschalidis. Paschalidis studies the GPS (generalized processor sharing) scheduling scheme using large deviations theory to characterize the packet loss probabilities and the probabilities of excessive delay in the competing flows, which can be used to determine how to choose the GPS scheduling parameters as well as for admission control. Finally, Prabhakar and Mckeown study how a switch with input buffers and internal speedup could emulate an output-buffered switch. They show that a speedup factor of four suffices.

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