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Optimal Distributed Power Control in Cellular Wireless Systems

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Abstract. In this paper, an optimal closed-loop SIR-based power control scheme is proposed for CDMA systems. The amount of power change is proportional to the SIR error, and the optimal gain is chosen to achieve the minimum SIR error at the next time instant. The proposed controller is an estimator based controller. Assuming perfect estimation and prediction of the channel quality, the SIR error goes to zero in one step. In practical situations, where the estimator need several steps to make accurate estimation and prediction, the SIR error goes to zero in less than ten steps. In order to adapt to frequent channel changes, an H_∞ filter is applied in the proposed scheme to facilitate the system filtering regardless of the nature of the system and measurement disturbances. The simulation results of a multi-cell CDMA system in all cases fit the theoretical analysis very well. These results indicate that the proposed optimal power control scheme is a very promissing solution to the distributed power control problem in wireless systems, both theoretically and practically.
Keywords. Power control, CDMA, H_∞ filter, SIR, distributed scheme.

1 Review of SIR based Power Control in Cellular Wireless Systems

In a cellular wireless network, certain quality-of-service (QoS) should be maintained for all active users in the network. A quantity that measures user's provided QoS is the signal-to-interference ratio (SIR). A general idea to achieve the desired SIR for all the active users is to allocate the network resources in the most efficient way. Resource allocation in a cellular wireless network includes channel allocation, power control, etc. The transmitter power is the most valuable resource in the network. By proper control of each transmitter power, the interference can be minimized. At the same time, it extends the battery life in the handset.

The initial work on SIR-based power control schemes for narrowband systems has been done by Zander [33]-[34]. Power control schemes can be