Adaptive Power Control Module in Cellular Radio System

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Abstract

Adaptive power control scheme based on the optimization of transmitter power and receiver filter coefficients is shown. The scheme is mapped to control logic, digital filter and adaptive amplifier.

Accurate power control can reduce the interference in both Global System Mobile (GSM) and CDMA system. When the mobile is close to the base station, it can use lower power since the signal loss is smaller. For GSM, interference to other cells using the same frequency is reduced when the power control is accurate. For CDMA, accurate power control is more important because all CDMA signals interfere with each other. Lack of accurate power control reduces the capacity for CDMA. Moreover, power control can reduce battery drain and increase possible talk time. The major objective of power control is to alleviate the co-channel and cross-channel interference [1]. Due to the effects of fast fading, shadowing and distance loss, an adaptive power control (APC) scheme is needed. In order to get a better estimation of the received power, the received power at the mobile can be estimated by using RAKE receiver [2] as shown in Figure 1. The outputs of the taps of the RAKE receiver are correlated with the de-spreading sequence c(t) over one bit time, then squared and summed to generate X(k) at time kT. X(k) is averaged over m bits to form an estimate of the received power. These processes

are typical DSP processes. By adaptively adjust the transmitter power level and receiver filter, we can minimize the interference that users create to each other while maintaining the desired signal to interference ratio (SIR) [3, 4].

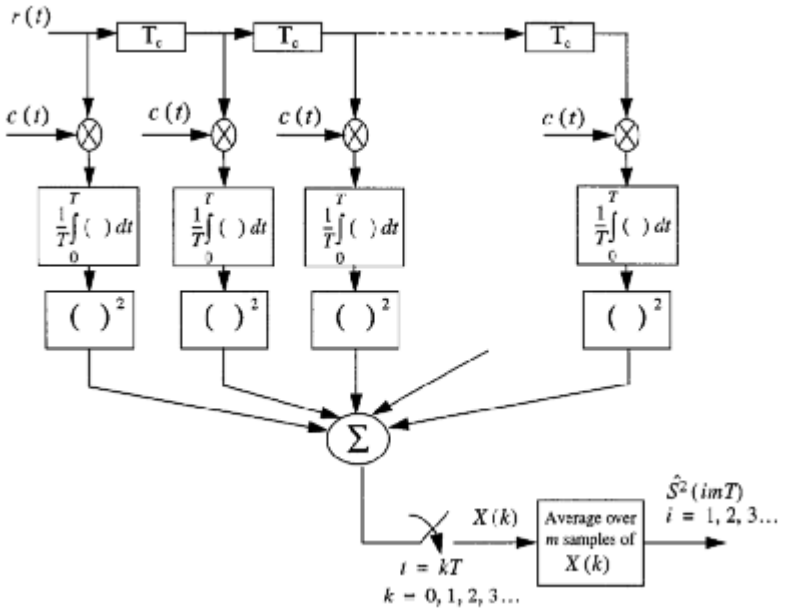

Figure 1. Power estimation diagram using RAKE [2]

The simple power control approach was concerned with assigning the transmitter powers to the users optimally with the assumption that the receiver filters of the users were fixed to single user detector [3]. Multi-user detection was concerned with designing receiver filters to suppress the interference seen by each user with the assumption that the received powers of the users were fixed. If the transmitter powers and receiver filters of the users are optimized jointly, the performance of a CDMA system can be improved greatly. This can be implemented in a distributed manner using local measurement. Each mobile can adapt its receiver filter coefficients to interference and perform iterative transmitter power level adjustment for fixed filter coefficients. The block diagram of the

adaptive power control scheme is shown in Figure 2. This scheme can be mapped to control logic, digital filter and adaptive amplifier. The power control algorithm will be reflected in control logic block.

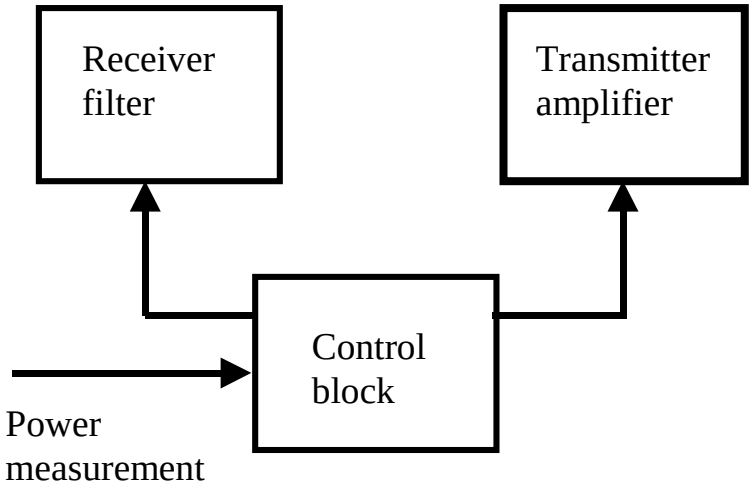

Figure 2. Block diagram of the adaptive power control scheme

References

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