HELSINKI UNIVERSITY OF TECHNOLOGY

ABSTRACT OF THE
LICENTIATE THESIS

Author: Jarno Tanskanen

Name of the Thesis: **Multiuser CDMA Power Control Simulator —**
Effects of Simple Prediction

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Faculty: Electrical and Communications Engineering
Professorship: S-88, Signal Processing and Computer Technology

Supervisor: Professor Iiro Hartimo

In this work, reported in *the Publications*, predictivity of Rayleigh fading signals is investigated, and multiuser CDMA communications simulators are developed for uplink closed loop power control studies. With the simulator, effects of applying predictive filtering within the closed power control loop are studied. In the simulator, the prediction is applied to radio channel power responses which are modeled by Rayleigh fading signals.

Motivation of the work arises from the power control needs of CDMA systems. The system user capacity greatly depends on the power control system operation quality. In this work, power control system aims to maintain the received power levels of all the mobile users at an equal and constant level at the base station receiver which is one of the possible basis for the practical power control. As the closed power control loop naturally includes signal processing and radio propagation delays, an intuitive approach for achieving power control system improvements is to apply predictive filtering. The user capacities are not directly observed but the results are given in the form of bit-error-rate improvements, and as reductions in the mobile transmitter power consumption and received power level variance, the latter of which is now the actual control variable.

The simulator consists of fairly simple mobile transmitter, radio channel, base station receiver, and power controller models, and is implemented in COSSAP (Communications Simulation and System Analysis Program) environment. For predictive closed power control loop simulations, a single user, 5 user, and 10 user simulators are constructed along with a simulator employing an AWGN multiuser interference model. Naturally, also a non-predictive reference controller is used in the same simulators. Predictive filtering is performed by application of Heinonen-Neuvo polynomial FIR predictors, and optimum predictive power estimators developed by A. Huang. Also, linear AR predictors are designed for the task but they are found inadequate.

The simulators model the Qualcomm CDMA closed loop power control system which is found very restrictive by itself, not leaving much room for improvements by the predictive filtering. It is concluded that in this system, fine tuning the closed control loop is possible with proper predictive filtering.

Keywords: closed loop power control, mobile power control, code-division multiple-access, CDMA, predictive filtering, optimum power estimation, Heinonen-Neuvo polynomial predictor, multiuser communications system simulation