6. Conclusions and Discussions

In the beginning, this research concentrated on the possibilities of predicting Rayleigh fading [P1], [P2] with the mobile speeds were within urban speed range 5 km/h, …, 50 km/h, as in all the cases presented in *the Publications*. It was clearly seen that a Rayleigh fading signal, typically encountered in mobile communications, is very well predictable by the means of, for example, Heinonen-Neuvo polynomial predictors. In [P1] and [P2] H-N polynomial predictor performances are evaluated, and predictor selection criteria are given for two different Rayleigh fading models. It is also found that mainly due to the differing frequency distribution, more attention should be paid on the method for generating Rayleigh fading in mobile communications simulations than what is generally considered. Though, in the polynomial prediction study, these differences have only marginal effects. These results, stating the predictability of the Rayleigh fading, set forward the work to find out the effects of prediction in an actual closed loop power controller. In [P3], obvious results of applying lowpass predictors in a closed control loop whose actions are dictated by the excess noise power are very clearly shown. Results in [P3] apply to the case where only a single user can exist at any time within a given carrier frequency band, and the power controller input is the total received signal after despreading. In this case, the excess noise power reduction is of crucial importance for the closed control loop operation, and the need for filtering is illustratively shown. In [P4], an actual multiuser simulator is presented, and the results achieved by applying H-N predictors are given. The results indicate that marginal transmitter power savings and a little improved power control functionality may be achieved by applying H-N predictors. In [P5], results of applying both H-N polynomial predictors and optimum power estimators by A. Huang are presented for singleuser, 5- and 10-user, and AWGN multiuser interference model simulations, with the same main conclusions as in [P4].

The simulator construction work was naturally found to be full of compromises. In a way, it would have been of more practical interest to create a simulator with more realistically implemented radio channel and base station receiver models. The channel model could have been a complete multipath channel model with different fading distributions available, and the base station receiver could have consisted of an actual RAKE receiver, or some MUD schemes could have been applied. This would have made the work more interesting reading for practical radio engineers. From the signal processing point of view, these additions would have obscured the effects of predictive filtering to a very large extend. Even in the multiuser simulator presented here, the multiuser interference makes it somewhat more difficult to be able to clearly see and analyze the effects of individual system component improvements. Therefore, the research direction with very simple, yet scientifically justifiable, system models was adopted.

The simulated power control system was found to be very restrictive by itself, not leaving much room for improvements, i.e., the power control period is fairly long and fixed, and the power control step size and the overall power control system dynamics are naturally also limited. Anyway, the final conclusion is that a closed power control loop can be fine tuned with application of proper predictive filtering, which enhances the noise content of the received power level measurement data, and possibly slightly adjusts power control timing.