Adaptive Power Control for UMTS

Rachod Patachaianand

Supervisor: Dr Kumbesan Sandrasegaran

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Certificate of Originality

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

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Chapter 4 Adaptive Power Control in UMTS

Abstract

Inner-loop power control is one of the essential radio resource management functions of WCDMA systems. It aims to control the transmission power to ensure that the quality of service for each communication link is adequate and the interference in the system is minimised.

Inner-loop power control currently used in UMTS is a SIR-based fixed stepsize power control (FSPC) algorithm. Transmit Power Control (TPC) commands are sent to control transmission power. This kind of power control algorithm has many limitations such as its inability to track rapid changes in radio channel fading. Furthermore, it creates oscillation when the channel is stable. These limitations result in power control error (PCE) in the received signal. High PCE leads to several performance degradations such as more outage probability and an increase in the total interference.

In this thesis, new inner-loop power control algorithms are proposed to minimise PCE. One of the new algorithms utilises historical information of TPC commands to intelligently adjust the power control stepsize. The performance of the proposed algorithm is compared with adaptive power control algorithms proposed in the literature. The simulation results show that the proposed adaptive power control algorithm outperforms the conventional fixed stepsize power control algorithm. Furthermore, it outperforms other adaptive power control algorithms in some scenarios.

The results from the simulations in this thesis show that delays in the power control feedback channel lead to performance degradations especially for adaptive power control algorithms. A new delay compensation technique named partial time delay compensation (PTDC) is proposed to mitigate the effect of delays. Simulations show that the performance in terms of PCE can be improved using this new compensation technique.

Knowledge of the maximum Doppler frequency, which is closely related to user speed, is invaluable for optimisation of radio networks in several aspects. It can be used to improve the performance of inner loop power control. A new parameter named Consecutive TPC ratio (CTR) is originally defined in this thesis. CTR has a correlation with the maximum Doppler frequency so that it can be used to estimate user speed. The simulation results show that with the use of 1dB FSPC, user speeds can be accurately estimated up to 45 km/h. A new adaptive power control algorithm, named CAAP, in which the stepsize is adjusted using CTR, is also proposed. The simulation result shows that CAAP can achieve similar performance as that of the adaptive power control algorithm in which the stepsize is adjusted based on perfect knowledge of the optimal fixed stepsize for every user speed. Furthermore, the performance of CTR aided speed estimation can be recursively improved with the use of CAAP.