PERFORMANCE MODELING OF ADAPTIVE MODULATION CODING SCHEMES ON RAYLEIGH FADING CHANNELS

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A thesis submitted in fulfilment of
the requirements for the award of the degree of
Doctor of Philosophy (Electrical Engineering)

Faculty of Electrical Engineering
Universiti Teknologi Malaysia

JUNE 2011

To God Who lets His Wisdom unfolds,

To my family,

To all who have loved me and supported me unconditionally

ACKNOWLEDGEMENT

Thankfully, to Al-Mighty Allah SWT, I want to take this chance to acknowledge the contribution of several people who helped me to complete this thesis. I would like to express my appreciation and gratitude to my supervisor, Assoc. Prof. Dr. Ahmad Zuri Sha'ameri, for his guidance, support, and patience during my graduate education. He has been an invaluable source of technical knowledge and has certainly helped inspire many of the ideas expressed in this thesis.

A special thanks to my family members for their patience, prayers, support and understanding over the entire period of my studies. They have been there to share my joy and my tears, my success and my failures. Without them, I would not be able to complete this research. Not forgetting also, all the lab members who have made the lab a very happy environment to work in. Special thanks to the lab members who have helped me during the field-testing phase of my research. And I would like to thank those who have been faithfully praying for my success and my well being.

I am also indebted with Ministry of Science, Technology and Innovation and Universiti Teknologi Malaysia for funding my research. I also would like to thank Suruhanjaya Komunikasi dan Multimedia Malaysia for provided grant to my research team and this gave opportunity for me to perform some experiments that essential in this research. The guardian and support from research team such as Zolkhonain bin Norizan, Mohd Aris bin Benawi and Cheah Peck Sheong are really appreciated.

ABSTRACT

Adaptive modulation coding schemes (MCSs) are important techniques in wireless data communication to minimize the bit-error-rate (BER) and maximize throughput. Usually, the adaptive system consists a few MCSs that will intelligently adapt to channel variation. At the receiver, the MCS transition is decided by link quality analysis and the result is sent to transmitter via acknowledgement data. Therefore, the system performance cannot rely on a single MCS. This research developes a methodology to estimate an adaptive MCS performance using Markov model. The model concerns type I Hybrid automatic repeat request (ARQ) system which is a combination of forward error control (FEC) and ARQ under the Rayleigh fading condition. The two-state Markov model performance estimation (MMPE-2) and four-state Markov model performance estimation (MMPE-4) are proposed, where the system performance are estimated based on packet error probability and level crossing probability of the Rayleigh fading condition. Performance comparison between estimation models and simulation using International Radio Consultative Committee (CCIR) 520-2 channel model is made and the results shows that MMPE-4 are comparable for fade duration longer than the packet length. From the models, the analysis on traffic and acknowledgement data in term of bit BER and throughput can be done theoretically prior to any simulation and experiment. This can save a lot of time and the modification on the system can be done before proceeding for further evaluation or implementation. By using the estimation models as tools, several new adaptive MCSs are evaluated and the best adaptive system is proposed for high frequency data communication system.

ABSTRAK

Adaptif modulasi pengekodan (AMP) adalah teknik yang penting dalam komunikasi data tanpa wayar bagi meminimumkan kadar salah bit dan memaksimumkan perolehan data. Biasanya, sistem adaptif terdiri daripada beberapa AMP yang akan menyesuaikan sistem dengan variasi saluran. Pada penerima, peralihan antara AMP ditentukan berdasarkan analisis kualiti talian dan hasilnya dihantar kepada pemancar melalui maklum-balas data. Oleh itu, prestasi sistem tidak boleh diandaikan berdasarkan satu AMP sahaja. Penyelidikan telah membangunkan satu methodologi untuk menganggar prestasi adaptif AMP dengan menggunakan model Markov. Model yang dibangunkan memberi penekanan kepada Adaptif sistem automatik ulang semula Jenis 1 yang merupakan gabungan kawalan salah hadapan and automatik ulang semula di dalam keadaan pemudaran Rayleigh. Model Anggaran Prestasi Markov Dua Keadaan dan Model Anggaran Prestasi Markov Empat Keadaan telah dicadangkan dengan prestasi sistem dihitung berdasarkan kebarangkalian salah data dan kebarangkalian kadar tahap persimpangan bagi keadaan pemudaran Rayleigh. Perbandingan di antara model dan simulasi menggunakan Jawatankuasa Konsultif Radio Internasional 520-2 saluran model telah dilaksanakan dan keputusan menunjukkan Model Anggaran Prestasi Markov Empat Keadaan sama dengan simulasi untuk keadaan masa pemudaran lebih panjang daripada panjang data. Daripada model-model yang dibangunkan, analisis untuk trafik dan maklum-balas data dari segi kadar salah bit dan perolehan data dapat dilakukan secara teori sebelum ke peringkat simulasi atau ekperimen. Ini dapat menjimatkan masa dan pengubahsuaian pada sistem boleh dilaksanakan sebelum meneruskan penilaian rekabentuk ke peringkat seterusnya. Dengan menggunakan model sebagai alat pengukur, beberapa AMP yang baru telah dinilai dan adaptif sistem yang paling baik telah dicadangkan untuk sistem komunikasi data frekuensi tinggi.