University of Victoria | Graduate Studies

Notice of the Final Oral Examination
for the Degree of Doctor of Philosophy

of

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"Channel Adaptive Transmission of Big Data: A Complete Temporal Characterization and its Application"

Department of Electrical and Computer Engineering

Friday, November 30, 2018
12:30 P.M.
Engineering and Computer Science Building
Room 467

Supervisory Committee:
Dr. Hong-Chuan Yang, Department of Electrical and Computer Engineering, University of Victoria (Supervisor)
Dr. T. Aaron Gulliver, Department of Electrical and Computer Engineering, UVic (Member)
Dr. Kui Wu, Department of Computer Science, UVic (Outside Member)

External Examiner:
Dr. Daniel Lee, School of Engineering Science, Simon Fraser University

Chair of Oral Examination:
Dr. Myer Horowitz, Department of Education Psychology & Leadership Studies, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies

Abstract

We investigate the statistics of transmission time of wireless systems employing adaptive transmission. Unlike traditional transmission systems, where the transmission time of a fixed amount of data is typically regarded as a constant, the transmission time with adaptive transmission systems becomes a random variable, as the transmission rate varies with the fading channel condition. To facilitate the design and optimization of wireless transmission schemes, we present an analytical framework to determine statistical characterizations for the transmission time with adaptive transmission. In particular, we derive the exact statistics of transmission time over block fading channels. The probability mass function (PMF) and cumulative distribution function (CDF) of transmission time are obtained for both slow and fast fading scenarios. We further extend our analysis to Markov channel, where transmission time becomes the sum of a sequence of exponentially distributed time slots. Analytical expression for the probability density function (PDF) of transmission time is derived for both fast fading and slow fading scenarios. Since the energy consumption can be characterized by the product of power consumption and transmission time, we also evaluate the energy consumption for wireless systems with adaptive transmission.

Cognitive radio communication can opportunistically access underutilized spectrum for emerging wireless applications. With interweave cognitive implementation, a secondary user (SU) transmits only if primary user does not occupy the channel and waits for transmission otherwise. Therefore, secondary packet transmission involves both transmission periods and waiting periods. The resulting extended delivery time (EDT) is critical to the throughput analysis of secondary system. With the statistical results of transmission time, we derive the PDF of EDT considering random-length SU transmission and waiting periods for continuous spectrum sensing and semi-periodic spectrum sensing. Taking spectrum sensing errors into account, we propose a discrete Markov chain modling slotted secondary transmission coupled with periodic spectrum sensing. The Markov modling is applied to energy efficiency optimization and queuing performance evaluation.