Notice and Invitation
Oral Defense of Doctoral Dissertation
The Volgenau School of Engineering, George Mason University

Wook Jung
Bachelor of Science, Ajou University, Korea, 2000
Master of Science, George Mason University, 2003

Error Controls for Broadcast Communication Systems:
An Integer Programming Approach to UEP Coding Scheme and
A Deterministic Approach to Network Coding

Tuesday, December 16th, 2014, 9:00 AM
Nguyen Engineering Building, Room 4801
All are invited to attend.

Committee
Dr. Shih-Chun Chang, Chair
Dr. Bijan Jabbari
Dr. Brian L. Mark
Dr. Bernd-Peter Paris
Dr. Robert Simon

Abstract

Traditional network protocols employ error control techniques for reliable information dissemination over noisy communication channels. In this dissertation, two main topics are investigated for efficient error controls over a broadcast channel. First, unequal error protection (UEP) coding schemes for multiuser communications are investigated, and we propose integer programming approaches to UEP coding and decoding. Second, reliable packet transmissions over a single-hop broadcast network are considered, and we propose a unified solution to use a deterministic network coding for a packet retransmission scheme and a packet-level forward error correction scheme.

For multiuser communications over a broadcast channel, integer programming approaches are introduced to the construction and the decoding of a binary linear UEP code. First, optimal UEP codes are constructed from integer programming for maximum efficiency, and lower bounds of UEP codes
are derived to show the efficiency. Then, performance of the UEP coding scheme for multiuser communications are analyzed on a degraded broadcast channel. Finally, a decoding method of the binary UEP code, that uses iterative integer programming and majority logic, is proposed. By presenting numerical results, examples, and comparisons, we demonstrate that the UEP coding scheme effectively provides efficient forward error correction for multiuser broadcast communications.

For reliable packet transmissions over a single-hop broadcast network, we propose packet-level error control schemes by using a deterministic linear network coding. We first construct a deterministic network code based on a Reed-Solomon (RS) error correcting code. Then, we provide an adaptive way to apply the deterministic network code for both retransmissions and forward error corrections by puncturing a generator matrix of the RS code. Numerical analysis and simulations are performed to show the efficiency of the error control schemes.