University of Victoria | Graduate Studies

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

of

## YUNLONG SHAO

MSc (University of Manchester, 2013)
BSc (Institute of Technology Tallaght, 2012)
BSc (Nanjing University of Technology, 2012)

## "Precoding for MIMO Full-Duplex Relay Communication Systems"

Department of Electrical and Computer Engineering

Monday, April 9, 2018
3:30 P.M.
Engineering and Computer Science Building
Room 467

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

External Examiner:
Dr. Hong Shen, National Mobile Communications Research Laboratory, Southeast University

Chair of Oral Examination:
Dr. Keivan Ahmadi, Department of Mechanical Engineering, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies

## Abstract

Multiple antennas combined with cooperative relaying, called multiple-input multipleoutput (MIMO) relay communications, can be used to improve the reliability and capacity of wireless communications systems. The design of the precoding design is a crucial to realize the full potential of MIMO relay systems. Full duplex (FD) relay communications has become realistic with the development of effective loop interference (LI) cancellation techniques. The focuses of this dissertation is on the precoding design for MIMO FD amplify-and-forward (AF) relay communication systems. First, the transceiver design for MIMO FD AF relay communication systems is considered with residual LI, which will exist in any FD system. Then the precoding design is extended to two-way MIMO FD relay communication systems. Iterative algorithms are presented for both systems based on minimizing the mean squared error (MSE) to obtain the source and relay precoders and destination combiner. Finally, the precoding design for MIMO FD relay communication systems with multiple users is investigated. Two systems are examined, namely a multiuser uplink system and a multiuser paired downlink system. By converting the original problems into convex sub problems, locally optimal solutions are found for these systems considering the existence of residual LI. The performance improvement for the proposed FD systems over the corresponding half duplex (HD) systems is evaluated via simulation in terms of both the MSE and achievable rate.