



summer school

4th

**CANADIAN SUMMER SCHOOL
ON COMMUNICATIONS AND
INFORMATION THEORY**

FINAL REPORT

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MESSAGE FROM THE CHAIR

On behalf of the organizing committee of the fourth summer school, I would like to send the warmest thanks to the members of the communications and information theory community that attended and contributed to this event. We also thank our sponsors, Informatics Core of Research Excellence (iCORE) and Mathematics of Information Technology and Complex Systems (MITACS), for their support, the staff of the summer school venue for their cooperation, and all of those who helped us make this event a success once again.

Majid Ghanbarinejad
Technical Chair of the Fourth Summer School

INTRODUCTION

The Fourth Canadian Summer School on Communications and Information Theory was held on August 17-19, 2009 at the Banff Park Lodge in Banff, Alberta. The rich beauty and tranquility of the Canadian Rockies provided an excellent environment for students, professors and other researchers to congregate and learn from leading expert in the field and also to share their research amongst each other.

The event had about 50 attendees representing the following six Canadian universities: McGill University, University of Toronto, University of British Columbia, University of Calgary, University of Saskatchewan and University of Alberta. In addition, there were attendees from Princeton University and San Diego State University. A list of all participants can be found in the Appendix.

Summer School was formed with three objectives in mind. The first objective is to provide a research exchange among students, encouraging them to present their work and get feedback from the group of their peers and leading researchers in the field. The second objective is for students to learn from leading experts in the field by way of the tutorial lectures and discussions inspired by the tutorials and research exchanges. The third objective is to help establish a community amongst communications and information theory researchers in Canada.

THEME

The Fourth Canadian Summer School on Communications and Information Theory falls within two main themes: (1) Communications, Networks & Security and (2) Information Processing. The specific areas of focus include:

- Ad-hoc Wireless Networks
- Channel Coding
- Channel Estimation
- Channel Modeling
- Communications SoCs
- Equalization
- Low-Power Architectures
- Multiple-Antenna Systems
- Multiuser Detection
- Synchronization
- System Implementations
- Wireless Medium Access
- Information Processing for Medical Applications

STRUCTURE OF SUMMER SCHOOL

In order to promote both formal and informal group discussion amongst all the participants, Summer School is set-up in a workshop fashion which consists of tutorial sessions, student presentations and open discussions.

Tutorial sessions are two hours in length and they are lead by an invited speaker who is an expert in the given field. The tutorial session is broken into one hour intervals by a coffee break which allows the participants to ask one-on-one questions with the speaker or to discuss amongst each other. The tutorial session is followed by a complimentary lunch where participants can sit together and exchange information in an informal manner.

Student presentations are fifteen minutes in length with five additional minutes for open discussion. Presenting students are selected based on submitting an abstract which is included in the Summer School Proceedings. Student presentations provide the opportunity for research exchange and discussion with colleagues from other schools.

A typical outline for a day's events is as follows:

09:15 - 09:45	Complimentary breakfast (socializing)
09:45 - 10:45	Tutorial session
10:45 - 11:00	Coffee Break
11:00 - 12:00	Tutorial session
12:00 - 13:00	Complimentary lunch (table discussions)
13:00 - 14:30	Student presentations and discussions
14:30 - 14:45	Coffee Break
14:45 - 16:15	Student presentations and discussions

BIOGRAPHIES OF INVITED SPEAKERS

Professor Robert Calderbank, Ph.D.

(Princeton University, United States)

Robert Calderbank is Professor of Electrical Engineering and Mathematics at Princeton University where he directs the Program in Applied and Computational Mathematics. He joined Princeton from AT&T where he was Vice President for Research and responsible for designing the first Research Lab in the world where the primary focus is data at massive scale. Inventions by Dr. Calderbank in his career at Bell Labs and AT&T have wireline modems, advanced read channels for magnetic recording, and wireless systems and have also opened the door to fault tolerant quantum computation.

Prof. Calderbank is an IEEE Fellow and was honored by the IEEE Information Theory Prize Paper Award in 1995 and again in 1999. He was elected to the National Academy of Engineering in 2005.

Professor Glenn Gulak, Ph.D.

(University of Toronto, Canada)

Dr. Glenn Gulak is a Professor in the Department of Electrical and Computer Engineering at the University of Toronto. He is a Senior Member of the IEEE and a registered Professional Engineer in the Province of Ontario. His present research interests are in the areas of algorithms, circuits, and CMOS system-on-chip implementations for digital communication

systems and, additionally, in the area of CMOS biosensors. Current research projects are focused on high-performance MIMO OFDM implementations and in CMOS biosensors. He has authored or co-authored more than 100 publications in refereed journal and refereed conference proceedings. In addition, he has received numerous teaching awards for undergraduate courses taught in both the Department of Computer Science and the Department of Electrical and Computer Engineering at the University of Toronto. He held the L. Lau Chair in Electrical and Computer Engineering for the 5-year term from 1999 to 2004. He currently holds the Canada Research Chair in Signal Processing Systems and the Edward S. Rogers Sr. Chair in Electrical Engineering. Dr. Gulak received his Ph.D. from the University of Manitoba while holding a Natural Sciences and Engineering Research Council of Canada Postgraduate Scholarship. From Jan. 1985 to Jan. 1988 he was a Research Associate in the Information Systems Laboratory and the Computer Systems Laboratory at Stanford University. He has served on the ISSCC Signal Processing Technical Subcommittee from 1990 to 1999, ISSCC Technical Vice-Chair in 2000 and served as the Technical Program Chair for ISSCC 2001. He received the IEEE Millenium Medal in 2001. From March 2001 to March 2003 he was the Chief Technical Officer and Senior VP LSI Engineering of a fabless semiconductor startup headquartered in Irvine, California. He served on the Technology Directions Subcommittee for ISSCC from 2005 to 2008.

Professor fredric j harris, Ph.D.

(San Diego State University, United States)

Autobiography written by frederic j harris

About me:

I hold the Signal Processing Chair of the Communication Systems and Signal Processing Institute at San Diego State University where since 1967 I have taught courses in Digital Signal Processing and Communication Systems. I hold a number of patents on digital receiver and DSP technology and lecture throughout the world on DSP applications. I consult for organizations requiring high performance, cost effective DSP solutions. I am an adjunct member of the IDA-Princeton Center for Communications Research and I am an Adjunct Professor at Imperial College in Great Britain.

I have written over 160 journal and conference papers, the most well known being my 1978 paper "On the use of Windows for Harmonic Analysis with the Discrete Fourier Transform". I am the author of the book Multirate Signal Processing for Communication Systems and I have contributed to a number of other books on DSP applications including the "Source Coding" chapter in Bernard Sklar's 1988 book, Digital Communications and the "Multirate FIR Filters for Interpolation and Resampling" and the "Time Domain Signal Processing with the DFT" chapters in Doug Elliot's 1987 book Handbook of Digital Signal Processing, and "A most Efficient Digital Filter: The Two-Path Recursive All-Pass Filter" Chapter in Rick Lyons 2007 book Streamlining Digital Signal Processing.

In 1990 and 1991 I was the Technical and then the General Chair of the Asilomar Conference on Signals, Systems, and Computers and was Technical Chair of the 2003 Software Defined Radio Conference and of the 2006 Wireless Personal Multimedia Conference. I became a Fellow of the IEEE in 2003, cited for contributions of DSP to communications systems. In 2006 I received the Software Defined Radio Forum's "Industry Achievement Award". My 2006 paper to the SDR conference was selected for the best paper award. I am the Co-Editor-in-Chief of the Elsevier DSP Journal.

The spelling of my name with all lower case letters is a source of distress for typists and spell checkers. A child at heart, I collect toy trains and old slide-rules.

GRADUATE STUDENT PRESENTATIONS

As stated before, one of the major goals of Summer School is to provide a friendly environment for Graduate Students to present their work. This year, twenty students had the opportunity to showcase their work for an audience of approximately 50 professors, post-doctoral fellows, professionals and other graduate students.

Each student had 15 minutes to present their work with an additional five minutes for questions and discussion. The title of the presentation and the contributing authors are listed in the table below.

Presentations	
1	On the Channel Capacity and Implementation Complexity of Binary CDMA with Non-Gaussian Multi-User Interference Aminata Amadou Garba, Jan Bajcsy
2	Finding Rare Objects in P2P File-Sharing Systems Using Network Coding A.R. Alizad, I. Nikolaidis, M. Ardakani
3	On the Dynamics of Trapping Sets for (Regular) LDPC Codes Christian Schlegel, Shuai Zhang
4	Efficient and Robust In-Network Processing in Wireless Sensor Networks Baljeet Malhotra, Ioanis Nikolaidis, Mario A. Nascimento
5	Quantum Key Distribution at the University of Calgary Philip Chan, Itzel Lucio-Marítnez, Xiaofan Mo, Steve Hosier, Wolfgang Tittel
6	Multi-Hop Relaying and Multiple Antenna Techniques - Performance Trade-Offs in Cellular Systems K.R. Jacobson, R. C. Elliott, W.A. Krzymien

- 7 Performance Analysis of TDMA based Cooperative Relay Protocols**
Saman Atapattu, Nandana Rajatheva, Chintha Tellambura
 - 8 Efficient and Robust In-Network Processing in Wireless Sensor Networks**
Baljeet Malhotra, Ioanis Nikolaidis, Mario A. Nascimento
 - 9 Data Fusion of Wireless Sensor Network Under Non-ideal Communication Condition**
Mingdong Xu, Henry Leung
 - 10 Reduced complexity velocity estimation in Rayleigh MIMO channels using autocorrelation function based schemes**
Salman A. Khan
 - 11 Sensing Order Problem in Cognitive Radio Networks with Heterogeneous Channel Availability**
Hai Jiang, Lifeng Lai, Rongfei Fan, H. Vincent Poor
 - 12 Wireless Body Area Sensor Network: A System Implementation Perspective**
Huasong Cao, Victor C. M. Leung
 - 13 Contribution to Adaptive Channel Tracking and Opportunistic Beamforming**
Saina Lajevardi, Christian B. Schlegel
 - 14 Towards the Accurate Simulation of Specific Indoor Wireless Sensor Networks**
Nicholas M. Boers, Pawel Gburzynski, Ioanis Nikolaidis
 - 15 Predicting Switching Activity in LDPC Decoders Through Density Evolution**
Brendan Crowley, Vincent Gaudet
 - 16 Smart Relaying in Wireless Networks**
Nam H. Vien
 - 17 Power Allocation in Wireless Relay Networks**
Tung T. Pham
 - 18 Review of Low Power Successive Approximation Register Analog to Digital Converters**
Ji Sun, Vincent Gaudet, Christian Schlegel
 - 19 Dynamic Resource Allocation for OFDM-based Cognitive Radio Systems**
Gaurav Bansal
 - 20 Signal Transmission with Unequal Error Protection in Wireless Relay Networks**
Ha X. Nguyen, Ha H. Nguyen, Tho Le-Ngoc
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THE 5th CANADIAN SUMMER SCHOOL ON COMMUNICATIONS AND INFORMATION THEORY

Planning for the 5th Canadian Summer School on Communications and Information Theory is underway! The 5th Summer School is set to be held during the month of August, from August 16 – August 18, 2010. Like previous years, the event will be held in the heart of the Rocky Mountains, Banff, Alberta. The goal of the Summer School Organizing Committee is to increase participation and diversity of attendees.

APPENDIX: ATTENDEES

Professors / Post-Doctoral Fellows / Faculty / Professionals		
Christian Schlegel	iCORE Professor	University of Alberta
Dmitry Truhkachev	Post-Doctoral Fellow	University of Alberta
Ha H. Nguyen	Faculty	University of Saskatchewan
Hai Jiang	Faculty	University of Alberta
Jan Bajcsy	Faculty	McGill University
John Nielsen	Faculty	University of Calgary
Renato J Cintra	Postdoctoral Fellow	University of Calgary
Vincent Gaudet	Faculty	University of Alberta
Witold Krzymien	Faculty	University of Alberta
Yindi Jing	Faculty	University of Alberta
Michiko Maruyama	Professional	University of Alberta
Robert Calderbank	Faculty	Princeton University
fred harris	Faculty	San Diego State University
Glenn Gulak	Faculty	University of Toronto

Students		
Amir Alizad	Ph.D. Student	University of Alberta
Arash Khabbazibasmenj	Ph.D. Student	University of Alberta
Baljeet Malhotra	Ph.D. Student	University of Alberta
Brendan Crowley	Ph.D. Student	University of Alberta
Eric Son	Master's Student	University of Alberta
Gaurav Bansal	Ph.D. Student	University of British Columbia
Huasong Cao	Master's Student	University of British Columbia
Ji Sun	Ph.D. Student	University of Alberta
Malihe Ahmadi	Master's Student	University of Alberta

Mandana Rahbari	Ph.D. Student	University of Alberta
Marcel Jar	Ph.D. Student	University of Alberta
Mingdong Xu	Ph.D. Student	University of Calgary
Mohamed Farhat Ibrahim	Ph.D. Student	University of Calgary
Nam Vien	Ph.D. Student	University of Saskatchewan
Neda Moazen	Ph.D. Student	University of Calgary
Nguyen Xuan Ha	Ph.D. Student	University of Saskatchewan
Nicholas Boers	Ph.D. Student	University of Alberta
Philip Chan	Master's Student	University of Calgary
Robert Elliott	Ph.D. Student	University of Alberta
Rongfei Fan	Master's Student	University of Alberta
Russel Dodd	Ph.D. Student	University of Alberta
Saina Lajevardi	Master's Student	University of Alberta
Salman Khan	Ph.D. Student	McGill University
Saman Atapattu	Ph.D. Student	University of Alberta
Shuai Zhang	Ph.D. Student	University of Alberta
Sultan A. Dweikat	Master's Student	Athens Information Technology
Sun Sun	Master's Student	University of Alberta
Tung Pham	Ph.D. Student	University of Saskatchewan
Majid Ghanbarinejad	Ph.D. Student	University of Alberta
Yong Jin Daniel Kim	Ph.D. Student	McGill University
Yves Pauchard	Ph.D. Student	University of Calgary