Program

European School of Information Theory (ESIT), 2016

April 4–8, 2016
Gothenburg

CHALMERS
UNIVERSITY OF TECHNOLOGY

Welcome Message

On behalf of the Organizing Committee we warmly welcome you to the European School of Information Theory (ESIT), 2016 held at Chalmers University of Technology in Gothenburg.

The European School of Information Theory (ESIT) is an annual educational event, organized by the IEEE Information Theory Society, for graduate students from institutes throughout Europe and beyond. The objective of the school is to provide the students with the opportunity (i) to learn from distinguished lecturers by attending long-format (3 hour) tutorials, (ii) to present their own work to obtain feedback and to start up collaborations, (iii) to hear about applications of information theory in industry, and (iv) to participate in a stimulating and inviting forum of scientists.

This year topics include wireless networks, distributed-storage systems, fiber-optical systems, modern coding theory, and nonasymptotic Shannon theory. Tutorial lectures will be given by

- Gerhard Kramer, Technical University of Munich, Germany
- Frank R. Kschischang, University of Toronto, Canada
- Vijay Kumar, IISc Bangalore, India
- Yury Polyanskiy, Massachusetts Institute of Technology, MA, USA
- Henry D. Pfister, Duke University, NC, USA
- Emanuele Viterbo, Monash University, Australia

We are grateful to our financial sponsors Ericsson, Chalmers University of Technology, IEEE Information Theory Society, and City of Gothenburg. Without their generous support we would not be able to run this event.

On behalf of the Organizing Committee
Fredrik Brännström, Giuseppe Durisi, and Alexandre Graell i Amat (General Chairs)

Sponsors

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General Information

Locations

The European School of Information Theory 2016 will be held at Chalmers University of Technology in Gothenburg, hosted by the Department of Signals and Systems. The school starts on Monday April 4, 2016 and ends on Friday April 8, 2016. The registration, coffee breaks, and poster sessions will be in the **Foyer, main entrance, Hörsalsvägen 11**. The Tutorials/Lectures will be in **room HC2, Hörsalsvägen 14**. The main Chalmers campus Johanneberg is located within walking distance from the city centre. The "Chalmers" tram and bus stops are at a near distance, which makes it convenient to get to and from Chalmers.

Lunches

Lunches are included in the registration fee. On Monday, Tuesday, Thursday, and Friday lunch will be served in **Café/Restaurant Linsen (EDIT building)**. Please bring your lunch coupons. On Wednesday, light lunch will be served in HC2.

Welcome Reception

The welcome reception on April 4 at 19.00 will be held at **Dicksonska Palatset, Parkgatan 2** (sponsored by the City of Gothenburg), where 1st Deputy Lord Mayor Åse-Lill Törnqvist is the host. Please bring your ticket.

Ericsson visit

The visit to Ericsson is in the afternoon on Wednesday April 6. We will get an introduction to Ericsson Research and a presentation of what is ongoing in 5G. We will also get an introduction on how to perform radio network simulations. Some demos will be shown during the coffee break.

You can get to Ericsson by bus 16 from bus stop "Chalmers" or bus 55 from bus stop "Chalmersplatsen" (both close to each other) and get off at bus stop "Lindholmen". From there you reach Ericsson **(Lindholmspiren 11)** easily by a 5 minute walk.

Shannon Centennial

We are celebrating Shannon's 100th birthday in the afternoon on April 7, including a panel discussion **(HC4)**, a poster event, and an activity **(Foyer, main entrance)**.

Banquet

The Banquet is on April 7 at 19.00 in **Café/Restaurant Linsen (EDIT building)**. Please bring your ticket.

Public Transportation

The västtrafik card provided in the registration is only valid for 72 hours after activation. You can use the "travel planner" application of the västtrafik system to plan your trips. For more information about public transportation system please check "http://www.vasttrafik.se/".

About Chalmers

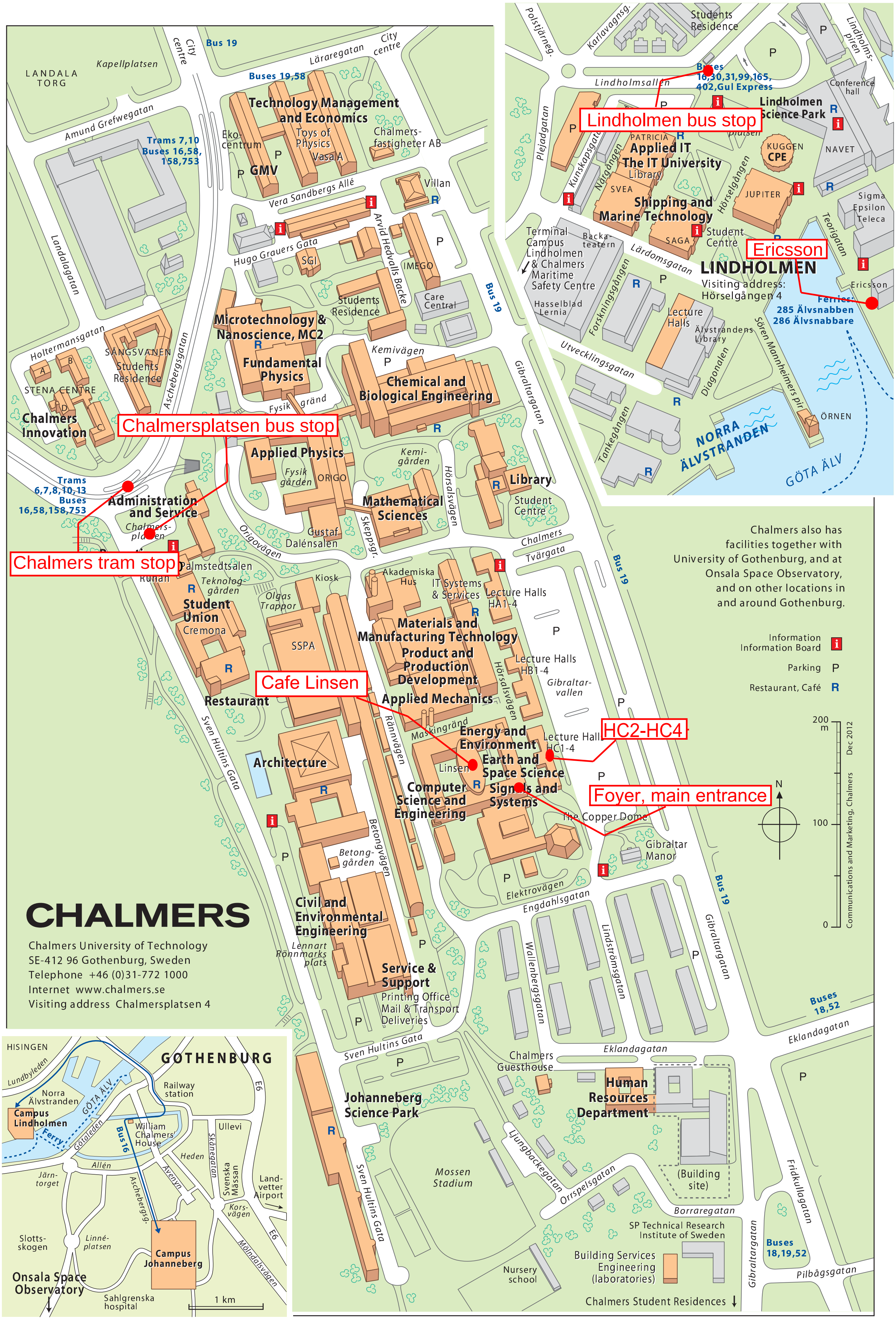
Chalmers was founded in 1829. The university is named after the major benefactor, William Chalmers, one of the directors of the successful Swedish East India Company in Gothenburg. William Chalmers (1748–1811) created a great wealth from his work within the Swedish East India Company during the late 1700s. Chalmersska Slöjdeskolan, which opened in Gothenburg in November 5, 1829, became the beginning of Chalmers University of Technology. The first president was the industrialist Carl Palmstedt. Therefore, there have been natural connections with industry and commerce from the very beginning.

Chalmers is the only university in Sweden named after a person. The emblem "Avancez", together with the logo, forms the university brand. The emblem has its origin in the seal of the donor, William Chalmers.

Today, Chalmers has about 11,000 students on two campuses in Gothenburg, and approximately 2,500 employees. Chalmers offers a wide range of education programmes, mainly in engineering and architecture.

About Gothenburg

Göteborg - the Swedish name of Gothenburg - is the second-largest city in Sweden (after Stockholm). Situated on the south-west coast of Sweden, the city has approximately 500,000 inhabitants in the urban area.



CHALMERS
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SE-412 96 Gothenburg, Sweden
Telephone +46 (0)31-772 1000
Internet www.chalmers.se
Visiting address Chalmersplatsen 4
Lindholmen bus stop
Ericsson
Chalmersplatsen bus stop
Chalmers tram stop
Cafe Linsen
HC2-HC4
Foyer, main entrance
LINDHOLMEN
Visiting address: Hörselgången 4
Buses 16,30,31,99,165, 402,Gul Express
Ferries: 285 Älvsnabben 286 Älvsnabbare
Lindholmen Science Park
Applied IT
The IT University
Library
Shipping and Marine Technology
Students Residence
Conference hall
KUGGEN
CPE
NAVET
JUPITER
PATRICIA
SVEA
SAGA
Student Centre
Terminal Campus Lindholmen & Chalmers Maritime Safety Centre
Backa-teatern
Hasselblad Lernia
Lecture Halls
Älvstrandens Library
Sigma Epsilon Teleca
ÖRNEN
NORRA ÄLVSTRANDEN
GÖTA ÄLV
Lindholmsallén
Lärdomsgatan
Utvecklingsgatan
Hörselgången
Forskningsgången
Teknikgatan
Plejadgatan
Polstjärneg.
Karlavagnsg.
Kunskapsgatan
Diagonalen
Tankegången
Sören Mannheimers plats
Lindholmspiren
Teorigatan
Chalmers also has facilities together with University of Gothenburg, and at Onsala Space Observatory, and on other locations in and around Gothenburg.
Information
Information Board
Parking P
Restaurant, Café R
Dec 2012
Communications and Marketing, Chalmers
LANDALA TORG
Kapellplatsen
City centre
Bus 19
Buses 19,58
Läraregatan
Amund Grefwegatan
Trams 7,10
Buses 16,58, 158,753
Technology Management and Economics
Toys of Physics
Eko-centrum
Chalmers-fastigheter AB
Vasa A
GMV
Vera Sandbergs Allé
Villan
Hugo Grauers Gata
SGI
IMEGO
Arvid Hedvalls Backe
Students Residence
Care Central
Landalagatan
Microtechnology & Nanoscience, MC2
Fundamental Physics
Kemivägen
Chemical and Biological Engineering
Holtermansgatan
SÄNGSVANEN
Students Residence
STENA CENTRE
Chalmers Innovation
Aschebergsgatan
Fysikgränd
Gibraltargatan
Applied Physics
Fysikgården
ORIGO
Kemigården
Mathematical Sciences
Library
Student Centre
Hörsalsvägen
Trams 6,7,8,10,13
Buses 16,58,158,753
Administration and Service
Chalmersplatsen
Gustaf Dalénsalen
Origovägen
Skeppsgr.
Chalmers Tvärgata
Palmstedtsalen
Runan
Teknologgården
Kiosk
Olgas Trappor
Akademiska Hus
IT Systems & Services
Lecture Halls HA1-4
Student Union
Cremona
SSPA
Materials and Manufacturing Technology
Product and Production Development
Applied Mechanics
Lecture Halls HB1-4
Gibraltarvallen
Restaurant
Rännvägen
Maskingränd
Energy and Environment
Earth and Space Science
Lecture Hall HC1-4
Linsen
Architecture
Sven Hultins Gata
Computer Science and Engineering
Signals and Systems
The Copper Dome
Gibraltar Manor
Betonggården
Betongvägen
Elektrovägen
Engdahlsgatan
Civil and Environmental Engineering
Lennart Rönnmarks plats
Service & Support
Printing Office
Mail & Transport
Deliveries
Wallenbergsgatan
Lindströmsgatan
Bus 19
Buses 18,52
Eklandagatan
Chalmers Guesthouse
Human Resources Department
Johanneberg Science Park
Mossen Stadium
Ljungbackegatan
Orrspelsgatan
(Building site)
Borraregatan
SP Technical Research Institute of Sweden
Building Services Engineering (laboratories)
Nursery school
Chalmers Student Residences
Fridkullagatan
Gibraltargatan
Buses 18,19,52
Pilbågsgatan
HISINGEN
GOTHENBURG
Lundbyleden
Norra Älvstranden
Campus Lindholmen
Ferry
GÖTA ÄLV
Götaleden
Railway station
E6
Bus 16
William Chalmers' House
Ullevi
Allén
Heden
Järntorget
Skånegatan
Svenska Mässan
Landvetter Airport
Aschebergsg.
Avenyn
Korsvägen
Slottsskogen
Linnéplatsen
Campus Johanneberg
Mölndalsvägen
Onsala Space Observatory
Sahlgrenska hospital
1 km

Schedule

	Monday	Tuesday	Wednesday	Thursday	Friday	
8:45	Opening ESIT 2016					8:45
9:00						9:00
9:15						9:15
9:30	Prof. Emanuele Viterbo	Prof. Vijay Kumar	Prof. Henry D. Pfister	Prof. Gerhard Kramer	Prof. Yury Polyanskiy	9:30
9:45	Lattice Codes	Distributed Storage	Coding & Graphical Models	Rate Bounds	Finite Blocklength IT	9:45
10:00	(HC2) (1/2)	(HC2) (1/2)	(HC2) (1/2)	(HC2) (1/2)	(HC2) (1/2)	10:00
10:15						10:15
10:30	Coffee break	Coffee break	Coffee break	Coffee break	Coffee break	10:30
10:45	(Foyer, Main Entrance)	(Foyer, Main Entrance)	(Foyer, Main Entrance)	(Foyer, Main Entrance)	(Foyer, Main Entrance)	10:45
11:00						11:00
11:15						11:15
11:30	Prof. Emanuele Viterbo	Prof. Vijay Kumar	Prof. Henry D. Pfister	Prof. Gerhard Kramer	Prof. Yury Polyanskiy	11:30
11:45	Lattice Codes	Distributed Storage	Coding & Graphical Models	Rate Bounds	Finite Blocklength IT	11:45
12:00	(HC2) (2/2)	(HC2) (2/2)	(HC2) (2/2)	(HC2) (2/2)	(HC2) (2/2)	12:00
12:15						12:15
12:30					Closing ESIT 2016	12:30
12:45			Light Lunch (HC2)	Lunch		12:45
13:00	Lunch	Lunch		(Café Restaurant Linsen)	Lunch	13:00
13:15	(Café Restaurant Linsen)	(Café Restaurant Linsen)	Moving to Ericsson		(Café Restaurant Linsen)	13:15
13:30			with bus 16 or 55			13:30
13:45						13:45
14:00				Poster session 2/2		14:00
14:15				(Foyer, Main Entrance)		14:15
14:30	Prof. Frank R. Kschischang	Poster session 1/2				14:30
14:45	Optical Communications	(Foyer, Main Entrance)				14:45
15:00	(HC2) (1/2)					15:00
15:15			Visit Ericsson	Shannon's Centennial Panel		15:15
15:30	Coffee break	Coffee break	(Lindholmspiren 11)	(HC4)		15:30
15:45	(Foyer, Main Entrance)	(Foyer, Main Entrance)				15:45
16:00				Coffee break		16:00
16:15				(Foyer, Main Entrance)		16:15
16:30	Prof. Frank R. Kschischang			Shannon's Centennial		16:30
16:45	Optical Communications			Poster Event and Activity		16:45
17:00	(HC2) (2/2)			(Foyer, Main Entrance)		17:00
17:15						17:15
17:30						17:30
17:45						17:45
18:00						18:00
18:15						18:15
18:30						18:30
18:45						18:45
19:00						19:00
19:15	Welcome Reception at					19:15
19:30	Dicksonska Palatset					19:30
19:45	(sponsored by the			Banquet		19:45
20:00	City of Gothenburg)			(Café Restaurant Linsen)		20:00
20:15						20:15
20:30						20:30
20:45						20:45

Tutorials/Lectures

Lecture 1 - April 4, 9:00–10:30 and 11:00–12:30

Lattice Index Codes: How to Utilize Side Information at the PHY Layer

Prof. Emanuele Viterbo
(emanuele.viterbo@monash.edu)

Monash University, Australia

Abstract

Several applications in wireless networking and broadcasting involve receivers which may already know some part of the messages that are being transmitted. Such prior knowledge or 'side information' may be obtained by overhearing previous wireless transmissions, by predownloading partial content to local cache at the receivers, or through parallel/orthogonal communication channels. Advanced coding techniques, known as 'Index Coding', can be utilized to exploit receiver side information and achieve higher transmission rates in these communication scenarios than what is naively possible.

The available results and literature on index coding are rich and view the problem from a network layer perspective, where the communication links are assumed to be noise free. Tools from algebraic network coding, graph theory and matroids have been traditionally used to approach this network layer problem. However, practical channels have inherent uncertainties such as noise and signal fading that a coding scheme has to additionally contend with. The existing communication schemes rely on the technique of using a network layer index code and a separate PHY layer channel code for these scenarios which is information-theoretically suboptimal.

The goal of this tutorial is to show how algebraic techniques can be utilized to construct efficient coding schemes that can exploit receiver side information at the PHY layer. Such techniques allow us to use side information to not only combat channel noise but also increase transmission rates. We deliver a tutorial introduction to the powerful mathematical concepts of rings and lattices. We then discuss the coding theoretic aspects of designing index codes for a noisy channel and show that the tools from rings and lattice theory can be used to construct modulation and coding schemes that can transform receiver side information into additional coding gains. The emphasis of the tutorial will be on constellations for the wireless channels that have beautiful algebraic and geometric properties. No prior mathematical background will be assumed.

Author Biography

Prof. Viterbo is Professor in the ECSE Department and Associate Dean Research Training of the Faculty of Engineering at Monash University, Melbourne, Australia. In 1997-98 he was a research fellow in the Information Sciences Research Center of AT&T Research, Florham Park, NJ, USA. He became first Assistant Professor (1998) then Associate Professor (2005) in Dipartimento di Elettronica at Politecnico di Torino, Turin, Italy. In 2006 he became Full Professor in DEIS at University of Calabria, Italy. Prof. Emanuele Viterbo is a Fellow of the IEEE, a ISI Highly Cited Researcher and Member of the Board of Governors of the IEEE Information Theory Society (2011-2013 and 2014-2016). He served as Associate Editor of IEEE Transactions on Information Theory, European Transactions on Telecommunications and Journal of Communications and Networks, Guest Editor for IEEE Journal of Selected Topics in Signal Processing: Special Issue Managing Complexity in Multiuser MIMO Systems, and Editor of Foundations and Trends in Communications and Information Theory. Prof. Viterbo was awarded a NATO Advanced Fellowship in 1997 from the Italian National Research Council, the 2012-13 Australia-India Fellowship from the Australian Academy of Science, and the 2013 Invitation Fellowship for Research in Japan from the Japan Society for the Promotion of Science.

Lecture 2 - April 4, 14:00–15:30 and 16:00–17:30

Digital Communication over Optical Fibers

Prof. Frank R. Kschischang
(frank@ece.utoronto.ca)

University of Toronto, Canada

Abstract

Optical fibers, thin strands of ultra-transparent silica glass not much thicker than a human hair and spanning many thousands of kilometers, carry the bulk of the world's telecommunications. At the high power densities created by the lasers used in fiber-optic transmission, the Kerr effect, which causes changes in refractive index in response to the electric field of a propagating wave, becomes significant. In optical fibers, this phenomenon, along with chromatic dispersion, is described by a partial differential equation known as the nonlinear Schrödinger (NLS) equation, giving rise to a channel model that challenges information-theoretic analysis. This lecture will serve as an introduction to this area, and provide some current information-theoretic perspectives and open problems.

Author Biography

Prof. Kschischang is the Distinguished Professor of Digital Communication in the Department of Electrical and Computer Engineering at the University of Toronto. During 1997-98, he was a visiting scientist at MIT, Cambridge, MA; in 2005 he was a visiting professor at the ETH, Zurich, and in 2011 and again in 2012-13 he was a visiting Hans Fischer Senior Fellow at the Institute for Advanced Study at the Technical University of Munich. In 1999 he was a recipient of the Ontario Premier's Excellence Research Award and in 2001 (renewed in 2008) he was awarded the Tier I Canada Research Chair in Communication Algorithms at the University of Toronto. In 2010 he was awarded the Killam Research Fellowship by the Canada Council for the Arts. Jointly with Ralf Koetter he received the 2010 Communications Society and Information Theory Society Joint Paper Award. He is a recipient of the 2012 Canadian Award in Telecommunications Research. He is a Fellow of the IEEE and currently serves as the Editor-in-Chief for the IEEE Transactions on Information Theory. He also served as technical program co-chair for the 2004 IEEE International Symposium on Information Theory (ISIT), Chicago, and as general co-chair for ISIT 2008, Toronto. He served as the 2010 President of the IEEE Information Theory Society. He was an IEEE Information Theory Society Distinguished Lecturer for 2012-2013.

Lecture 3 - April 5, 9:00–10:30 and 11:00–12:30

Codes for Big Data: Error-Correction for Distributed Storage

Prof. Vijay Kumar
(vijay@ece.iisc.ernet.in)

IISc Bangalore, India

Abstract

Error-correcting codes in distributed storage are forced to address a new challenge, namely that of recovery of of one or more individual symbols of a codeword as opposed to the customary recovery of the entire codeword. This is because in a storage system, different code symbols are stored on different nodes of the storage network and each node is a storage unit that is prone to failure or else is otherwise unavailable at the time when access to the node's contents is desired.

Two classes of codes have sprung up to meet this challenge, namely regenerating codes and codes with locality. This talk will provide an overview of these two classes of codes, from their early beginnings to current developments. Quite apart from their application to storage, these two classes of codes also have served to enrich coding theory by giving rise to new classes of codes possessing additional and desirable properties.

Author Biography

Prof. Kumar obtained his PhD from the University of Southern California (USC). Between 1983-2003, he was a full-time faculty in the EE department of USC. Since 2003, he has been a Professor in the ECE department of the Indian Institute of Science (IISc) Bangalore, where he is currently department Chairman and Tata Chem Chaired Professor of IISc. He also holds the position of Adjunct Research Professor at USC. He is an ISI highly cited author, an IEEE Fellow and a Fellow of the Indian National Academy of Engineering. He is also co-recipient of the 1995 IEEE Information Theory Society Prize-Paper award, a Best-Paper award at the DCOSS 2008 conference on sensor networks and the IEEE Data Storage Best-Paper Award of 2011/2012. A pseudo-random sequence family designed in a 1996 paper co-authored by him now forms the short scrambling code of the 3G WCDMA cellular standard. He received the USC School of Engineering's Senior Research Award in 1994 and the Rustum Choksi Award for Excellence in Research in Engineering in 2013 at IISc. He has been on the Board of Governors of the IEEE Information Theory Society since 2013, was a plenary speaker at ISIT 2014 and TPC Co-Chair of ISIT 2015.

Lecture 4 - April 6, 9:00–10:30 and 11:00–12:30

Capacity Achieving Codes: There and Back Again

Prof. Henry D. Pfister
(henry.pfister@duke.edu)

Duke University, NC, USA

Abstract

Many of the recent advances in coding theory have, at their root, ideas that originated between 1954 and 1960. In this lecture, we give a tutorial description of these ideas. We begin by introducing factor graphs and belief propagation (BP) as tools for understanding large systems of dependent random variables. Then, we describe briefly how, over the past 20 years, these techniques have revolutionized error-correcting codes, compressed sensing, and random satisfiability. Next, we use the example of low-density parity-check (LDPC) codes on the binary erasure channel to introduce the density-evolution analysis of BP decoding. A key result is that BP decoding of LDPC codes has a noise threshold, below which, decoding succeeds with high probability. The first part of the lecture concludes by discussing how extrinsic-information transfer (EXIT) functions can be used to connect the performance of BP decoding and optimal decoding.

In the second part of the lecture, we introduce spatially-coupled (SC) codes. In 2010, it was shown that a regular LDPC ensemble can be spatially coupled so that the BP noise threshold of the coupled ensemble increases up to the optimal noise threshold of the uncoupled ensemble. Based on this observation, we discuss a few communication scenarios where this property allows SC-LDPC codes to achieve optimal performance in cases where optimized irregular LDPC codes cannot. Finally, we describe some recent results that bring us back to 1954. We conclude by describing some interesting open problems.

Author Biography

Henry D. Pfister received his Ph.D. in electrical engineering in 2003 from the University of California, San Diego and he is currently an associate professor in the electrical and computer engineering department of Duke University. Prior to that, he was a professor at Texas A&M University (2006-2014), a post-doctoral fellow at the École Polytechnique Fédérale de Lausanne (2005-2006), and a senior engineer at Qualcomm Corporate R&D in San Diego (2003-2004).

He received the NSF Career Award in 2008, the Texas A&M ECE Department Outstanding Professor Award in 2010, and was a coauthor of the 2007 IEEE COMSOC best paper in Signal Processing and Coding for Data Storage. He is currently an associate editor in coding theory for the IEEE Transactions on Information Theory (2013-2016) and a Distinguished Lecturer of the IEEE Information Theory Society (2015-2016).

His current research interests include information theory, communications, probabilistic graphical models, and machine learning.

Lecture 5 - April 7, 9:00–10:30 and 11:00–12:30

Secrecy, Stealth, Privacy and Storage for Noisy Channels and Identifiers

Prof. Gerhard Kramer
(gerhard.kramer@tum.de)

Technical University of Munich (TUM), Germany

Abstract

The goal of the talk is to teach information theory for two problems: wiretap channels and biometric (or physical) identifiers. For wiretap channels, we focus on a security measure called "effective" secrecy that includes the concept of stealth in addition to secrecy. The security portion of the coding theorem is established by using a simple proof whose key step is applying Jensen's inequality to the logarithm. The converse follows by a short proof that uses a telescoping identity. An operational meaning for stealth is developed by using binary hypothesis testing concepts. Examples illustrate the impact of the stealth requirement. For identifier channels, a model is studied where the randomness source is hidden from the encoder during enrollment. The capacity region is derived by using standard tools. The impact of having the source hidden is discussed via several examples.

The talk is based on joint work with Jie Hou, Onur Günlü, and Matthieu Bloch.

Author Biography

Prof. Kramer is Alexander von Humboldt Professor and Head of the Institute for Communications Engineering at the Technische Universität München (TUM). He received the Dr. sc. techn. (Doktor der technischen Wissenschaften) degree from the Swiss Federal Institute of Technology (ETH), Zrich, Switzerland, in 1998. From 1998 to 2000, he was with Endora Tech AG, Basel, Switzerland, as a communications engineering consultant. From 2000 to 2008 he was with the Math Center, Bell Laboratories, Alcatel-Lucent, Murray Hill, NJ, as a Member of Technical Staff. He joined USC in 2009 and TUM in 2010. Prof. Kramer is an IEEE Fellow. He received several awards for his work, including an ETH Medal for his doctoral dissertation in 1999, a Bell Labs President's Gold Award in 2003, the IEEE Communications Society Stephen O. Rice Prize Paper Award in 2005, an Alexander von Humboldt Professorship in 2010, the Vodafone Innovations Prize in 2011, a Thomas Alva Edison Patent Award in 2012, and a EURASIP Best Paper Award in 2014. He was elected a Full Member of the Bavarian Academy of Sciences and Humanities in 2015. He is an IEEE Information Theory Society Distinguished Lecturer for 2015-2016.

Lecture 6 - April 8, 9:00–10:30 and 11:00–12:30

Finite Blocklength Methods in Information Theory

Prof. Yury Polyanskiy
(yp@mit.edu)

Massachusetts Institute of Technology (MIT), MA, USA

Abstract

Traditional results on the fundamental limits of data compression and data transmission through noisy channels apply to the asymptotic regime as delay (or blocklength) goes to infinity.

Motivated by modern practical applications in which limited delay is a key design constraint, there is considerable current interest on non-asymptotics in information theory. (For example, state-of-the-art 4G wireless standards employ error-correcting codes with blocklengths 100-20000.)

This tutorial covers the elements of the current approaches to the analysis of the fundamental limits as a function of blocklength. Going beyond traditional refinements to the fundamental asymptotic information theoretic limits, we investigate the backoff from capacity (in channel coding) and the overhead over entropy (in lossless compression) and the rate-distortion function (in lossy source coding) incurred by coding at a given blocklength.

The tutorial covers the single-shot approach in information theory in which computable upper/lower bounds are obtained without imposing assumptions such as memorylessness or stationarity, and which does not hinge either on typicality or on combinatorial methods. The achievability and converse bounds are tight enough to reduce the uncertainty on the non-asymptotic fundamental limit to a level that is negligible compared to the gap to the long-blocklength asymptotics. The bounds are also powerful enough to prove the traditional coding theorems in the widest known generality. A prototypical result is: Over the BSC of crossover probability 0.11, the (yet to be discovered) best possible code of blocklength 500 can transmit between 190 and 193 information bits decodable with error 10^{-3}.

In addition, the tutorial shows how to obtain analytical approximations to the bounds, which are accurate even for short blocklengths, and which, in addition to Shannon's fundamental limits only depend on the dispersion of sources and channels, a key performance measure which determines the time required for the source or channel to behave typically.

Author Biography

Prof. Polyanskiy is an Associate Professor of Electrical Engineering and Computer Science in the Department of EECS at MIT and a member of LIDS. He received the MSc degree in applied mathematics and physics from the Moscow Institute of Physics and Technology, Moscow, Russia in 2005 and the PhD degree in electrical engineering from Princeton University, Princeton, NJ in 2010. In 2000-2005 he lead the development of the embedded software in the Department of Surface Oilfield Equipment, Borets Company LLC (Moscow). Prof. Polyanskiy won the 2013 NSF CAREER award and 2011 IEEE Information Theory Society Paper Award.

Poster Presentations

Session 1 - April 5, 14:00–15:30

Finite Length Weight Enumerator Analysis of Braided Convolutional Codes

Saeedeh Moloudi,[1] Michael Lentmaier,[1]
and Alexandre Graell i Amat[2]
[1]Lund University
[2]Chalmers Univeristy of Technology

Discrete Signaling for Non-Coherent, Single-Antenna, Rayleigh Block-Fading Channel

Marcin Pikus,[1] Gerhard Kramer,[2] and Georg Böcherer[2]
[1]Huawei Technologies
[2]Technische Universität München

Future Vehicular Connectivity Systems in Next-Generation Radio Networks

Christian Arendt,[1] Adrian Posselt,[1] Peter Fertl,[1]
and Holger Boche[2]
[1]BMW Group
[2]Technische Universität München

Queueing Analysis for Fading Channels with Imperfect CSI and Finite Blocklength

Sebastian Schiessl, James Gross,
and Hussein Al-Zubaidy
KTH Royal Institute of Technology

General Sub-packetized Access-Optimal Regenerating Codes

Katina Kralevska, Danilo Gligoroski, and Harald Øverby
Norges teknisk-naturvitenskapelige universitet (NTNU)

Wireless Networks of Bounded Capacity

Grace Villacrés and Tobias Koch
Universidad Carlos III de Madrid

Ultra Wideband Communications Based on Massive MIMO and Multi-mode Antennas Suitable for Mobile Handheld Devices

Peter A. Hoeher, Dirk Manteuffel, Niklas Doose,
and Eugen Safin
Kiel University

Novel Quasy-Analitical Simulation of Block Codes

Aleksandar Minja
University of Novi Sad

Cooperative Two-Party Function Computation

Ivo Kubjas and Vitaly Skachek
University of Tartu

LDPC Code Design for the Two-User Fading Gaussian Interference Channel

Mahdi Shakiba Herfeh,[1] Korhan Tanc,[2]
and Tolga M. Duman[1]
[1]Bilkent University
[2]Kirklareli University

Privacy and Secrecy with Noisy Physical and Biometric Identifiers

Onur Günlü and Gerhard Kramer
Technische Universität München

Non-Binary Low Density Parity Check Codes

Patrick Schulte
Technische Universität München

Code Design for Binary Energy Harvesting Noisy Channel

Mehdi Dabirnia and Tolga M. Duman
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Polar Coding for Empirical Coordination of Signals and Actions over Noisy Channels

Giulia Cervia,[1] Laura Luzzi,[1] Matthieu R. Bloch,[2]
and Mael Le Treust[1]
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Compression for Letter-Based Fidelity Measures

Lars Palzer, Roy Timo, and Gerhard Kramer
Technische Universität München

Session 2 - April 7, 13:30–15:00

Massive MIMO with Low-Resolution ADCs

Sven Jacobsson,[1,2] Giuseppe Durisi,[1] Mikael Coldrey,[2]
Ulf Gustavsson,[2] and Christoph Studer[3]
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A High-SNR Normal Approximation for Unitary Space-Time Modulation

Alejandro Lancho-Serrano,[1] Tobias Koch,[1]
and Giuseppe Durisi[2]
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Performance Analysis of Network Coding with Relay Selection

Semiha Tedik Başaran, Güneş Karabulut Kurt,
Enver Özdemir, and Ergün Yaraneri
Istanbul Technical University

Nonasymptotic Coding-Rate Bounds for Binary Erasure Channels with Feedback

Rahul Devassy,[1] Giuseppe Durisi,[1]
Benjamin Lindqvist,[1] Wei Yang,[2] and Marco Dalai[3]
[1]Chalmers Univeristy of Technology
[2]Princeton University
[3]University of Brescia

Slotted ALOHA with Multiple Base Stations and Directional Antennas

Aleksandar Mastilovic, Dejan Vukobratovic,
Dusan Jakovetic, and Dragana Bajevic
University of Novi Sad

Reliability and Security Metrics for Practical Transmissions over Fading Wiretap Channels

Marco Baldi, Franco Chiaraluce, and Linda Senigagliesi
Università Politecnica delle Marche

Resource Allocation Using Stable Matching over Channels with Nonideal CSI

Yağmur Sabucu,[1,2] Ali Emre Pusane,[2]
and Güneş Karabulut Kurt[1]
[1]Istanbul Technical University
[2]Bogazici University

Channel Metrization

Rafael G. L. D'Oliveira and Marcelo Firer
University of Campinas

Ultra-Reliable Low-Latency Communication in Quasi-static Rayleigh Fading

Johan Östman, Giuseppe Durisi,
and Erik G. Ström
Chalmers Univeristy of Technology

On LDPC Code Ensembles with Generalized Constraints

Yanfang Liu, Pablo M. Olmos, and Tobias Koch
Universidad Carlos III de Madrid

Transmit Signal Design for MIMO Wiretap Channel with Finite-Alphabet Input and Statistical CSI

Sina Rezaei Aghdam and Tolga M. Duman
Bilkent University

Multidimensional Phase Shift Keying: Energy-Efficient MIMO Communication with Low Peak-to-Average-Sum-Power-Ratio

Christoph Rachinger, Ralf Müller, and Johannes Huber
Friedrich-Alexander University Erlangen-Nürnberg

On the Decay - and the Smoothness Behaviour of the Fourier Transform

Holger Boche and Ezra Tampubolon
Technische Universität München

Systematic Low Leakage Coding for Physical Unclonable Functions

Matthias Hiller,[1] Meng-Day (Mandel) Yu,[2,3]
and Michael Pehl[1]
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[2]KU Leuven
[3]MIT

Information Theoretic Clustering

Rana Ali Amjad and Bernhard Geiger
Technische Universität München

Probabilistic Frameworks for RLNC Based P2P Networks

Amjad Saeed Khan and Ioannis Chatzigeorgiou
Lancaster University