President's Column

Emina Soljanin

Like many of my esteemed predecessors, I will start my first column by saying that it is an honor and a privilege to act as the President of the Information Theory Society. But I must add that in 2019, having that role is a challenge as well. We had a turbulent year, and many have told me that it fell to me to steer us back to the calm and prosperity. I am grateful for the opportunity to serve and welcome the challenge as *this being human is a guest house [1]*.

If you have read the president's column in the last Newsletter issue of 2018, you know that already a lot has been done over the past several years for the advancement of our technical field and our scientific environment. We have re-affirmed and introduced relevant codes of conduct & ethics, and established committees to help us be a more diverse & inclusive and a fiscally sound society. Our library of short educational videos is growing both in size and popularity. We had preliminary screenings of the movie about Shannon, and this project is advancing exceedingly well. We have set up a new journal and are working on introducing a new magazine. These are just a few recent activities out of many that continue to be done by numerous volunteers throughout the world, whose dedication makes this society what it is. I firmly believe that we are still the same, if not better, Information Theory Society that was awarded the 2014 IEEE Professional Development Award, which recognizes exemplary educational, mentoring, and member support services. However, on occasion, *everything needs to change, so everything can stay the same [2]*.

This year, the new initiatives are centered around special sessions at our flagship conferences that involve topics and researchers from related fields. (You may have just attended some at ITA.) A benefit for information theorists is a direct exposure to problems where information theory could be used. A benefit for researchers in other fields is a deeper exposure to information theoretic techniques. A common goal is to identify problems of shared interest and form interdisciplinary teams to solve such problems. However, the success of these sessions mostly rests on the vision and endeavor of the organizers (myself included). At the same time, such efforts may not be directly and obviously important for their careers and even scientific benefits may not be immediate and may never be realized. Venturing in new directions is risky in terms of both papers and proposals as *the peer review process rarely supports pursuing paths that sharply diverge from the mainstream direction, or even from researchers' own previously published work [3]*.

But then again, let us remember the following words spoken by R. P. Feynman some 50 years ago to then NSF Postdoctoral fellows in Washington: "If you give more money to theoretical physics, it doesn't do any good if it just increases the number of guys following the comet ahead. So it is necessary to increase the amount of variety ... and the only way to do it is to implore you few guys to take a risk with your lives that you will never be heard of again, and go off in the wild blue yonder and see if you can figure it out."

However, big risks for advancements of science are not always required. Some simple and small departures from the ordinary and expected can generate excitement about our research area. When students inquire about my coding theory class, I ask them if they have heard of Morse, bar and QR codes, ISBN, and Blockchains. I tell them these coding schemes, and many more, play important roles in numerous scientific disciplines and virtually all telecommunication systems. In practice, codes are used to efficiently insure reliable, secure, and private transmission and storage of information. In theory, codes are used to e.g., study computational complexity, design screening experiments, provide a bridge between statistical mechanics and information theory, and even help understand the (quantum) spacetime fabric of reality. I tell them that one can also use

From the Editor

Salim El Rouayheb

The first issue of the newsletter this year starts with the column of the new president of our society, Emina Soljanin, discussing the challenges and accomplishments of our society. Then, we congratulate all the members of our community that have recently received prestigious awards and honors.

Thomas Marzetta reviews the new book of Massimo Franceschetti on Wave Theory of Information. Natasha Devroye and Lalitha Sankar update us on the activities of The Women in Information Theory Society (WI-THITS) program. The past few months witnessed several successful seminars and workshops on topics related to information and coding theory. We have reports on the Dagstuhl Seminar on Algebraic Coding Theory for Storage, Networks and Security, the recent Information Theory Workshop (ITW 2018) in Guangzhou, the Sun Yat-Sen University Coding and Information Theory Workshop (SYSU-CITW), the 2018 Workshop on Coding, Cooperation, and Security in Modern Communication Networks (COCO 2018) and the 2018 Munich Workshop on Information Theory of Optical Fiber (MIO 2018).

As a reminder, announcements, news, and events intended for both the printed newsletter and the website, such as award announcements, calls for nominations, and upcoming conferences, can be submitted at the IT Society website http://www.itsoc.org. Articles and columns can be e-mailed to me at salim.elrouayheb@rutgers.edu with a subject line that includes the words "IT newsletter."

The next few deadlines are:

April 10, 2019 for the issue of June 2019.

July 10, 2019 for the issue of September 2019.

October 10, 2019 for the issue of December 2019.

Please submit plain text, LaTeX, or Word source files; do not worry about fonts or layout as this will be taken care of by IEEE layout specialists. Electronic photos and graphics should be in high resolution and sent as separate files.

Salim El Rouayheb

Table of Contents

Awards

2019 IEEE Medals and Recognitions Recipients and Citations

IEEE Richard W. Hamming Medal: David Tse

The IEEE Richard W. Hamming Medal is awarded for exceptional contributions to information sciences, systems, and technology, sponsored by *Qualcomm, Inc.,* to **DAVID TSE** (FIEEE)—Professor, Stanford University, Stanford, California, USA. *For seminal contributions to wireless network information theory and wireless network systems.*

IEEE Jack S. Kilby Signal Processing Medal: Alan Willsky

The IEEE Jack S. Kilby Signal Processing Medal is awarded for outstanding achievements in signal processing, sponsored by *Texas Instruments, Inc.,* to **ALAN WILLSKY** (FIEEE)—Edwin S. Webster Professor of EECS, Massachusetts Institute of Technology, Cambridge, Massachusetts, USA. *For contributions to stochastic modeling, multi-resolution techniques, and control-signal processing synergies.*

2019 IEEE Technical Field Award Recipients and Citations

IEEE James L. Flanagan Speech and Audio Processing Award: Hermann Ney

The IEEE James L. Flanagan Speech and Audio Processing Award that recognizes an outstanding contribution to the advancement of speech and/or audio signal processing—sponsored by the *IEEE Signal Processing Society,* is awarded to **HERMANN NEY** (FIEEE)—RWTH Aachen University, Professor, Aachen, Germany. *For pioneering contributions to statistical and computational modeling for speech recognition and machine translation.*

IEEE Leon K. Kirchmayer Graduate Teaching Award: Gregory Wornell

The IEEE Leon K. Kirchmayer Graduate Teaching Award that recognizes inspirational teaching of graduate students in the IEEE fields of interest—sponsored by the *Leon K. Kirchmayer Memorial Fund,* is awarded to **GREGORY WORNELL** (FIEEE)—Sumitomo Professor of Electrical Engineering and Chair, Department of Electrical Engineering and Computer Science, Massachusetts Institute of Technology, Cambridge, Massachusetts, USA. *For leadership in the mentoring of research students and in the development of graduate curricula that incorporate cutting-edge research perspectives.*

IEEE Koji Kobayashi Computers and Communications Award: Rayadurgam Srikant

The IEEE Koji Kobayashi Computers and Communications Award that recognizes outstanding contributions to the integration of computers and communications—sponsored by *NEC Corporation,* is awarded to **RAYADURGAM SRIKANT** (FIEEE)—Professor, University of Illinois, Urbana, Illinois, USA. *For contributions to congestion control and scheduling in computer communication networks.*

IEEE Eric E. Sumner Award: Andrea J. Goldsmith

The IEEE Eric E. Sumner Award that recognizes outstanding contributions to communications technology—sponsored by *Nokia Bell Labs,* is awarded to **ANDREA J. GOLDSMITH** (FIEEE)—Stephen Harris Professor of Engineering, Stanford University, Stanford, California, USA. *For contributions to the fundamental understanding and innovation in adaptive and multiple antenna techniques for wireless communication networks.*

IEEE Kiyo Tomiyasu Award: Robert W. Heath, Jr. and Jeffrey G. Andrews

The IEEE Kiyo Tomiyasu Award that recognizes outstanding early to mid-career contributions to technologies holding the promise of innovative applications—sponsored by *Dr. Kiyo Tomiyasu, the IEEE Geoscience and Remote Sensing Society,* and the *IEEE Microwave Theory and Techniques Society,* is awarded to **ROBERT W. HEATH, JR. And JEFFREY G. ANDREWS** (FIEEE)—Cullen Trust Endowed Professor, University of Texas at Austin, Austin, Texas, USA. *For contributions to wireless communication systems.*

2019 Newly Elevated IEEE Fellows:

Brian Classon
For contributions to commercial cellular system standardization.

Timothy Davidson
For contributions to optimization of signal processing and communication systems.

Nicola Elia
For contributions to networked control systems.

Venkatesan Guruswami
For contributions to list error-correction and algorithmic coding theory.

Dong In Kim
For contributions to cross-layer design of wireless communications systems.

Yonghui Li
For contributions to cooperative communications technologies.

Joachim Rosenthal
For contributions to algebraic coding theory and cryptography.

Igal Sason
For contributions to the achievable rate region of the Gaussian interference channel and the analysis of low-complexity capacity-achieving linear codes.

Mikael Skoglund
For contributions to source-channel coding and wireless communications.

Joseph Tabrikian
For contributions to estimation theory and Multiple Input Multiple Output radars.

Meixia Tao
For contributions to resource allocation in broadband wireless networks.

Namrata Vaswani
For contributions to dynamic structured high-dimensional data recovery.

Yimin D Zhang
For contributions to high-resolution direction finding and radar signal processing.

Board of Governors: New Members

Congratulations to the new members of the IT Society Board of Governors (a full list of members can be found on the ITSoc website).

Matthieu Bloch
Georgia Institute of Technology

Suhas N. Diggavi
University of California, Los Angeles

Stark Draper
University of Toronto

Olgica Milenkovic
University of Illinois, Urbana-Champaign

Prakash Narayan
University of Maryland

Henry D. Pfister
Duke University

President's Column *(continued from page 1)*

codes for entertainment, e.g., to solve balance puzzles such as the penny weighing problem, or to design social (hat color) guessing-game strategies that significantly increase the odds of winning. Afterwards, to many the subject starts to look less abstract and arcane, and of lasting relevance rather than a fleeting interest of some bygone era. Then some immediately take the class where I teach almost all that, and others a year later, while already working in industry. And when I tell the latter "Aha, now you like coding!" they, more often than not, reply "No, Professor. Now I know I need it, and you have not told me that."

References

[1] "The Guest House" a poem by J. Rumi, translated by C. Barks.

[2] G. Tomasi Di Lampedusa. *The Leopard*. Pantheon, 1960.

[3] D. Geman and S. Geman, "Opinion: Science in the age of selfies." *Proc. Natl. Acad. Sci.* USA 2016, 113, 9384–9387.

Book Review: Wave Theory of Information

Thomas L. Marzetta
NYU Tandon School of Engineering

"Wave Theory of Information", Massimo Franceschetti (Cambridge University Press 2018; 451 pp) Reviewed by Thomas L. Marzetta.

Some years ago, I was privileged to hear a lecture by Prof. Massimo Franceschetti, *On Landau's Eigenvalue Theorem and Information Cut-Sets*, in the Bell Labs Henry Landau Seminar. On that basis alone, I anticipated a great deal from Prof. Franceschetti's new book, *Wave Theory of Information*. I am happy to report that my prior expectations were fully justified.

This is an ambitious and important book. It comes at a time when, once again, the wireless industry and the academic research community face the existential question, **Is the PHY Layer Dead?** [1]. Eight years ago, the emergence of Massive MIMO answered this question with a resounding **No!** But now Massive MIMO is a commercial reality, and together with Millimeter Wave it dominates 5G wireless technology. Should a new physical layer breakthrough fail to emerge, then all future development will be limited to a mere adaptation of existing principles to shorter wavelengths.

One possible avenue to a breakthrough would be a unification of wireless communication theory and electromagnetic theory, something that has never been achieved [2]. It is (or should be) an embarrassing fact that all of today's wireless systems rely on exceedingly elementary models for the function of antennas and the propagation of signals, and Maxwell's equations play only a peripheral role within the theory that underlies these systems. A genuine fusion of electromagnetic theory with communication theory presents fascinating new research problems, and the incorporation of neglected physics in the formulation of new theories has a chance of yielding breakthroughs. Unfortunately, researchers in electromagnetics and in communication theory have shown little inclination to learn each other's field. As the Preface makes clear, Prof. Franceschetti aims to break down the barriers between these fields.

Chapter 1 introduces a recurring theme of degrees of freedom of a communication system. A bandlimited temporal signal has essentially *2WT* degrees of freedom. Analogously, wave propagation physics implies that a closed region of space has an essential number of degrees of freedom that is proportional to the *area* of the surface of the region, measured in units of wavelength-squared, and not the volume. Together, the temporal and spatial dimensions provide a total number of degrees of freedom, that may be regarded as the number of parallel channels that comprise the link. In turn, the noisiness of the receivers dictates the precision with which signals can be distinguished, and, in combination with the number of degrees of freedom, determines the capacity of the system.

Chapter 2 treats bandlimited temporal signals from two points of view: the sampling theorem (the *Folk Theorem*), and more precisely, prolate spheroidal wave functions. For one who learned spheroidal wave functions from Van Trees [3], Prof. Franceschetti's presentation is illuminating: these functions are, in fact, solutions to the one-dimensional Helmholtz equation (the temporal Fourier

transform of the wave equation) when expressed in a particular coordinate system!

Chapter 3 introduces the Hilbert-Schmidt integral operator, which is the continuous time (more generally, space/time) analog to the familiar singular value decomposition, in which the left and right eigenvectors are replaced by a countably-infinite number of left and right orthogonal eigenfunctions. Comparatively unknown among engineers, the Hilbert-Schmidt decomposition is the natural tool for formulating continuous-time linear least-squares problems [4].

Chapter 4 is a classical treatment of Maxwell's equations: the field is represented by a vector-valued potential, and a scalar potential, the substitution of which into Maxwell's equations implies that each of the four potentials satisfies the scalar wave equation. The complete solution, in space/time coordinates, is presented for an electric dipole source. The absence of temporal frequency in the formulation motivates an unconventional, wide-band definition of the Fraunhofer distance for a line-source of length L: ($L/\sqrt{2}$), instead of the usual definition $L^2/2\lambda$ (the range beyond which the curvature of an incoming spherical wave can be neglected).

Chapter 5 treats Maxwell's equations in terms of an equivalent linear space/time system. The Green's function—the space/time impulse response—is the natural tool for describing the solution.

Chapter 6 discusses non-line-of-sight propagation, which, when dense multipath scattering is involved, is best treated stochastically. The Green's function becomes a non-stationary random field, for which the Karhunen-Loeve decomposition provides the ideal representation.

Chapter 7 reviews some existing wireless communication techniques and typical problems encountered in wireless system design: inter-symbol interference, multiplexing, and diversity.

Chapters 8–10 bring all the previous material together, resulting in a remarkably simple description of propagation between a transmitting region of space and a receiving region of space in terms of the space/time Hilbert-Schmidt decomposition. The number of degrees of freedom is simply the number of significant singular values, which for temporally wide-band signals is obtained by calculating the degrees of freedom at each resolvable frequency, and then integrating over the signal bandwidth. The number of degrees of freedom for the system can be no greater than the minimum of the number of degrees of freedom associated with the transmitter and receiver regions. This is analogous to the classical point-to-point MIMO result that the number of degrees of freedom is no greater than the minimum of the number of transmit and receive antennas.

Chapter 11 is all about noise processes, and it includes classical derivations of black-body radiation, and Johnson noise in resistors. The treatment of noise for wireless receivers could have been improved by including an explicit list of sources of noise (external natural thermal noise, external man-made noise, Johnson noise arising from imperfectly conducting antenna components, and

noise internal to the pre-amplifier). A beginner might be tempted to assume, incorrectly, that the antenna itself is a source of noise, e.g., by gratuitously substituting the radiation resistance of the antenna into the Johnson noise formula. In fact, a lossless antenna (where all conducting components have zero-resistivity) itself contributes nothing to receiver noise.

Chapter 12 is an exposition of Shannon information theory, via sphere packing, and also random coding. The chapter also presents Kolmogorov's notion of capacity in a deterministic setting. It would have been useful to point out that, while random codes are only decodable by exhaustive search, practical codes, such as turbo or LDPC, can operate very close to capacity.

Chapter 13 deals with universal entropy bounds. It is gratifying to read that the data storage capacity of a typical flash memory card could theoretically be improved by a factor as great as 10^{26} !

The goal of the book is more ambitious than merely educating electromagnetic theorists about Shannon theory, and educating communication theorists about electromagnetic theory. Throughout the book there are forays into diverse topics, such as Heisenberg's Uncertainty Principle, blind sensing, compressed sensing, communication network strategies, quantum mechanical corrections to the classical black body radiation and Johnson noise theories, gravitational limits (e.g., black holes), and rate-distortion theory. The reader can easily skip around these peripheral topics, if desired.

The book is exceedingly well written, and surprisingly thin, given the amount of material. The mathematics, supplemented by considerable intuitive explanation, is never overwhelming, and should be readily followed by the diligent reader. There are extensive references, and a useful summary at the end of each chapter, along with well-crafted exercises.

Unquestionably this book will contribute hugely to Prof. Franceschetti's goal: "to break through the compartmentalized walls of several disciplines". That said, there are some aspects of Shannon theory and electromagnetic theory which might have been emphasized to a greater extent, with good effect.

The book emphasizes connections between Shannon theory and classical thermodynamics; for example, Shannon entropy and thermodynamic entropy. But it is important to keep in mind that Shannon theory is completely self-consistent as an axiomatic mathematical theory, involving nondimensional quantities only. Valid physical interpretations of Shannon theory do not emerge automatically. It is all too easy to fall into the trap of assigning a physical interpretation merely because of similarity of terminology. The quantity E_b in the celebrated formula $(E_b/N_0) > \ln 2$, does not necessarily represent physical energy extracted from an antenna!

For a communication theorist, electromagnetic theory can be intimidating. Yet, looking beyond the mathematical complications, there are some results of supreme generality, but supreme simplicity. No matter what takes place in a closed volume of space, the resulting external electromagnetic field can be exactly represented as a linear combination of plane-waves, both ordinary and evanescent [5]. (This is an extension of the Weyl plane-wave representation for the spherical wave [6].) Point-to-point MIMO in an arbitrary scattering environment can be rigorously formulated in terms of the generation of plane-waves, the scattering of plane-waves, and the reception of plane-waves [7]. The interactions among any system of antennas, operating in a linear time-invariant medium (including passive scattering and dynamic mutual coupling) is rigorously described by old-fashioned Ernst Guillemin network theory: a complex-valued impedance matrix as a function of temporal frequency. For a real communication system, the computation of the plane-wave amplitudes and the mutual impedances requires elaborate numerical techniques, but these details should be of little concern to the communication theorist: the mere existence of the plane-wave representation and the impedance matrix provides the essential physics for the formulation of a physics-based communication theory.

To summarize: any researcher who purports to work on the advancement of wireless communication theory should take time to study *Wave Theory of Information*. Prof. Franceschetti's message, over-all, is profoundly optimistic: "Engineers are far from reaching the limits that nature imposes on communication: our students have a bright future in front of them!"

References

[1] M. Dohler, R.W. Heath Jr., A. Lozano, C.B. Papadias, and R. A. Valenzuela, "Is the PHY Layer Dead?," *IEEE Communications Magazine*, April 2011.

[2] T.L. Marzetta, E.G. Larsson, and T.B. Hansen, "Massive MIMO and Beyond," in *Information Theoretic Perspectives on 5G Systems and Beyond*, I. Maric, O. Simeone, S. Shamai (editors), Cambridge University Press, 2019.

[3] H.L. van Trees, *Detection, Estimation, and Modulation Theory*, Wiley, New York, 1968.

[4] T.L. Marzetta and J. Salz, "Singular value decomposition of a matrix-valued impulse response," *Proceedings of IEEE International Conference on Acoustics, Speech, and Signal Processing*, 2005.

[5] T.B. Hansen and A.D. Yaghjian, *Plane-Wave Theory of Time-Domain Fields: Near-Field Scanning Applications*, IEEE Press, New York, 1999.

[6] H. Weyl, "Ausbreitung elektromagnetischer Wellen über einem ebenen Leiter," *Annalen der Physik*, Nov. 1919.

[7] T.L. Marzetta, "Fundamental limitations on the capacity of wireless links that use polarimetric antenna arrays," Proceedings of IEEE International Symposium on Information Theory, July 2002.

WITHITS Chairs Bid Adieu; Welcome New Chairs

Natasha Devroye and Lalitha Sankar

The Women in Information Theory Society (WITHITS) program's mission is to provide events and services that address the needs of and encourage the participation of our underrepresented demographics, while being of interest and use to the community at large. The ITSOC supports 2–3 WITHITS events per year, generally in the form of sponsored lunches for event participants. From 2016–2018, WITHITS was voluntarily co-chaired by Associate Professors Natasha Devroye and Lalitha Sankar. Leadership is currently being transitioned to Assistant Professors Gireeja Ranade and Christina Lee Yu. We are excited to pass the baton to these intrepid chairs and help them bring their own flair to WITHITS. Before we exit the stage completely, we wanted to quickly recap the events we have hosted and encourage everyone to participate in the exciting ones to come!

At ISIT 2016, we hosted a Samoan Circle Event which attracted about 60 participants. We discussed topics in a leaderless Samoan circle style including the tenure process, transition challenges, finding good mentors, gender and evaluations (in particular letters of recommendation), and how to mentor/advise female students. At Allerton 2016, our Student Event was focused on issues pertaining to students in information theory in an open discussion format. At ITA 2017, Andrea Goldsmith, a fantastic supporter and participant in all WITHITS events, presented an enlightening summary of IEEE Award statistics. At ISIT 2017, the Burning Questions Mentoring Event paired senior and junior participants in a speed networking event where participants could ask each other whatever "burning question" they had in mind before switching to a different mentor.

More recently, at both ITA 2018 and ISIT 2018 we hosted two Statistics Quiz events. Each was an interactive true-false quiz on statistics about women in science, engineering and (closer to home) information theory, where participants were (sometimes) shocked by the statistics, and aimed to be the last one standing. This quiz was particularly valuable to the attendees in understanding the time it takes to achieve representation; it also gave incoming co-chair Gireeja an opportunity to join us in planning and organizing a WITHITS event. At ITA 2019, the current ITSOC President Emina Soljanin and the membership chair Wei Yu also hosted a lunch event Monday afternoon to introduce the new WITHITS co-chairs and summarize the activities of the membership committee at large. Finally, at ITA 2019, as is now tradition, Andrea Goldsmith organized the informal WITHITS Monday evening drinks event where we honored the accomplishments of attendees over the last year and enjoyed each other's company.

Despite all the usual intensity of our academic avatars, creating interactive and fun events for WITHITS was a great bonding experience for both of us. The creation of the WITHITS Google group has encouraged discussions on complex topics and served as a means to celebrate the achievements of the women in the community. It has been a pleasure serving the ITSOC through the WITHITS organization events. We would like to thank all participants and contributors for making these events enlightening and fun. WITHITS is an active group https://www.itsoc.org/withits, with an active google group and email list, which you can join at https://groups.google.com/d/forum/withits.

Dagstuhl Seminar: Algebraic Coding Theory for Storage, Networks and Security

Organizers:

Martin Bossert (Universität Ulm, DE)

Eimear Byrne (University College Dublin, IE)

Antonia Wachter-Zeh (TU München, DE)

The Dagstuhl Seminar (18511) *Algebraic Coding Theory for Storage, Networks and Security* was held in the Leibniz Centre for Informatics at Schloss Dagstuhl during December 16–21, 2018. This was the fourth in a series of seminars exploring applications of coding theory in modern communications theory (see also Dagstuhl Seminars 16321 (2016), 13351 (2013) and 11461 (2011)). The seminar brought together 50 mathematicians, engineers and computer scientists with expertise in coding theory, network coding, storage coding, cryptography and code-based security, to participate in dissemination and collaboration within the seminar themes. The main focus of this workshop was to explore novel results in coding theory for application in data storage management, cryptography and privacy. The impact of novel coding techniques across these domains

was discussed and explored. Particular emphasis was placed on new applications of coding theory in public key cryptography and on practical schemes using coding theory for content delivery.

Overview talks were given by Philippe Gaborit (*Recent Results for Cryptography Based on Rank Metric*), Emina Soljanin, (*Service Rates of Codes*), Eitan Yaakobi, (*Private Proximity Retrieval*), Sacha Kurz, (*Multisets of Subspaces and Divisible Codes*), Heide Gluesing-Luerssen (*On Ferrers Diagram Codes*) and Salim El Rouayheb (*GASP Codes for Secure Distributed Matrix Multiplication*). In addition, several short talks were given by other participants based on current research interests with a view to stimulating collaboration. Presentations on system cybersecurity, private information retrieval, locally recoverable codes, and various aspects of rank metric codes were given. The remaining seminar time was allocated to discussion groups, including those in code-based cryptography, private computation, service rates of codes, algebraic geometry codes and adversarial channels.

There were about 20 PhD and postdoctoral researchers in attendance, who reported a very positive experience and satisfaction

at being given the opportunity to explore new collaborations with more senior researchers and to get exposure to new problems in coding theory. All participants welcomed the time made available to them to take part in discussion groups and in more focussed collaborations. All were very pleased with the quality of the facilities and administrative support offered by staff at Schloss Dag-

stuhl, which made for a very productive meeting. Andreas Lenz and Rawad Bitar organised an afternoon excursion to Trier for the group. Giuseppe Cotardo collected and compiled data for the final published report.

Eimear Byrne

Report on the 2018 IEEE Information Theory Workshop

The 2018 IEEE Information Theory Workshop (ITW) was held in Guangzhou, China, from November 25 to 29. This was the third ITW in mainland China, following ITW 1988 in Beijing and ITW 2006 in Chengdu. The workshop was held at the Sun Yat-sen University Kaifeng Hotel, which is located on the historic University campus residing at the south bank of the Pearl River. The Pearl River is the third longest river in China and breeds the historic legacy of Guangzhou.

The workshop was chaired by Pingzhi Fan, Aria Nosratinia and Li Chen. Thanks to the donations of Sun Yat-sen University, Huawei, and Dongguan University of Technology, the workshop was able to waive the registration fee for the plenary speakers and to offer 10 student travel grants, free excursions, and an ITW 2018 mug for all registrants.

Among 222 regular paper submissions, 110 were accepted, with two of them being withdrawn after the acceptance decision.

Finally, 126 paper presentations (including 18 invited paper presentations) were arranged in two parallel tracks during the four-day-long event. On November 27, a recent results session hosting 11 posters was interleaved with the regular paper presentation sessions. The review of the submitted papers and the four-day-long program were organized by our TPC co-chairs Krishna Narayanan, Dongning Guo, Pascal Vontobel and Daniela Tuninetti.

ITW 2018 recorded 187 participants, among which 73 were students. The participants came from 23 countries, with China, USA, France, South Korea and Australia being the top 5 countries. The paper authors also came from 23 countries, with the top 5 being USA, China, France, Australia and Germany.

The conference started on the afternoon of Sunday, November 25, with two parallel tutorials, one of them being on *Coded Caching and Distributed Computing: Opportunities and Challenges*, delivered by Aditya Ramamoorthy and Petros Elia, and the other being on *Taming Nonconvexity in Information Science*, delivered by Yuxin Chen and Yuejie Chi. This was the first time for an ITW to offer tutorials. A welcome reception was organized on Sunday evening, giving a warm welcome to the participants with food and music.

The plenary talks of ITW 2018 started with polar codes and ended with polar codes: on November 26, Erdal Arıkan delivered the first plenary talk on *A Survey of Polarization Techniques for*

Multi-Terminal Source and Channel Coding, whereas on November 29, Peiying Zhu of Huawei delivered the last plenary talk on *Polar Codes for 5G New Radio*. In between, David Tse delivered his plenary talk on *Operating Blockchains Near Physical Limits* on November 27 and Raymond W. Yeung delivered his plenary talk on *Information Diagrams for Markov Random Fields* on November 28. From the theoretical explorations of polar codes to their industrial realization, and from blockchains to information diagrams, the plenary talks have ignited many discussions among the participants.

Besides the welcome reception, our social events included a memorable Pearl River night cruise on November 26, a banquet at the unique Sky No.1 Restaurant on November 27, the student/postdoc luncheon on November 28 and walking tours to Canton tower, Ersha Island and Sun Yat-sen University campus after the luncheon. During the banquet, local general co-chair Li Chen proposed a poem for ITW 2018 in Chinese

来穗论熵乐融融 (*rong*)

举杯共饮意浓浓 (*nong*)

八方学子聚中山 (*shan*)

刻界谱码志趣同 (*tong*)

Pronunciations of the last words are given to highlight the rhymes. The poem can be translated to

> *We are delighted to gather at Guangzhou to discuss a subject defined by entropy*
> *Our friendship has been strengthened by raising our glasses and having a good cheer*
> *Scholars from all over the world are galvanized at Sun Yat-sen University*
> *Because we have the common interests in characterizing transmission limits and designing codes*

The organizing committee sincerely hopes that the success of ITW 2018 can proliferate information and coding theory research within the IEEE Information Theory Society and beyond. The program, slides of plenaries and photos are all available at the workshop website http://www.itw2018.org.

Report on Sun Yat-Sen University Coding and Information Theory Workshop

The Sun Yat-sen University Coding and Information Theory Workshop (SYSU-CITW) took place on November 30, 2018, at the fringe of ITW 2018. For this one-day-long workshop, seven information and coding theorists were invited to deliver in-depth talks of their work, each lasting for 50 minutes. The invited speakers were Richard Blahut, Aditya Ramamoorthy, Aylin Yener, Fang-Wei Fu, Meir Feder, Pascal Vontobel and Daniela Tuninetti. The workshop was free of charge so that participants of ITW 2018 had an opportunity to gather for one more day and continue their exchange of knowledge. More importantly, it was hoped that students of Sun Yat-sen University were able to benefit from meeting and discussing with participants of ITW 2018.

SYSU-CITW was funded by Sun Yat-sen University and was held at Sun Yat-sen University Higher Education Megacentre campus, 20km east of the ITW 2018 venue. Shuttle buses were arranged for the commute between the two venues. The workshop was chaired by Xiao Ma and Li Chen, and had more than 70 participants.

After the welcome speech by Prof. De-Pei Qian, Dean of School of Data and Computer Science, Sun Yat-sen University, the first talk of the day was delivered by Richard Blahut on *Channel Capacity from Waves to Particles*. The subsequent talks include *Coded Caching Schemes with Reduced Subpacketization from Linear Block Codes*, delivered by Aditya Ramamoorthy, *Recent Advances in Cache-aided Wireless Networks*, delivered by Aylin Yener, *Stopping Set Distributions of Linear Codes*, delivered by Fang-Wei Fu, *Information and Uncertainty in Learning*, delivered by Meir Feder, *Graphical Models for Quantum Information Processing*" by Pascal Vontobel, and *On (Reliability, Latency, Rate) Tradeoffs for Downlink Wireless Systems*, delivered by Daniela Tuninetti.

During lunch break, a tour to the National Supercomputer Center in Guangzhou was organized. SYSU-CITW participants visited the Tianhe-II supercomputer, which championed the supercomputer race during 2013–2016. Initiatives of applying the supercomputer for certain information/coding theoretic problems were discussed during the visit.

Further information about SYSU-CITW, including program and photos, are available at http://www.itw2018.org/CITW
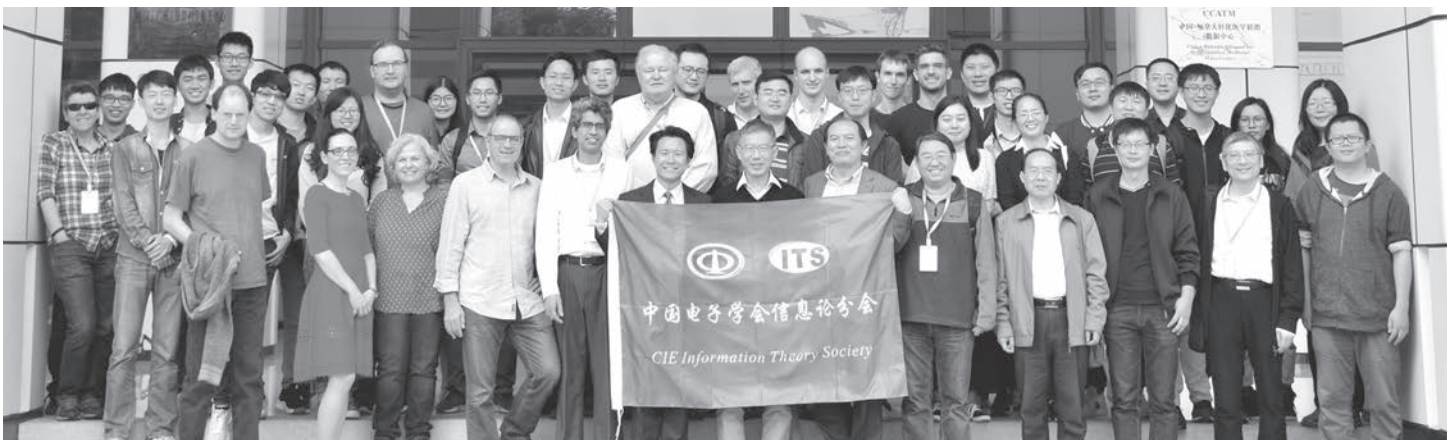
Report on the 2018 Workshop on Coding, Cooperation, and Security in Modern Communication Networks (COCO 2018)

Organizers: Ido Tal, Haim Permuter, and Gerhard Kramer

The first Workshop on Coding, Cooperation, and Security in Modern Communication Networks (COCO 2018) was held at the Technion, Haifa, Israel, on December 10-11, 2018. The event was part of a German Israeli Project Cooperation supported by the German Research Foundation (DFG) and the German Federal Ministry of Education and Research (BMBF). The workshop had over 70 registered participants.

The technical program included 20 talks. Shlomo Shamai and Eitan Yaakobi (Technion) held keynote talks, and Haim Permuter (BGU) and Gerhard Kramer (TUM) gave tutorial talks. The program also featured seven invited speakers and nine student speakers. The senior scientists giving talks were Krishna Narayanan (Texas A&M Univ.), Albert Guillén i Fàbregas (Universitat Pompeu Fabra), Moshe Schwartz (BGU), Anelia Somekh-Baruch (Bar Ilan Univ.), Christian Deppe (TUM), Antonia Tulino (Universitá di Napoli Federico II and Bell Labs), and Giuseppe Caire (TU Berlin). The student talks were by Peihong Yuan (TUM), Boaz Shuval (Technion), Han Cai (BGU), Andreas Lenz (TUM), Uzi Pereg (Technion), Oron Sabag (BGU), Elad Domanovitz (Tel Aviv Univ.), Thomas Wiegart (TUM), and Eli Shmuel (BGU).

The workshop participants were honored by the presence of Jacob Ziv, shown in a photo together with Giuseppe Caire and Krishna Narayanan.

The social program included lunches, refreshments, and a dinner. The organizers would like to thank Iris Berg for her organizational support, and Thomas Wiegart for managing the web page. Funding was provided by DFG, BMBF, the Ollendorff Minerva Center, the Hiroshi Fujiwara Cyber Security Research Center, the TUM International Graduate School of Science and Engineering (IGSSE), Technion, and Ben Gurion University. The program, presentations, and photos are available at the web address:

http://www.lnt.ei.tum.de/en/events/2018-workshop-on-coding-cooperation-and-security-in-modern-communication-networks-coco/

Jacob Ziv with Krishna Narayanan and Giuseppe Caire.

Workshop organizers Haim Permuter and Ido Tal.

Photo of COCO 2018 participants. On the front right are Nahum Shimkin, Ido Tal, Haim Permuter, and Yossef Steinberg. On the front left are Albert Guillén i Fàbregas, Giuseppe Caire, Antonia Tulino, and Shlomo Shamai.

Report on the 2018 Munich Workshop on Information Theory of Optical Fiber (MIO 2018)

Organizers: Javier García, Benedikt Leible, René Essiambre, and Gerhard Kramer

The Institute for Communications Engineering at the Technical University of Munich (TUM) organized the 2018 Munich Workshop on Information Theory of Optical Fiber (MIO 2018) on December 6-7, 2018. This was the fourth MIO since 2014, and this year there was a focus on quantum communications. The workshop had 60 registered participants.

The technical program included 12 talks. The speakers on Thursday, December 6, were Konrad Banaszek (Univ. Warsaw), Francisco Elohim Becerra (Univ. New Mexico), Roland Ryf (Bell Labs), Jasmin Meinecke (LMU), Amr Helmy (Univ. Toronto), Christoph Marquardt (MPI), Amirhossein Ghazisaeidi (Bell Labs), and Georg Böcherer (Huawei). The speakers on Friday, December 7, were Darko Zibar (DTU), Christian Schäffer (Helmut Schmidt Univ.), Mingming Tan (Aston Univ.), and Arkady Shipulin (Skolkovo Institute).

The social program included lunches, coffee, snacks, and a Christmas concert by magic flutists Norina Bitta and Nastassja Zalica. On Thursday evening the attendees enjoyed a Bavarian dinner at the Löwenbräukeller on the Stiglmaierplatz in Munich.

Funding for the workshop was provided by the German Research Foundation (DFG) and the TUM Chair of Communications Engineering (LNT). The organizers wish to thank Doris Dorn, Rita Henn-Schlune, Nicole Roßmann, Erika Herian, and Robert Schetterer for administrative support, and Tasnad Kernetzky, Patrick Schulte,

Discussion during the poster session.

Emna Ben Yacoub, Mustafa Cemil Coskun, Thomas Wiegart, and Delcho Donev for espresso & cappuccino & photo support.

The program, presentations, posters, and photos are available at the web address:

http://www.lnt.ei.tum.de/en/events/2018-munich-workshop-on-information-theory-of-optical-fiber-mio/

Group photo of MIO 2018 participants with Christmas concert musicians.

Call for Nominations

(ordered by deadline date)

IEEE Information Theory Society Paper Award

The Information Theory Society Paper Award is given annually for an outstanding publication in the fields of interest to the Society appearing anywhere during the preceding two calendar years. The purpose of this Award is to recognize exceptional publications in the field and to stimulate interest in and encourage contributions to fields of interest of the Society.

NOMINATION PROCEDURE: Nominations and letters of endorsement must be submitted by March 15, 2019. All nominations should be submitted using the online nomination forms. Please see http://www.itsoc.org/honors/information-theory-paper-award/itsoc-paper-award-nomination-form for details. Please include a statement outlining the paper's contributions.

IEEE Information Theory Society James L. Massey Research & Teaching Award for Young Scholars

The purpose of this award is to recognize outstanding achievement in research and teaching by young scholars in the Information Theory community. The award winner must be 40 years old or younger and a member of the IEEE Information Theory Society on January 1st of the year nominated.

NOMINATION PROCEDURE: Nominations and supporting materials must be submitted by March 15, 2019. All nominations should be submitted using the online nomination forms. Please see http://www.itsoc.org/honors/massey-award/nominationform for details.

IEEE Awards

The IEEE Awards program pays tribute to technical professionals whose exceptional achievements and outstanding contributions have made a lasting impact on technology, society and the engineering profession. For information on the Awards program, and for nomination procedures, please refer to http://www.ieee.org/portal/pages/about/awards/index.html

Recent Publications

IEEE Transactions on Information Theory

Table of content for volumes 65(1), 65(2)

Vol. 65(1): Jan. 2019.

Workshop in memory of František Matúš

The workshop will be organized as a part of the conference *Prague Stochastics 2019*, to be held in August 19–23, 2019, in UTIA, the Institute of Information Theory and Automation of the Academy of Sciences of the Czech Republic, Prague.
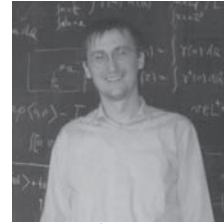
The workshop will be devoted to **František Matúš**, who passed away on May 17, 2018. His research interests reached several mathematical fields. He was involved in information theory, probability theory, statistics, geometry, algebra, and matroid theory. The workshop to commemorate him is intended to be multidisciplinary, involving these fields in which František worked, and the areas close to his interests. We particularly welcome contributions devoted to information geometry, entropic regions, information inequalities, cryptography, polymatroids, optimization of convex integral functionals, discrete Markovian random sequences, conditional independence, semi-graphoids, graphical models, exponential families, and algebraic statistics.

The workshop will take place at his home institution. Presentations at the workshop will include about ten invited talks given by experts in the area of his interest, and contributions from registered participants on close topics. A preliminary list of main speakers include:

> László Csirmaz (Renyi Institute, Budapest)
> Imre Csiszár (Renyi Institute, Budapest)
> Thomas Kahle (OvGU, Magdeburg)
> Seffen Lauritzen (University of Copenhagen)
> Carles Padró (Universitat Politecnica de Catalunya)
> Johannes Rauh (Max Planck Institute)
> Andrei Romashchenko (Laboratoire d'Informatique, Montpellier)
> Bernd Sturmfels (Max Planck Institute)
> Raymong Yeung (Chinese University of Hong Kong)
> Piotr Zwiernik (Barcelona)

Shorter contributed talks or posters will be selected from submitted abstracts by the program committee. The option to present open problems within smaller topic-specific sessions, moderated by invited chairs, is also considered, and will depend on the interest expressed by the preregistered participants. No conference fee is planned.

In case of you interest, please use the pre-registration form

http://simu0292.utia.cas.cz/pragstoch2019/callFM.php

and provide us with an abstract of a suggested presentation by **May 17, 2019**.

On behalf of the Program Committee:

> Nihat Ay (MPI MIS, Leipzig)
> László Csirmaz (Renyi Institute, Budapest)
> Milan Studený (UTIA, Prague)

CANADIAN SOCIETY OF INFORMATION THEORY
SOCIÉTÉ CANADIENNE DE THÉORIE DE L'INFORMATION

**The 2019 Canadian Workshop on
Information Theory**

Hamilton, Ontario, Canada
June 2-5, 2019

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McMaster University
Tim Davidson
McMaster University

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McMaster University
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McMaster University

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Andrew Eckford
York University

The 16th Canadian Workshop on Information Theory (http://cwit.ca/2019/) will be held on the campus of McMaster University, Hamilton, Ontario, from Sunday, June 2 to Wednesday, June 5, 2019. Papers in (but not exclusive to) the following fields of research are solicited:

- Shannon Theory
- Big Data Analytics
- Multiuser Information Theory
- Quantum Information Processing
- Coding Theory and Practice
- Coded Modulation
- Data Compression and Source Coding
- Optical Communications
- Cooperative Communication
- Low-latency Communication
- Information Theory in Biology

- Cryptology and Data Security
- Information Theory and Statistics
- Signal Processing
- Pattern Recognition and Learning
- Sequences and Complexity
- Multi-terminal Information Theory
- Data Networks
- Detection and Estimation
- Cognitive Radio
- Underwater Communications
- Network Coding and Applications

Authors wishing to have papers considered for the workshop should electronically submit their full papers (suggested length: five pages, maximum length: six pages) in PDF format through EDAS (https://edas.info/) using the standard IEEE two-column format (https://www.ieee.org/). Accepted papers will be published on IEEE Xplore.

Important Deadlines:

Full-length papers submission:	April 5, 2019
Notification of acceptance:	April 22, 2019
Final manuscript submission/Author registration:	May 6, 2019

57th Allerton Conference
ON COMMUNICATION, CONTROL, & COMPUTING

Call for Papers: Due July 8, 2019

Manuscripts can be submitted from June 15-July 8, 2019 with the submission deadline of July 8th being firm. Please follow the instructions at **allerton.csl.illinois.edu**.

CONFERENCE CO-CHAIRS | **Daniel Liberzon and Alejandro Dominguez-Garcia**

INFORMATION FOR AUTHORS | Regular papers suitable for presentation in 20 minutes are solicited. Regular papers will be published in full (subject to a maximum length of eight 8.5" x 11" pages, in two column format) in the Conference Proceedings. Only papers that are actually presented at the conference and uploaded as final manuscripts can be included in the proceedings, which will be available after the conference on IEEE Xplore. For reviewing purposes of papers, a title and a five to ten page extended abstract, including references and sufficient detail to permit careful reviewing, are required.

IMPORTANT DATES | 2019

JULY 8 — **Submission Deadline**

AUGUST 2 — **Acceptance Date** Authors will be notified of acceptance via email by August 6, 2018, at which time they will also be sent detailed instructions for the preparation of their papers for the Conference Proceedings.

AFTER AUGUST 5 — **Registration Opens**

SEPTEMBER 24-27 — **Conference Dates**

September 24 — **Opening Tutorial Lectures** at the Coordinated Science Lab, University of Illinois at Urbana-Champaign

September 25-27 — **Conference Sessions** at the University of Illinois Allerton Park & Retreat Center. The Allerton House is located 26 miles southwest of the Urbana-Champaign campus of the University of Illinois in a wooded area on the Sangamon River. It is part of the 1,500 acre Robert Allerton Park, a complex of natural and man-made beauty designated as a National natural landmark. Allerton Park has 20 miles of well-maintained trails and a living gallery of formal gardens, studded with sculptures collected from around the world.

Plenary Lecture: **Benjamin Van Roy,** Professor at Stanford University

SEPTEMBER 29 — **Final Paper Deadline** Final versions of papers that are presented at the conference must be submitted electronically in order to appear in the Conference Proceedings and IEEE Xplore.

PAPERS PRESENTING ORIGINAL RESEARCH ARE SOLICITED IN THE AREAS OF:

- Biological Information Systems
- Coding Techniques and Applications
- Coding Theory
- Data Storage
- Information Theory
- Multiuser Detection and Estimation
- Network Information Theory
- Sensor Networks in Communications
- Wireless Communication Systems
- Intrusion/Anomaly Detection and Diagnosis
- Network Coding
- Network Games and Algorithms
- Performance Analysis
- Pricing and Congestion Control
- Reliability, Security and Trust
- Decentralized Control Systems
- Robust and Nonlinear Control
- Adaptive Control and Automation
- Robotics
- Distributed and Large-Scale Systems
- Complex Networked Systems
- Optimization
- Dynamic Games
- Machine Learning and Learning Theory
- Signal Models and Representations
- Signal Acquisition, Coding, and Retrieval
- Detection and Estimation
- Learning and Inference
- Statistical Signal Processing
- Sensor Networks
- Data Analytics
- Power System Control and Optimization

ILLINOIS

The Allerton Conference is co-sponsored by the **Coordinated Science Lab** and the **Department of Electrical and Computer Engineering.**

WEBSITE | **allerton.csl.illinois.edu** EMAIL | **amellis@illinois.edu**

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Aug 25-28

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itw2019.org

The IEEE Information Theory Workshop will be held in Visby, Gotland, Sweden, from the 25th to the 28th of August 2019.

The Hanseatic city Visby is located on the island of Gotland in the Baltic sea. It is one of the best-preserved medieval cities in Scandinavia with its 3.4km long town wall and several church ruins in the old city center. Visby is listed on the UNESCO World Heritage Site since 1995 and Gotland is a very popular summer vacation destination for Scandinavians.

We seek original, unpublished contributions in **all areas of information theory**, including but not limited to the focus topics listed below.

- **Modern Coding Theory**
  Graph based codes and iterative decoding
  Spatially coupled codes
  Polar codes

- **Security, Privacy, and Trust**
  Physical layer security
  Private information retrieval
  Security and privacy in distributed storage
  Security and privacy in machine learning

- **Cyber-Physical Systems**
  Interaction of information and control
  Time-sensitive source and channel coding
  Networked control systems
  Entropy in control, dynamics, and information theory

In addition, papers that broaden the reach of information theory, including emerging fields and novel applications of information theory, are encouraged.

Full papers of up to a five-page limit should be submitted via EDAS.

Important Dates

Date of submission: **April 10, 2019** (tentative)
Date of notification: June 10, 2019
Camera ready paper due: July 1, 2019

We are looking forward to welcoming you in Visby!
The organization committee

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2019 North American School of Information Theory
https://www.itsoc.org/conferences/schools/nasit2019

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The 2019 North American School of Information Theory will be held from **Tuesday, July 2nd to Friday, July 5th** at Boston University in Boston, MA, USA**.** The school will offer graduate students and postdoctoral researchers the opportunity to learn from leading experts in information theory through short courses and talks as well as the chance to present their own work.

This year's lecturers are

- Kannan Ramchandran, University of California, Berkeley
  Padovani Lecturer

- Alexander Barg, University of Maryland, College Park

- Tara Javidi, University of California, San Diego

- Maxim Raginsky, University of Illinois, Urbana-Champaign

- Adam Smith, Boston University

Graduate students and postdoctoral researchers in North America working on problems of information theory in a broad sense are encouraged to apply with the title and a short (less than 250 words) abstract of a poster they would like to present.

The application deadline for the school is **April 25th, 2019**. Note that the school takes place the week before ISIT 2019 in Paris, giving students the option to add Boston as a stopover.

2019 European School of Information Theory

The 2019 European School of Information Theory (ESIT) will be held in the French Riviera during April 15-19.

(Photo: Office de tourisme et des Congrès d'Antibes Juan-les-Pins, Antibes La vague © F. Trotobas)

The European School of Information Theory (ESIT) is an annual educational event, organized by the IEEE Information-tion 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 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.

The scheduled tutorial lecturers for 2019 are:

- **Matthieu Bloch (Georgia Institute of Technology)**
- **Deniz Gündüz (Imperial College London)**
- **Tara Javidi (University of California, San Diego)**
- **Mari Kobayashi (CentraleSupélec)**
- **Ido Tal (Technion)**

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Michèle Wigger (Télécom ParisTech), Technical Program

Contact

esit2019@ieeefrance.org

Conference Calendar

DATE	CONFERENCE	LOCATION	WEB PAGE	DUE DATE
April 15–19, 2019	IEEE Wireless Communications and Networking Conference	Marrakech, Morocco	http://wcnc2019.ieee-wcnc.org/	Passed
April 15–19, 2019	European School of Information Theory	French Riviera, France	https://www.itsoc.org/conferences/schools/esit-2019	—
April 29, 2019	The 2nd Age of Information Workshop	Paris, France	https://www.eng.auburn.edu/AoIWorkshop/2019/	Passed
June 03–07, 2019	The International Symposium on Modeling and Optimization in Mobile, Ad Hoc, and Wireless (WiOpt)	Avignon, France	http://www.wi-opt.org/	Passed
June 10–12, 2019	IEEE Conference on Communications and Network Security	Washington, D.C., USA	https://cns2019.ieee-cns.org/	Passed
June 23–26, 2019	51st Annual ACM Symposium on the Theory of Computing (STOC)	Phoenix, Arizona	http://acm-stoc.org/stoc2019/	Passed
July 02–05, 2019	North American School of Information Theory (NASIT)	Boston, Massachusetts	https://www.itsoc.org/conferences/schools/nasit2019	—
July 07–12, 2019	IEEE International Symposium on Information Theory	Paris, France	https://2019.ieee-isit.org/	passed
August 25–28, 2019	IEEE Information Theory Workshop (ITW) 2019	Visby, Gotland, Sweden	http://itw2019.org/	April 10, 2019
September 24–27, 2019	57th Annual Allerton Conference on Communication, Control, and Computing	Allerton, University of Illinois at Urbana-Champaign, USA	https://allerton.csl.illinois.edu/	July 08, 2019

Major COMSOC conferences: http://www.comsoc.org/confs/index.html