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Ubiquitous Networking

4th International Symposium, UNet 2018
Hammamet, Tunisia, May 2–5, 2018
Revised Selected Papers


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About UNet Conference Series

UNet is an international scientific event that highlights new trends and findings in hot topics related to ubiquitous computing/networking. This fourth edition was held during May 2–5, 2018, in the fascinating city of Hammamet, Tunisia.

Ubiquitous networks sustain the development of numerous paradigms and technologies such as distributed ambient intelligence, context-awareness, cloud computing, wearable devices, and future mobile networking (e.g., B4G and 5G). Various domains are then impacted by such a system, such as security and monitoring, energy efficiency and environment protection, e-health, precision agriculture, intelligent transportation, home-care (e.g., for elderly and disabled people), etc. Communication in such a system has to cope with many constraints (e.g., limited capacity resources, energy depletion, strong fluctuations of traffic, real-time constraints, dynamic network topology, radio link breakage, interferences, etc.) and has to meet the new application requirements. Ubiquitous systems offer many promising paradigms aiming to deliver significantly higher capacity to meet the huge growth of mobile data traffic and to accommodate efficiently dense and ultra-dense systems. A crucial challenge is that ubiquitous networks should be engineered to better support existing and emerging applications including broadband multimedia, machine-to-machine applications, Internet of Things, sensor networks, and RFID technologies. Many of these systems require stringent quality-of-service constraints including better latency, reliability, higher spectral and energy efficiency, but also some quality-of-experience and quality-of-context constraints.

The main purpose of UNet Conference Series is to serve as a forum that brings together researchers and practitioners from academia and industry to discuss recent developments in pervasive and ubiquitous networks. This conference provides a forum for exchanging ideas, discussing solutions, debating the challenges identified, and sharing experiences among researchers and professionals. UNet also aims to promote adoption of new methodologies and to provide the participants with advanced and innovative tools able to catch the fundamental dynamics of the underlying complex interactions (e.g., game theory, mechanism design theory, learning theory, SDR platforms, etc.).

Welcome Message from the UNet 2018 Chairs

It is our pleasure to welcome you to the proceedings of the 2018 edition of the International Symposium on Ubiquitous Networking, UNet 2018. The conference was held in the city of Hammamet, Tunisia, during May 2–5, following up on the success of past editions. Tunisia has a growing and active community of networking researchers and the choice of Hammamet for UNet 2018 allowed its attendees, coming from all parts of the globe, to interact in a fascinating environment.

The growth of pervasive and ubiquitous networking in the past few years has been unprecedented. Today, a significant portion of the world's population is connected to the Internet most of the time through smart phones, and the Internet of Things promises to broaden the impact of the Internet to encompass devices ranging from electric appliances and medical devices to unmanned vehicles. The goal of UNet is to be a premier forum for discussing technical challenges and solutions related to such a widespread adoption of networking technologies, including broadband multimedia, machine-to-machine applications, Internet of Things, security and privacy, data engineering, sensor networks, and RFID technologies. Toward this aim, we had four main technical tracks of papers covering all the aspects of ubiquitous networks.

The UNet 2018 program featured four invited talks addressed by distinguished keynote speakers: Prof. Michele Zorzi from University of Padua (Italy), Prof. Robert Schober from Friedrich Alexander University (Germany), Prof. Moncef Gabbouj from Tampere University of Technology (Finland), and Prof. Mounir Ghogho from the International University of Rabat (Morocco)/University of Leeds (UK). This year, UNet was co-located with the IEEE 5G-IoT Summit Hammamet led by Professors Mohamed-Slim Alouini (KAUST University, Saudi Arabia), Nouredine Boudriga (University of Carthage, Tunisia), Slim Rekhiss (University of Carthage, Tunisia), Fethi Tlili (University of Carthage, Tunisia), Essaid Sabir Hassan II University of Casablanca, Mustapha Benjillali (INPT, Morocco), Latif Ladid (University of Luxembourg, Luxembourg), Ashutosh Dutta (Columbia University, USA), Mounir Ghogho (International University of Rabat-Morocco/University of Leeds, UK), Walid Abdallah (Aviation School of Borj El Amri, Tunisia), and Yacine Djemaiel (Higher Institute of Technological Studies in Communications, Tunisia).

With a rich program that reflects the most recent advances in ubiquitous computing, involving a broad range of theoretical tools (e.g., game theory, mechanism design theory, learning theory, machine learning, etc.) and practical methodologies (e.g., SDR/SDN platforms, embedded systems, privacy and security by design, etc.) to study modern technologies (e.g., LTE-A, LTE-B, 5G, IoT), we were very pleased to welcome our attendees to this new edition of the UNet conference series.

We are very thankful to the Communication Networks and Security Research Lab (CN&S) from the University of Carthage, and the Tunisian Association for Research and Innovation in Telecommunication and Security (@RITS) for co-organizing this exciting event. We are grateful to our technical sponsors, without whom UNet 2018

would not have been possible. We would like to thank Springer Science+Business Media the and IPv6 Forum. We are also very thankful to all our sponsors and patrons (SUP'COM, University of Sfax, University of Tunis, TBS, ENSEM, MOBITIC).

Enjoy the proceedings!

September 2018

Noureddine Boudriga
Mohamed-Slim Alouini

Welcome Message from the UNet 2018 TPC Chairs

It is with great pleasure that we welcome you to the proceedings of the 2018 International Symposium on Ubiquitous Networking (UNet 2018), which was held in Hammamet, Tunisia. The conference featured an interesting technical program of five technical tracks reporting on recent advances in ubiquitous communication technologies and networking, ubiquitous Internet of Things: emerging technologies and breakthroughs, mobile edge networking and fog-cloud computing, data engineering for ubiquitous environments, and cyber-security for ubiquitous communication. UNet 2018 also featured four keynote speeches by world-class experts, and one invited paper session.

We received 87 paper submissions from 19 countries and four continents. From these, 30 regular papers and five short papers were accepted after a careful review process to be included in the UNet 2018 proceedings. The regular-paper acceptance rate was 34% whereas the overall acceptance rate in UNet 2018 was 40%.

The preparation of this excellent program would not have been possible without the dedication and the hard work of the different chairs, the keynote speakers, and all the Technical Program Committee members and reviewers. We take this the opportunity to acknowledge their valuable work, and sincerely thank them for their help in ensuring that UNet 2018 will be remembered as a high-quality event.

We hope that you will enjoy this edition's proceedings.

September 2018

Slim Rekhis
Essaid Sabir
Sofie Pollin

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UNET'18 Keynote Speakers

Overview of Artificial Intelligence, Machine Learning and Big Data Analytics with Applications in Various Decision-Making Environments

Moncef Gabbouj

Tampere University of Technology, Finland

Abstract. Artificial Intelligence (AI) can be defined in many ways, but one thing all experts agree upon is the key role machine learning plays in AI. This keynote will adopt a tutorial style to first provide a quick overview of the current state of AI and reviews in some details the main approaches followed in machine learning, with a special focus on the more recent advances in deep learning and neural networks. We will also present a hierarchical layered approach that exploits many types of sensor and non-sensor signals and data, and proposes suitable representations, as well as processing and analysis algorithms in order to apply machine learning, including deep and shallow learning. The framework can be explored in various decision-making environments, including healthcare and wellbeing, surveillance, and media and entertainment to mention a few fields.

Biography



Moncef Gabbouj received his BS degree in electrical engineering in 1985 from Oklahoma State University, Stillwater, and his MS and PhD degrees in electrical engineering from Purdue University, West Lafayette, Indiana, in 1986 and 1989, respectively.

Dr. Gabbouj is a Professor of Signal Processing at the Department of Signal Processing, Tampere University of Technology, Tampere, Finland, where he leads the Multimedia Research Group. Dr. Gabbouj held the prestigious post of Academy Professor with the Academy of Finland 2011–2015. He held several visiting professorships at different universities, including The Hong Kong University of Science and Technology, Hong Kong (2012–2013), Purdue University, West Lafayette, Indiana, USA (August–December 2011), the University of Southern California (January–June 2012), and the American University of

Sharjah, UAE, (2007–2008). He was Head of the Department during 2002–2007, and served as Senior Research Fellow of the Academy of Finland in 1997–1998 and 2007–2008. His research interests include multimedia content-based analysis, indexing and retrieval, machine learning, nonlinear signal and image processing and analysis, voice conversion, and video processing and coding.

Dr. Gabbouj is a Fellow of the IEEE, a member of the European Academy and the Finnish Academy of Science and Letters. He is the past Chairman of the DSP Technical Committee of the IEEE Circuits and Systems Society and member of the IEEE Fourier Award for Signal Processing Committee. He was Honorary Guest Professor of Jilin University, China (2005–2010). He served as associate editor of the IEEE Transactions on Image Processing, and was guest editor of Multimedia Tools and Applications, the European journal Applied Signal Processing. He is the past chairman of the IEEE Finland Section, the IEEE Circuits and Systems Society, Technical Committee on Digital Signal Processing, and the IEEE SP/CAS Finland Chapter. He was also (co-)Chairman of BigDataSE 2015, EUVIP 2014, CBMI 2005, and WIAMIS 2001.

Robotic Communication: When Communication Theory Meets Control Theory

Mounir Ghogho

International University of Rabat-Morocco/University of Leeds, UK

Abstract. Mobile robots (terrestrial and aerial) are gaining importance in an increasing number of applications. They often require wireless communication capabilities to complete their tasks, and in some applications the main task of the robot is communication/relaying of information. The conventional approach to adding communications capabilities to mobile robots does not leverage the fact that the robot can control its position and can hence move in such a way as to improve the communication performance through spatial/mobility diversity. Since the energy consumption due to mobility is tightly linked to the robot's state vector transitions (kinematics and dynamics) over time, communication-aware path/trajectory planning requires a good knowledge of both control theory and communication theory. Therefore, designing efficient communication systems for mobile robots calls for a new paradigm where control theory plays a pivotal role. In this talk, this paradigm will be described and illustrated through examples, and new research opportunities will be presented.

Biography



Mounir Ghogho received his PhD degree in 1997 from the National Polytechnic Institute of Toulouse, France. He was an EPSRC Research Fellow with the University of Strathclyde (Scotland), from Sept 1997 to Nov 2001. In December 2001, he joined the University of Leeds where he was promoted to full Professor in 2008. While still affiliated with the University of Leeds, he joined the International University of Rabat (UIR) in January 2010, where he is currently the Director of TICLab (ICT Research Laboratory) and Scientific Advisor to the President. He is a Fellow of IEEE, a recipient of the 2013 IBM Faculty Award, and a recipient of the 2000 UK Royal Academy of Engineering Research Fellowship. He is currently an associate editor of the IEEE Signal Processing Magazine and a member of the steering committee of the Transactions of Signal and Information Processing. In the past, he served as an Associate Editor of the IEEE Transactions on Signal Processing and IEEE Signal Processing

Letters, a member of the IEEE Signal Processing Society SPCOM, SPTM and SAM Technical Committee. He chaired many conferences and workshops including the European Signal Processing conference Eusipco2013 and the IEEE workshop on Signal Processing for Advanced Wireless Communications SPAWC'2010. He is the Eurasp Liaison in Morocco.

Spectrum Sharing and Networking Issues in 5G mmWave Cellular Networks

Michele Zorzi

University of Padova, Italy

Abstract. This talk will discuss some relevant networking issues for 5G mmWave cellular systems. First, we will give an extensive discussion on the potential benefits and technical challenges of spectrum sharing in a mmWave context. We will show that from this points of view this scenario is much more promising than traditional cellular systems in sub-6 GHz bands. We will also discuss the role of coordination between different operators for the purpose of managing the inter- and intra-system interference, which is shown to be the ultimate limiting factor in spectrum sharing. Second, we will discuss how directionality makes it more difficult to implement and operate network management functionalities, with specific reference to Initial Access and Cell Search, where the energy/latency/detection tradeoff is of particular interest. Finally, we will briefly describe our full-stack 5G mmWave cellular simulator, which includes the whole protocol suite as well as detailed mmWave channel models, and present some examples of system-level results it can provide.

Biography



Michele Zorzi was born in Venice, Italy, on December 6th, 1966. He received the Laurea Degree and the Ph.D. in Electrical Engineering from the University of Padova, Italy, in 1990 and 1994, respectively. During the Academic Year 1992/93, he was on leave at the University of California, San Diego (UCSD), attending graduate courses and doing research on multiple access in mobile radio networks. In 1993, he joined the faculty of the Dipartimento di Elettronica e Informazione, Politecnico di Milano, Italy. After spending three years with the Center for Wireless Communications at UCSD, in 1998 he joined the School of Engineering of the University of Ferrara, Italy, where he became a Professor in 2000. Since November 2003, he has been on the faculty at the Information Engineering Department of the University of Padova. His present research interests include performance evaluation in mobile communications systems, random access in mobile radio

networks, ad hoc and sensor networks, energy constrained communications protocols, and broadband wireless access.

Dr. Zorzi was the Editor-In-Chief of the IEEE Wireless Communications Magazine in 2003–2005, is currently the Editor-In-Chief of the IEEE Transactions on Communications, and serves on the Editorial Boards of the IEEE Transactions on Wireless Communications, the Wiley Journal of Wireless Communications and Mobile Computing and the ACM/URSI/Kluwer Journal of Wireless Networks. He was also guest editor for special issues in the IEEE Personal Communications Magazine (“Energy Management in Personal Communications Systems,” Jun. 1998) and the IEEE Journal on Selected Areas in Communications (“Multi-media Network Radios,” May 1999, and “Underwater Wireless Communications and Networks,” to be published in 2008). He is a Fellow of the IEEE.

Synthetic Molecular Communication for Future Nano-Communication Networks

Robert Schober

Friedrich Alexander University (FAU), Erlangen, Germany

Abstract. Synthetic molecular communication is an emerging research area offering many interesting and challenging new research problems for communication engineers, biologists, chemists, and physicists. Synthetic molecular communication is widely considered to be an attractive option for communication between nano-devices such as (possibly artificial) cells and nano-sensors. Possible applications of nano-communication networks include targeted drug delivery, health monitoring, environmental monitoring, and bottom-up² manufacturing. The IEEE and ACM have recently founded several new conferences and journals dedicated to this exciting new and fast growing research area.

In this keynote, we will give first a general overview of the areas of synthetic molecular communication and nano-networking. Components of synthetic molecular communication networks, possible applications, and the evolution of the field will be reviewed. Subsequently, we will give an introduction to various synthetic molecular communication strategies such as gap junctions, molecular motors, and diffusion based molecular communication. Thereby, we will focus particularly on diffusion based synthetic molecular communication, identify the relevant basic laws of physics and discuss their implications for communication system design. One particular challenge in the design of diffusive synthetic molecular communication systems is intersymbol interference. We will discuss corresponding mitigation techniques and provide some results. Furthermore, we will present several receiver design options for diffusive synthetic molecular communication, discuss their respective advantages and disadvantages, and elaborate on the impact of external phenomena such as molecule degradation and flow. In the last part of the talk, we will discuss some research challenges in synthetic molecular communication from a communication and networking point of view.

Biography



Robert Schober received the Diplom (Univ.) and the Ph. D. degrees in electrical engineering from Friedrich-Alexander University Erlangen-Nuremberg (FAU), Germany, in 1997 and 2000, respectively. From May 2001 to April 2002 he was a Postdoctoral Fellow at the University of Toronto, Canada, sponsored by the German Academic Exchange Service (DAAD). From 2002 to 2011, he was a Professor and Canada Research Chair at the University of British Columbia (UBC), Vancouver, Canada. Since January 2012 he is an Alexander von Humboldt Professor and the Chair for Digital Communication at FAU. His research interests fall into the broad areas of Communication Theory, Wireless Communications, and Statistical Signal Processing.

Robert received several awards for his work including the 2007 Wilhelm Friedrich Bessel Research Award of the Alexander von Humboldt Foundation, the 2008 Charles McDowell Award for Excellence in Research from UBC, a 2011 Alexander von Humboldt Professorship, a 2012 NSERC E.W.R. Stacie Fellowship, and the 2017 Wireless Communication Technical Committee Recognition Award. In addition, he has received several best paper awards for his research and is listed as a 2017 Highly Cited Researcher by the Web of Science. Robert is a Fellow of the Canadian Academy of Engineering, a Fellow of the Engineering Institute of Canada, and a Fellow of the IEEE. From 2012 to 2015, he served as Editor-in-Chief of the IEEE Transactions on Communications. Currently, he is the Chair of the Steering Committee of the IEEE Transactions on Molecular, Biological and Multiscale Communication and serves on the Editorial Board of the Proceedings of the IEEE. Furthermore, he is a Member at Large of the Board of Governors and a Distinguished Lecturer of the IEEE Communications Society.

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