Optoelectronic concepts for extreme wideband radio communications

Andreas Czylwik

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Abstract

Radio communications with extreme bandwiths require also correspondingly high carrier frequencies. An effective method to create high carrier frequencies up the terahertz frequency range is utilizing optoelectronic mixing of semiconductor laser signals. The optoelectronic RF signal generation has the advantage that it even works in frequency ranges where no amplifiers are available. The optoelectronic mixing is typically carried out by combining two laser signals and detecting the combined (sum) signal with high-speed photodiodes or photoconductors. Signal modulation may be performed by modulating one of the laser signals with Mach-Zehnder modulators which show both linear and nonlinear distortions. Due to the high carrier frequencies, even for small distances between transmitter and receiver, high antenna gain is necessary. In order to track line-of-sight in case of moving or portable terminals, adaptive beamforming has to be used. Beamforming concepts which utilize multiple signal sources have the advantage that more transmit power compared with single source solutions is available.

Bio

Andreas Czylwik studied Electrical Engineering at the Technical University of Darmstadt, Germany, from 1978 to 1983. In 1988 he received the Dr.-Ing. degree and in 1994 the Habilitation degree, both from the Technical University of Darmstadt and both in the field of optical communications.

From 1994 to 2000 he was with the research and development center (Technologiezentrum) of Deutsche Telekom. In 2000 he became a full professor at the Technical University of Braunschweig heading the research group of Microcellular Radio Systems. Since 2002 he has been with University Duisburg-Essen heading the Chair of Communication Systems. His research interests are mainly in the field of radio communications on link and system level with special focus on adaptive multicarrier MIMO techniques. Several research activities focus on utilizing high frequency (up to THz) electromagnetic waves with applications in the field of extreme wideband communications and radar systems.

Localization-of-Things in the 5G Ecosystem

Andrea Conti

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Abstract

The availability of real-time high-accuracy location awareness is essential for current and future wireless applications, particularly those involving Internet-of-Things and 5G ecosystem. Reliable localization and navigation of people, objects, and vehicles – Localization-of-Things – is a critical component for a diverse set of applications including connected communities, smart environments, vehicle autonomy, asset tracking, medical services, military systems, and crowd sensing. The coming years will see the emergence of network localization and navigation in challenging environments with sub-meter accuracy and minimal infrastructure requirements. We will discuss the limitations of traditional positioning and move on to the key enablers for high-accuracy location awareness such as wideband transmission and cooperative processing.

Bio

Andrea Conti is a professor and founding director of the Wireless Communication and Localization Networks Laboratory at the University of Ferrara, Italy. His current research topics include network localization and navigation, distributed sensing, adaptive diversity communications, and quantum information science. He received the HTE Puskás Tivadar Medal, the IEEE Communications Society's Stephen O. Rice Prize in the field of Communications Theory, and the IEEE Communications Society's Fred W. Ellersick Prize. Dr. Conti has served as editor for IEEE journals, as well as chaired international conferences. He has been elected Chair of the IEEE Communications Society's Radio Communications Technical Committee. He is a co-founder and elected Secretary of the IEEE Quantum Communications & Information Technology Emerging Technical Subcommittee. He is an elected Fellow of the IET and has been selected as an IEEE Distinguished Lecturer.

Spectrally - Efficient Multiple Access and Resource Allocation Design for B5G/6G Networks Exploiting Deep Reinforcement Learning

Ekram Hossain

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Abstract

While the fifth generation (5G) cellular wireless communication technologies are currently being developed and deployed, research on the beyond 5G (B5G) technologies, also referred to as 6G technologies, has already begun. For design and optimization of multiple access and resource allocation techniques in 6G, machine learning (ML) tools, including deep supervised learning and deep reinforcement learning (DRL), will be particularly useful. In this talk, I will discuss the role of ML in general for design and optimization of multiple access and resource allocation in 6G systems. Also, I will give a specific example of how DRL techniques can be used for massive non-orthogonal multiple access in a cell-free MIMO system.

Bio

Ekram Hossain (IEEE Fellow) is a Professor in the Department of Electrical and Computer Engineering at University of Manitoba, Winnipeg, Canada. He is a Member (Class of 2016) of the College of the Royal Society of Canada, and also a Fellow of the Canadian Academy of Engineering. He received his Ph.D. in Electrical Engineering from University of Victoria, Canada, in 2001. Dr. Hossain's current research interests include design, analysis, and optimization of wireless communication networks (with emphasis on beyond 5G cellular), and applied machine learning, game theory, and network economics (http://home.cc.umanitoba.ca/~hossaina). He was elevated to an IEEE Fellow “for contributions to spectrum management and resource allocation in cognitive and cellular radio networks". He was listed as a *Clarivate Analytics Highly Cited Researcher in Computer Science* in 2017, 2018, 2019, and 2020. Dr. Hossain has won several research awards including the “2017 IEEE Communications Society Best Survey Paper Award”, IEEE VTC 2016-Fall “Best Student Paper Award” as a co-author, IEEE Communications Society Transmission, Access, and Optical Systems (TAOS) Technical Committee's Best Paper Award in IEEE Globecom 2015, University of Manitoba Merit Award in 2010, 2013, 2014, and 2015 (for Research and Scholarly Activities), the 2011 IEEE Communications Society Fred Ellersick Prize Paper Award, and the IEEE Wireless Communications and Networking Conference 2012 (WCNC'12) Best Paper Award. He received the 2017 IEEE ComSoc TCGCC (Technical Committee on Green Communications & Computing) Distinguished Technical Achievement Recognition Award “for outstanding technical leadership and achievement in green wireless communications and networking”. Currently he serves as the Editor-in-Chief of the IEEE Press and an Editor for IEEE Transactions on Mobile Computing. Previously, he served as an Area Editor for the IEEE Transactions on Wireless Communications in the area.

Aerial platforms in beyond 5G networks

Hamed Ahmadi

University of York, UK, and University College Dublin, Ireland

Bio

Hamed Ahmadi is an assistant professor in the department of Electronic Engineering at University of York, UK, He is also an adjunct assistant professor at the school of Electrical and Electronic Engineering, University College Dublin, Ireland. He received his Ph.D. from National University of Singapore in 2012 where he was a PhD scholar at Institute for Infocomm Research, A-STAR. Since then, he worked at different academic and industrial positions in Republic of Ireland and UK. Dr. Ahmadi has published more than 50 peer reviewed book chapters, journal, and conference papers. He is a member of editorial board of IEEE Systems, IEEE Access, and Springer Wireless Networks. He is a senior member of IEEE, Fellow of UK Higher Education Academy, and Networks working group co-chair and a management committee member of COST Action 15104 (IRACON). His current research interests include design, analysis, and optimization of wireless communications networks, the application of machine learning in wireless networks, airborne networks, blockchain, Internet-of-Things, cognitive radio networks, and small cell and self-organizing networks.

Dependable 6G Universal Platform Based on Regulatory and Data Sciences for Pandemic and High QoL

Ryuji Kohno

Yokohama National University, Yokohama, Japan

Abstract

To combat with pandemic of COVID-19 and support medical healthcare services, dependable ICT such as beyond 5G(6G), body area network (BAN) and data science, virtual reality (VR) can be integrated for a virtual general clinic. To promote a sustainable service and business while combating with COVID-19, his talk will address a way how to manage risk versus benefit of the service and business using regulatory science and to create a new style of daily life. hen comprehensive solution will be introduced including projects for UAE-Japan, EU-Japan etc. and promotion of IEEE802.15 standard for enhanced dependability.

Bio

Ryuji Kohno received the Ph.D. degree from the University of Tokyo in 1984. Since 1998, he is a Professor while a PI of MEXT 21st century and Global COE programs in Yokohama National University. He was a visiting Scientist in Univ. of Toronto, Canada, and a Distinguished Professor with the Univ. of Oulu, Finland in academia. In industry, he was also a Director in Sony CSL/ATL, and in the UWB and the Medical ICT Institutes of NICT, and the CEO of CWC-Nippon Co. Since 2006, he has also been an Associate Member of the Science Council of Japan. He is IEICE and IEEE Fellows. He was elected a BoG Member of the IEEE Information Theory Society in 2000-2006. He received NTT DoCoMo Mobile Science Award in 2002.

Channel modeling supported by the physical laws of wave propagation and measurements

Katsuyuki Haneda

Aalto University School of Electrical Engineering, Espoo, Finland

Abstract

Channel modeling for radio communications evolves in various dimensions, e.g., frequency, space, and time-dependent is an encouraging insight that allows us to model channels across the vast range of frequencies. In this talk, we first review the frequency-dependency of wave propagation mechanisms, i.e., reflection, scattering, diffraction, and penetration. We then introduce a few experimental evidences of frequency-dependency of measured radio channels that support the channel modeling. Once supported by experimental evidence, channel modeling based on the physical laws of wave propagation becomes a powerful tool to serve various dimensions.

Bio

Katsuyuki Haneda is an associate professor in the Aalto University, Finland. He has been an associate editor of the IEEE Transactions on Antennas and Propagation for 2012-2016, and of an editor of the IEEE Transactions on Wireless Communications for 2013-2018. He has been an active member of a number of European Cooperation in Science and Technology (COST) Actions, e.g., CA15104 "Inclusive Radio Communication Networks for 5G and beyond (IRACON)", where he is a co-chair of a disciplinary working group on radio channels. His current research activity includes radio frequency instrumentation, measurements and modeling, millimeter-wave radios, in-band full-duplex radio technology and radio applications in medical and healthcare scenarios.