List of Keynote Speakers and Abstracts

Dr. Jeffrey Hesler
Chief Technical Officer
Virginia Diodes

Virginia Diodes, Inc.

Development of Test & Measurement Instrumentation for 5G and Beyond

Abstract: The spectral bandwidth available at mm-waves has generated considerable interest in using mm-waves in communication networks and in automotive radar. This talk will discuss recent developments in test equipment and measurement techniques for mm-wave communications and radar systems. Schottky diode mixers, combined with amplifiers and bandpass filters, enable the generation and detection of broadband modulated mm-wave signals with low-distortion and high signal-to-noise. A variety of measurement examples will be presented.

Short bio: Jeffrey L Hesler is the Chief Technology Officer of Virginia Diodes and has a visiting position at the University of Virginia. For more than 25 years he has been working on creating new technologies that utilize the Terahertz (THz) frequency band for scientific, defense, and industrial applications. He has published over 200 technical papers in journals and international conferences proceedings, is a member of IEEE Technical Committee MTT-21 (THz Technology and Applications) and is a co-Editor of the IEEE Transactions on Terahertz Science and Technology. Terahertz systems based on his innovative designs are now used in hundreds of research laboratories throughout the world.

Dr. Emile de Rijk
CEO and Co-Founder
SWISSto12 S.A.

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Antennas to Support mmw and THz Communication Systems

Abstract: The demand for wireless data traffic has increased significantly since the evolution of internet and mobile technologies. However, existing wireless technology cannot meet the demands of future ultra-high bandwidth communication networks, since data rates beyond 10 Giga bits per second (Gbps) are not achievable by current millimeter wave (mmw) systems, typically operating below 60 GHz.

In this perspective, there are still exist several research challenges that need to be addressed before achieving the Tbps links in practice. In this talk, challenges related to the design and manufacturing of antennas to support mmw and THz communication systems will be discussed and several antenna devices designed and manufactured by SWISSto12 over the past few years will be presented to highlight the potential, but also the difficulties of novel AM technologies in that field.

Short bio: Emile is a passionate physicist and entrepreneur in the field of Additive Manufacturing and Radio Frequency applications. He co-founded SWISSto12 and serves as its CEO. Emile contributed to the technological inventions behind the company's products and has helped the company in its growth from an early stage startup to a successfully growing business with international clients and partners.
Emile obtained a PhD in Physics at the Swiss Federal Institute of Technology (EPFL), in Lausanne (Switzerland) after obtaining his MSc in Physics at the University of Amsterdam (the Netherlands) and his BSc in Physics at EPFL.

Dr. Florian Pivit
Department Head
Nokia Bell Labs

NOKIA Bell Labs

Opening the THz-spectrum for communication in 5G and beyond

Abstract: Since the early 90's of the last century our world is subjected to a fundamental transformation into the so-called networked society. Social, political and economic trends, as well as our professional and personal life became widely determined by the rapid worldwide exchange of information among individuals, cybernetic systems and machines. The continuous data traffic growth together with the demand for anywhere and anytime connectivity, mainly fueled by the demand for transmission of high definition video contents, is driving the available radio bandwidth in wireless communication networks to the limit.

In consequence and enabled by the impressing progress of semiconductor device technologies future radio communication systems will have to utilize frequency bands in the so called "THz-spectrum", which roughly describes the range from ~100 GHz up to several 100 GHz. This will provide an abundance of bandwidth and open entirely new perspectives for a nearly unlimited increase of data traffic. However, the exploitation of THz spectral resources involves high technical challenges as well: Propagation properties as well as environmental influences of "THz-waves" will require new devices, system-concepts, and radio-architectures. In this talk we will discuss these challenges and the fundamental limitations of the THz spectrum, was well as the latest progress in device and system design and some of the visions discussed in industrial and academic research towards a successful utilization of the THz spectrum.

Short bio: Florian Pivit is a Department Head at Nokia Bell Labs, located in Dublin, Ireland, from where he is leading an international team of researchers in Dublin, Ireland and Paris, France, working on future generation wireless access technologies for the sub-6GHz, mm-wave and THz-range, such as digital transceiver architectures, massive MIMO systems, tunable devices, antennas and filter systems. He is a member of the Nokia wireless IP advisory board and is involved in commercialization and licensing projects with Nokia Technologies, Nokia's IP- and brand- licensing business. He received a Dipl.-Ing. (M.S.E.E.) from the University of Karlsruhe, Germany, in 2000. In 1999 to 2000 he started his career with Anaren Microwave Inc., Upstate-NY, USA, working on antenna feed systems for communication satellites. He then joined the University of Karlsruhe as a member of research staff from where he received a Dr.-Ing. (Ph.D. E.E.) in 2005 for his work on base station antenna technology. In 2006 he joined Lucent Technologies Bell Labs in Dublin, Ireland (now Nokia Bell Labs) as a Member of Technical Staff. He was promoted to Senior Member of Technical Staff in 2012 at Alcatel-Lucent, and in 2016 he took over the RF-Device & Antenna Research Department at Nokia Bell Labs in Dublin and later in Paris.

Gavin Fisher

Benefits of reduced insertion loss for mmw over temperature wafer test

Abstract: The frequency of on wafer RF test has increased rapidly recently, and several customers need to do this over a wide temperature range. FormFactor has provided banded thermal mmw solutions for several years but frequently this has required electrically and physically long waveguide extensions for the probe to enter the MicroChamber measurement enclosure. The chamber is required to keep the probing environment dry and dark at low temperatures as well as providing EMI shielding.

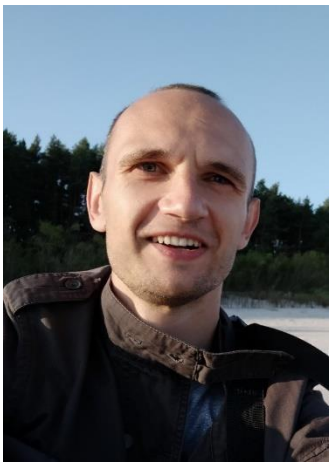
At lower frequencies the losses involved with an extended guide can be acceptable although not optimized. However, at elevated bands like WR3, these losses are more problematical. In part the extended approach has historically been due to the large size of the frequency extender. Virginia Diodes Inc (VDI) have a range of compact

FormFactor

extenders and we wished to capitalize on their small size and excellent performance and create an optimized solution with minimal additional losses.

In this talk we will show our new reduced loss solution on the CM300 wafer prober using WR3 Mini extenders and compare the performance with the extended path solutions we have used historically. Key benchmarks are the improvement in measurement drift, raw directivity and dynamic range. With the revised approach it's possible to make better measurements for longer without recalibration. We will show correlation between temperature and drift also. The revised approach also enables us to use our new compact programmable positioners for automatic MLTRL calibrations with WinCal XE™ for a modest price increase to the system.

Short bio: Gavin Fisher is applications specialist at FormFactor working on RF application layers for the systems group. He provides application support and technical services to FormFactor's customers as well as evaluating and helping to develop new product. With almost two decades of experience working with Cascade probe systems, and with experience in a broad spectrum of applications such as high-frequency measurement, calibration and power device measurement, he educates and trains customers on best practices to achieve accurate measurement results. He has made several presentations at European Microwave Week, International Microwave Symposium, MOS-AK workshops, and Agilent/Keysight seminars. Prior to joining FormFactor, he served as a Mechanical Engineer at Alenia Marconi Systems. He holds an upper-second degree from Brunel University in Mechanical Engineering with electronic systems.



Dr. Marcin Bialek
Post-Doctoral Researcher
EPFL

THz-frequency magnetic resonance

Abstract: The growth of an interest in antiferromagnets in recent years is mostly due to their THz-frequency resonances and robustness to external magnetic fields. Matter-photon coupling is a topic of great interest in the solid-state physics research because of their hybrid quantum nature. We report on investigations of high-frequency magnetic resonance in antiferromagnetic materials: bismuth ferrite ($BiFeO_3$), dysprosium ferrite ($DyFeO_3$), thulium ferrite ($TmFeO_3$) and yttrium ferrite ($YFeO_3$). Using frequency extenders to a vector network analyser, we measured transmission amplitude and phase, in 200-750 GHz frequency band and temperatures ranging from 50 to 700 K. This technique allows us to trace temperature dependences of antiferromagnetic resonances in these materials almost up to the antiferromagnetic ordering (Néel) temperature. We observed couplings of magnetic resonances with cavity fields. With rising temperature, magnetic resonance frequencies soften and cross with subsequent Fabry-Pérot-type cavity modes formed in the sample itself. We quantitatively explained our results with a model developed in the framework of electrodynamics and we confront it with a microscopic model describing magnon-photon interaction.

Short bio: Marcin Bialek finished master in solid state physics at the University of Warsaw, Poland. At the same place, he obtained a PhD degree by working on experimental investigations of THz-frequency plasmon resonances in AlGaAs/GaAs transistors. In 2016, he started a post-doc in the group of prof. Jean-Philippe Ansermet at EPF Lausanne in Switzerland. The current subject of his work is magnetic resonance at THz frequencies in antiferromagnetic materials.

Dr. Bertrand Thomas
High Frequency Development Engineer
Radiometer Physics GmbH

Radiometer Physics
A Rohde & Schwarz Company

Ground and space based remote sensing instruments to characterize the atmospheric attenuation and delay for THz telecommunications

Abstract: Passive radiometers and active FMCW radar systems are developed by RPG to determine the amount of water vapor in the atmosphere and perform temperature profiling in areas where it is essential to characterize the atmosphere. This includes ground-satellite communication sites, astronomical observatories, but also agriculture fields where water resources management is critical. As the frequency of the telecommunications is expected to increase in the near future well into the mm-wave up the submillimeter-wave range thanks for advances in 5G technology and beyond, it is critical to understand and predict the atmospheric response in this range. We will present the latest developments in terms of ground-based and space-based instrumentation at RPG to improve atmospheric remote sensing, such as scintillation radiometers to characterize air turbulences above the ground. THz radio-link experiments will also be addressed.

Short bio: Bertrand Thomas received his M.Sc. degree in radio-communication and microwave engineering from ESIEE-Paris, France and Université Marne-la-Vallée, France in 1999. He received his Ph.D. degree in Astrophysics and Space Instrumentation from University Paris-VI, France and Observatoire de Paris, France in 2004. From 1999 to 2001, he was in the receiver group of the IRAM 30-m radio-telescope in Granada, Spain. From 2001 until 2004, he was with the LERMA department, Observatoire de Paris, France. From 2005 until 2008, he was a research engineer at the Rutherford Appleton Laboratory, Oxfordshire, England. From 2008 until 2010, he was with the Submillimeter-Wave Advanced Technology group at JPL as a NASA Postdoctoral Program fellow. Since 2011, he joined the company Radiometer Physics GmbH in Meckenheim, Germany to develop millimeter and submillimeter-wave Schottky technology for space applications. His current research interests are the design and development of semi-conductor devices for terahertz heterodyne receivers for atmospheric & planetary science, astrophysics. Dr. Thomas is recipient of the 2009 JPL Outstanding Postdoctoral Research Award from NASA.

Dr. Karam Noujeim
Technology Fellow
Anritsu

Anritsu

Transceiver Technologies for THz Applications

Abstract: In this talk, we will focus on broadband transceiver architectures, components, and technologies for use in a number of high-frequency scenarios such as measurement instruments, radar, and sensors. We will show that frequency scalability, miniaturization, stability, and accelerated data acquisition result in high-performance systems with reduced complexity and increased throughput. These features open up unique possibilities for a variety of applications. We conclude by highlighting the benefits of spatially distributed transceivers in an era of ever-increasing demand for high data rates.

Short bio: Karam Noujeim received his M.A.Sc. and Ph.D. degrees from the University of Toronto, Ontario, Canada in 1994 and 1998. In 2001, he was a visiting academic researcher at the Picosecond Electronics Laboratory, University of California, Santa Barbara. He was a Member of the Scientific Staff with Bell-Northern Research in Ottawa (1990-1992) where he was mainly involved with the development of CAD tools for assessing the susceptibility of printed circuit boards to electromagnetic interference; Senior Member of the Technical Staff with Stellex Microwave Systems in Palo Alto (1998-1999), where he was involved with the development of millimeter-wave components for LMDS; and Technology Fellow Director with Anritsu USA in Morgan Hill, California (1999-2018) where he designed mm-wave subsystems, chips, and wide-band components for several instruments; MM-wave frontends and antennas for radar target simulation and industrial

	imaging; and micro-machined thermal power sensors. In February 2018, he joined Baidu USA in Sunnyvale, California where he built up and lead the Automotive Radar team with focus on high-resolution radar, LTE C-V2X, time-of-flight cameras, and fusion with other sensors for autonomous driving platforms. He recently returned to Anritsu as Technology Fellow. His current areas of interest include high-performance imaging radar and sensors; traveling-wave structures for use in millimeter-wave harmonic generation, sampling, reflectometry, imaging, and antenna beam scanning; and THz measurement instruments. Dr. Noujeim holds several patents.
 **Dr. Laura Resteghini** **Huawei Technologies** HUAWEI	**Sub-THz Chance: a Building Block to create the Beyond-5G Technology** **Abstract:** The Fifth-Generation New Radio (5G NR) network is a close reality: peak datarates of 10 Gpbs per device, E2E latency below 10 ms, maximum spectral efficiency of 30 bps/Hz, support to device that are travelling up to 500 kph. By 2020 it is expected that the 5G would become a worldwide deployment. Since 1980, approximately every ten years, there have been a technological evolution for a generation change, starting from a new network vision. Ultra-high bandwidth, negligible latency, high capacity (Tbps) and ubiquitous services are envisioned as breakthrough solutions to bring a revolution in how society exploit information (Beyond-5G tagerts). While the spectrum envisioned for 3GPP for mobile access will be more focused on below 100 GHz, the sub-Terahertz (0.1-1 THz) frequency band look promising for those scenarios where high speed transmission is needed like the backhauling and fronthauling links of the Network. To enable the evolution toward sub-Terahertz spectrum, we need to identify the milestone technologies to ensure high throughput: THz frequency generators, packaging solution, channel modelling, high integration of active and passive structures, standards etc. From the experience done at Huawei with a Point-to-Point link in the D-Band we can see the challenges and the technology steps necessary to make possible the use of the sub-Terahertz.
	Short bio: Laura Resteghini received her M.Sc. degree in Telecommunication Engineering from the Politecnico di Milano (Italy) in 2009 and then she joined the propagation research group at the Politecnico di Milano as researcher in the field of adaptively controlled antennas system. In 2014 she received her Ph.D. degree in Information Technology from Politecnico di Milano, Italy. Her experience grew across researches about E.M. wave propagation through the atmosphere at radio frequencies: physical and statistical modeling for E.M. propagation applications also implementing optimization strategies for Fade Mitigation Techniques in Satcom systems. Since 2014 she has been involved in several project related to 5G NR network taking care of the design of prototypes and antenna modelling for mmW bands. In 2016 she joined the Milan R&D center of Huawei Technologies Italia as Microwave Antenna Engineer. She takes care of the synthesis and design of Unconventional Antenna Array for 5G mmW BS and she is coordinating the Sub-TeraHertz working group created within the Huawei-Polimi joint Lab.
Dr. Mira Naftaly **National Physical Laboratory** NPL	**Dielectric properties of materials at THz and sub-THz frequencies** **Abstract:** The talk will address dielectric properties of materials and will be in three parts. First, an overview will be given of major techniques for broadband dielectric measurements of materials, focusing on free-space techniques and including time-domain spectroscopy, frequency-domain spectroscopy, Fourier transform spectroscopy, and VNA-based. This will be followed by an introduction to the dielectric properties of materials at THz and sub-THz frequencies, including frequency dependence of permittivity and loss mechanisms, and what types of

	materials are low-loss or high-loss at those frequencies. The talk will conclude by presenting examples of permittivity and loss curves for a number of common materials.
	Short bio: Dr Mira Naftaly is a laser physicist and spectroscopist. She has worked in the areas of laser materials, optical glasses and crystals, and optical fiber amplifiers and lasers. Her current work is in the field of terahertz, where her interests include THz metrology and device characterization, materials spectroscopy, and THz communications. She is currently working at the National Physical Laboratory, UK.
 **Dr. Panagiotis Diamantoulakis** **Post-Doctoral Fellow** **Aristotle University** ARISTOTLE UNIVERSITY OF THESSALONIKI	**Wireless networks Empowered by Non-orthogonal Multiple Access and AI** **Abstract:** Future wireless networks are expected to constitute a distributed intelligent communications, sensing, and computing platform. Considering the recent prediction for future mobile data growth and the requirement of multipurpose use of wireless systems, innovative approaches are required to the road to 2030, ranging from air technologies and network design to services. To this end, of particular interest is the use of non-orthogonal multiple access (NOMA) and artificial intelligence. In this talk, the effective use of NOMA in emerging communication networks will be considered, including buffer-aided, cloud-radio access, optical wireless communication, mobile edge computing, and wireless powered networks. Next, the use of artificial intelligence for supporting intelligent networks and performing resource allocation in wireless networks will be discussed. Finally, a number of challenges and future research directions will be presented.
	Short bio: Panagiotis D. Diamantoulakis is Senior Member IEEE. He received the Diploma (five years) and Ph.D. degrees from the Department of Electrical and Computer Engineering, Aristotle University of Thessaloniki (AUTH), Greece, in 2012 and 2017, respectively. From 2017 to 2019, he was a Visiting Post-Doctoral Researcher with the Key Laboratory of Information Coding and Transmission, Southwest Jiaotong University, China, and the Telecommunications Laboratory (LNT), Institute for Digital Communications (IDC), Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), Germany. Since 2017, he has been a Post-Doctoral Fellow with the Wireless Communications Systems Group (WCSG), AUTH. His current research interests include resource allocation in optical wireless communications, optimization theory and applications, game theory, non-orthogonal multiple access, and wireless power transfer. He serves as an Editor for IEEE Wireless Communications Letters, Physical Communications (Elsevier), and IEEE Open Journal of the Communications Society. He was also an Exemplary Reviewer of IEEE Communications Letters in 2014 and IEEE Transactions on Communications in 2017 (top 3% of reviewers).
	**Dielectric Measurements at mmw Frequencies with the MCK** **Abstract:** The Material Characterization Kit (MCK) is a compact, waveguide-based fixture that can be used as part of a VNA system in order to measure the dielectric properties of materials in frequencies between 25 GHz and 1.1 THz. It is mainly composed of two circular corrugated horn antennas that can accommodate and clamp a solid sample between them in a repeatable fashion, while in parallel a digital caliper provides a precise reading of the sample's thickness in situ. In this presentation, measurements in various frequency ranges for different types of materials will be used to show the advantages but also the limitations of this approach. Also, recent developments regarding the measurement of soft samples (of foams), liquid samples (or powders), and plastics with coatings (or multi-layered

Dr. Alexandros Dimitriadis
RF Project Manager
SWISSto12 S.A.

materials) will be introduced. These extensions of the original functionality of the MCK, introduced commercially by SWISSto12 during 2019, are of extreme importance for specific applications and market sectors, like the automotive radar transparency. Finally, some current research developments regarding the characterization of thin conductive films and magneto-dielectric materials will be briefly discussed.

Short bio: Alexandros Dimitriadis was born in Larissa, Greece, in 1985. He received his M.Sc. and Ph.D. degrees in electrical and computer engineering from Aristotle University of Thessaloniki, Greece, in 2008 and 2013, respectively. In 2014, he joined the Swiss Federal Institute of Technology of Lausanne (EPFL), Switzerland, as a Postdoctoral Researcher and since 2015 he is with SWISSto12 S.A. as an RF Project Manager. His current research interests lie in the fields of passive, waveguide-based RF components such as waveguides, antennas, and filters, with an emphasis on devices that can be fabricated with novel additive manufacturing (AM) technologies. He is also passionate about material characterization and is currently the Product Manager of the Material Characterization Kit (MCK), a text fixture capable of measuring dielectric properties of materials between 25 GHz and 1.1 THz as part of a table-top, VNA-based system.

Prof. Plamen Stamenov
Trinity College Dublin

Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

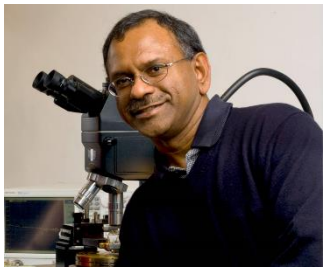
Towards THz oscillators on chip - the magnetic options

Abstract: Modern data centres boast ever-increasing storage capacity, processing power and inter-connectivity, all bringing both high capital investment but also operational costs. Module-to-module connectivity within those depends on either copper cables or fibre-optic connections and is essentially fixed infrastructure. A high-bandwidth wireless, metre-scale connectivity can help fight wire congestion and lower the cost of reconfiguration, on-the-fly replacements, but would depend on the existence of tuneable THz local oscillators. In TRANSPIRE we are advancing two spintronic paths towards these – one based on spin-transfer torque in nano-pillar type structures and another based on spin-orbit torque in structurally simpler current-in-plane stacks. Both will be described, together with the attempts at prodicing functional prototype oscillators.

Short bio: Dr. Plamen Stamenov received a BSc degree from the University of Sofia (Bulgaria) in Theoretical and Experimental Physics in 2002, with research work on the magnetic and structural properties of some manganese perovskites. He completed his PhD research in 2007 under the supervision of Prof. J. M. D. Coey in Trinity College Dublin. This research focused on metals, semimetals and semiconductors for spin electronics applications. After completing his PhD, he stayed on in Trinity College as a research fellow and teaching assistant within the School of Physics and CRANN conducting research in the field of spin-dependent transport and collaborating with industry in applied magnetics and microwave technology. He has worked extensively on magnetic semiconductors, spin transport in organics and has developed a new method of real-time Andreev reflection spectroscopy to measure spin polarization in thin films and buried layers as well as depth selective Mossbauer spectroscopy. In 2010, Dr. Stamenov became an Ussher Lecturer in Physics and Principal Investigator within CRANN in the area of nanomagnetism. He is currently an Associate Professor at Trinity College, Dublin and the coordinator of the H2020 project TRANSPIRE.

Advances in Millimeter Wave and Terahertz Applications

Abstract: The talk will focus on the application of millimeter wave frequencies for wireless, automotive and component characterization. It will provide an insight in



Suren Singh
Industry Application Specialist
Keysight Technologies

the advances in each of these areas and solutions that for the addressing the measurement needs in each of these areas. We will look at measurement of wideband modulated signals at mm-wave frequencies as applied to wireless communication systems. In the area of automotive we will look at an example of automotive radar performance characterization and final cover a novel example of NF measurements at millimeter wave frequencies. The talk will conclude with a summary of the trends in future applications for millimeter wave frequencies.

Short bio: Suren Singh received his BSEE from University of Durban-Westville, Durban South Africa in 1985. He completed a Graduate Diploma at the University of Witwatersrand, Johannesburg South Africa in December 1992. He then went on to complete his MSEE at the University of Witwatersrand, Johannesburg in 1995. Suren has been with the Hewlett-Packard Company, Agilent Technologies and now Keysight Technologies since 1986. His experience at Keysight includes application engineering, product design, manufacturing and test process development for microwave hybrid microcircuits. He currently holds the position of industry application specialist focused on the Terahertz measurement solutions and applications. Currently an IEEE member and presented several papers at IEEE conference on materials and 5G testing. In addition, he is responsible for the metrology products for performance network analyzers, including both calibration and verification.

Dr. Vadim Nozdrin,
International Telecommunication Union

International spectrum management basics and state

Abstract: Efficient spectrum use requires international standardizations to make appropriate regulatory framework for introduction of new technologies on worldwide scale on non-interference base. International Telecommunication Union (ITU) is UN specialized agency responsible for development appropriate international treaty and administrative and technical provisions in this area, based on World Radiocommunication Conference and Study Group's activities. Presentation describes main fundamentals of international management system, in particular the frequency allocation procedures, and focuses on latest results of ITU studies and decisions in the field of development new broadband standards, such as 5G, RLAN, HAPS, LEO satellites, as well as the challenges of moving radio systems to higher frequencies.

Short bio: Since 2010 Vadim Nozdrin is BR Counselor of ITU-R Study Groups, in particularly dealing with operational and technical aspects of systems for remote sensing and space research, operating on both ground-based and space-based platforms, as well as airborne and maritime communications. Before Vadim Nozdrin has been working on technical and regulatory aspects of satellite coordination at ITU's Radiocommunication Bureau since 2000.

Before joining ITU his career has been devoted to Moscow Radio Research & Development Institute (NIIR) in positions with increasing responsibility, ultimately attaining the position of Deputy Director on International Affairs.

He has degree a telecommunication engineer (1988), a PhD in economics from Moscow University of Telecommunication and Information (1999) and a Grand Doctor of Philosophy from Saint Petersburg State University of Economics (2019).

He has published about 70 articles as well as co-authoring 3 monographs on spectrum management and electromagnetic compatibility of radio systems.