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GSASET2022

Global Summit on Applied Science, Engineering and Technology

March 17, 2022

Virtual

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FOREWORD

Dear Colleagues,

It is our pleasure to invite all scientists, academicians, young researchers, business delegates and students from all over the world to attend the Global Summit on Applied Science, Engineering and Technology will be held in Dubai, UAE during March 17-19, 2022.

GSASET2022 shares an insight into the recent research and cutting edge technologies, which gains immense interest with the colossal and exuberant presence of young and brilliant researchers, business delegates and talented student communities.

GSASET2022 goal is to bring together, a multi-disciplinary group of scientists and engineers from all over the world to present and exchange break-through ideas relating to the Applied Science, Engineering and Technology.

Topics of the conference covers a comprehensive spectrum of issues from:

1. Fundamental Sciences: Pure and Applied Mathematics, Applied Physics, Applied Nano Science, Astro Physics, Magnetism and Magnetic Materials, Applied Biomaterials, Applied Energy Materials,Applied Nanomaterials, Applied Materials and Interfaces, Computational Methods in Engineering, and others...

2. Computers Engineering: Modeling and Simulation, Machine Learning, Cloud Computing, Artificial Intelligence, Software Engineering, Data Bases, and others...

3. Electrical and Electronics Engineering: Circuits and Systems, Optoelectronics, Photonic technologies, Quantum technologies, Signal Processing, Electric Motors, Power and Energy Engineering, and others...

4. Mechanical Engineering: Nanotechnology and Nano Science, Thermal Engineering, Mechanics, Mechatronics, AeroSpace engineering, Robotic Systems Engineering, Production Engineering, Constructions, Automotive and Traffic Engineering, Safety Engineering, Reliability, and others...

5. Materials Engineering: Materials Science, 3D, 4D Printing of Materials, Metallic Materials, Composite Materials, Metal Alloys, Metallurgy, Heat Transfer, and others...

6. Biological Engineering: Biotechnology, Tissue Engineering, Biomedical Engineering, Molecular Bioengineering, Polymer Science, Nucleic Acid Engineering, Controlled-Environment Agriculture, Applied Toxicology, Applied Pharmacology, and others…

7. Civil and Environmental Engineering: Applied Building Science, Construction Materials, Global Warming, Climate Change, Ecology Soil and Water Engineering and others...

The conference will be focused on several fields of application, operation and influence of the applied sciences and technologies on industry.

We’re looking forward to an excellent meeting with scientists from different countries around the world and sharing new and exciting results in Applied Science, Engineering and Technology

COMMITTEES

Organizing Committee

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SPEAKERS

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I: Invited Speaker

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Virtual Presentations

David Moss

Director Optical Sciences Centre, Swinburne University of Technology, Melbourne, Australia

Ultra-high Bandwidth Applications of Integrated Kerr Optical Frequency Microcombs

Abstract

This talk will focus on our work on ultrahigh bandwidth applications of Kerr microcombs to optical neural networks, optical data transmission and microwave photonics. Convolutional neural networks (CNNs) are a powerful category of artificial neural networks that can extract the hierarchical features of raw data to greatly reduce the network complexity and enhance the accuracy for machine learning tasks such as computer vision, speech recognition, playing board games and medical diagnosis. Optical neural networks can dramatically accelerate the computing speed to overcome the inherent bandwidth bottleneck of electronics. We use a new and powerful class of micro-comb called soliton crystals that exhibit robust operation and stable generation as well as a high intrinsic efficiency with an extremely low spacing of 48.9 GHz. We demonstrate a universal optical vector convolutional accelerator operating at 11 Tera-OPS/s (TOPS) on 250,000 pixel images. We use the same hardware to form a deep optical CNN, achieving successful recognition of full 10 digits. We also report world record high data transmission over standard optical fiber from a single optical source, at 44.2 Terabits/s over the C-band. We achieve error free transmission across 75 km of standard optical fiber in the lab and over a field trial with a metropolitan optical fiber network. Our work demonstrates the ability of optical soliton crystal micro-combs to exceed other approaches in performance for the most demanding practical optical communications applications.

Biography and Research Interests

David J. Moss is Director of the Optical Sciences Centre at Swinburne University of Technology in Melbourne, Australia, since 2016. He was with RMIT University in Melbourne, 2014-16, the University of Sydney 2004 - 14 and was a senior manager and scientist with JDS Uniphase in Ottawa Canada from 1998-2003. From 1994-98 he was a Senior Research Fellow with the Optical Fiber Technology Centre at Sydney University prior to which he was a visiting Scientist with Hitachi Central Research Laboratories in Tokyo, Japan,1992-94. From 1988-92 was with the National Research Council of Canada in Ottawa. He received his PhD from the University of Toronto in Physics and BSc from the University of Waterloo. He won the 2011 Australian Museum Eureka Science Prize and Google Australia Prize for Innovation in Computer Science. He is a Fellow of the IEEE Photonics Society, the OSA (now the Optical Society) and the SPIE (International Photonics Society). His research interests include optical microcombs, integrated nonlinear optics, quantum optics, microwave photonics, optical neural networks, optical networks and transmission, 2D materials including graphene oxide for nonlinear optics, optical signal processing, nanophotonics, biomedical photonics for cancer diagnosis and therapy, and other areas.

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Qining Fan, Jicheng Jiang, Jiazhao Wang*

Institute for Superconducting and Electronic Materials, University of Wollongong, Wollongong, New South Wales 2500, Australia

Development of Materials for Advanced Rechargeable Lithium-Sulfur Batteries

Abstract

Lithium–sulfur batteries are considered a promising energy storage system due to their high energy density (2600 Wh/kg), natural abundance, low cost and environment-friendly. Its low active material utilization, however, and poor cycle life are obstructing the commercialization of Li–S batteries [1]. In order to solve these problems, Sulfur-carbon composites and comducting polymer composites have been studied by our group for Li-S batteries [2-4]. Sulfur-carbon composites were synthesised using vapor-phase infusion method, wet chemical precipitation, ball-milling and spray-pyrolysis/sublimation methods. Sulfur-conducting polymer composites were prepared with chemical polymerization method. In this presentation, author will report the advances in the research on electrode materials, electrolytes, separators, multiscale characterization and analysis, advanced electrochemical characterizations, and operando characterizations.

Keywords

Sulfur-carbon composites, comducting polymer composites, Li-S batteries

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F. Li, M.R. Kaiser, J.M. Ma, Z.P. Guo, H.K. Liu, J.Z. Wang, Energy Storage Materials 13 312-322, (2018).

Biography

Jiazhao Wang is a Professor at the Institute for Superconducting and Electronic Materials, University of Wollongong, Australia. Her research activities are focused on electrochemical energy storage in batteries, including Li-ion batteries, Na-ion batteries, metal-air batteries (Li-air, Na-ion Zn-air batteries), and Li/Na-sulfur batteries. She has won more than 30 research grants including 20 Australian Research Council (ARC) grants as a chief investigator (CI). She has published more than 240 papers in international journals (Citations>21600, H index = 81, Google Scholar). She is an associate editor of Energy Material. She has supervised more than 30 PhD students to completion.

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Chua Kian Jon

Department of Mechanical Engineering; National University of Singapore

Technologies and Strategies to Achieve Better Energy-Efficient Air Conditioning

Abstract

Air conditioning is essential to sustain thermal comfort in indoor environments, particularly for hot and humid climates. In tropical climates, the energy consumed by heating, ventilation and air-conditioning (HVAC) often exceed 50% of the total energy consumption of a building. This significant figure is attributed to the heavy duty placed on cooling technologies to remove both sensible and latent heat loads. Therefore, there is tremendous potential to improve the overall efficiency of the air-conditioning systems in buildings. This talk focuses on recent innovative cooling technology and strategies that markedly improves the energy efficiency of air conditioning.

It talk focuses on recent research advancements related to sensible cooling and air dehumidification. Several key technologies are presented, namely, dew-point evaporative cooling, membrane dehumidifier, polymer based super-absorbents and nano-hybrid Metal-Organic Frameworks. It further highlights their most recent advancements, performances, and provides key insights on their global energy and sustainability impacts.

Biography

Dr Chua Kian Jon is currently an Associate Professor with the Department of Mechanical Engineering, National University of Singapore. He has been conducting research on air-conditioning, refrigeration, and heat recovery systems since 1997. He has conducted both modelling and experimental works for specific thermal energy systems. These include dehumidification, cooling, heat pumping, compact heat exchangers and refined temperature/humidity control. He is highly skilled in designing; fabricating; commissioning and testing many sustainable energy systems to provide for heating, cooling and humidity control for both small and large scale applications. He has more than 200 international peer-reviewed journal publications, 6 book chapters and two recent monographs on advances in air conditioning He was highlighted among the top 1% of scientists in the world by the Universal Scientific Education and Research Network and top 0.5% in the Stanford list of energy researchers. His works has garnered more than 10,900 over citations with a current h-index of 55. Further, he owns more than 10 patents related to several innovative cooling and dehumidification systems. He is the Principal Investigator of several multi-million competitive research grants. Additionally, he has been awarded multiple local, regional, and international awards for his breakthrough research endeavours.

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Mahavir Singh

Acoustics and Vibration Metrology, CSIR-NPL, New Delhi, India

Basics of Airborne Sound Transmission through Walls and Floors

Abstract

The aim of this paper is the basics of airborne sound transmission through walls and floors (a dry construction system) including effects of mainly mass and stiffness in single layer and method of adding gypsum board or framing arrangement, sound-absorbing material, cavity thickness and mass in double or triple layer walls. Different kinds of materials and dry construction systems, which are focused on the reduction of wastes, like the dry system, are increasing in the Market. The development of materials and dry construction systems which integrate residues in their composition is a growing tendency in the Indian building sector. There are, nowadays, sustainable and industrialized panels for sealing walls, such as Oriented Strand Boards (OSB), Cement-Concrete Block (CCB), Fiber-reinforced cement boards and gypsum plasterboard. These panels have found their place in the sealing walls market because of their better performance and lower costs, when compared to conventional sealing materials, such as concrete or ceramic masonries. This paper shows the acoustic performance of a dry construction system, which is built with steel framing and the different kinds of panels described above. The measurements were performed according to ASTM 413. Results show that the acoustic performance of the dry construction system, measured according to ASTM 413 parameters, is better than those from traditional walls built with concrete or ceramic masonries, in regard to sound insulation.

Keywords

Airborne sound transmission, Sustainable wall & floor panels, Acoustic measurements

Jinlong Wei[1*]

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A View of F6G: Optics to Everything

Abstract

Similar to wireless communication, the fixed network has gone through a few generations starting from the first generation (F1G) telephone network to today's fifth generation (F5G) network featuring high speed optical fiber connections. The evolution witnessed the gradual replacement of fiber with conventional copper in a way that fiber keeps strong momentum of penetrating into the last mile and the last meter. Each generation evolution shows a 10 × speed and density increase as well as 10 × latency reduction. With the explosive growth in the number of connections between human, things and facilitates in the coming metaverse age, there is significant demand of intelligence of the network in addition to speed, density and latency. In this plenary talk, I will share a view of the sixth generation fixed network (F6G) and discuss about how optical network to address the new challenges of intelligent connections.

Biography

Dr. Wei is currently a principle researcher at Huawei German Research Center. He received a PhD from the University of Wales in 2010. Dr. Wei's research interests include optics communications, photonics switching/signal processing, advanced modulation/coding, digital signal processing, algorithms, and machine learning. He edited one book and (co-)authored over 170 peer-reviewed journal/conference papers including more than 10 invited. He holds several US/European patents. Dr. Wei is a Marie Curie fellow and a senior member of IEEE.

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Sevia Mahdaliza Idrus

University of Technology, Malaysia

High Precision Foreign Object Debris Detection Millimetre Wave Radar For Airport Runway Safety and Surveillance

Abstract

Foreign object debris (FOD) on airport runways can cause problems (e.g., runway closure, accidents) to airplanes and airport operators if not removed immediately. Hence, airport operators need to remove any FODs that are detected via a manual or automated FOD detection system. Manual detection implies that airport operators carry out periodical manual FOD inspection while automated FOD detection is able to perform rapid detection continuously without any airport personnel on-site. Automated detection system also avoids unnecessary runway closure due to manual inspection, which is inefficient for busy airport operation. Millimeter-wave radar is often chosen as the sensor of the automated FOD detection system, due to its high-sensitivity, high-range resolution and weather robustness. In general, a millimeter-wave signal has significantly higher transmission loss (including free-space propagation loss and atmospheric attenuation) compared to microwave bands, making it difficult to obtain high power in semiconductor circuits and as such, the detection range of a single radar will be limited. Hence, many radio access units (RAUs) need to be installed to cover the whole span of an airport runway. However, the cost and footprint of millimeter-wave synthesizer with high precision, for the realization of precise radiolocation services, are too high to install them in each RAU.

In this talk, successful collaborative Malaysia and Japan research project on Foreign Object Debris Detection System (FODDS) experiment and field trial at Kuala Lumpur International Airport will be presented. The system currently under field trial and in accordance to the International Civil Aviation Organization (ICAO), Aerodrome Design and Operation. The field trial and operation of FODDS was established in collaboration with National Institute of Information and Communication (NICT), Japan, Hitachi Kokusai Electric Inc (HiKE), Japan and Malaysia Airport (Sepang) Sdn Bhd, Malaysia Airports Holding Berhad (MAHB) supported by Ministry of Internal Affairs and Communication Japan. The FODDS system construction and installation at KLIA was begins with preliminary experiment and system infrastructure design since February 2018. First field trial experiment was performed in the UTM campus and KLIA apron to show capability on small FOD detection and provide sensitivity on the antenna height in the airport surface situation. The advantages of the system include its low operational cost, low emission of radio waves, and most importantly a highly scalable system for busy airports.

Through more than a year field trial at Narita International Airport, the system demonstrated highly accurate and fast, the system is able to detect 3cm FOD within the range of 500 meters in 10 seconds by using the millimeter wave radar over fiber technology. The FOD detection systems is able to spot FOD the moment it is deposited on the runway by radar sensing, identifying, and locating at a previously unprecedented level of speed and accuracy for objects as small as an aircraft rivet. This is extremely valuable when aircraft take-offs are only minutes apart. Finally improved airport management by not only increases efficiency, enhances safety and improves security, but also saves airports and airlines countless hours in time, money, and manpower. The field trial experiment facility in Kuala Lumpur International Airport will be world focal point and model

case in Asia Pacific where aviation demands are high and airport construction plans well demanding. This FODDS will be a promising candidate to enhance security against intruders or attack drones in important facilities and to enhance safety to avoid critical incident in the airport runways.

Biography

Professor Ir Dr Sevia Mahdaliza Idrus is the Deputy Dean (Development & Alumni), Faculty of Engineering, UTM. She received her Bachelor in Electrical Engineering in 1998 and Master in Engineering Management in 1999, both from UTM. She obtained her Ph.D in 2004 from the University of Warwick, United Kingdom in optical communication engineering. She has served UTM since 1998 as an academic and administrative staff. Her main research interests are optical communication system and network, optoelectronic design, and engineering management. Her research output have been translated into a number of publications (H-index-15) and IPR including a high-end reference books, 'Optical Wireless Communication: IR Connectivity' published by Taylor and Francis, 49 book chapters and monographs, over 200 refereed research papers, 8 patents granted, 36 patent filings and holds 31 UTM copyrights. To date, she has secured and been involved in 84 research and consultation projects with a total value of USD25M. She is the founder and Director of a UTM spin-off company, iSmartUrus Sdn Bhd (1057063A) successfully commercialized her invention, a novel airtime based mobile micropayment solution and application-centric IoT based mobile enforcement device for smart city. She is actively involved in a number industrial and international research collaboration projects, delivered keynote and invited speeches to many international conferences and seminars. Based on her active contribution with industry for smart city solution, she has been awarded 'The Top Research Scientists Malaysia 2021' by Academy Science Malaysia, Ministry of Science, Technology and Innovation and '51 Most Impactful Smart Cities Leaders 2019 Award' in conjunction with World CSR Day & World Sustainability Congress 2019, Mumbai, India on March 2019. She led a four years G2G project on 'Radar over Fiber Foreign Object Debris Detection System' field trial at Kuala Lumpur International Airport (KLIA) a collaboration project between UTM, Hitachi Kokusai Electric Japan and Malaysia Airport (Sepang) under financial support from Ministry of Internal Affairs and Communication Japan. The project has made KLIA and Malaysia as world focal point for development of high precision millimetre wave radar at 90-100GHz range. She is Senior Member of IEEE and member of Editorial Board of few refereed international journals. She has been appointed as Guest Professor at Osaka Prefecture University and Tokai University, Japan in 2011 and 2014, respectively.

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[2]Nankai University, No.38 Tongyan Road, Jinnan District, Tianjin, 300350, China.

Eye Diagram Based Multiparameter Monitoring of Optical Channels Using Convolutional Neural Network

Abstract

Convolutional neural network has attracted widespread interest over the past few years in optical performance monitoring (OPM) [1, 2]. A designed Visual Geometry Group (VGG)-based CNN model with less computational cost and high accuracy is utilized to monitor optical channel performance using eye diagram measurements. Experiments show that it can determine the modulation format, optical signal to noise ratio (OSNR), roll-off factor (ROF), and timing skew with >98% prediction accuracy for 32 GBd coherent channels with quadrature phase shift keying (QPSK), 8-QAM or 16-QAM formats [3]. Furthermore, the proposed technique can also achieve a > 97% accuracy to jointly monitor modulation format, probabilistic shaping (PS), ROF, baud rate, OSNR, and chromatic dispersion (CD) for pulse amplitude modulation channels. Moreover, three other modern CNN networks are also studied, including ResNet-18, MobileNetV3 and Efficient NetV2. By contrast, the designed VGG-based model with fewer layers and the lightweight MobileNetV3 is more cost-efficient without sacrificing accuracy.

Keywords

Convolutional neural networks, deep learning, optical performance monitoring

References

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Biography

Yang Yue is a Professor with the School of Information and Communications Engineering, Xi'an Jiaotong University, China. Dr. Yue's current research interests include intelligent photonics, optical communications and networking, optical interconnect, detection, imaging and display technology, integrated photonics, free-space and fiber optics. He has published over 200 peer-reviewed journal papers (including Science) and conference proceedings with >9,000 citations, four edited books, >50 issued or pending patents, >100 invited presentations (including 1 tutorial, >10 plenary and >30 keynote talks). Dr. Yue is a Senior Member of the Institute of Electronic and Electrical Engineers (IEEE). He is an Associate Editor for IEEE Access, and an Editor Board Member for three other scientific journals. He also served as Guest Editor for ten journal special issues, Chair or Committee Member for >80 international conferences, Reviewer for >60 prestigious journals.

Ivan Zelinka

Technical University of Ostrava, Czech Republic

Quo Vadis Cyber Security

In recent years, cyber security has become a fundamental pillar of modern technology. In recent years, we have witnessed many incidents in cyberspace, which have the character of both random incidents (computer viruses) and organized attacks, both from amateur hacker groups and organized cyber units from various armies or countries worldwide. So it is clear that if we are to use and rely on our technologies safely, we must secure them properly. The issue of cyber security is so complex that standard methods of security and defense are no longer enough, but it is also necessary to use artificial intelligence, which has recently become a hot topic. Whether on its own or in conjunction with quantum technologies such as quantum computing or underlying cryptography. This keynote aims to present a cross-section of cyber security with an emphasis on modern aspects of cyber security, where both artificial intelligence and new quantum technologies meet in the field of encryption and computing. The keynote will also introduce a prediction for possible developments in the near future. Keynote is intended for the general professional public and does not require specific expertise to understand the information contained therein.

Biography

Ivan Zelinka is currently working at the Technical University of Ostrava (VSB-TU), Faculty of Electrical Engineering and Computer Science. He graduated consequently at Technical University in Brno (1995 – MSc.), UTB in Zlin (2001 – PhD) and again at Technical University in Brno (2004 – assoc. prof.) and VSB-TU (2010 - professor). During his career he proposed and opened numerous lectures mostly focused on AI and unconventional algorithms. He also has been invited for lecturing at various universities worldwide including keynote speaker and tutorial positions. The field of his expertise if mainly on AI, unconventional algorithms and cyber security. He is and was responsible supervisor / co supervisor of 6 Czech grant of fundamental and applied research and as a member of a few international (H2020). Currently, he is a professor at the Department of Computer Science and in total, he has been the supervisor of more than 50 MSc. and 25 Bc. diploma thesis. Ivan Zelinka is also supervisor of doctoral students including students from the abroad. He was awarded by Siemens Award for his PhD thesis, as well as by journal Software news for his book about artificial intelligence. Ivan Zelinka is a member of British Computer Society, Editor in chief of Springer book series: Emergence, Complexity and Computation (http://www.springer.com/series/10624), Editorial board of Saint Petersburg State University Studies in Mathematics, a few international program committees of various conferences and international journals. He is the author of journal articles as well as of books in Czech and English language and one of three founders of TC IEEE on big data. He is also head of research group NAVY.

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Kim Choon Ng[*1], Muhammad Burhan[1], Qian Chen[1], M Kumja[1] and Muhammad Wakil Shahzad[2]

[1]Water Desalination and Reuse Center, King Abdullah University of Science & Technology (KAUST), Thuwal, Saudi Arabia,

[2]Dept of Mechanical & Construction Engineering, Northumbria University, Newcastle, UK.

A Standard Primary Energy Platform for Evaluating Energy Efficiency of Desalination Plants

Abstract

The energy efficiency (EE) of seawater desalination processes is usually expressed in terms of the consumption of derived energy, either kwh electricity or low-grade heat per m3 of water produced. Nevertheless, the conventional figure of merit (FOM) of EE is defined as the ratio of useful output to energy input, i.e., m3/kwh_electric or m3/kwh_thermal. These foms have unfortunately omitted the embedded quality of derived energy (DE) input, underlying their generation methods. To avoid any thermodynamic misconception, it is important that the quantity and quality (Q&Q) of DE input are equally recognized: The numerator (m3 of distillate produced) and denominator (kwh_DE consumption) terms are benchmarked to a common platform for fair evaluation for assorted desalination methods, i.e., in the English cliché an “apple to apple” comparison. An inadequate efficacy analysis, based merely on unmerited quantitative apportionment, may result in an unjust comparison of energy efficacy across the desalination methods. This article clarifies the misconception of seeming parity between the quantitative units of electricity and thermal heat sources underlying the co-generation in power plants. Hence, we proposed a common energy platform, called the Standard Primary Energy (QSPE), to address the Q&Q of DE consumed. The DE employed in the EE definition must be transformed to the proposed common platform, i.e., QSPE, achieving the causative Q&Q in energy consumption. A rigorous thermodynamic framework of heat and reverse heat engines is invoked for the transformation methodology. We examined the specific energy efficiency from many desalination plants to demonstrate the novel concept of standard primary energy approach.

Keywords

Desalination, Energy efficiency, Thermodynamic Platform, Standard Primary energy

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O. Adiguzel

Firat University, Department of Physics, Elazig, Turkey

Shape Memory Phenomena and Nanoscale Aspects of Reversibility in Shape Memory Alloys

Abstract

Shape memory alloys take place in a class of smart materials by exhibiting a peculiar property called shape memory effect. This property is characterized by the recoverability of two certain shapes of material at different temperatures. These materials are often called smart materials with the functionality and capacity of responding to changes in the environment. These materials are used as shape memory devices in many interdisciplinary fields such as medicine, bioengineering, metallurgy, building industry and many engineering fields. Shape memory effect is performed thermally by heating and cooling after first cooling and stressing treatments, and this behavior is called thermoelasticity. Shape memory effect is based on a solid-state phase transformation, martensitic transformation, and this transformation is characterized by changes in the crystal structure of the material. Shape memory effect is result of successive thermally and stress induced martensitic transformations. These alloys exhibit thermoelasticity and superelasticity by means of deformation in low temperature product phase and high temperature parent phase region, respectively. Superelasticity is performed by stressing and releasing the material in parent phase region. Loading and unloading paths are different in stress strain diagram, and cycling loop reveals energy dissipation. The strain energy is stored after releasing, and these alloys are mainly used as deformation absorbent materials in control of civil structures subjected to seismic events, due to the absorbance of strain energy during any disaster or earthquake. Thermal induced martensitic transformation occurs on cooling along with lattice twinning with cooperative movements of atoms by means of lattice invariant shear, which occurs in two opposite directions, <110 > -type directions on the {110} - type planes of austenite matrix. Ordered parent phase structures turn into the twinned martensite structures with thermal induced transformation, and the twinned structures turn into the detwinned structures by means of stress induced martensitic transformation by stressing the material in low temperature condition. Copper based alloys exhibit this property in metastable β-phase region, which has bcc-based structures at high temperature parent phase field. Lattice invariant shear and twinning is not uniform in these alloys and gives rise to the formation of the layered structures, depending on the stacking sequences on the close-packed planes of the ordered parent phase lattice.

In the present contribution, x-ray diffraction and transmission electron microscopy (TEM) studies were carried out on two copper based CuAlMn and CuZnAl alloys. X-ray diffraction profiles and electron diffraction patterns exhibit super lattice reflections inherited from parent phase due to the displacive character of the transformation. X-ray diffractograms taken in a long-time interval show that diffraction angles and intensities of peaks change with the aging duration at room temperature. This result refers to the rearrangement of atoms in diffusive manner.

Keywords: Shape memory effect, martensitic transformation, superelasticity, twinning, detwinning and lattice invariant shear

Charles Sven
Observational and Theoretical Scientist, USA

New Found 3D Physics: Re Space, Dark Energy & Big Bang

Abstract
Much conjecture exists regarding the inscrutable nature of Space, Dark Energy and Galaxy Formation, overlooking any insight that common 3D physics may have in this matter. Deep thinking and careful observation of the world around us allowed me to uncover the mystery of how the Big Bang materialized which sets the stage for Galaxy Formation in 3D Space.

Biography
I am Observational & Theoretical Scientist immersing myself independently into the study of Cosmology and Space since 1997 that included 7 philosophical and 14 science conference presentations of my evolving work .This paper, New Found 3D Physics: re Space, Dark Energy & Big Bang, was derived from common 3D physics discovered via the latest technology over the last 100 years, overlooked by cosmologists but can be reviewed in my latest book: The Big Bang Book: How, Where, & When Demonstrated – available at Amazon.

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Chandrashekhar P. Joshi

Michigan Technological University, Houghton, MI 49931, USA

Plant Biotechnology for Improving Biofuels Production

Abstract

Rapid depletion of the underground supply of fossil fuels and mounting demands for liquid transportation fuels has initiated an urgent search for alternative energy resources. The first-generation biofuels are produced from starch and sugars (bioethanol) and oils (biodiesel). But these biofuels have only limited ability to meet the increasing transportation fuel demands of the burgeoning world population. Current bioethanol production technologies are largely dependent on using crops like sugarcane and corn but issues such as competition with food and feed supply, significant land-use changes, and many other ethical, ecological, and economic issues are clouding such applications. Therefore, lignocellulosic biomass from plant cell walls is being explored as an alternate yet significant resource for the production of second-generation biofuels. However, commercial production of bioethanol from lignocellulosic biomass requires substantial improvements in plant biomass, pretreatment conditions, saccharification (sugar release processes), and fermentation of the released simple sugars. Plant biotechnology offers an effective means of developing targeted structural alterations in the lignocellulosic secondary cell walls of bioenergy plants for improved saccharification reflecting the potential for bioethanol production. This presentation will provide a comprehensive yet critical assessment of past genetic modification efforts in plants that will assist in reducing the secondary cell wall recalcitrance to enhance biofuels production. I will discuss our recent work with improved saccharification as well as oil production from transgenic plants

Biography

Dr. Chandrashekhar Joshi is the Chairman of the Biological Sciences Department and Professor of Plant Molecular Genetics at Michigan Technological University. He is a leading plant biotechnologist who is working towards deciphering the process of biosynthesis of cell walls in bioenergy trees such as poplars. His current research interests include molecular genetics and genomics of cellulose and lignin synthesis in trees, genetic improvements of lignocellulosic products for bioenergy and paper industries, molecular basis, and biotechnology of tree growth and wood development and development of fast-growing bioenergy trees for efficient cell wall deconstruction to biofuels or paper production. He has over 40 years of research experience in plant biotechnology. Dr. Joshi has recently served as the Director of a 40-faculty strong Biotechnology Research Center and also was the Director of Graduate Programs at the School of Forest Resources and Environmental Science at Michigan tech. Since 2012, he is serving as the chair of the biological sciences department at Michigan Tech. He has authored over 231 journal articles, presentations, patents, book chapters, and two books on poplars and bioenergy crops. He is a recipient of a highly prestigious NSF-CAREER award; Michigan Tech's 2011 Research Award and is an inductee of Academic of Teaching Excellence at Michigan Tech. During 2009-2013, Professor Joshi visited Chonnam National University in Gwangju, South Korea as a World Class University distinguished visiting professor and participated in establishing a new Department of Bioenergy Sciences and Technology. Dr. Joshi has served on 60 graduate student committees and garnered over $10 million in funding from various national and international agencies for his research. His current research with genetic improvement of bioenergy trees has many direct applications in the areas of bioenergy production, forest and crop productivity, and plant improvement.

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A Common Energy Platform for Evaluating Energy Efficacy of all Types of Chillers and Heat Pumps

Abstract

The energy efficiency (EE) of air conditioning chillers is usually defined as a ratio of useful cooling to the consumption of input derived energy (DE), either in the form of electricity or low- grade heat expressed by kW or kWh. Despite inherent dissipative losses incurred by finite temperature reservoirs of cooling cycles, the figure of merit (FOM) couched as a coefficient of performance (COP) would have its numerical values exceeding unity. The psychological barrier of accepting COP values greater than unity seems contravening basic thermodynamic principles, as one achieved more output than the input energy quantities. It indicates a fundamental misconception in the energy units and yet, pedagogically, the COP has been taught and propagated hitherto in universities and cooling industry alike, ever since Willis Carrier first invented the electric cooling machine in 1902. The key issue is the oversight of embedded quality of energy units when quantifying them. Hence, the rectification resides in the inclusion of quality and quantity (Q&Q) of all energy forms in the user defined FOM. In this paper, we propose all FOM related energy types consumed or delivered by chillers and these DE are benchmark to a standard primary energy (SPE) platform using the catalog data of assorted chiller types available in literature. Based on the First and Second Laws of Thermodynamics, the common platform resolved the efficiency argument, aligning with conventional energy efficiency. The efficacy results are both accurate and fair comparison across all chiller types consuming multifarious forms of derived energy.

Keywords

Energy efficiency, Chillers, Coefficient of performance, quality and quantity of derived energy.

Biography

Dr. Shahzad is working as a Senior Lecturer in Mechanical and Construction Engineering Department at Northumbria University (NU), Newcastle Upon Tyne, United Kingdom. I worked as a Research Scientist in the Water Desalination and Reuse Center of King Abdullah University of Science and Technology from 2014-2019 before joining NU, UK.

His research focused on hybrid desalination processes, heating and cooling, solar thermal energy storage and renewable energy research. He has recieved many international awards including, Sustainability Medal 2020, Global Innovation Award 2020, National Energy Globe Award Saudi Arabia 2020 and 2019, Excellence and Leadership Award 2019, IDA Environmental & Sustainability Award 2019. His research is also highlighted at Yahoo business, Nature Middle East, Arab News and many other national and international platforms. We successfully commercialized desalination processes through a spin-off companies.

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Ivan Ganchev*

University of Plovdiv “Paisii Hilendarski”, Plovdiv, Bulgaria

Smart Service Recommendations Supported by Cloud Computing

Abstract

A highly contextualized, customized, and personalized way for recommending of services to mobile users (consumers) by utilizing efficient cloud computing techniques is introduced, considering the current consumer-, network-, and service context. A smart cloud-based service recommendation system, which builds up and dynamically manages consumer profiles, is presented for facilitating the service discovery, recommendation, and association, supporting the consumer-choice optimization process, and achieving the best quality of experience (QoE) for consumers when using different services, accessible through any kind of mobile devices via heterogeneous wireless access networks, anytime-anywhere-anyhow. The system allows consumers to receive timely recommendations about the ‘best’, for them, instances of mobile services, at any location and at any moment, and use them via the ‘best’ available access networks, thus realizing a truly consumer-oriented Always Best Connected and best Served (ABC&S) communication paradigm. The recommended services range from typical telecommunication services to Internet services, and to more sophisticated services, such as finding (with subsequent dynamic changing, if needed) the most ‘healthy’ or ‘secure’ driving/biking/jogging/walking route to follow as to avoid areas posing particular health or safety risk to consumers. Working in cooperation with an ABC&S mobile apps installed on the consumer devices, the system is not only able to discover other (better) instances of the same or equivalent service, and recommend these (in real time) to the engaged consumers but can also automatically select and switch to a particular (better) service instance. A possible system design solution, realized through a structured composition of domains and tiers, is presented in the keynote talk. Also discussed are possibilities to apply the Internet of Services paradigm to enable the integration of different types of basic services into a composite service, while simultaneously customizing and personalizing it to interested consumers, by taking into account all aspects of the current context.

Biography

Prof. Ivan Ganchev is an IEEE Senior Member, a URSI Senior Member, an ITU-T Invited Expert, and an IET Invited Lecturer. He was involved in 40+ international and national research projects. Prof. Ganchev has served on the Technical Program Committee of 350+ prestigious international conferences, symposia, and workshops. He has (co)authored 1 monographic book, 3 textbooks, 4 edited books, and 300+ research papers in refereed international journals, books, and conference proceedings. Prof. Ganchev is an Area Editor of the Elsevier “Computer Networks” journal, an Editorial Board Member of the Hindawi “Wireless Communications and Mobile Computing” journal, the MDPI “Electronics” journal, the MDPI “Mathematics” journal, and the Wiley “Internet Technology Letters” journal, and a Regional Editor (Europe) of the International Journal on Trust Management in Computing and Communications. He also seats on the Editorial Board of and has served as a Guest Editor for multiple other international journals.

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Yuri Feldman

The Hebrew University of Jerusalem, Israel

Water and its Dielectric Signature: New Marker for Biosensing

Abstract

Whenever water molecules interact with either dipolar or charged systems, the main water dielectric relaxation peak broadens. If a solute is dipolar in nature, new solute-water clusters are created due to dipole-dipole interactions. It leads to the “red shift” of the dielectric loss maximum frequency. In the case of ionic solutions, another cluster structure develops, due to dipole-charge interactions and a “blue shift “is observed. In the general case when a solute molecule has both charged and dipole groups, the dielectric loss maximum demonstrates a “red” or “blue” shift, depending on the entity concentration. In all aqueous solutions, the water-solute interactions can be considered as dipole-matrix interactions in which water is the dipole subsystem. The phenomenological 3D trajectories approach was applied to the results of isothermal dielectric measurements of different concentrations of the following aqueous solutions: Hydrocarbons, NaCl and KCl, AMP and ATP, Amino Acids and proteins [1-5]. The parameters of the main water peak define a trajectory that can clarify the nature and rate, at which water interacts with the solute. In this paper, we extend this approach from comparatively simple solutions to the complexity of Red Blood Cells (RBC) suspensions by monitoring the RBC cytoplasm under different external conditions [6,7]. Dielectric measurements of RBC suspensions in the frequency region of 100 MHz to 50 GHz as a function of aging or external glucose concentration also reveal a distinct time point or glucose concentration after which the spectra are radically changed. The conclusion is that the dielectric response of the cytoplasm in microwaves is due to the water therein and its interaction with physiological active components in cytoplasm. This opens a window of opportunity to exploit this for the non-invasive monitoring of diabetes or to non-invasive control of the quality of Stored RBC in a Blood bank in order to manage the inventory.

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Biography

Yuri Feldman received the M.S. degree in radio physics and Ph.D. degree in molecular physics from the Kazan State University, Kazan, USSR, in 1973 and 1981, respectively. From 1973 to 1991, he was with the Laboratory of Molecular Biophysics, Kazan Institute of Biology, Academy of Science of the USSR. In 1991, he moved to The Hebrew University of Jerusalem, Israel, where he is currently a Full Professor and the Head of the Soft Condensed Matter Physics Laboratory. He has spent over 40 years in the field and has more than 400 scientific publications related to dielectric spectroscopy and its applications. He holds 15 patents in the areas of electromagnetic properties of the matter. In 1992 and 2010, the Israel Government acknowledged his work with an award for the outstanding contribution to the development of Israel Science; in 1998, he received the Kaye Award for the best innovation and invention. Feldman is a Director of the Centre for Electromagnetic Research and Characterization (CERC); he is a Member of the Boards of International Dielectric Society (IDS) and International Society for Electromagnetic Aquametry (ISEMA). His current interests include broadband dielectric spectroscopy in frequency and time domain; theory of dielectric polarization and relaxation; relaxation phenomena and strange kinetics in disordered materials; electromagnetic properties of biological systems in vitro and in vivo.

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A Novel Method to Study Drug-Induced Cellular Apoptosis: Raman Spectroscopy and Phase Imaging

Abstract

Non-invasive live cell measurements are important in biomedical research. I will present a combined digital holographic/Raman spectroscopy technique to study live cell cultures during methamphetamine-induced apoptosis. The measurement of live cell cultures by digital holographic microscopy yields information about cell cycle and cell death mechanisms, since these processes are correlated with individual cell volume and shape. Raman spectroscopy, on the other hand, is sensitive to rotational and vibrational molecular transitions, and intermolecular vibrations. Thus, Raman spectroscopy provides complementary information about cells, such as protein, lipid and nucleic acid content, and, particularly, the spectral signatures associated with structural changes in molecules. I will present the analysis of cell cultures obtained by these two methods. Our Raman data indicate that the chemical changes in proteins preceded morphological changes, which were seen with holography. Our study also emphasizes that phase imaging and Raman spectroscopy can be utilized for noninvasive simultaneous monitoring of morphological and chemical changes in cells during many dynamic processes.

Keywords

Apoptosis, Digital Holographic Microscopy, Phase imaging, Phase Reconstruction, Raman Spectroscopy, Live Cell Imaging

Biography

Dr. Alexander Khmaladze received his Ph.D. from the University of South Florida, where he published a number of papers on digital holographic phase imaging. He then accepted a postdoctoral position at the University of Michigan, where he worked on the application of near-infrared Raman Spectroscopy to monitoring of tissue constructs implanted in mice, with the ultimate goal of applying this technique to human patients. Dr. Khmaladze joined the physics department of SUNY at Albany in September 2014. Currently, his lab has several digital holographic microscopic setups, 3D Cell imaging tomographic microscope, and a portable Raman microscopic system. His research interests include Raman spectroscopy and microscopy, three-dimensional digital holographic imaging, microscope design, hyperspectral imaging of live cells and biological tissue imaging.

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Fatigue Properties of Continuous Wave and Pulsed Wave Laser Cold-Wire Welding of thick Section AA6005-T6 Aluminum Alloys

Abstract

The effect of laser wave modes on the fatigue behavior of laser cold-wire welding made of 4.8 mm thick AA6005-T6 aluminum alloy was investigated using continuous and pulsed wave lasers. Due to the inherent differences in these two wave laser modes, different welding parameters were used, while keeping the interaction time constant. The mechanical properties of welded joints were measured using tensile tests, while their fatigue performances were quantified using a constant amplitude force-controlled technique to obtain S-N curves. The pulsed wave laser mode produced higher fatigue resistance as compared to the continuous wave mode. The fatigue strength corresponding to the run-out condition (i.e., 107 cycles, in this study) was about 28% higher for the pulsed wave mode than for the continuous wave laser mode. At a high stress amplitude (30 MPa), the lifespan of the pulsed wave joints was about twice as high as that with continuous wave joints. These fatigue results were cross-referenced with a 3D topographic map, a 2D microhardness map, a metallographic study, and a fractographic analysis to better understand the crack nucleation and crack propagation mechanisms. A microhardness analysis performed along the cross-section of the joints did not reveal any significant difference between pulsed wave and continuous wave modes. A fractographic analysis confirmed crack propagation within the fusion zone and that 83 to 90% of cracks nucleated from the root undercuts. Topographic maps of the joints before fracture revealed that the continuous wave laser mode produces deeper and narrower (i.e., more acute) undercut defects than does the pulsed wave mode. A Weibull approach based on the biggest defects found on the fracture surfaces also confirmed that the continuous wave process produces larger defects at the root. Top defects are significantly small (55%), but they have a larger size dispersion than do root defects. Since the root undercuts act as the main stress concentrators, they are mainly responsible for the lower fatigue performance of the joints, and their sizes and shapes should be minimized during further process development of the welding process.

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Multi--Scale Adaptive Mesh and Machine Learning-Based Predictive Modelling for Environmental Problems

Abstract:
Multi-physics problems (e.g. turbulent flows, chemical reactions, radiation, heat exchange, and interaction between the physical processes) typically have important dynamics that operate over a range of length scales. The use of adaptive unstructured meshes in multi-physics modelling can provide accurate results since the mesh is dynamically adapted according to the evolving physical features. That is, the mesh resolution can be adjusted dynamically to simulate the physical process accurately and effectively. Here we introduce a multi-scale fluid flow model (Fluidity-ME) for atmospheric and environmental problems, which has the capability including (1) advanced multiscale adaptive mesh numerical methods for the dispersion of pollutants at city, building, street scales down to personal scales; (2) a 3D complex urban geometry tool which can be used for generating high-quality urban geometric meshes and identifying the land types (water, tree, roof, wall, greening etc); (3) a green/tree and land surface for modelling complex radiation and thermal dynamic processes. Here we will demonstrate the capability of multi-scale adaptive modelling for urban environmental problems. We also present new numerical techniques such as, machine learning (ML), reduced order modelling (ROM) and data assimilation (DA), for real-time operational modelling and uncertainty analysis. Having the compatibility of ML and ROM will be nothing short of revolutionary for a large number of disciplines. The combination of ROM, ML and DA enables a rapid and accurate modelling response in emergencies. The multiscale adaptive mesh and rapid response modelling capability will be demonstrated in some realistic cases in China and London (UK).

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Assessment on the Impact of Interior Insulation on External Walls in Three Swedish Buildings

Abstract

Among thermal improvements of external walls in some heritage buildings, interior insulation of external walls might be the only option. However, interior insulation is associated with several risks for damage due to diminishment of the hygrothermal performance of the existing wall. This project aims to assess the impact of available solutions for interior insulation in three case studies. Field measurements were conducted on external walls in three Swedish buildings, placed in the cities of 1) Uppsala, 2) Gothenburg, and 3) Finspång. Temperature and relative humidity were measured indoors, outdoors, and on the exterior and interior surfaces of the external walls. Measurements were used to validate models of the walls in WUFI Pro [1]. The models were used to determine the impact of 13 different solutions for interior insulation. The considered solutions are either vapor open or vapor tight, and some are capillary active. The results were analyzed regarding risks for accumulation of moisture in the existing wall, and microbial growth on biological materials (using the Viitanen model [2]). In walls with no biological materials the analyses considered the possibility of contamination. The validation shows that on-site measurements give more accurate simulation results than when using statistically generated climate data from Meteonorm [3] and simultaneously using standards, even if the ASHRAE-standard generates results with good coherence with the measurements on the interior surfaces. Analyses on (1) an exteriorly painted sandwich-wall consisting of masonry and insulation show no significant risks of moisture damage due to the application of the investigated solutions. However, the risk increases with a traditional solution using mineral wool and vapor retarder, as well as a modern solution using vacuum insulation that is vapor tight. Results from analyses on (2) a pressure equalized rainscreen wall shows that vapor tight options are preferable, and that vapor-open options should be capillary active. The third (3) wall presents several practical possibilities due to a preexisting condition that is favorable to changes: an external load-bearing masonry layer with interior insulation. Preliminary results on this wall shows that options that generate the lowest risk for moisture damage are vapor open and capillary active, or those that are vapor tight. In conclusion, the risk for damage relies on the design of the existing external wall – whether it is a pressure equalized rainscreen, or contains biological material, or exterior surfaces are hydrophobically treated, or not. Nonetheless, results show that all included external walls can be insulated from the interior without considerable risks for moisture damage. Based on the work conducted, a framework for assessment of the impact of interior insulation on external walls is proposed. The framework will be the basis for further assessment of interior insulation on typical walls in Swedish buildings that need renovation.

Keywords

field measurements, case studies, interior insulation, hygrothermal simulations, moisture damage

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Biography

As a researcher, I specialize in the subject of Building Physics and have also conducted research in the subject of Building Services. I have investigated the practical and theoretical aspects of renovation measures for building technology (materials, constructions) and equipment for construction services, in Swedish buildings. My research has focused on the effects of such measures on the moisture safety and energy use in Swedish buildings and on the indoor environment. As a teacher, I have mainly taught the subjects construction technology (materials and structures) and building physics. This, both in terms of the design of new buildings and in terms of maintenance and renovation of existing (old) buildings. Specifically considering the energy performance and moisture safety of buildings. As a consultant, I have mainly worked as a moisture specialist in both smaller and larger projects, both locally and remotely.

Eugene Frumker*

Ben-Gurion University, Israel

Application of Attosecond Science to Metrology and Nanotechnology

Abstract

The remarkable progress in Nano-science and nanotechnology has created the need for practical tools capable of resolving and analyzing nanometer scale structures. Analytical and imaging tools that have spatial resolution at the nanometer scale are of paramount importance for both fundamental nanoscience and applied nanotechnology. Developing the ability to monitor and steer electrons at subatomic resolution at their natural (Attosecond) time scale bears the promise of revolutionary advances not only in physics, but also in chemistry, life sciences and the technologies of the future. In my talk, I will introduce the key concepts of Attosecond science, present the state-of-the art in the field, and discuss possible future directions and applications to metrology.

Biography

Dr. Eugene Frumker is a head of Attosecond science and nanophotonics group in the Department of Physics of Ben-Gurion University and fellow of Institute of Quantum Science and Engineering of Texas A&M University. Frumker received his Ph.D. in physics at the Weizmann Institute of Science in 2007. As a Marie-Curie postdoctoral fellow, his research focused on Attosecond science at Joint Attosecond Science Laboratory of the Canadian National Research Council / University of Ottawa (JasLAB) and at Texas A&M University; and the Max Planck Institute of Quantum Optics (Germany). His research interests include ultrafast nonlinear optics, nanophotonics and Attosecond science.

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Utilization of Unconventional Water Sources

Abstract

Worldwide, the ongoing climate change leads to shifts in precipitation patterns, rising sea levels, and increasing frequency of extreme weather events. Furthermore, environmental pollution and growing rural exodus have an additional impact on quality and availability of fresh water from conventional groundwater and surface water sources. Accordingly, new strategies for water supply have to be developed. They include the implementation of sophisticated treatment technologies for water reclamation from industrial, commercial, and residential sources or from sea water and air moisture. Compared to conventional fresh water sources, the unconventional water sources show a more complex composition and a higher concentration of potentially hazardous substances. The required treatment gives rise to additional technical efforts and causes extra costs. Furthermore, when exploiting unconventional water sources, psychological issues of the customers as well as increasing health concerns due to the prevalence of pathogens need to be addressed. This presentation gives an overview of existing and new approaches for improved water supply worldwide.

Keywords

water reclamation, water supply, environmental pollution, unconventional water sources, membranes, air moisture

Biography

Since 2014 Frank Rögener has been working as Professor of Fluid Process Engineering at Cologne University of Applied Sciences (TH Köln). His focus is on thermal process technology, including membrane and wastewater technology. He studied chemical engineering at TU Clausthal. In 2000 he received his doctorate from the University of Saarland on the application of membrane processes. For more than 20 years, Dr. Rögener has been involved in the development of energy- and resource-efficient processes, especially in the food industry, chemical industry and metal finishing industry.

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