Tomsk State University of Control Systems and Radioelectronics

TUSUR UNIVERSITY

RITSUMEIKAN
Ritsumeikan University

University Technology Dialogue 2013

INNOVATIONS IN INFORMATION AND COMMUNICATION SCIENCE AND TECHNOLOGY
The Third Postgraduate Consortium International Workshop – IICST2013

September 2-5, 2013

OFFICIAL LANGUAGE: **ENGLISH**

http://iicst.net

INNOVATIONS IN INFORMATION AND COMMUNICATION SCIENCE AND TECHNOLOGY

IICST2013 – The Third Postgraduate Consortium International Workshop

Day 1 — September 2, 2013

Location: House of Scientists, 45 Sovetskaya Street

09:30 - 10:00

Transfer to Tomsk Special Economic Zone

10:00 - 12:00

Introduction to Tomsk Innovation Infrastructure
by invitation only

13:00 – 14:00

Lunch Time

14:00 - 14:30

Registration

14:30 – 14:45

Opening
Prof. Alexander Uvarov , IICST General Co-Chair, TUSUR University Vice-Rector
Prof. Victor Kryssanov, IICST General Co-Chair, Ritsumeikan University
A. Knyazev, Vice Governor for Tomsk Region Administration, Russia (to be confirmed)

14:45 – 16:30

Plenary Discussion: Matching the University research with future industry needs
Moderator: *Prof. Eric Cooper, Ritsumeikan University, Japan*
Dr. Gennady Kobzev, TUSUR University, Russia
Discussion topics:
— Selection of the most promising research directions for international recognition and valorization
— Feedback from the most technologically advanced international corporations
— Foresights for future technology advancements
— University-Industry-Government interaction for technological innovation development
Participants:
— *A. Uvarov, TUSUR University, Russia*
— *I. Koutsaroff, Murata Electronics, Japan*
— *Y. Nakatani, Ritsumeikan University, Japan*
— *A. Pozdnyakov, Elecard Group, Russia*
— *A. Stukanov, Tomsk Region Administration, Russia*
— *A. Knyazev, Vice Governor for Tomsk Region Administration, Russia (to be confirmed)*
— *W. N. Mureithi, Polytechnique Montreal, Canada*
— *T. Whitaker, Motion Analysis Corporation, USA*
— *M. Pinotti, Federal University of Minas Gerais, Brazil*

16:30 – 18:00

Invited talk: Bioengineering: Engineering Knowledge and Solutions for life
Prof. M. Pinotti, Federal University of Minas Gerais, Brazil

Day 2 — September 3, 2013

Location: House of Scientists, 45 Sovetskaya Street

09:00 – 10:00

Invited Tutorial: Multi-sensory Brain Computer Interfaces: State of the Art and Future Challenges
Prof. Tomasz M. Rutkowski, University of Tsukuba, Japan

10:00 – 11:10

Session 1a: IT in Medicine and Healthcare
Moderator: Prof. F. Rinaldo, Ritsumeikan University, Japan
Commentators: H. Murao, Y. Izuno
Human Activity Recognition System, based on Acceleration Data Obtained from a Smartphone
— Miyamoto S., Ogawa H.
Morphometric test-system for outcome prediction of ischemic cardiomyopathy
— Gutor S.
Prediction of Protein Phosphorylation Sites by Support Vector Machine
— Ishino T., Nishikawa I., Tohsato Y., Fukuchi S., Nishikawa K.
Entropic methods in study of adaptation processes in the human body
— Murzina S.
Parallel Computing on GPU for Solving Computer Tomography Problems
— Martyushev A.P., Khandorin A.A.

11:10 - 11:20

Coffee Break

11:20 - 12:00

Session 1b: IT in Medicine and Healthcare (continued)
Moderator: Prof. F. Shibata, Ritsumeikan University, Japan
Commentators: J.-H. Lee, T. Rutkowski
Study on Human Attribute Recognition by Applying the LPC Cepstrum Analysis to Human Gait
— Su Y., Murao H.
The use of 3D-slicer for investigation of expansive processes in the brain
— Shchadenko S.
Construction of an Interactive Hepatectomy Supporting System
— Miyawaki K., Shindo T., Kaibori M., Matsui K., Tsuda T., Kwon A.-H., Chen Y.-W.

12:00 - 13:00

Invited talk: HEVC (High Efficiency Video Coding) upcoming standard for video compression
Dr. Andrey Pozdnyakov, Elecard Co-Founder, President

13:00 – 14:00

Lunch Time

14:00 – 15:00

Invited Talk: VIRTUAL VISTAS: Digital Training in the Virtual World
Tom Whitaker, Motion Analysis Corporation, President, CEO, USA

15:00 – 16:30

Session 2: Application Software
Moderator: *Prof. E. Cooper, Ritsumeikan University, Japan*
Commentators: *H.Ogawa, D.M. Marutschke*
Implementation of Element Model Libraries in the INDESYS Framework
— Salnikov A.S., Kalentyev A.A., Goryainov A.E.
Locking Dance Instruction Support Method for Teachers Inexperienced in Street Dance
— Takesue T., Izumi T., Nakatani Y.

Street Lighting Simulation
— Litvinova M.N., Malomuj P.V., Soldatkin V.S., Tuev V.I.
Efficiency and Sensitivity Analysis of Distributed Power Networks
— Suzuki M., Sakakibara K., Nishikawa I.
GRID: Building a BOINC-based Virtual Campus Supercomputer
— Naumenko R.I.
Increasing the Performance of Density-Based Clustering Technique for Rapid Analysis of Large Scale Datasets
— Axyonov S.V., Lycom D.N.

16:30 – 16:40

Coffee Break

16:40 - 17:40

Round table: Innovative Educational Technologies
Moderator: *Dr. Gennady Kobzev, TUSUR University, Russia*
Exploring Innovative Educational Technologies
— Amaldas C., Shankaranarayanan A., Rinaldo F., Gemba K.
Project-based group learning at TUSUR University
— Pavlova I.
Elite Engineering Education at Tomsk Polytechnic University
— Zamiatina O.
CDIO Implementation at TUSUR University
— Afanasyeva M.

18:00 – 20:00

Public Lecture: Bioengineering: New Science shapes the future
Prof. Marcos Pinotti, Federal University of Minas Gerais, Brasil
Title changes may occur
Location: *Tomsk Library, 14, Karl Marx Street*

Day 3 — September 4, 2013

Location: House of Scientists, 45 Sovetskaya Street

09:00 – 10:00

Invited talk: Waveguide Optical Devices & Systems for Information Processing
Prof. V.M. Shandarov, TUSUR University, Russia

10:00 – 11:20

Session 3: Nano and optoelectronics
Moderator: *Prof. V. M. Shandarov, TUSUR University, Russia*
Commentators: *F. Rinaldo, I. Koutsaroff*
Simulation of the PDLC Diffraction Structure Characteristics under the Influence of Spatially Non-uniform Control Field
— Semkin A.O., Sharangovich S.N.
Spatial Self-action of Light Field in a Nonlinear Fabry-Perot Interferometer
— Perin A.S., Shandarov V.M., Batrshin V.F.
Design of a 1.2-1.8 GHz MMIC Low Noise Amplifier using gMatch Synthesis Tool for Matching Networks
— Kalentyev A.A., Dobush I.M., Garays D.V., Goryainov A.E., Babak L.I.
A New Analytical Technique for Bias-Dependent Drain Resistance Extraction for HEMTs
— Kokolov A.A.

11:15 – 11:30

Coffee Break

11:30 - 12:30

Invited Talk: Total Quality and Risk Management in Microelectronic Production: Recent Developments of Advanced Process Control (APC) Techniques and toward Automatic Virtual Metrology (AVM) Systems
Dr. Ivo(yl) P. Koutsaroff, Murata Electronics, Japan

13:00 – 14:00

Lunch Time

14:00 – 15:00

Invited Talk: Hydrodynamics and Fluid-structure Interaction: Complex Flow Modeling and Control
Prof. N. Mureithi, Politechnique Montreal, Canada

15:00 – 16:50

Session 4: Robotics and AI
Moderator: *Prof. F. Rinaldo, Ritsumeikan University, Japan*
Commentators: *I. Nishikawa, Y. Nakatani*
A Solution for a Car Model for the FreeScale Smart-Car Cup
— Yakushin D.O., Pekarskih E.A., Shandarov E.S.
A Teleoperated Manipulator for Supporting Independent Living of People with Disabilities
— Morishita M., Miyoshi T., Ando N., Lee J.-H.
Robot-Assistant Behavior Analysis for Robot-Child Interactions
— Zimina A.N., Ermakova P.S., Shandarov E.S.
Preliminary Experiments with a Brain-Computer Interface to Control a Robot
— Koike T., Hayashi K., Ono K., Ogawa H.
Synchronization System for a Group of Robobuilder Robots
— Ushakov A.S., Shepeleva N.E., Shandarov E.S.
Adopting Scouting and Heuristics to Improve the AI Performance in STARCRAFT
— Wang Z., Nguyen Q.K., Thawonmas R., Rinaldo F.
Application of Gamification in Knowledge Economies
— Shankaranarayanan A., Amaldas C., Rinaldo F., Gemba K.

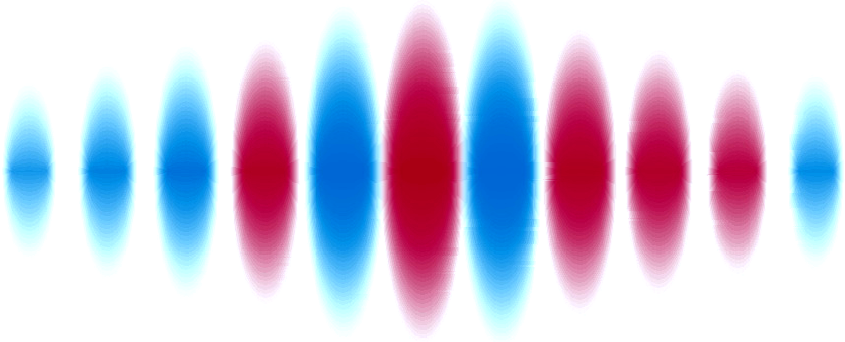
16:50 – 17:00

Coffee Break

17:00 – 18:45

Session 5: Simulation and Modeling
Moderator: *Prof. K. Nefedev, Far Eastern Federal University, Russia*
Commentators: *N. Mureithi, V. Kryssanov*
Continuous Multistep Methods for Solving First Order Ordinary Differential Equations
— Semenov D.E., Mohammed U., Semenov M.E.
Petri Net Modeling of Mass Service Systems in the MARS Simulation Environment
— Istigecheva E.V., Grigorieva T.E., Kornyushina A.I.
Brute-Force and Monte-Carlo Ground State Calculation Methods of 2D Dipolar Magnetics
— Shevchenko Y.A., Nefedev K.V.
Calculation of the Magnetoactive Elastomer Reaction on an External Magnetic Field
— Andriushchenko P.D., Nefedev K.V.
Monte Carlo Simulation of Long-Range Interaction between Ising Spins on Flat Lattice
— Nefedev K.V., Kapitan V.Yu.
Numerical Approach to Research of Magnetic States of Disordered Systems of Spherical Dipoles on Plane and in Volume
— Makarov A.G., Nefedev K.V
Education Technology in a Virtual Space with the Help of Avatars
— Kataev M.Yu., Korikov A.M., Mkrttchian V.S.

Eric W. Cooper
Gennady A. Kobzev
Alexander F. Uvarov
Victor V. Kryssanov (Eds.)



Innovations in Information and Communication Science and Technology

IICST 2013
Third Postgraduate Consortium
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Proceedings

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TOTAL QUALITY AND RISK MANAGEMENT IN MICROELECTRONIC PRODUCTION: Recent Developments of Advanced Process Control (APC) Techniques and toward Automatic Virtual Metrology (AVM) Systems

Koutsaroff I.P.

Murata Manufacturing Co. Ltd., Japan, ivo_kutsuro@murata.co.jp

LECTURE ABSTRACT

During the manufacturing flow of integrated circuits or other electronic components yield loss is caused for example by random defects, faults, contaminations, process variations, and other factors. One of the prime functions of manufacturing engineers is rapidly to diagnose and to take effective actions for proper identification and elimination of the root causes of the yield losses for different product classes.

In this talk, an overview is made about advanced process control (APC) techniques that can be used to supplement the traditional statistical process control (SPC) methods in various manufacturing steps of the modern semiconductor manufacturing lines. Few examples are outlined covering recent APC approaches which enable significant variation reduction and to respond quickly to process disturbances in sophisticated modern semiconductor manufacturing processing steps. The selected case studies examples focus on wafer front-end manufacturing steps utilizing the plasma-based deposition and etching equipment, which exhibit highly nonlinear and complex multidimensional relationships between input and output process variables and are not trivial to simulate and control. The methodologies discussed here include quantitative regression algorithmic diagnosis, qualitative experiential, and pattern recognition-based neural network approaches, as well as hybrid approaches with the main goal of reducing equipment downtime, limiting misprocessing, and enhancing manufacturing productivity and throughput. Examples of intelligent supervisory control approaches for multiprocess sequences are also given. When the outputs of equipment drift, the automatic controller generates a new recipe to bring them back on target. The second approach, on the other hand, keeps the final target of the process sequence fixed, while intermediate targets are subject to dynamic adjustments.

Last part of this talk will cover a promising technology denoted virtual metrology (VM) that has been introduced very recently. Widely used metrology systems for the conventional process control, have some limitations. The sampling-based metrology assumes that one randomly sampled wafer can represent the whole lot, which is very unrealistic. In contrast, VM actually tries to predict, not actually measure, and it is estimating values (i.e., film thickness measurements from a wafer) by using equipment/process parameters and other available production data which may include values from previous metrology steps as well as production context information. The key advantages of an automatic virtual metrology (AVM) system are being equipped with the capabilities of automatic data quality evaluation (data mining), automatic model refreshing process to promptly refresh its own data quality evaluation models and VM conjecture models (also called “fanning out” process), and overall automatic model refreshing process to promptly refresh its own model set. Once a prediction model is built, the sensor data of other “non-measured” (also called synthetic) wafers are used to predict the metrology values. Usually VM embeds also run-to-run (R2R) control system for the process under control using distribution-free (nonparametric) exponentially weighted moving average (EWMA) control charts.

Key words: Total quality and risk management, Microelectronic production, Automatic virtual metrology.

Industry Track

HEVC (High Efficiency Video Coding) upcoming standard for video compression

Keynote Speaker: Andrey Posdnyakov, Elecard Co-Founder, President

Mr. Posdnyakov has 19 years of professional programming experience, including 16 years in the digital video/audio field. His expertise includes both hardware and software systems and architectures. For the past 14 years, he has served in a number of executive management, strategic business development, and business planning positions. He holds an MS in Theoretical Physics.

Lecture Abstract

HEVC/H.265 is the latest and most advanced video compression standard that is expected to trigger a large-scale transition to Ultra High-Definition (UHD) systems. A key requirement for the new standard is to double the data compression ratio for the same video quality compared to the wide spread H.264/AVC standard. To achieve this goal, a number of algorithmic tools should take into account many aspects of video compression. Andrey Posdnyakov is going to speak about the newest solutions from Elecard developers that will help create a universal 4K UHD HEVC live encoder.

Total Quality and Risk Management in Microelectronic Production:

Recent Developments of Advanced Process Control (APC) Techniques and toward Automatic Virtual Metrology (AVM) Systems

Keynote Speaker: Ivo(yl) P. Koutsaroff

Dr. Ivo(yl) P. Koutsaroff is a Chief Research Engineer working on Advanced Functional Thin Film Materials & Devices at Murata Manufacturing Co. Ltd., Business & Technology R&D Development Unit, New Process Development Center, Kyoto, Japan. He received his M.Sc. degree in Applied Physics from Sofia University in 1986, and his Ph.D. degree in Semiconductor Material Physics from Sun-Yat Sen University, Guangzhou and Institute of Semiconductors, Chinese Academy of Sciences, Beijing in 1993. Prior to joining Murata in 2005, since 1994, he had held several engineering positions at the University of Toronto, Canada; Electrotechnical Laboratory (AIST), Tsukuba, Japan; and E&G Optoelectronics (Perkin-Elmer), Montreal, Quebec. From 1999 to 2005 he has been engaged in manufacturing and development activities at Gennum Corporation (Semtech Corp. & ON Semiconductor) in Burlington, Toronto area, Canada, related primarily to the low dielectric loss high density ferroelectric thin film decoupling and tunable capacitor devices used in RF-frontend communication modules. Being a manufacturing engineer from 1998 to 2001, he was actively involved in Statistical Process Control (SPC) and Design of Experiments (DOE) activities for Plasma Enhanced Chemical Vapor Deposition (PECVD), Reactive Ion etching (RIE), RF sputtering, and Rapid Thermal Annealing (RTA) steps in different semiconductor class production lines. His quality control optimization and monitoring methodology led to significant improvement of overall yield and robustness of the above wafer front-end critical steps used for the microdevice fabrication. He was a licensed Professional Engineer (P.Eng) in Ontario, Canada. He has authored more than 60 publications, co-edited proceedings in the ferroelectric thin films field, and chaired sessions in various international conferences, as well as holds dozen patents. He is a member of the IEEE, the Materials Research Society (MRS), the European Materials Research Society (EMRS), the American Chemical Society (ACS), and the American Ceramic Society (ACerS). Dr. Koutsaroff founded and organized the First International Symposium on “Advances and Enhanced Functionalities of Anion-controlled New Inorganic Materials (ANIM)”, as one of the 24 Symposia at E-MRS 2013 Spring Meeting which was held in Strasbourg, France, May 27-31, 2013. He is the lead Guest-Editor of the Special Issue on ANIM materials of the ACS Journal of Crystal Growth & Design.

Lecture Abstract

During the manufacturing flow of integrated circuits or other electronic components yield loss is caused for example by random defects, faults, contaminations, process variations, and other factors. One of the prime functions of manufacturing engineers is rapidly to diagnose and to take effective actions for proper identification and elimination of the root causes of the yield losses for different product classes.

In this talk, an overview is made about advanced process control (APC) techniques that can be used to supplement the traditional statistical process control (SPC) methods in various manufacturing steps of the modern semiconductor manufacturing lines. Few examples are outlined covering recent APC approaches which enable significant variation reduction and to respond quickly to process disturbances in sophisticated modern semiconductor manufacturing processing steps. The selected case studies examples focus on wafer front-end manufacturing steps utilizing the plasma-based deposition and etching equipment, which exhibit highly nonlinear and complex multidimensional relationships between input and output process variables and are not trivial to simulate and control. The methodologies discussed here include quantitative regression algorithmic diagnosis, qualitative experiential, and pattern recognition-based neural network approaches, as well as hybrid approaches with the main goal of reducing equipment downtime, limiting misprocessing, and enhancing manufacturing productivity and throughput. Examples of intelligent supervisory control approaches for multiprocess sequences are also given. When the outputs of equipment drift, the automatic controller generates a new recipe to bring them back on target. The second approach, on the other hand, keeps the final target of the process sequence fixed, while intermediate targets are subject to dynamic adjustments.

Last part of this talk will cover a promising technology denoted virtual metrology (VM) that has been introduced very recently. Widely used metrology systems for the conventional process control, have some limitations. The sampling-based metrology assumes that one randomly sampled wafer can represent the whole lot, which is very unrealistic. In contrast, VM actually tries to predict, not actually measure, and it is estimating values (i.e., film thickness measurements from a wafer) by using equipment/ process parameters and other available production data which may include values from previous metrology steps as well as production context information. The key advantages of an automatic virtual metrology (AVM) system are being equipped with the capabilities of automatic data quality evaluation (data mining), automatic model refreshing process to promptly refresh its own data quality evaluation models and VM conjecture models (also called “fanning out” process), and overall automatic model refreshing process to promptly refresh its own model set. Once a prediction model is built, the sensor data of other “nonmeasured” (also called synthetic) wafers are used to predict the metrology values. Usually VM embeds also run-to-run (R2R) control system for the process under control using distribution-free (nonparametric) exponentially weighted moving average (EWMA) control charts.

Quality Control for Supply Chain Management

Keynote Speaker: Yuki Izuno

Ms. Yuki Izuno is a graduate of Miyazaki International College now working at Omron Corporation. She received additional education at the Graduate School of Management of Globis University. Since 2001, Ms. Izuno has been working in the area of production control. Her work assignments and responsibilities have included management of the company’s sales in foreign countries, introduction of the Japan-based quality control system to European facilities, and business planning for the Solar Invertor Business Unit. Ms Izuno's current interest is in the area of supply chain management, where she is actively involved in the development of a new standard of management quality between sales and production.

Lecture Abstract

SCM (Supply Chain Management) is a management operation to boost competitiveness through improving the product flow via supplier, factory, sales and logistics to the customers.

The aim of SCM production innovation is to become a much stronger manufacturer that can vary supply volume to customers flexibly and within a shorter time frame to handle demand fluctuations. This production innovation is to realize "synchronization with demand". This means production performance will be synchronized with the customer's real (current) demand, delivering top quality with the fastest possible speed and flexibility. This requires near instantaneous information flow between suppliers, factories, sales and customers via a new and innovative SCM.

Academic Track: The Digital Dimensions of Social Evolution

Virtual Vistas: Digital Training in the Virtual World

Keynote Speaker: Tom Whitaker

Tom Whitaker joined Motion Analysis Corporation in December 1984 as CEO and Chairman, and currently directs the overall strategy of the Company. Mr. Whitaker was previously employed by General Electric Company for twenty five years. His twelve assignments and relocations throughout the United States included sales, sales management, marketing, strategic planning, engineering, manufacturing, customer service and finance. He held positions from trainee to general management (1977-1984). Mr. Whitaker completed the highest level General Electric Executive Development programs. He also served as Chairman of National Bank of the Redwoods and Redwood Empire Bancorp for ten years. Mr. Whitaker holds a B.S.E.E. degree from the University of Nevada and an M.B.A. degree from the University of California, Berkeley.

Lecture Abstract

Driven by high quality digital content, production and time efficiencies and portability, most industry segments are turning to the virtual world for today's training needs. Virtual training is being used today for medical staff, industrial operators and designers, sports performance, dance performance, airlines, military armed forces and many others. Historically, virtual training has been "Computer Based Training (CBT)". The trainee sits in front of a computer monitor and, by using the mouse, interacts with the virtual scene. This level of training is very similar to playing a video game. Today's advanced virtual training immerses the trainee into a full scale virtual scene. The trainee either wears a "Head Mounted Device (HMD)" or is located in a virtual cave. The trainee has full freedom of movement while interacting with the virtual scene's props or assets. Tactical feedback (collision detection), sound and biofeedback can be added to enhance the training experience.

Hydrodynamics and fluid-structure interaction: Complex flow modeling and control

Keynote Speaker: Njuki Mureithi

Njuki Mureithi received his M.Eng in Mechanical Engineering and PhD in Nonlinear Dynamics and Fluid-Structure Interaction in 1988 and 1993, respectively, at McGill University. From 1993-1996, he worked in the Vibration & Noise Control Laboratory of the Takasago R&D Center, Mitsubishi Heavy Industries. He was Visiting Researcher at the University of Tokyo, Japan, from 1996-1997, working in nonlinear dynamics and fluid-structure interaction. From 1997-2002 he was Associate Professor of Mechanical Engineering at Kobe University Japan. Currently he is Professor of Mechanical Engineering and a faculty member of the Institute of Nuclear Engineering at Polytechnique Montreal. He holds the BWC/AECL/NSERC Industrial Research Chair of Fluid-Structure Interaction. The Chair research work is in the area of fluid-structure interaction with particular applications to nuclear and industrial components. He has made significant contributions in two-phase flow induced-vibrations and vibration design of nuclear components. Fundamental research areas of interest include nonlinear dynamics of fluid-structure interactions, low order modelling of complex flows and development of low-order-model-based flow controllers. Other research interests include system identification applied to complex multi-phase flow systems, and machine health monitoring of high speed turbomachinery.

Lecture Abstract

The subject of interest is the nonlinear dynamics of bluff-body-wake – structure interaction and bluff-body-wake control. This fluid-'structure' interaction problem is encountered in numerous fields ranging from offshore structures and nuclear engineering to biological flight.

Advances in nonlinear dynamics have opened the possibility of developing very low dimensional fluid-structure interaction models that could eventually form a basis for complex nonlinear system spatio-temporal controllers. The example problem under consideration is the Karman wake behind a cylinder subjected to transverse. The interaction between the cylinder motion and the wake is a complex feedback phenomenon in which the symmetry relationship between the wake and the cylinder motion play a key role. The present talk will discuss the development of low order dynamical models by employing symmetry group equivariance. The resulting low order 2D models are shown to represent the complex 3D dynamics surprising well for the range of parameters considered. A bifurcation analysis of the resulting system yields a rich set of dynamical behavior, which is confirmed to exist in the physical fluid-structure system.

The talk concludes with a discussion of future developments including implementation of the symmetry-equivariant low order models in the development of nonlinear fluidstructure interation spatio-temporal controllers.

Waveguide Optical Devices & Systems for Information Processing

Keynote Speaker: Vladimir Shandarov

Prof. -Dr. Vladimir Shandarov occupies a professor position at the department of Microwaves and Quantum