Optical Sensing Workshop

From THz to X-ray – Inventing the Future

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Prof. Dr. Lukas Novotny is a Professor of Photonics at ETH. His research focuses on nanophotonics. He is the author of *Principles of Nano-Optics*, the holder of six patents, and a fellow of the Optical Society of America and the American Association for the Advancement of Science.

Welcome and Introduction

Dr. Carolina Medrano

CEO Rainbow Photonics AG, Zürich
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Dr. sc. nat. Carolina Medrano holds a PhD in physics from the National Autonomous University of Mexico UNAM. From 1984 to 1986 she was a post-doctoral fellow at the Universidad Autonoma de Madrid and from 1987 to 1990 an associate professor at the Institute of Physics of the UNAM. In 1990 she joined the Nonlinear Optics Laboratory at ETH-Zurich. She is a co-founder of Rainbow Photonics AG and is in charge of the executive direction.

Advanced THz measurement technology and high-value applications

In the last years there has been a boom in the development of narrow band, broadband, and tunable sources of THz radiation. With THz waves it is possible to investigate molecular vibrations, inspect materials non-destructively, use these waves in security and biomedical applications. A road map of THz instrumentation will be presented.

Prof. Dr. Peter Seitz

Head, Hamamatsu Photonics Innovation Center Europe
Adjunct Professor of Optoelectronics, EPFL
Deputy Managing Director, Innovation and Entrepreneurship Lab (ieLab), ETH
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Prof. Dr. Peter Seitz studied physics at ETH, receiving his PhD from ETH in 1984. He worked for RCA Research Labs, General Electric, PSI, CSEM, the University of Neuchâtel, EPFL and ETH.
He authored 200 publications in the fields of applied optics, semiconductor image sensing, optical metrology and MedTech. He holds 50 patents, and he has won 20 national and international awards. He is a member of the Executive Board of Photonics21, chairing the workgroup on sensing, metrology and security.

Moderator Roundtable Discussion

Dr. Bruno Koller

CEO Scanco Medical AG, Brütisellen ZH
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Dr. Bruno Josef Koller, Dr. sc. techn.

1981 - 1985	Dept. of Electrical Engineering at ETH Zurich, Dipl. El.-Ing.
1986 - 1993	Research at Institute for Biomedical Engineering UNI/ETH Zurich, Dr. Thesis
1993 - 1997	Senior Research Assistant in Computed Tomography Research Group Project LeaderMicrotomographic System
1995 - 1998	General Manager R&D SCANCO Medical AG
1999 -	General Manager SCANCO Medical AG

Dr. Stefan Hämmerle

Dr. Stefan Hämmerle, Dr. sc. techn.

1987 - 1993	Dept. of Electrical Engineering at ETH Zurich, Dipl. El.-Ing.
1993 - 1997	Research at Institute for Biomedical Engineering UNI/ETH Zurich, Dr. Thesis
1997 -	Project Manager SCANCO Medical AG Chief Engineer CT-Systems

Recent developments in X-ray imaging

Although the X-ray imaging field covers from planar X-ray to complex multimodal systems, we focus on the main components and new developments in microtomographic imaging. We cover the currently used x-ray sources and detectors, their geometric setup, and give an outlook on current trends in methods, image analysis and quantification approaches.

Dr. Francesca Venturini

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I received my PhD in physics from the Technical University of Munich, Germany in 2003. From 2003 to 2013 I worked in industrial research and development at Bruker Biospin and at Mettler-Toledo. Since 2013 I am lecturer and researcher in the Applied Optic Group of the Zurich University of Applied Sciences ZHAW. My research interests are optical sensing, focusing on fluorescence and laser absorption spectroscopy.

Progress in NIR spectroscopy and its industrial applications

Tunable Diode Laser Absorption Spectroscopy has proved to be a powerful technique for gas sensing. The relevance of this technique for industrial applications has enabled it to gain a leading position for industrial gas analysers. In this talk the advantages, the current challenges and the future perspectives of this technique will be discussed.

Dr. Andreas Hugi

Co-Founder and Manager IRsweep GmbH, Zürich
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Dr. Andreas Hugi has over 7 years of experience working with and developing broadband Quantum Cascade Laser QCL and QCL-based systems. He worked with broadband external cavity QCLs and demonstrated the first room-temperature comb operation of QCLs in the group of Prof. Jérôme Faist. He was awarded the ETH Zürich medal for an outstanding doctoral thesis. He also had a major involvement in the development of the first QCL based dual-comb spectroscopy setup. While working at Empa, he gained important expertises on QCL sensing systems.
His expertise in QCL type FM-comb design, system design as well as know-how of the industry resulted in him co-founding IRsweep as an ETH Zürich spin-off company in May 2014.

Fast and broadband mid-IR sensing for multi-species detection

The mid-infrared region is emerging as the favorite wavelength band for a number of applications such as high sensitivity trace gas detection, emission monitoring, safety & security applications, process control, and biological sensing applications. An efficient way to get precise and specific information is to employ spectroscopic analysis. The mid-infrared optical spectrum is especially appropriate, since the fundamental roto-vibrational absorption bands of most molecules are within this wavelength range. As of today, the mid-infrared laser market is comparably small with respect to the total laser market. However, the growth rate is almost four times larger as compared to the entire laser market . As such, it is important to focus on this innovative and technologically driven market. The growing importance of the mid-infrared market is also reflected by the strong commitment of leading optical technology companies such as Thorlabs. In the past years, mid-infrared lasers, mid-infrared fibers, as well as mid-infrared sensors have all greatly improved. Room-temperature operation, decreased size, weight, and prices opened up a range of applications that were not possible to realize a few years ago. Exemplary for this are mid-infrared QLS system.
After an initial overview of the mid-infrared market and its applications, we will concentrate on innovative QCL systems which set new standards with respect to sensitivity, selectivity and speed. We will illustrate the importance and the emergence of broadband QLS systems to tackle the most challenging sensing tasks of today. The talk will end with the presentation of the innovative solution IRsweep is bringing to the table ready to tackle the next mid-infrared sensing problems.

Prof. Dr. Jürg Leuthold

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Prof. Dr. Jürg Leuthold was born in 1966 in Switzerland. He has a PhD degree in physics from ETH Zürich for work in the field of integrated optics and all-optical communications. From 1999 to 2004 he has been affiliated with Bell Labs, Lucent Technologies in Holmdel, USA, where he has been performing device and system research with III/V semiconductor and silicon optical bench materials for applications in high-speed telecommunications. From 2004-2013 he was a full Professor at Karlsruhe Institute of Technology KIT, where he headed the Institute of Photonics and Quantum Electronics IPQ and the Helmholtz Institute of Microtechnology IMT. Since March 2013 he is a full Professor at Swiss Federal Institute of Technology ETH.

Jürg Leuthold is a fellow of the Optical Society of America, a fellow of the IEEE. When being a Professor at the KIT he was a member of the the Helmholtz Association Think Tank and a member of the Heidelberg Academy of Science. From 2008 to 2011 he was chairing the Photonics Division of the Optical Society of America OSA and in 2010 he was the general chair of the OSA Optics and Photonics Congress OPC in Karlsruhe. Jürg Leuthold has been and is also serving the community in many technical program committees such as OFC, ECOC, CLEO and many others.

Metamaterial - a technique to make Mid-IR Sources practical

Plasmonics is emerging as a enabling technology in sensing, biophotonics, chemistry or communications. In the field of sensing plasmonics is of interest because plasmons are very prone to changes on a surface. They thus can be used to detect changes on a functionalized surfaces or they can be used to change the properties of an electromagnetic field along the surface. In this talk we will discuss the role of plasmonics with respect to IR gas sensing. We will further discuss a novel plasmonic interferomter solution to detect changes on funtionalized surfaces.