



INSTITUT FÜR
TECHNISCHE OPTIK
UNIVERSITÄT STUTTGART

annual report
2009 / 2010



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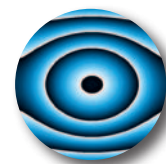
Prof. Dr. W. Osten



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ANNUAL REPORT 2009/2010

FRINGE 2009


The 6th International Workshop on Advanced Optical Metrology

In 1989 the time was hot to create a workshop series dedicated to the discussion of the latest results in the automatic processing of fringe patterns. This idea was promoted by the insight that automatic and high precision phase measurement techniques will play a key role in all future scientific and industrial applications of optical metrology. However, such a workshop must take place in a dynamic environment. Therefore the main topics of the previous events were always adapted to the most interesting subjects of each period. In 1993 new principles of optical shape measurement, setup calibration, phase unwrapping and non-destructive testing were the focus of discussion, while in 1997 new approaches in multi-sensor metrology, active measurement strategies and hybrid processing technologies played a central role. 2001, the first meeting in the 21st century, was dedicated to optical methods for micro-measurements, hybrid measurement technologies and new sensor solutions for industrial inspection. The fifth workshop took place already in Stuttgart and was organized by the staff of ITO. Here the focus was directed to new methods and tools for data processing, resolution enhanced technologies, wide scale 4D optical metrology, hybrid measurement technologies, and new optical sensors and measurement systems. Thus after Berlin 1989, Bremen 1993, 1997 and 2001, Stuttgart was the third Fringe city where international experts met each other to share new ideas and concepts in optical metrology. And this was continued in 2009 where the city Nürtingen, a lovely medieval town nearby Stuttgart, was chosen as conference place.

The focus of the Stuttgart meeting was in particular directed to digital wavefront engineering, resolution enhanced technologies, 3D methods addressing applications from macro to nano considering dynamic changes, sensor fusion and new advances in the unification of modeling, simulation and experiment. Since optical metrology becomes more and more important for industrial inspection, sophisticated sensor systems and their applications for the solution of chal-

lenging measurement problems were chosen again as one of the central topics of the workshop. This extended scope was honored again by a great response on our call for papers. Scientists from all around the world offered more than 150 papers. The presented papers were summarized under 5 topics and published by Springer in a representative proceedings volume [1]:

1. New Methods and Tools for the Generation, Acquisition, Processing, and Evaluation of Data
2. Application Enhanced Technologies
3. 4D Optical Metrology over a Large Scale Range
4. Hybrid Measurement Techniques
5. New Optical Sensors and Measurement Systems

As in the former workshops, each dedicated session was introduced by an acknowledged expert who gave an extensive overview of the subject and a report of the state of the art.

The organizers and the whole audience appreciated the presentations of many internationally recognized scientists such as Mitsuo Takeda, Colin Sheppard, Joseph Rosen, Peter de Groot, Byongho Lee, Gerd Jäger, Ryszard Pryputniewicz, Heidi Ottevere, and Nadya Reingand. Since the early beginning of the Fringe series it has been a good tradition to distinguish deserved scientists with honorary lectures. In 2009 Jim Wyant was awarded with the honorary lecture while Charles Vest, President of the US National Academy of Engineering and former president of the MIT, was selected to present the key note at the banquet. On occasion of the Stuttgart conference the Hans Steinbichler award was presented for the second time by his son Marcus Steinbichler. The winner of the 2009 prize was Michael Küchel, an internationally acknowledged expert in optical interferometry, for his numerous contributions to the field over many years of active scientific

[1] Osten, W.; Kujawinska, M. (Eds.): Fringe 2009. Proc. Of the 6th International Workshop on Advanced Optical Metrology. Springer Heidelberg, Dordrecht, London, New York 2009

work. For all Fringe workshops a special event is the celebration of a new HoloKnight. The former Holoknight, Sir Charles of Washington (Charles Vest) honored Lady Nadya of St. Petersburg (Nadya Reingand) with the sword and the sealed parchment.

The engagement of many people is necessary to make a conference to a successful event in all aspects. Special thanks goes to the international program committee (see Figure 1) that again was a guarantee for a high class scientific meeting, with the special spirit of a workshop where people find time and space for inspiring discussions about such an exciting topic as modern optical metrology is.

Looking forward to FRINGE 2013.



Fig. 1: The program committee of Fringe 2009

ITO celebrated its 50th anniversary

In 1947 the first preparations for the founding of an institute in the field of applied optics at the University of Stuttgart started. Apart from the scientific interest, the main motivation was to support the optical industries in Württemberg and Germany. It took more than 10 years until this institute, ITO, was finally founded in 1960 and, therefore, in 2010 we had the 50th anniversary of ITO.

More than 250 former ITO alumni and friends of ITO celebrated this event at our university. Prof. Osten gave an introductory presentation entitled "Wege zum Licht" where he talked about the importance of light and optical research starting from Genesis and ending with today's latest achievements. An emphasis, of course, was put on the last 50 years of research at ITO.

Prof. Leuchs of the Max Planck Institut für die Physik des Lichts in Erlangen, gave an introduction on quantum engineering in optics.

After the feastful lunch, presentations were given by former Ph.D. Alumni of ITO. Prof. Küchel took over and told about the optical characterization of surfaces. Dr. Dörband (responsible at Carl Zeiss SMT AG for the precision measurement of high-end optical components) reviewed interferometric testing of aspherical surfaces and Dr. Liesener of Zygo, USA completed the interferometry session with a presentation on optical measurement techniques in the semiconductor industry.

The second session was opened by Dr. Totzeck of Carl Zeiss AG. He gave an outlook about the future of optical measurement systems. Dr. Reichelt (SeeReal Technologies) gave a presentation about future 3D display technologies and finally Dr. Windecker from the European Patent Office talked about the role of intellectual property in optics. Finally, the banquet was followed by a social get-together night.



Fig. 1: ITO alumni at the 50th anniversary

Optik-Kolloquium 2009

Photonik im Maschinenbau

am 25. Februar 2009, Teilnehmer: ca. 200

Begrüßung und Einführung	Prof. Dr. W. Osten <i>ITO, Universität Stuttgart</i>
Materialbearbeitung mit High-Brightness-Lasern	Dr. A. Wetzig, Prof. Dr. E. Beyer <i>Fraunhofer IWS, Dresden</i>
Scheibenlaser in der industriellen Materialbearbeitung	Dr. K. Mann <i>TRUMPF Laser GmbH, Schramberg</i>
Innovative Bearbeitungsverfahren und Maschinenkonzepte für reibungsoptimierte Zylinderlaufbahnen	Dr. T. Abeln, G. Flores, T. Birkner <i>Gehring Gmbh, Ostfildern</i>
Zerstörungsfreie Prüfung im Maschinenbau mit photonischen Methoden	Prof. Dr. G. Busse <i>IKT Universität Stuttgart, Stuttgart</i>
New design methods for state-of-the-art lithographic objectives	Dr. F. Bociort <i>Delft University of Technology, Delft, The Netherlands</i>
Interaktion zwischen optischer Verbrennungsdiagnostik und CFD-Simulation in der Daimler Vorentwicklung zur Optimierung verbrauchs- und schadstoffarmer Brennverfahren	Dr. C. Krueger <i>Daimler AG, Stuttgart</i>
Photonik im Verbrennungsmotor: Beobachtung von innermotorischen Detailvorgängen mit Lasermesstechniken	Prof. Dr. T. Dreier, Prof. Dr. C. Schulz <i>IVG Universität Duisburg-Essen, Duisburg</i>
Innovative optische Komponenten für die minimal-invasive Diagnostik in Verbrennungsmotoren	R. Reichle, C. Pruß, Prof. Dr. W. Osten <i>ITO Universität Stuttgart, Stuttgart</i>
Dynamische Formvermessung von rotierenden Objekten mit dem Laser-Doppler-Distanzsensor	Prof. Dr. J. Czarske <i>Universität Dresden, Dresden</i>
Schwingungsmessung mit Licht	Dr. C. Rembe <i>Polytec GmbH, Waldbronn</i>
Vision-basierte Fahrerassistenzsysteme	Prof. Dr. P. Knoll <i>Robert Bosch GmbH, Leonberg</i>
Interferometrische Messung von 3D Innenraumkonturen für den industriellen Einsatz	A. Knüttel <i>ISIS sentronics GmbH, Mannheim</i>

Fest-Kolloquium 2010: 50 Jahre ITO und gleichzeitig 25. Optik-Kolloquium

Photonik im Maschinenbau

am 10. September 2010, Teilnehmer: ca. 350

Begrüßung	Prof. Dr. W. Osten <i>ITO, Universität Stuttgart</i>
Grußwort	Prof. Dr.-Ing. Wolfram Ressel <i>Rektor der Universität Stuttgart</i>
50 Jahre ITO: Wege zum Licht	Prof. Dr. W. Osten <i>ITO, Universität Stuttgart</i>
Quantum Engineering in der Optik	Prof. Dr. Gerd Leuchs <i>Gastredner MPI Physik des Lichts, Erlangen</i>
Optische Vermessung von Präzisionsoberflächen	Prof. Dr. Michael Küchel <i>Oberkochen</i>
Messtechnik für High-End-Optikkomponenten der Lithographie	Dr. Bernd Dörband <i>Carl Zeiss SMT AG, Oberkochen</i>
Hochgenaue Messtechniken für die Halbleiterindustrie	Dr. Jan Liesener <i>ZYGO Corporation, Middlefield, USA</i>
Optische Messtechnik – Perspektiven aus Zeiss-Sicht	Dr. Michael Totzeck <i>Carl Zeiss AG, Oberkochen</i>
Future 3D-Vision	Dr. Stephan Reichelt <i>SeeReal Technologies, Dresden</i>
Die Rolle von Intellectual Property (IP) in der Optik	Dr. Robert Windecker <i>Europäisches Patentamt, München</i>

Optik-Kolloquium 2011

Mikro- und Nanooptik: Design, Herstellung, Prüfung und Anwendung

am 23. Februar 2011, Teilnehmer: ca. 200

Begrüßung und Einführung	Prof. Dr. W. Osten <i>ITO, Universität Stuttgart</i>
Mikrooptik als Schlüsseltechnologie: Von der DUV Lithographie zur Wafer-Level Kamera	Dr. R. Voelkel <i>SUSS MicroOptics SA, Neuchatel, Schweiz</i>
Planar-integrierte Mikrooptik: Entwurf, Fertigung, Anwendungen	Prof. Dr. J. Jahns <i>Lehrgebiet Optische Nachrichtentechnik, FernUniversität Hagen</i>
Fourier-Optik in der Integration: Breitstreifen-Halbleiterlaser mit monolithisch integrierten Fourier-optischen Transversalmodenselektoren	Prof. Dr. H. Fouckhardt <i>AG Integrierte Optoelektronik und Mikrooptik, TU Kaiserslautern</i>
Durchstimbare Mikro- und Nanooptik	Prof. Dr. H. Zappe <i>IMTEK, Labor für Mikrooptik, Universität Freiburg</i>
Adaptive Mikrooptik für Ultrakurzpuls-Laser	Dr. R. Grunwald <i>Max-Born-Institut für Nichtlineare Optik und Kurzzeit-Spektroskopie, Berlin</i>
3D Laser-Lithographie – ein vielseitiges Werkzeug für die Nanotechnologie	Prof. Dr. G. von Freymann <i>AG Optische Technologien und Photonik, TU Kaiserslautern</i>
Perspektiven für die Subwellenlängen-Mikrooptik: Design, Herstellung und Anwendung	Dr. E.-B. Kley <i>Institut für Angewandte Physik, Friedrich-Schiller-Universität Jena</i>
Neue Fertigungstechnologien zur Herstellung diffraktiver Optiken mittels Laser-Lithographie	M. Häfner <i>ITO, Universität Stuttgart</i>
Inspektionskonzepte für die Detektion von Mikro/Nano-Defekten in großflächigen Strukturen	Dr. K. Gastinger <i>SINTEF ICT Optical Measurement Systems and Data Analysis, Trondheim, Norwegen</i>
3D-Metamaterialien	Prof. Dr. H. Giessen <i>4. Physikalisches Institut, Universität Stuttgart</i>
Superlinsen durch Metamaterialien: Visionen und Möglichkeiten	P. Schau <i>ITO, Universität Stuttgart</i>
Aktive Mikrooptik zur orts aufgelösten Steuerung des Polarisationszustandes	F. Schaal <i>ITO, Universität Stuttgart</i>

SCoPE – Opening Ceremony

From basic research in photonics to engineering innovation

In March 2009, the University of Stuttgart established the Stuttgart Research Center of Photonics Engineering (SCoPE), as part of its new research strategy. This is the second major research center founded at the University of Stuttgart.

In close cooperation with the industry SCoPE will strengthen research and development, from basic research on photonics to photonic innovation and interdisciplinary collaboration between physicists and engineers at the University of Stuttgart.

ITO was one of the initiators of SCoPE and together with seven other institutes founded the research center in March 2009. Currently, 11 institutes from two engineering departments (the department of Construction, Industrial Engineering, Automotive Engineering and the department of Informatics, Electrical Engineering and Information Technology), as well as the department of physics collaborate on the SCoPE center. It is planned to integrate other institutes and research facilities in the near future.

Primary scientific objectives in SCoPE's interdisciplinary research are:

- Modelling, simulation, fabrication and characterization of structured photonic components with critical dimensions in the sub-wavelength range
- Integration of photonic components into active optical devices and systems,
- Modelling and technical implementation of photoninduced and photon-based processes and components for photonic machines with special emphasis on process safety in industrial manufacturing.

One of the most important aims of SCoPE is to increase excellence and visibility of the research in photonic technologies at the University of Stuttgart. This is achieved by:

- Improvement of interdisciplinary collaborations between scientists and engineers
- Improvement of the width and coherence of research and education
- Establishment of mid and long term research foci

SCoPE has an interdisciplinary and interfaculty research structure, collaborating with national and international research and industry partners, including Alcatel-Lucent, Bosch, Daimler, Trumpf and Zeiss.

SCoPE was officially founded in November 2009, with wide participation of industry, academia and politics. During the opening ceremony, the structure and mission of





SCoPE were presented, together with the following three keynote speeches:

- Photonic crystal fibres: mastering the flow of light, Prof. Dr. Philip Russell, MPI, Erlangen
- Future Photonic Production – wissenschaftlich-technische und strukturelle Perspektiven eines Schwerpunktes an der RWTH-Aachen, Prof. Dr. R. Poprawe, FhG ILT, Aachen
- Die Graduiertenschule “Karlsruhe School of Optics & Photonics”: Ausbildungskonzepte für die Optischen Technologien, Prof. Dr. U. Lemmer, KSOP Universität Karlsruhe.

SCoPE is not only an interdisciplinary research consortium, but has evolved into a team-oriented interfaculty organization of physicists and engineers.

In addition to the scientific work a beach volleyball tournaments is organized each Year. The most recent took place on July 3rd 2010, when 15 teams from eight institutes played at the university sports facilities. One of the two ITO teams reached the second place in this tournament.

For more information on SCoPE:
www.scope.uni-stuttgart.de



Organized International Conferences: 2009 - 2010

W. Osten, M. Kujawinska, P. Ferraro:

SPIE Europe Optical Metrology Conference 2009

June 15 -18, 2009, Munich, Germany

P. Lehmann, W. Osten:

Optical Measurement Systems for Industrial Inspection VI

SPIE Congress, June 15 – 18, 2009, Munich, Germany

W. Osten, M. Kujawinska:

Fringe 2009

The 6th International Workshop on Advanced Optical Metrology,
September 13 – 18, 2009, Stuttgart, Germany

C. Gorecki, A. Asundi, W. Osten:

Optical Micro- and Nanometrology III

April 13 – 14, 2010, Brussels, Belgium

Z. Füzessy, S. Krüger, W. Osten:

HoloMet 2010

3rd International Workshop on Advanced Imaging and Metrology,
June 13 – 17, 2010, Balatonfüred, Hungary

