

Optical Metrology 2019

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Plan to Participate



Take this opportunity to share your research at SPIE Optical Metrology 2019. Come to Munich to meet with users and researchers to discuss the latest inventions and applications in the field of optical metrology. The symposium will highlight new optical principles and systems for metrology, multimodal sensing, artificial intelligence, and machine vision with applications in industrial design, production engineering, process monitoring, maintenance support, biotechnology, vehicle navigation, multimedia technology, architecture, archaeology, and arts. Special emphasis is directed to model-based, remote and active approaches, sensor fusion, robot guidance, image sequence processing and scene modelling, and biomaterials characterization, as well as to the preservation of our shared cultural heritage.

We invite engineers, scientists, researchers, trustees, and managers to attend this year's meeting.

Co-located with Laser 2019 in Munich, Germany, this symposium will address the role of optics and lasers in the following areas:

- Optical Measurement Systems for Industrial Inspection
- Modeling Aspects in Optical Metrology
- Optical Methods for Inspection, Characterization and Imaging of Biomaterials
- Multimodal Sensing and Artificial Intelligence: Technologies and Applications
- Automated Visual Inspection and Machine Vision
- Optics for Arts, Architecture, and Archaeology

Take advantage of this unique opportunity to hear about the latest solutions to practical problems in industrial design and production engineering. Learn about recent advances in using optical technologies to preserve our shared cultural heritage. Find out about new approaches that push optical principles of measurement and testing at the macro, micro- and nanoscales to the forefront of metrology. Exchange new ideas, address your shared concerns, and get access to information not yet published in the mentioned topical areas. Share your research with other engineers, scientists, researchers, and managers. Presentations will be permanently archived in the SPIE Digital Library, and made available to others in the international scientific community who seek to learn, make discoveries, and innovate.

We invite you to join your colleagues and share the most recent developments and applications at SPIE Optical Metrology 2019.

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Authors are encouraged to include figures and diagrams in a supplemental file to illustrate the concepts outlined in the abstract.

If submitting abstract with figures and graphs in the supplemental file format, please be aware that this submission is optional and needs to be made IN ADDITION to the plain-text only abstract and following the online instructions at the time of submission.

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Optical Measurement Systems for Industrial Inspection XI (OM101)

Conference Chair: **Peter Lehmann**, Univ. Kassel (Germany)

Conference Co-Chairs: **Wolfgang Osten**, Univ. Stuttgart (Germany); **Armando Albertazzi Gonçalves Jr.**, Univ. Federal de Santa Catarina (Brazil)

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The conference addresses optical metrology methods and their application to solve measurement problems in production engineering, process and product monitoring, and industrial design. Respective applications range from the optical inspection of large scale industrial components to the investigation of microsystems and nanostructures using ultraviolet, visible, or infrared wavelengths. Special emphasis shall be put on the implementation of new methods, algorithms and sensor components into higher-level measurement systems. In particular, the design and implementation of powerful and robust optical systems close-to-production as a prerequisite of ongoing digitization is of interest. Furthermore, new approaches related to resolution enhancement and uncertainty reduction of optical measurement systems are in the focus of this conference. Scientific contributions related to one of the following topics are greatly appreciated.

The conference organizers intend to establish a joint session dedicated to the metrology of advanced optical components and systems together with the EOS Conference on Manufacturing and Testing of Optical Components.

GENERAL ITEMS

- optical metrology
- reliable and robust measurement systems
- process integrated and in-process measurement and inspection
- resolution enhancement
- metrology for efficient use of resources
- measurement uncertainty
- features of performance assessment.

METHODOLOGY AND TECHNIQUES

- interferometry
- holographic and speckle techniques
- Moire and structured illumination techniques
- deflectometry
- 3D microscopy
- hyperspectral techniques
- confocal and focus scanning techniques
- coherence scanning, time-of-flight techniques
- light scattering techniques
- diffraction-based analysis

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Optical Measurement Systems for Industrial Inspection XI (OM101 continued)

- reconstruction/retrieval algorithms and approaches
- advanced image and signal processing
- digital image correlation techniques
- fiber and micro-optical sensors
- smart sensors
- multisensor approaches and sensor fusion
- multimodal inspection and measurement techniques.

APPLICATIONS

- micro-, nanostructure, and roughness measurement
- measurement of precision components
- shape measurement/reverse engineering
- nondestructive testing and fault detection
- thickness measurement
- inspection of functional surfaces
- stress and vibration analysis
- inspection of components for renewable energy systems
- inspection of large-scale objects
- inspection of 2d-material (meta-surfaces)
- inspection of scattering surfaces and volumes
- high-speed measurement/high volume production
- remote technologies
- determination of material properties and parameters.

Save the date

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26 February 2019

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27 May 2019 (Conf. OM103 only)

PLEASE NOTE: Submissions imply the intent of at least one author to register, attend the conference, present the paper as scheduled, and submit a manuscript for publication in the conference proceedings.

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Modeling Aspects in Optical Metrology VII (OM102)

Conference Chair: **Bernd Bodermann**, Physikalisch-Technische Bundesanstalt (Germany)

Conference Co-Chairs: **Karsten Frenner**, Institut für Technische Optik (Germany); **Richard M. Silver**, National Institute of Standards and Technology (USA)

Programme Committee: **Markus Bär**, Physikalisch-Technische Bundesanstalt (Germany); **Jörg Bischoff**, Osires Optical Engineering (Germany); **Sven Burger**, Konrad-Zuse-Zentrum für Informationstechnik (Germany); **Peter Evanschitzky**, Fraunhofer-Institut für Integrierte Systeme und Bauelementetechnologie IISB (Germany); **Liwei Fu**, Univ. Stuttgart (Germany); **Wolfgang Holzapfel**, DR. JOHANNES HEIDENHAIN GmbH (Germany); **Rainer Koenig**, PTB (Germany); **Andreas Rathsfeld**, Weierstrass-Institut für Angewandte Analysis und Stochastik (Germany); **Thomas Scherübl**, Carl Zeiss SMS GmbH (Germany); **Irwan D. Setija**, ASML Netherlands B.V. (Netherlands); **Michael Totzeck**, Carl Zeiss AG (Germany); **Jari Turunen**, Univ. of Eastern Finland (Finland)

This conference will focus on essentially any optical metrology, where modelling aspects play a crucial role and accurate modelling is a prerequisite for traceable and comparable measurements. One important topic is the development and verification of methods to describe the interaction of light with matter for quantitative characterization of micro- and nanostructures. The verification of these methods often relies on comparison measurements with independent metrology methods. Improved data analysis is often achieved applying sophisticated hybrid metrology and holistic approaches. Relevant applications include e.g. optical metrology and inspection of nanostructures for semiconductor and nanotechnologies, display production to the investigation of grating structures and grating-based devices. In most of the applications nanometer or sub-nanometer measurement uncertainties are required. Thus, complex and increasingly challenging metrology applications emphasize even more the importance of error modelling for optical systems. Special emphasis shall be placed on the description and modelling of new methods, algorithms, components or complete measurement systems up to the treatment of big data.

The topics will include, but are not limited to:

- optical metrology
- image modelling
- lensless imaging, coherent diffraction imaging
- modelling of sensor response, parametric modelling
- modelling of optical metrology systems
- novel microscopy methods
- super-resolution
- reference metrology
- measurement uncertainty and error modelling in optical systems

- multiprobe characterization
- hybrid metrology
- scatterometry, OCD
- inverse problems in optics
- Maxwell equation solving algorithms
- algorithms for real 3D simulations
- modelling of material properties in optics
- modelling of polarization effects, ellipsometry and Mueller ellipsometry
- optimization for diffractive optical elements
- 3D shape metrology
- placement, registration, alignment and overlay metrology
- modelling for nanomanufacturing and nanolithography
- metrology for multi patterning/exposure and EUV lithography
- modelling of stochastic parameters, objects and interactions
- phase metrology, phase retrieval techniques
- flatness metrology, deflectometry
- high-precision interferometry
- high-precision displacement metrology
- grating characterization and modelling
- optical scattering, SERS and related
- time dependent phenomena, modelling of ultrafast processes
- new materials, metamaterials
- plasmonics for metrological applications
- photonic crystals, photonic devices
- modelling of optomechanical systems (NOMS, MOMS, MOEMS...).

The Conference will organize a joint session together with the CLEO/Europe-EQEC Conference dedicated to modern approaches in computational photonics for metrology.

O3A: Optics for Art, Architecture, and Archaeology VII (OM103)

Conference Chairs: **Haida Liang**, Nottingham Trent Univ. (United Kingdom); **Roger M. Groves**, Technische Univ. Delft (Netherlands)

Conference Co-Chair: **Piotr Targowski**, Nicolaus Copernicus Univ. (Poland)

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The 9th conference on O3A: Optics for Arts, Architecture and Archaeology under the SPIE Optical Metrology symposium series is being held again in Munich at the World of Photonics Congress in June 2019. O3A is an established event for discussing advanced methods and new instruments for the historical study, conservation and documentation of cultural heritage. The symposium is a unique forum focused on optics research in the field of heritage science. Optics applications in cultural heritage has a long and dynamic history owing to the non-destructive nature of optical imaging starting with microscopy, infrared photography and X-radiography. Optical imaging provided the most popular methods of examination for cultural heritage before micro-chemical analysis became possible. In recent years, the development of new imaging and spectroscopic techniques have revitalized the application of optics in cultural heritage. The non-invasive nature of these techniques has meant that whole objects and collections can now be examined with multiple techniques which will inevitably result in unprecedented amount of data collected that will in turn push new boundaries in data and image processing methods. The demand of the upcoming European Research Infrastructure for Heritage Science (www.e-rihs.eu) for new instruments, data processing methods and facilities will no doubt advance the field even further.

The 2019 symposium will cover instruments and techniques that span the entire electromagnetic spectrum covering a broad range of scales along with the associated data and image process-

ing and visualization methods. New instruments and techniques, multi-modal imaging and multi-technique integrated analysis and data fusion techniques that meets the challenges of big data analytics are expected to be the focus.

Contributions are welcome and will be considered in all fields of research for cultural and natural heritage including the following areas of interest:

- 3D topographic scanning, surface examination and analysis (e.g. RTI, structured light and other imaging and triangulation based methods, optical profilometry etc.)
- 3D tomographic imaging, stratigraphic and depth resolved methods (e.g. optical coherence tomography, non-linear microscopy, terahertz imaging, micro-CT etc.)
- structural analysis (e.g. holography and other interferometric techniques)
- imaging and spectroscopy for material analyses (e.g. the various spectral imaging modalities such as reflectance imaging from UV to infrared, fluorescence imaging and fluorescence lifetime imaging, laser induced breakdown spectroscopy, laser induced fluorescence and Raman spectroscopy, synchrotron based techniques etc.)
- remote imaging, sensing and spectroscopy at large stand-off distances including drone based methods
- new portable instruments for in situ applications
- multimodal imaging and multitechnique analysis

- multiscale and multiwavelength imaging for structural and material analysis
- light-matter interactions (e.g. fundamentals of laser interactions with materials, light induced material degradation, including those used for the illumination and excitation in the various techniques)
- advanced image processing methods including artificial intelligence and machine learning method to tackle big data problems
- new methods and applications to cultural heritage research.

The symposium will be an ideal forum to introduce new applications, to exchange ideas and to discuss methods and best practices for optics applied to heritage science. The World of Photonics Congress offers a perfect opportunity for instrumentalists to engage with industry finding out the latest developments in sensor technology and optical components at the accompanying exhibition.

Save the date

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Multimodal Sensing and Artificial Intelligence: Technologies and Applications (OM104) **NEW**

Conference Chair: **Ettore Stella**, CNR (Italy)

The conference will focus on the following topics:

- multi-modal sensing (optical, thermal, etc)
- applications in ranging, recognition
- incorporating artificial intelligence
- applications in automated vehicles and security.

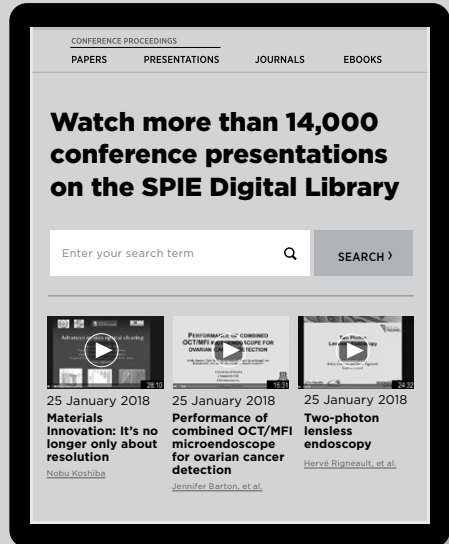
Full call for papers announcement will be available online at www.spie.org/om in mid-October.

Please visit the conference website www.spie.org/om for conference details.

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Optical Methods for Inspection, Characterization, and Imaging of Biomaterials IV (OM105)

Conference Chairs: **Pietro Ferraro**, Institute of Applied Sciences and Intelligent Systems (ISASI-CNR) (Italy); **Simonetta Grilli**, Institute of Applied Sciences and Intelligent Systems (ISASI-CNR) (Italy); **Monika Ritsch-Marte**, Medizinische Univ. Innsbruck (Austria); **Christoph K. Hitzengerger**, Medizinische Univ. Wien (Austria)

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Biocompatible materials (or “Biomaterials”) are substances that are intended to mimic and interact with biological systems. For the safe and reliable function of implants, composition and materials are as important as form. Surfaces may require appropriate coatings or functionalization. Therefore the last two decades have seen strong advancements in biomaterials and related science, with capital investments and research efforts into the development of new products in several fields of applications. Biomaterials science embraces several disciplines such as materials science, tissue engineering, chemistry, biology, and medicine.

When a new material is designed and created or optimized and adopted, application specific characterization is of paramount importance. The need of imaging and metrological tools is very important in defining and measuring properties of the materials from different points of view: morphological properties and their spatio-temporal changes, mechanical properties (stress and strain analysis), surface characterization, reaction to stimulus, degradation, assembling, and many more.

INNOVATIVE ASPECTS

Optical techniques have some advantageous features: they are largely non-invasive, non-contact, possibly have a large field of view and high spatial resolution and very high sensitivity for measuring and evaluating most of physical and material parameters. This gives them a prominent role among

diagnostic tools. The requirements depend on the situation, varying substantially from single cell and tissue engineering to complex biological systems or components. In analogy to what occurred in „Photomechanics“ which furnished many decisive answers in the past 40 years, in a variety of engineering problems (in materials engineering, testing and characterization of components and structures for aerospace, automobile industry, optics and micromechanics industries), optical metrology can provide answers for emerging problems and key issues in biomaterials research.

INTENTION

The intention of this conference is to bring together researchers working in the emerging fields of biomaterials, either at microscopic or at macroscopic scale. The conference will provide a rare platform for detailed exchange between groups working on the development of “biomaterials” and experts in “optical metrology”, in order to promote and stimulate stronger interaction between these topics. We invite experts from very different areas, who are usually not attending the same conferences, and we expect new collaborations to come into being from these encounters. The emphasis of the conference lies on the development of new and smart diagnostic metrological tools of biomaterials, to furnish quantitative data to optimize engineering design, fabrication and characterization of biomaterials.

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Optical Methods for Inspection, Characterization, and Imaging of Biomaterials IV (OM105 continued)

EXPECTED TOPICS AMONG CONTRIBUTIONS INCLUDE:

- characterization of implantable devices and materials
- visualization and evaluation of self-assembly processes at the nanoscale/microscale of biological/polymeric matter
- characterization of biocompatible and/or biodegradable polymers
- biodegradable polymers and their characterization
- mechanical strength, viscoelastic, optical and other properties of bone, cartilage, and other soft tissues
- measurements polymer scaffold characterization for tissue engineering
- single cell mechanics, cell motility, cell adhesion and morphological evolution and correlation to biomechanisms and cell fate
- collagen and other tissue investigation
- optics of the eye and vision correction (i.e. characterization of intraocular lenses)
- materials for dental applications
- diagnostic systems on innovative phase-contrast imaging and optical tomography
- optical micro-manipulation for materials characterization
- study of liquid-solid interfaces by optical/imaging methods
- bioinspired biomimetic and nanobiomaterials
- investigation and characterization of biological nano-diffractive materials/surfaces
- characterization of soft-like biomaterials
- optical method for study fluids at micro and nanoscale.

Contributions are expected but not limited to the following approaches and multimodal methods:

- quantitative phase contrast imaging
- digital differential image contrast imaging
- interference microscopy
- holographic interferometry
- deep learning in microscopy
- SLM-based microscopy
- lensless imaging
- photoacoustic imaging
- ultrasound imaging
- spectroscopy, microscopy, and endoscope optics
- optical absorption, reflection, transmission and scattering techniques
- 3D modeling and profiling
- speckle interferometry and imaging
- optical methods for biomechanics of materials and evaluation of its functionalities
- fluorescence microscopy techniques
- optical coherence tomography and microscopy
- wavefront sensing
- fringe projection accurate shape measurement
- topography and 3D shape measurements.

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Automated Visual Inspection and Machine Vision IV (OM106)

Conference Chairs: **Jürgen Beyerer**, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung IOSB (Germany), Karlsruhe Institut für Technologie (Germany); **Fernando Puente León**, Karlsruhe Institut für Technologie (Germany)

Programme Committee: **Christian Frese**, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); **Andreas Heinrich**, Hochschule Aalen (Germany); **Michael Heizmann**, Karlsruhe Institut für Technologie (Germany); **Bernd Jähne**, Ruprecht-Karls-Univ. Heidelberg (Germany); **Thomas Längle**, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); **Markus Maurer**, VITRONIC Dr.-Ing. Stein Bildverarbeitungssysteme GmbH (Germany); **Wolfgang Osten**, Univ. Stuttgart (Germany); **Felix Salazar**, Univ. Politécnica de Madrid (Spain); **Robert Schmitt**, Fraunhofer-Institut für Produktionstechnologie (Germany); **Hugo Thienpont**, Vrije Univ. Brussel (Belgium); **Stefan Werling**, Duale Hochschule Baden-Württemberg (Germany); **Ernst Wiedenmann**, Serious Enterprises (Germany); **Volker Willert**, Technische Univ. Darmstadt (Germany)

This conference addresses image acquisition and image exploitation topics to solve visual inspection and machine vision tasks automatically. Since elaborated approaches for acquiring images constitute the crucial base to successfully accomplish inspection tasks, particularly illumination, optics, sensors, and the complete acquisition setup composed of these ingredients are within the focus of the conference. Moreover, to extract the inspection-relevant information from images, signal processing and exploitation methods that account for the physical formation of the images are of great interest. As many inspection tasks cannot be solved based on a single image, frequently it is necessary to acquire sequences of images that have to be fused in an adequate manner to draw a final inspection decision. Therefore, the question is not only how to acquire appropriate single images, but how to acquire controlled image series that comprise sufficient information with respect to the inspection task and how such image series can be exploited efficiently.

GENERAL ITEMS

- automated visual inspection
- machine vision
- robust, high performance inspection
- visual quality monitoring and control
- image acquisition and exploitation.

METHODOLOGY

- image data based on diverse optical properties of materials (reflectance, roughness, spectrum, complex refraction index, etc.)
- illumination techniques
- deflectometry

- mathematical models and methods
- image series, image fusion and active vision
- image processing and exploitation methods
- detection and classification
- physically-based image formation models
- pattern recognition
- light field methods
- machine learning for automated visual inspection.

APPLICATIONS

- automated inspection of industrially produced goods
- material recognition and verification
- detection of surface defects
- image-based measurement and control
- inspection of specular surfaces
- safety, security, and biometrics
- medicine and biology
- other application fields.

GENERAL INFORMATION

TECHNICAL PROGRAMME

Available March 2019

The comprehensive Advance Technical Programme for this symposium will list conferences, paper titles, and authors in order of presentation; an outline of all planned special events; and hotel and registration information.

REGISTRATION

Available Online March 2019

All participants, including invited speakers, contributed speakers, session chairs, co-chairs, and committee members, must pay a registration fee.

Fee information for conferences, courses, a registration form, and technical and general information will be available on the SPIE website in March 2019.

HOTEL RESERVATIONS

Hotel Booking information will be available online at the Laser World of Photonics 2019 website.

VISA INFORMATION

Attendees from certain countries may not require a visa to enter Germany. For more details, please visit our information page: spie.org/om-visa or the website of the German Foreign Office, which will list the point of information within your country.

LETTERS OF INVITATION

FOR CONFERENCE CHAIRS, TECHNICAL COMMITTEE MEMBERS, AND AUTHORS: If you are listed as an author on a paper, or as a participant in the programme, and you require an Official Invitation Letter for visa application purposes, please look for the instructions published at the Optical Metrology Website www.spie.org/om following the Optical Metrology 2019 acceptance notifications on 26 February 2019.

NOTE: We recommend that you secure your travel visa before registering for the conference as cancellations after the preregistration cutoff may result in a cancellation fee.

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