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Senaatszaal, TU Delft

08:30 - 08:35 **OPENING BY THE CHAIRS**

Jani Tervo, University of Eastern Finland (FI)
Paul Urbach, Delft University of Technology (NL)

08:35 - 09:20 **PLENARY TALK**

3D photonic metamaterials by diffraction-unlimited laser lithography

J. Fischer, T. Ergin, M. Wegener; Institut für Angewandte Physik, Institut für Nanotechnologie, and DFG-Center for Functional Nanostructures (CFN) Karlsruhe Institute of Technology (KIT) (DE).
We review our recent efforts towards diffraction-unlimited far-field optical lithography based on stimulated-emission-depletion (STED) inspired direct laser writing (DLW). This has, for example, enabled the first three-dimensional polarization-independent visible-frequency invisibility cloak (for the light amplitude and phase). [4881].....Pg 1

09:20 - 10:20
SESSION I
Chair: Paul Urbach, Delft University of Technology (NL)

09:20 - 09:40 STUDENT PRESENTATION
Time-domian measurement of diffraction phenomena
P. Piksarv[1], M. Lähmus[1], H. Valtna-Lukner[1], B. Bowlan[2], R. Trebino[2], P. Saari[1,3]; [1]Institute of Physics, University of Tartu (EE); [2]School of Physics, Georgia Institute of Technology (US); [3]Estonian Academy of Sciences (EE).
Employing the SEA TADPOLE measurement technique, we directly measure the spatio-temporal field of ultrashort pulses after diffracting off simple apertures and pulsed Bessel beams generated by circularly symmetric diffraction gratings. Our measurements beautifully confirm the time-domain treatment of diffraction. [4871].....Pg 3

09:40 - 10:00
Investigating Phase Talbot Image of Wavelength-Scale Period Amplitude Grating
M.-S. Kim[1], T. Scharf[1], H.P. Herzig[1], C. Menzel[2], C. Rockstuhl[2]; [1]Ecole Polytechnique Fédérale de Lausanne (EPFL), Optics & Photonics Technology Laboratory (CH); [2]Friedrich-Schiller-Universität Jena, Institute of Condensed Matter Theory and Solid State Optics (DE).
We interferometrically measure the Talbot length of amplitude gratings with periods comparable to the wavelength. By recording phase images in real-space with superresolution, the Talbot length can be determined with an unprecedented precision. Rigorous simulations verify all experiments. The measurements allow us to access the predictive strength of analytical expressions for the Talbot lengths and show that these expressions maintain their accuracy well beyond the limits usually anticipated. [4827].....Pg 5

10:00 - 10:20
Stokes imaging polarimetry with a single-pixel detector
V. Durán[1,2], P. Clemente[1,3], M. Fernández[1,2], E. Tajahuerce[1,2], J. Lancis[1,2], P. Andrés[4]; [1]Institut de Noves Tecnologies de la Imatge (INIT), Universitat Jaume I (ES); [2]GROC - UJI, Departament de Física, Universitat Jaume I (ES); [3]Servei Central d'Instrumentació Científica, Universitat Jaume I (ES); [4]Departamento de Óptica, Universitat de València (ES).
We present an optical system that performs spatially resolved measurements of the Stokes parameters of light with a single-pixel detector. This fact is possible by applying the theory of compressive sampling. Experimental results are presented for an object that provides an inhomogeneous polarization distribution. [4903]..... Pg 7

10:20 - 10:50 Coffee break

10:50 - 12:10
SESSION II
Chair: Lifeng Li, Tsingua University (CN)

10:50 - 11:10 STUDENT PRESENTATION
Design of a circular wire grid grating to generate radially polarized light in the near UV region
K. Ushakova, S.F. Pereira, H.P. Urbach; Delft University of Technology, Faculty of Applied Sciences, Department of Imaging Science & Technology, Optics Research Group (NL).
Formation of a high quality radially polarized light in the near UV wavelength region (405 nm, 365 nm, 193 nm) using thin metal film diaphragm compound of sub wavelength concentric nanoslit grooves is inspected by using subsequently models of ideal metal-insulator-metal waveguide, 1D grating and 3D diaphragm configuration. [4862].....Pg 9

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11:10 - 11:30
Phase retardation in diffracted light
K. Ventola[1], J. Tervo[1], S. Siitonen[2], M. Kuittinen[1]; [1]University of Eastern Finland, Dep. of Physics and Mathematics (FI); [2]Nanocomp Ltd (FI).
Phase retardation occuring in non-zeroth diffraction orders of 3-D dielectric gratings is studied numerically and experimentally. An element producing half-waveplate effect in -2nd reflected order is presented.[4879] .....Pg 11

11:30 - 11:50
Security diffractive elements – Nanogravure of 2nd kind
L. Kotačka, P. Vízdal, T. Běhounek; Optaglio s.r.o. (CZ).
The paper summarizes recent development on the synthesized holographic and diffractive security elements. Such security devices are recorded by means of the electron beam lithography with the resolution 2,500.000 dpi, thus with particular resolution of the beam spot 10 nm. This allows to originate very unique devices serving for anti-counterfeit measures, where some special and/or rudimentary diffractive features are synthetically introduced to other security diffractive elements. Such security holograms are reflecting the highest requirements for protection of governmental documents and banknotes. [4880].....Pg 13

11:50 - 12:10
Improved resolution for soft x-ray spectroscopy: single-order operation of lamellar multilayer gratings
R. van der Meer[1], I.V. Kozhevnikov[2], B. Krishnan[1], J. Huskens[1], M.J. de Boer[1], B. Vratzov[3], P.E. Hegeman[4], G.C.S. Brons[4], H.M.J. Bastiaens[1], K.-J. Boller[1],F. Bijkerk[1,5]; [1]MESA+ Institute for Nanotechnology, University of Twente (NL); [2]Institute of Crystallography, Russian Academy of Sciences (RU); [3]NT&D - Nanotechnology and Devices (DE); [4]PANalytical (NL); [5]FOM-Institute Rijnhuizen (NL).
Spectral resolution improvements of nearly a factor four using Lamellar Multilayer Gratings in the soft x-ray range are reported. The design is based on single-order operation, in which the incident beam effectively only excites a single diffraction order. Measured bandwidths are in good agreement with the theoretical model. [4878].....Pg 15

12:10 - 14:00 Lunch break

14:00 - 15:50
SESSION III
Chair: Martin Wegener, Karlsruhe Institute of Technology (DE)

Invited talk

14:00 - 14:30
Wave propagation, diffraction, and focusing in uniaxially and biaxially anisotropic media
J.J. Stamnes; Department of Physics and Technology, University of Bergen (NO).
In many applications, such as wave plates, resonators, electro-optic modulators, polarizers, and thin-film couplers, it is important to have an accurate description of the propagation of electromagnetic beams in anisotropic media. Therefore, considerable attention has been devoted to these issues in the past. [4883].....Pg 17

14:30 - 14:50
Fourier-space filtering in classical ghost imaging and diffraction
T. Shirai[1], H. Kellock[2], T. Setälä[2], A.T. Friberg[2,3,4]; [1]Electronics and Photonics Research Institute, National Institute of Advanced Industrial Science and Technology (AIST) (JP); [2]Department of Applied Physics, Aalto University (FI); [3]Department of Physics and Mathematics, University of Eastern Finland (FI); [4]Department of Microelectronics and Applied Physics, Royal Institute of Technology (KTH) (SE).
We show that introduction of a spatial filter into the reference arm of the conventional classical ghost-imaging setup allows for imaging of phase objects, while a spatial filter in the conventional classical ghost-diffraction arrangement enables imaging through phase aberrations, whether deterministic or random. [4950].....Pg 19

14:50 - 15:10
A generalization of the van Cittert-Zernike theorem and the interconnection between the temporal- and spatial longitudinaltransverse degrees of partial coherence
B.J. Hoenders[1], Y. Cai[2], Y. Dong[2]; [1]University of Groningen, Center for Theoretical Physics and Zernike Institute for Advanced Materials (NL); [2]School of Physical Sciences and Technology, Soochow University (CN).
A generalization of the Zernike-van Cittert theorem is used to analyse the interdependence between the temporal- longitudinal- and transverse spatial coherence. We use a model which assumes that the mutual coherence function is spatial incoherent at a planar surface and that the temporal coherence is not only quasi monochromatic (as in the Zernike-van Cittert case), but contains temporal correlation terms as well. [4907].....Pg 21

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15:10 - 15:30

Spatial correlation for propagated fields and the phase problem

O. El Gawhary[1,2], A. Wiegmann[3], N. Kumar[1], S.F. Pereira[1], H.P. Urbach[1]; [1]Optics Research Group, Delft University of Technology (NL); [2]Dutch Metrology Institute (VSL) (NL); [3]Physikalisch-Technische Bundesanstalt (PTB) (DE).

Measuring the phase of an optical field it is known to be not an easy task. In fact, any common detector shows integration times much longer than the typical period of an electromagnetic field in the visible. Although there are methods that allow to turn the phase information into intensity one, such as interferometry, often specific applications require solutions easier from an implementation point of view. In optics, retrieving the phase of a field has important implications in microscopy as well as in the analysis of the performances of an optical system, as, for instance, in the measurement of its aberrations. [4956]..... Pg 23

15:30 - 15:50

Resist based aberration metrology using Phase-Shift Gratings

S. van Haver[1], W. Coene[1], P. van Adrichem[2], L. de Winter[3]; [1]ASML, TE RES Research SMC (NL); [2]ASML, TE SE Focus (NL); [3]ASML, DE EUV ISQ Reticles&Imaging (NL).

We propose a method to reconstruct the aberrations of a lithographic system through wafer overlay metrology. We designed new 1D and 2D phase-shift gratings (PSG's) that translate a phase difference of two diffracted beams into an overlay error of the resulting resist pattern. The combined information of the lateral image position for many of our new 1D and 2D PSG's allows for reconstruction of the aberration function of the optical imaging system of the scanner. [4947] Pg 24

15:50 - 16:20 Coffee break

16:20 - 18:00

SESSION IV

Chair: Jani Tervo, University of Joensuu (FI)

16:20 - 16:40

High-NA diffractive array illuminators

S. Stallinga; Quantitative Imaging Group, Department of Imaging Science and Technology, Delft University of Technology (NL).

Binary phase diffractive array illuminators are studied, which can produce large area arrays of high-NA spots. These array illuminators may serve as key component in costeffective imaging systems. [4932].....Pg 26

16:40 - 17:00 STUDENT PRESENTATION

Planar Diffractive Diffuser

V. Zagolla, C. Moser; EPFL, LAPD (CH).

We aim to investigate the use of a novel Red, Green, Blue sensitive holographic photopolymer for creating diffracting structures providing diffuse illumination and light trapping over the whole visible spectrum, targeting an increase of light absorption in polymer/dye-sensitized solar cells. [4860].....Pg 28

17:00 - 17:20

Diffractive optics for lighting applications

H.J. Cornelissen[1], C. Ho[2], N. Haj-Hosseini[2]; [1]Philips Research, Optics Department (NL); [2]Delft University, Optics Research (NL).

Sub-micron diffraction gratings have been used for two illumination application. One is to create a transparent see-through luminaire which can be used to illuminate and read a paper document. A second is a light sensor that can be used in a feedback loop to control a multicolor LED lamp. Optical design and prototypes are presented. [4976].....Pg 30

17:20 - 17:40

Optical design with smooth and diffractive optical surfaces by generalized ray tracing

M.A. Golub; Tel Aviv University, Department of Electrical Engineering (IL).

A generalized ray tracing method based on calculation of local wavefront curvatures was developed. Sequentially cascaded curved refractive optical surfaces with nonsymmetrical diffractive phase functions can now be designed with nearly the same simplicity as customary in paraxial optics of thin lenses and Fourier optics. [4940].....Pg 31

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17:40 - 18:00 STUDENT PRESENTATION

Exact simulation of the diffraction of large, high-NA DOE-sections with O(NlogN) time and memory resort

A.V. Tishchenko[1], A.A. Shcherbakov[2]; [1]University of Lyon, Lab. H. Curien UMR CNRS 5516 (FR); [2]Moscow Institute of Physics and Technology (RU).

A major jump in the capacity of exactly solving 3D diffraction problems in microoptics is achieved by a unique chain of mathematical steps permitting to avoid any matrix inversion. This powerful new method exhibiting a linear CPU time dependence on the number of considered diffraction orders enables the instant simulation of 2D high-NA DOE-sections large enough for an exact and meaningful representation/optimization of the optical function of the complete element under arbitrary incidence conditions. [4858].....Pg 33

18:00 - 20:00 Welcome reception - sponsored by TNO

Venue: Atrium at TNO
(adjacent building to the TU Delft),
Stieltjesweg 1

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08:30 - 09:40
SESSION V
Chair: Ari T. Friberg, University of Eastern Finland, Aalto University (FI) & Royal Institute of Technology (KTH) (SE)

NOTES

08:30 - 09:00 Invited talk
Scattering Lenses
E.G. van Putten[1], D. Akbulut[1], J. Bertolotti[1,2], W.L. Vos[1], A. Lagendijk[1,3], A.P. Mosk[1]; [1]Complex Photonic Systems, Faculty of Science and Technology and MESA+ Institute for Nanotechnology, University of Twente (NL); [2]Dipartimento di Fisica, University of Florence (IT); [3]FOM Institute for Atomic and Molecular Physics (AMOLF) (NL).
Scattering of light by random collections of particles or surface roughness can be used to increase the resolution of imaging systems. We demonstrate 100-nm resolution focusing of light by scattering in a high-index material. [4875].....Pg 35

09:00 - 09:20
Compensation of spatio-temporal light spreading in second harmonic generation with diffractive optical elements
R. Martínez-Cuenca[1], J. Pérez-Vizcaino[1], O. Mendoza-Yero[1], B. Alonso[2], Í.J. Sola[2], G. Mínguez-Vega[1], J. Lancis[1], P. Andrés[3]; [1]GROC•UJI, Institut de Noves Tecnologies de la Imatge (ES); [2]Dept. de Física Aplicada, Universidad de Salamanca (ES); [3]Dept. de Óptica, Universitat de València (ES).
We propose a technique for one-shot generation of arbitrary second harmonic (SH) patterns based on diffractive optical elements (DOEs) and ultrafast pulses. We show that for pulse durations fewer than 100 fs spatio-temporal shaping is mandatory to overcome dispersive effects that spread irradiance patterns both in space and time. [4904].....Pg 37

09:20 - 09:40 STUDENT PRESENTATION
Glass Metal Nanocomposites Based Diffraction Gratings
M.I. Petrov[1], Y.P. Svirko[1], A.A. Lipovskii[2], O.V. Shustova[2]; [1]University of Eastern Finland (FI); [2]St.-Petersburg State Polytechnical University (RU).
In this work we investigate the implementation of glasses with embedded metal nanoparticles for diffraction gratings fabrication. Spectral properties of diffraction strongly depend on nanocomposite parameters such as filling factor and nanoparticle diameter. Fabrication technics of nanocomposites based gratings are also discussed. [4938].....Pg 39

09:40 - 10:10 Coffee break

10:10 - 11:50
SESSION VI
Chair: Zbigniew Jaroszewicz, Institute of Applied Optics (PL)

10:10 - 10:30
Diffractive optical elements for testing cylindrical surfaces
A.G. Poleshchuk[1], R.K. Nasyrov[1], J.-M. Asfour[2]; [1]Institute of Automation & Electrometry SB RAS (RU); [2]Dioptic GmbH (DE).
Different types of DOEs and optical test layouts for testing cylinder surfaces have been developed, investigated and experimentally approved. Results for design and fabrication of holograms for cylindrical mirrors testing are presented. [4916].....Pg 41

10:30 - 10:50
Towards absolute interferometry for the testing of freeform surfaces
C. Pruss, S. Peterhänsel, F. Schaal, W. Osten; Universität Stuttgart, Institut für Technische Optik (DE).
One of the most accurate methods to test steep high-precision freeform surfaces in an interferometer is the well established null test using computer generated holograms (CGH). In this contribution we discuss error sources and ways for their separation from the errors of the surface under test. [4945].....Pg 43

10:50 - 11:10 STUDENT PRESENTATION
Semiconductor metrology with inverse diffraction approach "Coherent Fourier Scatterometry"
N. Kumar[1], O.El. Gawhary[1], S.F. Pereira[1], W. Coene[2], H.P. Urbach[1]; [1]Delft University of Technology(NL); [2]A.S.M.L BV (NL).
A new approach for optical far field analysis and its implementation is presented here. Under suitable conditions, using focused beam from a spatially coherent light source can increase the accuracy of the optical Scatterometry technique. [4900].....Pg 45

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11:10 - 11:30

Analysis of Scanning and Polarization Effects in Coherent Fourier Scatterometry

S. Roy, O. El Gawhary, S.F. Pereira, H.P. Urbach; Optics Research Group, Department of Imaging Science and Technology, Delft Institute of Technology (NL).

Coherent Fourier Scatterometry (CFS) is a promising candidate for high accuracy nano-metrology as this method offers accuracy, convenience of measurement and fast processing time simultaneously. In this paper we show that the use of coherence and multiple scanning makes CFS more sensitive than incoherent scatterometry and how an optimum number of scanning positions can be predicted for a specific case. The sensitivity of the method can be further increased by making the incident and measured fields cross- polarized. [4893].....Pg 47

11:30 - 11:50 STUDENT PRESENTATION

Hyperchromatic Confocal Sensor Systems

M. Hillenbrand, C. Wenzel, X. Ma, P. Feßer, S. Sinzinger; TU Ilmenau, IMN MacroNano® (DE).

We discuss the potential and challenges of diffractive and hybrid systems for hyperchromatic sensor applications. Design, fabrication, and characterization of chromatic confocal sensors for innovative distance and wall thickness measurement systems are presented. [4847]..... Pg 49

11:50 - 13:40 Lunch break

13:40 - 15:30

SESSION VII

Chair: Benfeng Bai, Tsinghua University (CN) & University of Eastern Finland (FI)

13:40 - 14:10 Invited talk

Perfect blazing for echelle gratings in Littrow mount

B.H. Kleemann; Carl Zeiss AG, Corporate Research and Technology (DE).

Perfect blazing for echelle gratings in Littrow mount really exists, even simultaneously in TE and TM polarization. Then no directed stray light from other diffraction orders occurs. In the ideal case of infinite conductivity, 100% efficiency is diffracted into the Littrow order. For real metal gratings, a small loss occurs. [4835].....Pg 51

14:10 - 14:30

Electromagnetic edge singularity and Rayleigh expansion

L. Li; Tsinghua University, Department of Precision Instruments (CN).

When irregular electric field singularity at the edge of a wedge composed of lossless metal and dielectric media is excited, all grating modeling methods that use Rayleigh expansion do not converge. This work generalizes a recent work to cases of an arbitrary wedge angle. Apparent conflict with Rayleigh expansion is also discussed. [4922].....Pg 53

14:30 - 14:50

Recent progress in numerical modeling of gratings. Should we abandon the MMFE?

G. Granet; Clermont Université, Université Blaise Pascal, Lasmea (FR) & Cnrs, UMR 6602, Lasmea (FR).

We report on significant improvements of various numerical methods for diffraction gratings. [4914].....Pg 55

14:50 - 15:10

Complex eigenvalues of Helmholtz equation in the absence of absorption

R.H. Morf; Paul Scherrer Institute (CH).

We consider one-dimensioal lamellar diffraction gratings consisting of ideal metals, i.e. metals without absorption. Such conditions occur for metallic silver at optical wavelength in the visible range around 600nm, where the dielectric constant $\varepsilon \approx -13$ with a small imaginary part of about 0.9. We thus study the idealized case, where we neglect the small imaginary part of the dielectric constant and study the case of non-absorbing ideal metals. [4970].....N/A

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15:10 - 15:30 STUDENT PRESENTATION

RMCA: an alternative algorithm for the fast computation of 2D gratings

B. Portier[1], F. Pardo[2], Riad Haïdar[1,3], J.-L. Pelouard[2]; [1]ONERA – The French Aerospace Lab (FR); [2]Laboratoire de Photonique et de Nanostructures (LPN-CNRS) (FR); [3]Ecole Polytechnique (FR).

Calculation speed is often an issue when simulating optical properties of complex nanostructures, such as 2D lamellar gratings. Here, we present a new modal method which enables fast computation of these properties without loss of precision. The Rigorous Maxwell with Constitutive Approximation (RMCA) is based on the exact discrete formulation of the Maxwell equations, in which we introduce polynomial approximations of the constitutive equations to obtain the eigenproblem equation in each layer. The use of sparse matrices enables us to significantly enhance the calculation speed by calculating only a short number of eigenmodes, and numerical results on published examples show that we can have the same precision as with the RCWA method in less time. [4928].....Pg 57

15:30 - 16:00 Coffee break

16:00 - 17:40

SESSION VIII

Chair: Pierre Chavel, Centre National de la Recherche Scientifique (FR)

16:00 - 16:20

Molding of Diffractive Glass Lenses

D. Hollstegge, B. Bulla, M. Hünten, O. Dambon, F. Klocke; Fraunhofer Institute for Production Technology (DE).

The trend towards miniaturization and functional integration of optical systems and components is also reflected in the increased demand for structured glass optics. Precision glass molding can be used to produce full glass diffractive optics, especially hybrid lenses such as asphero-diffractive lenses. [4944].....Pg 59

16:20 - 16:40 STUDENT PRESENTATION

Nearly temperature independent waveguide gratings

M.R. Saleem[1,3], M.B. Khan[3], S. Honkanen[1,2], J. Turunen[1]; [1]University of Eastern Finland, Department of Physics and Mathematics (FI); [2]Aalto University, Department of Micro and Nanosciences (FI); [3]National University of Science and Technology, School of Chemical and Materials Engineering (PK).

We investigated nearly athermalized organic-inorganic devices as athermal guided mode resonance filters GMRFs. The spectral reflectance efficiency is observed to be nearly independent on temperature over tens of degrees above room temperature. Two important factors are considered for the shift in the resonance peak; mainly thermal expansion TEC and thermo-optic TOC coefficients of the selected materials. [4887].....Pg 61

16:40 - 17:00

Advanced matrix laser lithography for fabrication of photonic micro-structures

M. Škereň, J. Svoboda, P. Fiala; Czech Technical University in Prague, Faculty of Nuclear Sciences and Physical Engineering, Department of Physical Electronics (CZ).

The laser lithography technique is presented, which enables to fabricate large area periodic and aperiodic micro-structures for various photonic applications. The device based on imaging the micro-structure from a computer driven spatial light modulator is presented together with experimental demonstration of fabricated structures. [4925].....Pg 63

17:00 - 17:20

Self-organisation of Nematic Gold Nanoparticles in Periodic Polymeric Structures

R. Caputo[1], B.J. Tang[2], L. De Sio[1], G.H. Mehl[2], C. Umeton[1]; [1]University of Calabria, LICRYL (Liquid Crystals Laboratory, IPCF-CNR), Center of Excellence (CEMIF.CAL) and Department of Physics (IT); [2]University of Hull, Department of Chemistry (GB).

We report on the self-organisation of Nematic Gold nanoparticles in host liquid crystal phases. Experiments show that these particles have a very good miscibility with several liquid crystal phases (nematics, cholesterics and smectics). Periodic channelled structures allowed checking the liquid crystalline behaviour of obtained materials. [4911].....Pg 65

17:20 - 17:40

Stitchingless grating at the wall of a cylinder by single-shot radial phasemask exposure

S. Tonchev[1], Y. Jourlin[1], C. Veillas[1], O. Parriaux[1], J. Laukkanen[2], M. Kuittinen[2]; [1]University of Lyon, Lab. H. Curien UMR CNRS 5516 (FR); [2]University of Eastern Finland, Physics and Maths Dept (FI).

A periodic grating with integer number of periods is fabricated at the resist-coated wall of a cylinder by exposing a radial phasemask grating to an axial, radially polarized exposure beam. The created interferogram performs a projection of the planar 2D-space of the high spatial coherence e-beam phasemask onto a cylindrical surface in the 3Dspace. [4855].....Pg 67

18:00 - 19:30 Poster session in the foyer

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08:30 - 10:00
SESSION IX
Chair: Kimio Tatsuno, OITDA / Hitachi Ltd. (JP)

08:30 - 09:00 Invited talk

All optical switchable diffraction gratings realized in liquid crystalline composite structure with metamaterial applications

C. Umeton[1], L. De Sio[1], R. Caputo[1], S. Serak[2], N. Tabiryan[2]; [1]LICRYL (Liquid Crystals Laboratory, IPCF-CNR) Center of Excellence CEMIF.CAL, Department of Physics, University of Calabria (IT); [2]Beam Engineering for Advanced Measurements Company Winter Park (US).

We report on the fabrication and all optical characterization of two different kinds of switchable diffraction gratings containing light responsive Liquid Crystals. We foresee that, when doped with gold nanoparticles, these structures can be exploited to obtain the tuning of "active" plasmonic responses, to be used for metamaterial applications. [4901].....Pg 69

09:00 - 09:20

Polarization-selective extraordinary transmission in inductive and capacitive goldnanogrids

B. Bai[1,2], X. Li[1], I. Vartiainen[2], J. Laukkanen[2], A. Lehmuskero[2], J. Turunen[2]; [1]State Key Laboratory of Precision Measurement Technology and Instruments, Department of Precision Instruments, Tsinghua University (CN); [2]University of Eastern Finland, Department of Physics and Mathematics (FI).

We report both theoretically and experimentally that properly designed inductive and capacitive gold nanogrids can exhibit a polarization-selective enhanced-suppressed transmission effect. Exceptionally, in a sparse array of gold nanoparticle chains, an anomalous polarization-dependent resonant suppressed transmission is discovered. The physical mechanisms of these effects are revealed and thoroughly studied and potential applications, such as novel-type compact polarizing filters, ultrasensitive biosensors, and enhanced nonlinear nanostructured devices, are suggested. [4889].....Pg 71

09:20 - 09:40 STUDENT PRESENTATION

Fabrication of Terahertz Wire-Grid Polarizers

A. Partanen[1], J. Väyrynen[2], S. Hassinen[2], H. Tuovinen[1], J. Mutanen[1], T. Itkonen[1], P. Silfsten[1], P. Pääkkönen[1], M. Kuittinen[1], K. Mönkkönen[2], T. Venäläinen[3]; [1]University of Eastern Finland, Department of Physics and Mathematics (FI); [2]North Karelia University of Applied Sciences (FI); [3]University of Eastern Finland, Department of Chemistry (FI).

This study shows fabrication of wire-grid grating polarizers for THz region in two ways: by ultra precision diamond machining and by silicon wet etching. The pattern is then transterred to COC and TPX by hot embossing. Aluminum is evaporated on top of the plastic to form the grid. Polarizers were tested with FTIR-spectrophotometer. [4849].....Pg 73

09:40 - 10:00

TE/TM phase matching for the shallowest half-wave 0th order transmission grating

T. Kaempfe[1], S. Tonchev[1], R. Torrez[2], J. Lopez[2], O. Parriaux[1]; [1]Univ. of Lyon, Lab. H. Curien UMR CNRS 5516 (FR); [2]ALPhANOV (FR).

The TE and TM round trip phases in a high index contrast subwavelength binary grating are set to the smallest possible integer numbers of 2π and their straight-through phase difference to π by tailoring the reflection and transmission phases at the boundaries of a relatively large period grating for obtaining a half-wave element of close to unity transmission. This TE/TM phase matching principle is applied to linear to radial/azimuthal polarization transformation in the 1030-1064 nm wavelength range with solar cell amorphous silicon as the grating layer material. [4859].....Pg 75

10:00 - 10:30 Coffee break

10:30 - 12:10
SESSION X
Chair: Silvania Pereira, Delft University of Technology (NL)

10:30 - 10:50 STUDENT PRESENTATION

Surface-relief gratings for solar and lighting applications

T.M. de Jong[1], D.K.G. de Boer[2], C.W.M. Bastiaansen[1,3]; [1]Eindhoven University of Technology, Functional Organic Materials & Devices (NL); [2]Philips Research Europe (NL); [3]Queen Mary University of London, Department of Materials (GB).

Surface-relief gratings with sub-wavelength periods can be used to diffract light into or out of a light guide. We show that efficient in- and out-coupling occurs for specific regions in the space of incident angles and discuss how this can be used to design compact solar concentrators and lighting systems. [4908].....Pg 77

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10:50 - 11:10 STUDENT PRESENTATION

Metallic nanostructures prepared by nanoimprint lithography for application in solar cells

S. Jüchter[1], H. Hauser[1], Ch. Wellens[1], M. Peters[1], J.C. Goldschmidt[1], U.T. Schwarz[2], B. Bläsi[1]; [1]Fraunhofer Institute for Solar Energy Systems ISE (DE); [2]Fraunhofer Institute for Applied Solid State Physics IAF (DE).

In this study we present first results concerning the advantage of using plasmonic effects in metallic nanostructures for improved photon management in solar cells. [4864].....Pg 79

11:10 - 11:30

Light scattering of superparamagnetic nanoparticles for biosensing applications

J. Schleipen[1], A. Ranzoni[1], J. van Kemenade[1], M. Prins[1], V. Schmidt[2], T. Wriedt[2]; [1]Philips Research Eindhoven (NL); [2]University of Bremen (DE).

Biomedical research delivers detailed knowledge about how specific molecules relate to human health and disease. Such specific molecules are called biomarkers when they can be used for diagnostic purposes. For example, the presence of certain protein biomarkers in blood indicates the onset of a heart attack. To enable wide-spread application of biomarker testing, biosensor systems are needed which can easily be used by doctors and patients. The requirements for these point-of-care biosensors are challenging: the systems need to be highly sensitive, reliable, cost-effective, rapid, and very easy to use. [4977].....Pg 81

11:30 - 11:50 STUDENT PRESENTATION

Enhancing the accuracy of a Hartmann Wavefront Sensor by retrieving the sub-aperture phase distribution

A. Polo, F. Bociort, S.F. Pereira, H.P. Urbach; Delft University of Technology, Department of Imaging Science and Technology, Optics Research Group (NL).

A phase retrieval algorithm is applied to the intensity pattern of a Hartmann wavefront sensor to retrieve the phase distribution inside the sub-aperture of a Hartmann hole array. This procedure permits to obtain a rms wavefront reconstruction error one order of magnitude smaller than the one obtained with a typical centroid algorithm. [4884].....Pg 82

11:50 - 12:10

Novel Fabrication Method of Computational Rainbow Holograms

S. Mader[1,2], T. Kozacki[1], H. Walter[2]; [1]Warsaw University of Technology (PL); [2]OVD Kinegram AG, Optical Technology (CH).

White-light reconstruction of conventional computational rainbow holograms is limited by the hologram's spatial resolution. A novel method is proposed, theoretically analyzed, and experimentally demonstrated to overcome the reconstruction limitations of computational rainbow holograms of objects at intermediate distances. [4927].....Pg 84

12:10 - 14:00 Lunch break

14:00 - 15:50

SESSION XI

Chair: Cesare Umeton, Università della Calabria (IT)

14:00 - 14:30 Invited talk

Theory, experiment, and applications of photonic resonance effects in nanopatterned films-A review

R. Magnusson[1,2], K.J. Lee[1], J. Yoon[1], D. Wawro[2], S. Zimmerman[2], W. Wu[1], M. Shokooh-Saremi[1,3], H.G. Svavarsson[4], S.H. Song[5]; [1]Department of Electrical Engineering, University of Texas at Arlington (US); [2]Resonant Sensors Incorporated (US); [3]Department of Electrical Engineering, Ferdowsi University of Mashhad (IR); [4]School of Science and Engineering, Reykjavik University (IS); [5]Department of Physics, Hanyang University (KR).

Fundamental photonic resonance effects in thin periodic films with nanoscale features are presented and examples of associated spectral expressions given. Potential applications including biosensors and optical components are discussed. [4972].....Pg 86

14:30 - 14:50

Avoiding Resonance in Dielectric Reflection Gratings

F. Fuchs[1], D. Michaelis[1], U.D. Zeitner[1,2], E.B. Kley[2]; [1]Fraunhofer-Institut für Angewandte Optik und Feinmechanik (DE); [2]Institute of Applied Physics, Friedrich-Schiller-University Jena (DE).

We study the formation of guided mode resonances in multilayer dielectric gratings computationally and devise a scheme of how to avoid them in grating design. [4877].....Pg 88

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14:50 - 15:10

Modal representation and normalized scaling rules for ultra narrow-band reflection from a 1D binary corrugation

T. Kämpfe, A.V. Tishchenko, O. Parriaux; University of Lyon, Lab. H. Curien UMR CNRS 5516 (FR).

A 1D, high index contrast subwavelength binary corrugation on a low index substrate may under normal incidence exhibit arbitrarily narrow band reflection. The conditions for its occurrence are given on the basis of the resonances and interference of two involved grating modes and a phenomenological representation of this effect will be proposed. Normalized heuristic analytical expressions are derived which identify exhaustively all possible structures exhibiting this effect. [4861].....Pg 90

15:10 - 15:30 STUDENT PRESENTATION

Simultaneous dual wavelength full field imaging in low coherence digital holographic microscopy

Z. Monemhaghdoust[1], F. Montfort[2], C. Moser[1]; [1]EPFL, LAPD (CH); [2]Lyncée Tec SA (CH).

We demonstrate a volume diffractive optical element (VDOE) that enables full field of view imaging at two wavelengths in off-axis digital holographic microscopy. Single shot image acquisition at both wavelengths allows for high speed imaging and an increase of the axial unambiguous range from 0.4*µm to 2.5µm*. [4853].....Pg 92

15:30 - 15:50 STUDENT PRESENTATION

Effective-medium enhanced three-level grating in resonance domain

M. Oliva[1], D. Michaelis[1], F. Fuchs[1], U.D. Zeitner[1,2]; [1]Fraunhofer Institute for Applied Optics & Precision Engineering (DE); [2]Institute for Applied Physics, Friedrich-Schiller-University Jena (DE).

A broadband blazed grating with maximum efficiencies above 90% composed of an effective medium structure and a subsequent mode conversion layer is designed for normal incidence in the deep resonance domain. Due to its demanding geometry, a standard multilevel fabrication process requires further optimizations. [4886].....Pg 94

15:50 - 16:30 Coffee break & Whiskey tasting

17:00 - 18:30 Social programme
Meeting time: 16:45
Meeting point: Conference Centre
Venue: Royal Delft, Koninklijke Porceleyne Fles
Rotterdamseweg 196

18:30 - 22:30 Conference dinner
Venue: Partycentrum - Restaurant de Brasserij
Brasserskade 2a

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08:30 - 10:00
SESSION XII
Chair: Joseph Braat, Delft University of Technology (NL)

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08:30 - 09:00 Invited talk
Polarization control with artificial chiral structures
M. Kuwata-Gonokami; Department of Physics, Graduate School of Science, Photon Science Center, University of Tokyo (JP).
Artificial sub-wavelength two dimensional grating structures without mirror symmetry exhibit strong optical activity and rotate polarization states of propagating optical and terahertz waves. We also demonstrate circularly polarized spontaneous emission of quantum dots embedded in a semiconductor chiral photonic crystal. [4867].....Pg 96

09:00 - 09:20
Calculation of local absorption in three-dimensional structures using the RCWA
M. Auer, K.-H. Brenner; University of Heidelberg (DE).
The calculation of local absorption has become very relevant in the optimization of photodetectors and solar cells. While total absorption is readily available in existing tools, local absorption requires additional effort. Especially in the RCWA, the field calculation is not unique and has significant effects on local absorption. [4924].....Pg 98

09:20 - 09:40
Optimization of local absorption in layered media
K.-H. Brenner; University of Heidelberg (DE).
For the design of detectors or solar cells, not only the total amount of absorbed power is relevant, but also whether the strongest absorption occurs in the desired layer or in the substrate. An exact definition for local absorption recently has been given. It enables a closed description and thus an optimization of performance. [4943].....Pg 100

09:40 - 10:00 STUDENT PRESENTATION
Deformable micromirror array for dynamic laser beam shaping and homogenizing
J. Masson[1], R. Bitterli[1], A. Bich[2], W. Noell[1], R. Voelkel[2], K. Weible[2], N.F. de Rooij[1]; [1]EPFL, SAMLAB (CH); [2]SUSS MicroOptics SA (CH).
We present a dynamic laser beam shaper that can generate smooth flat-top and Gaussian intensity profiles. It consists of a 100% fill factor membrane, supported by beams or posts, which deforms dynamically to shape and smooth coherent light. The mirror array is fabricated over a scanning stage that enables interference averaging. [4882].....Pg 102

10:00 -10:30 Coffee break

10:30 - 12:20
SESSION XIII
Chair: Oliver Parriaux, University of Lyon (FR)

10:30 - 11:00 Invited talk
Modified quantum dot emission with arrays of plasmonic nanoparticles
G. Lozano[1], S.R.K. Rodriguez[1], M. Vershuuren[2], R. Gomes[3], Z. Hens[3], J. Gómez Rivas[1,4]; [1]Center for Nanophotonics, FOM Institute AMOLF (NL); [2]Philips Research Laboratories (NL); [3]Physics and Chemistry of Nanostructures, Center for Nano and Biophotonics, Ghent University (BE); [4]COBRA Research Institute, Eindhoven University of Technology (NL).
We present an experimental study of the modified emission of a layer of quantum dots (QDs), just a few nanometers thick, with plasmonic structures. The coupling of localized surface plasmon resonances in metallic particles through in-plane diffraction in arrays of these particles leads to the formation of quasi-bound surface states known as surface lattice resonances (SLRs). The recent observation of extremely narrow SLRs in arrays of gold nanoparticles has created expectations for these arrays as plasmonics sensors. We show here that these resonances can lead to a strong modification of the emission due to the modified density of optical states at which the excited QDs can decay and the diffractive coupling of SLRs into the far-field. [4957].....Pg 104

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11:00 - 11:20 STUDENT PRESENTATION

In-situ hologram correction in SLM setup

V. Carrat, B. Viaris de Lesegno, L. Pruvost; Laboratoire Aimé Cotton CNRS UPR3321 Bat 505 Univ. Paris-Sud (FR).

By adding another wavelength in an existing SLM phase modulation setup, we developed a robust method to get the birefringence map of the modulator. By this way we are able to see and correct the defects in-situ without disturbing the running experiment. [4902].....Pg 105

11:20 - 11:40

Hybrid diffractive-refractive wide field of view objective

E. Sokolova[1], I. Livshits[2]; [1]River Diagnostics B.V. (NL); [2]Lab CAD of opto-information and energy saving systems, NRU ITMO (RU).

The method of substitution lenses with complicated high order aspherical surfaces by the hybrid diffractive-refractive lenses is proposed. Two examples with the same number of elements are given. As a result the image quality is improved without using aspheric surfaces. [4866].....Pg 107

11:40 - 12:00

Unidirectional Surface Plasmon Launchers and Decouplers

A. Baron[1], E. Devaux[2], J.-C. Rodier[1], J.-P. Hugonin[1], E. Rousseau[1], C. Genet[2], T.W. Ebbesen[2], P. Lalanne[1,3]; [1]Laboratoire Charles Fabry, Institut d'Optique, Univ Paris-Sud, CNRS (FR); [2]ISIS, Université de Strasbourg et CNRS (UMR 7006) (FR); [3]Lab. de Photonique Numérique et Nanosciences, Institut d'Optique, Univ Bordeaux 1, CNRS (FR).

We designed, fabricated and characterized a compact novel device composed of eleven grooves which displays unprecedented performances regarding two important figures-of-merit of SPP launchers, namely the launching/decoupling efficiencies and the extinction ratio that characterizes the directionality of the launching. [4851].....Pg 109

12:00 - 12:20

Compressive sensing inverse imaging techniques in diffraction optics

V. Katkovnik, A. Migukin, J. Astola; Department of Signal Processing, Tampere University of Technology (FI).

Let us start from a wave field reconstruction in the following simple setup. A coherent complex-valued wave field propagates from an object plane to a parallel image plane. This free space forward propagation is modeled by the Rayleigh-Sommerfeld diffraction integral. The problem is to reconstruct the complexvalued wave field at the object plane from complex-valued observations given at the image plane. [4824].....Pg 111

12:20 END OF EOS TOPICAL MEETING

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4764_DO2012_01 STUDENT PRESENTATION
Plasmonic nanosensor in the treatment of cancer: An attempt to conquer the immortal illness
S. Das, J. Turunen; University of Eastern Finland, Department of Physics and Mathematics (FI).
We present a novel method based on silver nanoparticle-generated transient photothmal vapour nanobubbles which is effective in the diagnosis (by optical scattering) and treatment (by mechanical, nonthermal and selective destruction of target cells) of cancerous cells.....Pg 113

4828_DO2012_03 STUDENT PRESENTATION
Accurate measurement of the Bidirectional Transmittance Distribution Function of Holographic Diffusers
J. Audenaert[1], G. Durinck[1], F. Leloup[1], G. Deconinck[2], P. Hanselaer[1,2]; [1]Light&Lighting Laboratory-Catholic University College Sint-Lieven (BE); [2]ESAT-ELECTA – Katholieke Universiteit Leuven (BE).
Due to the instrument characteristics of the measurement device, large deviations can be encountered between theoretical and experimental Bidirectional Transmittance Distribution Functions. The application of an iterative algorithm to simulated and measured BTDFs, based on the theorem of Bayes, is proposed. A significant improvement of the accuracy of the distribution functions is achieved compared to the raw untreated data.....Pg 115

4832_DO2012_04
Hybrid diffractive-refractive objective for Raman microscopy/spectroscopy
E. Sokolova; River Diagnostics B.V. (NL).
A number of variants of a compact microscope objective all lenses of which are made of the same material (preferably fused silica) are presented. One of the lens surfaces (plane or spherical) is diffractive. Other lens surfaces are spherical..... Pg 117

4836_DO2012_05 STUDENT PRESENTATION
Definition of a compact infrared camera based on a binary implemented continuously self-imaging grating
M. Piponnier[1], G. Druart[1], N. Guérineau[1], J.-L. De Bougrenet[2], J. Primot[1]; [1]ONERA – The French Aerospace Lab (FR); [2]Telecom Bretagne, Optics Department (FR).
A dewar is a sealed environment used to cool infrared detectors. Specific diffractive gratings such as axicons or continuously self-imaging gratings are investigated to integrate a simple imagery function inside the dewar, because they are known to have a long depth of focus and a small mass.....Pg 119

4837_DO2012_06
Diffractive and interferometric methods to characterize photopolymers with crystal liquid molecules as holographic recording material
S. Gallego, A. Márquez, M. Ortuño, J. Francés, P. Gallego, A. Beléndez, I. Pascual; Universidad de Alicante, Instituto Universitario de Física Aplicada a las Ciencias y las Tecnologías (ES).
We present two methods, interferometry at the zero spatial frequency limit and analysis of diffracted orders for very low spatial frequency gratings, to characterize photopolymers with dispersed nematic liquid crystals. These methods provide us information in real time about the transformations taking place inside the material during recording.....Pg 121

4848_DO2012_07
Theoretical description of a 2D volume hologram with sources
Y.G. Boucher[1,2], F.F.L. Bentivegna[3], D. Moussa Djama[3], T.V. Galstian[4]; [1]Université Européenne de Bretagne (UEB) (FR); [2]CNRS, UMR 6082 Foton (FR); [3]RESO, École Nationale d'Ingénieurs de Brest (FR); [4]COPL, Laval University (CA).
We present an all-analytical description of a two-dimensional active volume hologram consisting of a distributed cavity with localized emitters. Using both coupled-mode theory and extended matrix formalism, we show that the modal response of the structure is fully determined by a set of dimensionless parameters.....Pg 123

4850_DO2012_08
Application of Fourier modal method to structures including negative-index media
H. Ichikawa; Ehime University, Faculty of Engineering (JP).
Fourier modal method is applied to analysis of optical elements which include negativeindex media. Its implementation and example computation are presented. It is shown that the method can handle negative-index media, but is associated with some problems.....Pg 125

4852_DO2012_09 STUDENT PRESENTATION
Double DOE system for near-field imaging formation
J.M. Herrera-Fernandez, L.M. Sanchez-Brea, E. Bernabeu; Universidad Complutense de Madrid, Optics Department, Applied Optics Complutense Group (ES).
We present an algorithm for forming the desired image in the near field with two DOEs; the first DOE modulates the amplitude and it is equal to the target image, whereas the second DOE modulates the phase.....Pg 128

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4854_DO2012_10
Stokes parameters for diffraction vector fields
J. Silva-Barranco[1], P. Martinez Vara[2], T. Quarton[3], G. Martínez-Niconoff[1]; [1]Optics Department, Instituto Nacional de Astrofísica, Óptica y Electrónica (MX); [2]Benemerita Universidad Autónoma de Puebla, BUAP, Dpto de Ingeniería (MX); [3]University of Texas at Dallas UTD, Physics Department (US).
We define the vector correlation function between two amplitude functions mutually orthogonal. We show that this function satisfies the Helmholtz equation and it allows the Stokes parameters for arbitrary diffraction fields to be obtained.....Pg 130

4856_DO2012_11
Exact modelling of large pixelated DOEs with wavelength-scale feature size
T. Kaempfe, A. Tishchenko; University of Lyon, Lab. H. Curien UMR CNRS 5516 (FR).
An ultra-fast exact electromagnetic modeling approach based on the generalized source method (GSM) achieving O(NlogN) calculation time and memory resort is applied to the simulation of the diffraction of a relatively large section of a 2D pixelated DOE in the form of square pillars of identical cross-section. The size of the considered area is several wavelengths across, enough to achieve a reasonable separation of the central region from the influence of neighbouring areas, enabling the use of a stitching method for the simulation of very large elements that could so far only be modeled by scalar approximations. A time and memory resort comparison is made between a standard scalar method and the rigorous GSM-based simulation of the spectra of the element.....Pg 132

4857_DO2012_12
Fabrication of (sub)wavelength resonant DOEs: a come-back of wet etching
S. Tonchev, O. Parriaux; University of Lyon, Lab. H. Curien UMR CNRS 5516 (FR).
Resonant diffractive elements are characterized by a strong field enhancement in the neighbourhood of the surface corrugation due to the presence of a surface wave. This confers a large radiation strength to a shallow corrugation which can therefore be wet-etched with negligible underetch. Low cost, high manufacturing productivity is expectable.....Pg 134

4863_DO2012_13
Accuracy analysis of lamellar diffraction gratings by means of simplified theories
J. Francés, S. Gallego, S. Bleda, C. Neipp, A. Márquez, I. Pascual, A. Beléndez; Universidad de Alicante, Instituto Universitario de Física Aplicada a las Ciencias y las Tecnologías (ES).
The validity of both the scalar diffraction theory and the effective medium theory is evaluated by the comparison of the diffraction efficiencies predicted from both simplified theories to accurate results calculated by the finite-difference time-domain method.....Pg 136

4868_DO2012_15 Student Presentation
Analysis of diffractive optical elements generated onto photopolymer materials using a liquid crystal display
A. Márquez[1,3], S. Gallego[1,3], M. Riquelme[1], M. Ortuño[1,3], M.L. Álvarez[1,3], A. Beléndez[1,3], I. Pascual[2,3]; [1]Dpt. de Física, Ing. de Sistemas y Teoría de la Señal, Univ. de Alicante (ES); [2]Dpt. de Óptica, Farmacología y Anatomía, Univ. de Alicante (ES); [3]I.U. Física Aplicada a las Ciencias y las Tecnologías, Univ. de Alicante (ES).
We produce phase-only diffractive optical elements (DOE) onto photopolymer. To this goal we use a liquid crystal display (LCD), displaying the DOE amplitude master, which is imaged onto the photopolymer. Various challenges need to be overcome such as accurate combined control of LCD and photopolymer and proper imaging of the master onto the photopolymer plane, which will be presented in the paper.....Pg 138

4870_DO2012_16
Near field of cylindrical gratings with point source illumination
F.J. Torcal-Milla, F.J. Salgado-Remacha, L.M. Sanchez-Brea, E. Bernabeu; Universidad Complutense de Madrid, Optics Department (ES).
We analyze how a diffraction grating engraved on the external surface of a cylinder diffracts the light in the near field. We assume a point source illuminating the grating and show how the distance between the source and the grating affects to the diffracted intensity. There is a situation in which the curvature is compensated giving parallel fringes.....Pg 140

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4872_DO2012_17

General properties of metallic gratings with subwavelength indentations

P. Lalanne[1,2], H.T. Liu[3]; [1]Laboratoire Charles Fabry, Institut d'Optique, Univ Paris-Sud, CNRS (FR); [2]Lab. de Photonique Numérique et Nanosciences, Institut d'Optique (FR); [3]Key Laboratory of Optical Information Science and Technology, Ministry of Education, Institute of Modern Optics, Nankai University (CN).

Under illumination by a transverse-magnetic (TM) wave, the electromagnetic field scattered on metallic surfaces corrugated by one-dimensional periodic arrays of tiny indentations exhibits several general properties. In general, the field on the surface between the indentations does not contain any surface-plasmon-polariton (SPP). Exception occurs in a narrow energy band centered around λ=λsp, the SPP-phased matched wavelength obtained when the momentum of the incident wave matches the SPP momentum of the *flat* interface.....Pg 142

4873_DO2012_18 STUDENT PRESENTATION

Generalized Phase Contrast with matched filtering using LCoS pico-projectors

A. Bañas, D. Palima, J. Glückstad; DTU Fotonik, Department of Photonics Engineering Programmable Phase Optics Technical University of Denmark (DK).

We report a beam shaping system for generating high intensity programmable optical spots using mGPC: matched filtering combined with Generalized Phase Contrast applying two consumer handheld pico-projectors. Such a system presents a low cost alternative for optical trapping and manipulation, optical lattices and other beam shaping applications usually implemented with high-end spatial light modulators.....Pg 144

4876_DO2012_19

Femtosecond laser pulse ablation with two-dimensional two-grating interferometer

J.J.J. Kaakkunen, M. Silvennoinen, K. Päiväsaari, P. Vahimaa; University of Eastern Finland, Department of Physics and Mathematics (FI).

In this paper, the realization of four waves interference pattern using two-dimensional two-grating interferometer is presented. Interference pattern is used to ablate large areas of under micron feature size structures into various materials using Ti:Sapphire femtosecond laser with a central wavelength of 800 nm.....Pg 145

4897_DO2012_20

Experimental and theoretical investigations of nanosecond laser damage on diffractive optics

R. Burla[1], X. Fu[1], F. Wagner[1], G. Demesy[1], L. Gallais[1], J.Y. Natoli[1], M. Commandré[1], S. Gautier[2], S. Tisserand[2]; [1]Institut Fresnel, CNRS, Aix-Marseille Université (FR); [2]SILIOS TECHNOLOGIES, Z.I Peynier-Rousset (FR).

The laser damage resistance of phase mirrors used for laser beam shaping in high peak power laser applications is studied. Laser Induced Damage Thresholds measurements are done at 1064nm, 6ns and the results are compared with simulations of the electric field within the multi-layer by using a wave propagation computer code.....Pg 147

4888_DO2012_22

Wideband, wide angular spectrum resonant reflection by mode coalescence in dual-mode slab waveguide

Y. Jourlin[1], S. Tonchev[1], A .V. Tishchenko[1], C. Pédrix[1], O. Parriaux[1], D. Jamon[2], F. Lacour[3] ; [1]University of Lyon, Lab. H. Curien UMR CNRS 5516 (FR); [2]University of Lyon, Lab. Telecom. C. Chappe (FR) ; [3]Eurofarad (FR).

A deep grating in a dual-mode high index waveguide causes the coalescence of the two reflection peaks into a single peak of broader wavelength spectrum and high angular robustness. This property extends the applicability of resonant reflection to the wide field of light processing systems dealing with low spatial and temporal coherence beams. Hydrogenated amorphous silicon deposited on polymer at 1500C is used as the low-loss slab-waveguide in the near-IR wavelength range.....Pg 149

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4892_DO2012_23 STUDENT PRESENTATION

Fabrication of Linear Grating like Laser Induced Perioidic Surface Structures

M.V.J. Silvennoinen, J.J.J. Kaakkunen, K. Paivasaari, P. Vahimaa; University of Eastern Finland, Department of Physics and Mathematics (FI).

Fabrication of the Laser Induced Periodic Surface Structures using IR femtosecond laser pulses is studied. It has been noticed that by using LCOS-spatial light modulator it is possible to fabricate large areas of linear grating like structures. The spatial light modulator can be used also to focus the pulses using a hologram of a cylindrical lens.....Pg 151

4894_DO2012_24 STUDENT PRESENTATION

Influence of phase fluctuactions of a LCOS based Hartmann-Shack sensor

J.L. Martínez-Fuentes[1], J. Campos[2], I. Moreno[1], A. Vargas[3]; [1]Universidad Miguel Hernández de Elche, Dept. de Ciencia de Materiales, Óptica y Tecnología Electrónica (ES); [2]Universitat Autònoma de Barcelona, Departament de Física (ES); [3]Universidad de la Frontera, Departamento de Ciencias Físicas (CL).

We study a Hartmann-Shack sensor implemented by means of a parallel aligned LCOS micro-display presenting temporal phase fluctuations and a CCD camera. Concretely, we perform a comparative analysis of the sensing position stability versus the camera integrating time and the size of the lenses addressed to the display......Pg 153

4895_DO2012_25 STUDENT PRESENTATION

Controlling plasmon resonance peaks in gold-based metamaterials

J. Lehtolahti[1], J. Laukkanen[1], M. Kauranen[2], M. Kuittinen[1]; [1]University of Eastern Finland, Department of Physics and Mathematics (FI); [2]Tampere University of Technology, Department of Physics (FI).

By varying the sizes and distances of circular subwavelength gold nanoparticles in two-dimensional periodic arrays it is possible to adjust both the plasmon resonance peak wavelengths and the strength of the resonances, as our numerical calculations show.....Pg 155

4896_DO2012_26 STUDENT PRESENTATION

Twin-SLM Complex Light Modulation for Computer Holography

A. Czerwinski[1], M. Makowski[1], J. Suszek[1], A. Siemion[1], M. Sypek[1], Z. Jaroszewicz[2], A. Kolodziejczyk[1]; [1]Warsaw University of Technology, Faculty of Physics (PL); [2]Institute of Applied Optics (PL).

We present an experimental evaluation of the technique of a complex modulation of the amplitude and phase of laser light. We use a pair of identical spatial Light Modulators (SLM) manufactured in the LCoS technology (Liquid Crystal on Silicon). The evaluation is performed by addressing the SLMs with computer-generated holograms, which is aimed at future applications in a compact, lensless projection of color images.....Pg 157

4898_DO2012_27

Partially coherent beams with spatially varying correlations

H. Lajunen, T. Saastamoinen; University of Eastern Finland, Department of Physics and Mathematics (FI).

We study a new class of partially coherent beams with spatially varying correlations. It is shown by numerical simulations that such inhomogeneous coherence distributions may produce extraordinary propagation-induced changes, such as sharpened and lat- erally shifted maxima of the beam intensity.....Pg 159

4899_DO2012_28

Liquid-crystal-based diffractive optical elements

S. Valyukh[1], P. Tytarenko[2]; [1]Laboratory of Applied Optics, Department of Physics, Chemistry and Biology (IFM), Linköping University (SE); [2]Institute of Semiconductor Physics (UA).

Tunable liquid-crystal (LC) -based diffractive optical elements (DOE) are studied. We investigate limitations and potential functional abilities of LC DOE utilizing homogeneous and inhomogeneous alignment. Influence of the anchoring energy of LC on diffractive properties of DOE is discussed. Pg 161

4905_DO2012_29 STUDENT PRESENTATION

Detection of dust and scratches on photographic material by combining dark field illumination and crossed polarization

G. Trumpy, A. Wassmer, R. Gschwind; University of Basel, Imaging & Media Lab (CH).

A solution for the elimination of dust and scratches on transparent photographic material is investigated. We are designing a scanning system that will detect defects taking advantage of depolarization of light scattered by irregularities in the film surface. This phenomenon is studied analytically to define the optimal optical setup.....Pg 163

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4906_DO2012_30

Diffraction pattern from mature and immature red blood cells

M. Mihailescu[1,2], A. Gheorghiu[2], J. Costescu[2]; [1]National Institute for Research and Development in Microtechnologies (RO); [2]Politehnica University from Bucharest (RO).

We present our study regarding mature and immature red blood cells diffraction patterns in Fresnel and Fraunhofer approximation. We model their shapes taking into account dimensions established experimentally in digital off-axis holographic microscopy. We considered few types: mature and immature, deformed and undeformed red blood cells.....Pg 165

4909_DO2012_31 STUDENT PRESENTATION

Beam shaping and light focusing by active selfoc microlenses

A.I. Gomez-Varela[1], M.T. Flores-Arias[1], C. Bao-Varela[1], X. de la Fuente[2], C. Gomez-Reino[1]; [1]Grupo de "Microóptica y Óptica GRIN", Unidad Asociada al Instituto de Ciencias de Materiales de Aragón, ICMA/CSIC, Zaragoza, y Facultade de Óptica e Optometría, Universidade de Santiago (ES); [2]Instituto de Ciencia de Materiales de Aragón (Universidad de Zaragoza-CSIC) (ES).

Light propagation in active GRIN (GRadient-INdex) materials with gain or loss is studied. Results are applied to an active selfoc microlens in order to examine Gaussian beam transformation. In particular, beam half-width and curvature radius are analized to find beam shaping and light focusing conditions.....Pg 167

4910_DO2012_32 STUDENT PRESENTATION

Geometric metrology of gold nanoparticle ensembles with optical extinction spectroscopy

N. Xu, B. Bai, Q. Tan, G. Jin; State Key Laboratory of Precision Measurement Technology and Instruments, Department of Precision Instruments, Tsinghua University (CN).

We present a method based on optical extinction spectroscopy to fast characterize the geometric features (including size, aspect ratio, and geometric distribution) of gold nanosphere and nanorod ensembles. The results are compared with those obtained by transmission electron microscopy, showing the effectiveness of the method. The influence of the particle parameters is analyzed and the possible methods for solving the ill-posed inverse problem are discussed.....Pg 169

4912_DO2012_33

Wavelength-Dispersive Micro Prism with Periodic Metal Structure in a Silicon Slab-Waveguide

S. Kameda, T. Otsuka, T. Morikawa, A. Mizutani, H. Kikuta; Osaka Prefecture University, School of Engineering (JP).

A micro triangular prism with periodic metal structure was fabricated in a silicon slab waveguide for a wavelength-dispersive device by use of the electroless copper plating. The micro prism was 1.2µm thick and the structure period was 0.3µm. The light refraction by the micro prism was observed for the 1.55µm wavelength light.....Pg 171

4913_DO2012_34 STUDENT PRESENTATION

Fabrication of metallic optical elements embedded in dielectric substrates by the bottom-up fill electroless copper plating

T. Otsuka[1], T. Morikawa[1], S. Kameda[1], A. Mizutani[1], H. Kikuta[1], S. Shingubara[2]; [1]Osaka Prefecture University, Graduate School of Engineering (JP); [2]Kansai University, Faculty of Engineering Science (JP).

Optical elements with metal-and-dielectric structure were fabricated by use of the "bottom-up fill" electroless copper plating. The 200nm-wide and 1200nm-deep trenches were filled up with copper. A wire-grid polarizer for near-infrared light and a micro-prism in the silicon-on-insulator substrate were fabricated.....Pg 173

4915_DO2012_35 STUDENT PRESENTATION

Comparison of convolution and Time Dependent Random Phase methods for modelling of the space invariant optical system with spatially incoherent illumination

A. Czerwiński, K. Kakarenko, M. Sypek, M. Makowski, I. Ducin, J. Suszek, A. Kołodziejczyk; Warsaw University of Technology, Faculty of Physics (PL).

In this paper we present the comparison of two methods for modeling space invariant optical system with spatially incoherent quasi-monochromatic illumination. The first one is a convolution method. The second one is a method based on the Time Dependent Random Phase (TDRP) algorithm. Both approaches provide equivalent results.
However, the TDRP method maintains energy relations and magnification of the system. In the convolution method the pre-processing of the input image is required.....Pg 175

Poster session

Tuesday, 28 February, 18:00 - 19:30 - Foyer, TU Delft

4917_DO2012_36
Measurement of aspherical surfaces using CGH test plates
A.G. Poleshchuk[1], R.K. Nasyrov[1], J.-M. Asfour[2]; [1]Institute of Automation & Electrometry SB RAS (RU); [2]Dioptic GmbH (DE).
A new method for measuring aspherical surface shapes using computer generated holograms (CGH) as a test plates is presented. Test results of the CGH design, fabrication and measurements are discussed.....Pg 177

4919_DO2012_38 STUDENT PRESENTATION
Fast one-exposure digital holography based on the Talbot effect and phase-shifting method
Ag. Siemion, M. Sypek, An. Siemion, J. Suszek, A. Kolodziejczyk, M. Makowski; Warsaw University of Technology, Faculty of Physics (PL).
Fast one-exposure digital holography technique based on the Talbot effect and phase-shifting method is presented. The optical system is very compact and does not need any imaging elements or advanced cameras. The reconstruction algorithm is simple, quick and based on the optical methods, avoiding any approximation.....Pg 178

4920_DO2012_39
Hybrid Collimating Optics for RGB LEDs
T. Bonenberger, J. Baumgart; Hochschule Ravensburg-Weingarten, ZAFH-LED OASYS (DE).
A technique that has been established to correct color aberrations in photographic optics was used to reduce color fringes in LED lighting applications. This technique is based on the combination of refractive, reflective and diffractive elements realizing a hybrid optical system.....Pg 180

4921_DO2012_40
Focusing properties of the non-paraxial Light Sword Optical Element
K. Kakarenko[1], I. Ducin[1], Z. Jaroszewicz[2], M. Makowski[1], A. Kolodziejczyk[1], K. Petelczyc[1], J. Suszek[1], M. Sypek[1]; [1]Warsaw University of Technology, Faculty of Physics (PL); [2]Institute of Applied Optics and National Institute of Telecommunications (PL).
We present an analysis of focusing realized by the light sword optical element (LSOE), especially designed for imaging with extended depth of field. The obtained numerical results illustrate that the non-paraxial design of such element can improve its performance in an imaging system.
Pg 182

4923_DO2012_41 STUDENT PRESENTATION
Numerical modeling of the EUV microscope optical setup
D. Wojnowski, M. Sypek, J. Suszek, A. Kołodziejczyk; Faculty of Physics, Warsaw University of Technology (PL).
In this work we present an effective algorithm for modeling the imaging phenomena by the EUV microscope optical setup. Using the algorithm, we focus on source's spectrum influence on spatial resolution of the microscope.....Pg 184

4926_DO2012_42
Diffractive elements for correction of aberrations of white light illumination systems: design and fabrication
M. Škereň, P. Fiala, J. Svoboda, J. Hopp, M. Květoň; Czech Technical University in Prague, Faculty of Nuclear Sciences and Physical Engineering, Department of Physical Electronics (CZ).
In this paper, the application of synthetic diffractive elements is presented for correction of chromatic aberration of white light illumination systems. The cost effective fabrication technology is also presented, which is compatible with the commonly used molding process for fabrication of plastic optical elements.....Pg 186

4929_DO2012_43
Fourier modal analysis of image formation in aplanatic systems
*H.J. Hyvärinen[1,2], S. Mehta[3], J. Turunen[1]; [1]University of Eastern Finland, Department of Physics and Mathematics (FI); [2]Institute of Microelectronics, A*STAR (SG); [3]Cellular Dynamics Program, Marine Biological Laboratory (US).*
Fourier Modal Method and Abbe theory are applied to analyze coherent image formation of periodic objects in aplanatic imaging systems. The model is applied to bright-field imaging systems, and the results are compared to respective approximative results.....Pg 188

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4930_DO2012_44
Coherence–polarization mixing in resonance waveguide gratings
T. Saastamoinen, I. Vartiainen, J. Tervo, M. Kuittinen; University of Eastern Finland, Department of Physics and Mathematics (FI).
We show that resonance gratings can be used to transfer partial spatial correlation to partial polarization even in the case of fully polarized incident beam. This phenomenon is based on the fact that one of the orthogonal polarization components can be coupled into the leaky mode while the other one is reflected without being coupled in the grating.....Pg 190

4931_DO2012_45 STUDENT PRESENTATION
Simulation of broad area laser diodes with elementary mode method
H. Partanen; University of Eastern Finland, Department of Physics and Mathematics (FI).
Propagation of partially coherent laser beam is modeled with elementary mode method to demonstrate its effectiveness. Intensity and degree of coherence is simulated and compared to results from Wolf's coherent mode representation.....Pg 192

4933_DO2012_46
Fabrication and testing of highly efficient resonance domain diffractive optical elements
O. Barlev[1], M.A. Golub[1], A.A. Friesem[2], D. Mahalu[2]; [1]Tel Aviv University, Dept. of Electrical Engineering (IL); [2]Weizmann Institute of Science, Dept. of Physics of Complex Systems (IL).
Experimental procedures for recording, evaluating different resonance domain diffractive optical elements are presented. Results reveal that when recorded in fused silica (FS) material as surface relief gratings with a period 520 nm and aspect ratio up to 2.5, they can have very high diffraction efficiency when illuminated with visible light.....Pg 194

4934_DO2012_47 STUDENT PRESENTATION
A short paper on the THz paper optics
A. Siemion[1], Ag. Siemion[1], J-L Coutaz[2], J. Suszek[1], M. Makowski[1], I. Ducin[1], A. Kołodziejczyk[1], M. Sypek[1]; [1]Warsaw University of Technology, Faculty of Physics (PL); [2]University of Savoie, IMEP -LAHC (FR).
The diffractive optical element for THz applications made of paper was designed and manufactured. It is a phase only structure, which is transparent for THz radiation. The experimental results by means of Time-Domain Spectroscopy shows bending and focusing of the THz beam (for 0,3-1,5 THz) after the paper element.....Pg 196

4935_DO2012_48
Computer generated matched spatial filters for multiplexing and demultiplexing of spatial modes of coherent light
S. Shwartz, M.A. Golub, S. Ruschin; Tel Aviv University, Department of Electrical Engineering (IL).
Computer generation of multichannel diffractive optical elements matched to several orthogonal transverse modes of laser beam was solved by a mathematical generating functions concept. Experimental and computer simulated results for reconstruction of modes in coherent optical correlator are in good match.....Pg 198

4936_DO2012_49 STUDENT PRESENTATION
Electromagnetic theory of Hanbury Brown–Twiss effect
T. Hassinen[1], J. Tervo[1], T. Setälä[2], A.T. Friberg[1,2,3]; [1]University of Eastern Finland, Department of Physics and Mathematics (FI); [2]Aalto University, Department of Applied Physics (FI); [3]Royal Institute of Technology (KTH), Department of Microelectronics and Applied Physics (SE).
We analyze the Hanbury Brown - Twiss experiment with thermal vector waves in the space-frequency domain. It is shown that the spectral degree of electromagnetic coherence fully characterizes the normalized correlation of intensity fluctuations measured in the experiment, a result analogous to the scalar-wave analysis.....Pg 200

4937_DO2012_50 STUDENT PRESENTATION
Simulation and design of photonic crystal cavities for optical trapping of bacteria in water
M.M. van Leest, J.T. Heldens, J. Caro; Delft University of Technology, Kavli Institute of Quantum-Nanoscience (NL).
A photonic crystal (PhC) cavity can be used as optical trap for single microorganisms and is promising for Raman fingerprinting these objects. We design three PhC cavities for optical trapping experiments, using the 3D FDTD method. Design criteria are a small trapping-induced resonance shift and a high in-plane transmission.....Pg 202

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4941_DO2012_51
Bifocal zone plates designed using the Thue-Morse sequence
W.D. Furlan[1], A. Calatayud[2], L. Remón[2], J.A. Monsoriu[2], P. Andrés[1]; [1]Departamento de Óptica, Universitat de València (ES); [2]Centro de Tecnologías Físicas, Universitat Politècnica de València (ES).
We present a new family of diffractive lenses constructed using the aperiodic sequence known as the Thue-Morse sequence. The result is a novel kind of bifocal diffracting lenses with self-similar focalization properties. The axial irradiance provided by several members of the family are presented.....Pg 204

4942_DO2012_52
Traveling waves approach for Airy beams
H.A. Jiménez-Romero[1], S. Chávez-Cerda[2]; [1]Depto. De Física Cinvestav-IPN (MX); [2]Instituto Nacional de Astrofísica, Óptica y Electrónica (MX).
We demonstrate that Airy beams share many physical properties with Bessel beams due to the fact that Airy functions are Bessel functions of order $\nu=1/3$. This allows to provide a clear and easy picture for the physics of Airy beams and their properties of propagation. We also show the existence of high order Airy beams.....Pg 206

4946_DO2012_53
Sensitivity analysis of rigorous effects in diffractive null optics
S. Peterhänsel, C. Pruss, W. Osten; University Stuttgart, Institut for Applied Optics (DE).
The increasing demand of precise measurements of steep high-precision free form surfaces leads to higher frequencies in computer generated holograms for the interferometric null test method. In this paper we discuss the impact of phase errors introduced by rigorous effects in diffractive null optics.....Pg 208

4952_DO2012_54
Joint Research on scatterometric characterization of planar and curved diffractive optics
A. Lassila[1], B. Bodermann[2], J. Turunen[3], P.-E. Hansen[4], M. Wurm[2], S. Siitonen[5], T. Saastamoinen[3], V. Korpelainen[1]; [1]Mittatekniikan Keskus (FI); [2]Physikalisch-Technische Bundesanstalt (DE); [3]University of Eastern Finland (FI); [4]Dansk Fundamental Metrolog (DK); [5]Nanocomp Oy Ltd (FI).
Within a European joint research project it is aimed to develop fast and simple methods for process development and quality control of both diffractive and diffractive-refractive optics in industrial environments. We describe the status of scatterometry for these applications and the intended goals of this project.....Pg 210

4953_DO2012_55
Using the optical code for simulation of the fiber-optic ESPI set-up design
V. Abaskin, E. Achimova; Academy of Sciences of Moldova, Institute of Applied Physics, Center of Optoelectronics (MD).
This article has discussed design of optical part of Electronic Speckle Pattern (ESPI) Interferometer set-up in ZEMAX code. Modulation Transfer Function (MTF), Interferometric Fringe Analysis, Image Analysis, Wavefront Map (WM) was calculated for verifying and predicting the performance of optical part of fiber-optic ESPI set-up.....Pg 212

5008_DO2012_56
Apodized phase masks obtained by means of HEBS glasses
T. Osuch[1,2], A. Kowalik[3], Z. Jaroszewicz[1, 4], M. Sarzyński[5]; [1]National Institute of Telecommunications (PL); [2]Warsaw University of Technology (PL); [3]Institute of Electronic Materials Technology (PL); [4]Institute of Applied Optics (PL); [5]Institute of High Pressure Physics (PL).
A new method of manufacture of diffractive optical elements (DOEs) with variable diffraction efficiency is proposed. For this purpose the high energy beam sensitive (HEBS) glass is used as a halftone mask for generation of the binary phase gratings with variable phase step height in a resist layer. The main advantages as well as limitations of proposed technology are presented and discussed.....Pg 213

5009_DO2012_57
Axicons with constant image intensity
Z. Jaroszewicz[1, 4], A. Kolodziejczyk[2], M.S. Millan[3], L.A. Romero[3], M Sypek[2], K. Petelczyc[2]; [1]National Institute of Telecommunications (PL); [2]Warsaw University of Technology (PL); [3]Technical University of Catalonia (ES); [4]Institute of Applied Optics (PL).
We propose a new kind of axicons designed for the purposes of imaging with extended depth of focus (EDOF). They are distinguishable by the constant intensity of images produced within the whole range of the assumed foci lengths.....Pg 215