SPIE

2013 LASE

SPIE Photonics West

2–7 February 2013

Technical Summaries

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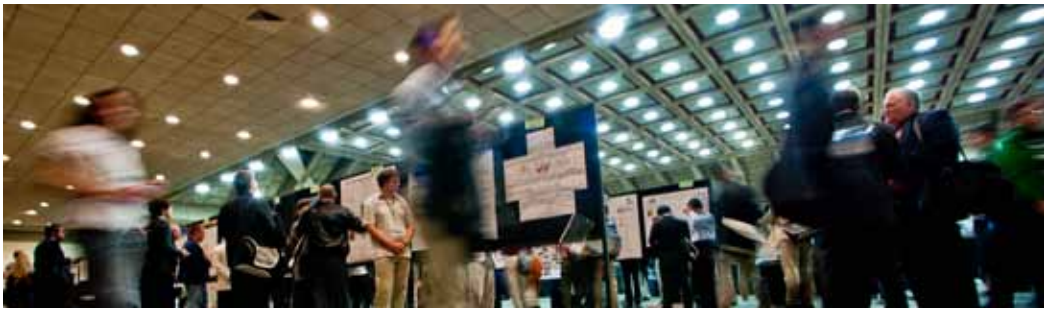
Conferences & Courses
2–7 February 2013

Exhibition
BiOS Expo: 2–3 February 2013
Photonics West: 5–7 February 2013

Location
The Moscone Center
San Francisco, California, USA



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SPIE Photonics West

Symposium Chairs

Bo Gu
Bos Photonics (USA)

Andreas Tünnermann,
Friedrich-Schiller-Univ. Jena (Germany)

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Friedhelm Dorsch
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Alberto Piqué
U.S. Naval Research Lab. (USA)

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the compression rate with increasing pump energy. In case of strong focusing, the pulse duration is shortest for low pump energies. However, for longer focal lengths the compression rate increases with pump energy.

8600-6, Session 2

Wavefront measurement and data analysis of XUV HHG beam

Pavel Homer, Bedrich Rus, Jaroslav Nejdl, Jan Hrebicek, Institute of Physics of the ASCR, v.v.i. (Czech Republic)

Extensive measurements of wavefront profile of the coherent XUV (eXtreme Ultra-Violet) HHG (High-order Harmonics Generation) beam at the wavelength of 30nm have been performed. The unique results have been achieved using the PDI (Point Diffraction Interferometer) technique. The basic principle of the PDI is simple – ultrathin aluminium foil with a miniature pinhole – and it benefits from the self-referencing feature which is very important due to the measured wavelength. On the other hand, a fabrication and experimental measurements are very difficult in this spectral domain. We present basic principles, experimental setup, novel alignment techniques, unique obtained data and their analysis.

8600-7, Session 2

Interaction of UV and IR filaments *(Invited Paper)*

Ladan Arissian, Jean-Claude M. Diels, The Univ. of New Mexico (United States)

No Abstract Available

8600-8, Session 2

Resonator interrogation using pulse interferometry

Amir Rosenthal, Daniel Razansky, Vasilis Ntziachristos, Helmholtz Zentrum München GmbH (Germany)

Resonator interrogation in sensing applications is mostly performed by using coherent or incoherent continuous-wave sources. Coherent techniques are usually characterized by higher sensitivity, whereas incoherent techniques enable multiplexing several resonators with a single source and offer compatibility with passive demodulation technique, leading to higher stability against environmental conditions. In this work we developed an alternative interrogation method in which pulsed lasers are used as the interrogating source. The use of coherent light leads to high sensitivities, whereas the wide spectrum can be used to multiplex numerous resonators with a single source.

The unique properties of the pulse-interferometry interrogation approach are studied theoretically and experimentally. It is found that amplified spontaneous emission is the main limiting factor on the sensitivity achieved. Methods for noise reduction in the proposed scheme are presented and experimentally demonstrated, while the overall performance is validated for broadband optical detection of ultrasonic fields using a fiber Bragg grating as the resonator. The achieved sensitivity is equivalent to the theoretical limit of a 6 MHz narrow-line width laser, which is 40 times higher than what can be achieved by incoherent interferometry for the same optical resonator.

We developed here a new optical-resonator interrogation scheme based on wideband pulse interferometry, capable of achieving high stability against environmental conditions without compromising sensitivity. Specifically, the method is compatible with passive demodulation techniques which do not require stabilization and could be resistant to shocks. Additionally, pulse interferometry may be used for multiplexing numerous resonators with a single interrogating source. The unique properties of the pulse-interferometry interrogation approach are studied theoretically and experimentally. It is found that amplified spontaneous emission is the main limiting factor on the sensitivity achieved. Methods for noise reduction in the proposed scheme are presented and experimentally demonstrated, while the overall performance is validated for broadband optical detection of ultrasonic fields using a fiber Bragg grating as the resonator. The achieved sensitivity is equivalent to the theoretical limit of a 6 MHz narrow-line width laser, which is 40 times higher than what can be usually achieved by incoherent interferometry for the same optical resonator.

In conclusion, its unique combination of properties makes pulsed interferometry an alternative to standard CW-based resonator interrogation technique and enable new sensing applications.

8600-9, Session 3

Terabit/s data transmission using frequency combs *(Invited Paper)*

Christian Koos, Jürg Leuthold, Wolfgang Freude, Karlsruher Institut für Technologie (Germany); Tobias J. Kippenberg, Ecole Polytechnique Fédérale de Lausanne (Switzerland) and Max-Planck-Institut für Quantenoptik (Germany); Joerg Pfeifle, Claudius Weimann, Karlsruher Institut für Technologie (Germany); Tobias Herr, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Klaus Hartinger, Ecole Polytechnique Fédérale de Lausanne (Switzerland) and Menlo Systems GmbH (Germany); Ronald Holzwarth, Max-Planck-Institut für Quantenoptik (Germany) and Menlo Systems GmbH (Germany); David Hillerkuss, Rene Schmogrow, Karlsruher Institut für Technologie (Germany)

As data rates in world-wide communication networks and warehouse-scale datacenters continue to grow exponentially, the fundamental limits of electrical interconnects in terms of bandwidth, spatial density and power consumption become increasingly obvious. Optical interconnects are the most promising option to overcome these bottlenecks. By using highly parallel wavelength division multiplexing (WDM) schemes with tens or hundreds of channels, high aggregate transmission capacity can be provided while keeping symbol rates compliant with the electrical bandwidth of CMOS driver circuitry. Silicon photonics provides a platform for CMOS-compatible integration of the corresponding photonic-electronic interface, but scalability at the transmitter side is still limited by the lack of adequate optical sources. Hybrid integration of III-V-dies on silicon is a promising approach to realize on-chip active devices, but dense integration of tens of narrowband DFB lasers is technologically challenging and subject to thermal constraints.

In this talk, we will discuss an alternative approach to Terabit/s data transmission which relies on using frequency combs as optical sources. Frequency combs consist of a multitude of equidistant and narrowband spectral lines, each of which can be used for data transmission. In a proof-of-principle experiment, we have used a mode-locked solid-state laser and subsequent spectral broadening in a highly nonlinear fiber (HNLF) to generate a broadband comb with a line spacing of 12.5 GHz. A total number of 325 optical carriers were extracted from the comb and modulated with dual-polarization 16 QAM signals at a symbol rate of 12.5 GBd, resulting in an aggregate data stream of 32.5 Tbit/s. The data was transmitted over 227 km of standard single-mode fiber, thereby achieving a spectral efficiency of 6.4 bit/s/Hz. We are currently exploring the potential of high-Q silicon-nitride (SiN) microresonators as frequency comb generators for high-speed data transmission. In a first experiment, we have demonstrated transmission of an aggregate data rate of 170.8 Gbit/s on four channels. By systematically investigating the received data signals, we identify the occurrence of multiplet spectral lines as the main source of impairment. We expect that multiplet generation can be avoided by careful dispersion engineering and advanced pumping schemes, thereby enabling efficient Terabit/s data transmission with chip-scale frequency comb sources.