Workshop on Information Optics

Program

August 20-24, 2012

Quebec City

Monday, August 20th

9h30-10h	OPENING SESSION
10h - 10h30	Opening Keynote speaker **Active Nanophotonics** **Y. Fainman** University of California, San Diego Achieving the goal of dense photonic circuits integration requires miniaturization of materials, devices and subsystems, including passive components (e.g., engineered composite metamaterials, filters, etc.) and active components (e.g., lasers, modulators, detectors). Numerous information processing systems and concepts in space and time have been studied during the past decades. Yet, optical systems so far failed to move out of the lab. The integration of current optical technology is costly, bulky, fragile to align, and difficult to integrate with electronic systems. Our most recent work emphasizes the construction of optical engineered materials, components and devices directly on-chip, with the same lithographic tools as the surrounding electronics. This has been made possible by the advances in these tools, which can now create features significantly smaller than the optical wavelength. Arranged in a regular pattern, sub-wavelength features act as a metamaterial whose optical properties are controlled by the density and geometry of the pattern and its constituent materials. To advance this technology we need to create design, fabrication and testing tools. The design needs to incorporate not only the electromagnetic equations, but also the material and quantum physics equations to enable the investigation and analysis of near field interactions. These studies need to be integrated with device fabrication and characterization to validate the device concepts and optimize their performance. In this talk, we discuss some of the passive metamaterials and devices that recently have been demonstrated in our lab. These include our most recent results on monolithically integrated short pulse compressor utilized with SOI material platform and design, fabrication and testing of nanolasers constructed using metal-dielectric-semiconductor resonators confined in all three dimensions.
10h30 -11h	COFFEE BREAK
11h - 11h30	**Optical robotics in mesoscopia** **J. Glückstad** Technical University of Denmark With light's miniscule momentum, shrinking robotics down to the micro-scale regime creates opportunities for exploiting optical forces and torques in advanced actuation and control at the nano- and micro-scale dimensions. Advancing light-driven nano- or

	micro-robotics requires the optimization of optical forces and optical torques that, in turn, requires optimization of the underlying light-matter interactions. The requirement of having tightly focused beams in optical tweezer systems exemplifies the need for optimal light-shaping in optical trapping. On the other hand, the recently demonstrated optical lift or light foil shows that optical manipulation can be achieved, even by using unshaped light, and instead applying an appropriately shaped structure. Hence, a generic approach for optimizing light-matter interaction will involve the combination of optimal light-shaping techniques with the use of optimized shapes in the micro-robotics structures [1]. We designed different three-dimensional micro-structures and had them fabricated by two-photon polymerization at BRC Hungary. These micro-structures were then handled by our proprietary BioPhotonics Workstation to show proof-of-principle demon-strations illustrating 6DOF optical actuation of these two-photon fabricated three-dimensional microstructures. In addtion, we demonstrated the light shaping capabilities available on the BioPhotonics Workstation to demonstrate a new strategy for controlling microstructures that goes beyond the typical refractive light deflections that are exploited in conventional optical trapping and manipulation. We also proposed designing micro-structures for so-called structure-mediated access to the nanoscale and a completely new concept: waveguided optical waveguides.
11h30 - 12h	**Three-dimensional position measurement of gold nanoparticles trapped in optical tweezers using in-line low-coherence digital holography** **Yoshio Hayasaki** Utsunomiya University We demonstrate the three-dimensional position measurement of a 100nm-gold nanoparticle held in optical tweezers in solution using an in-line low-coherence digital holographic microscope. The trapped gold nanoparticle had the axial movement of 4.5nm in the standard deviation when a 300mW laser beam was focused with a 1.25NA objective lens.
12h - 13h30	LUNCH
13h30 - 14h	**On-axis holographic high performance 3D imaging using time multiplexing particles encoding** **Zeev Zalevsky** Bar-Ilan University In this paper we will present a new configuration for super resolution as well as for field of view extension in a digital holography concept based on random movement of sparse metallic particles. In the super resolution configuration, the particles are in proximity to the recorded object while in the field of view configuration, the particles are in proximity to the hologram plane. The particles movement encodes the high spatial

	features in the plane of their movement. This high resolution information can later be decoded by proper numerical post processing that either remedies the resolution limitations in the object plane (or the limited numerical aperture of the lens) or extends the field of view in the object plane. In both cases the time multiplexing encoding and decoding done via the particles allows enhanced holographic performance which of course, since holography is involved, can be translated into extraction of enhanced 3D information about the inspected object.
14h - 14h30	**Reconstruction characteristics of polarization holograms** **Kazuo Kuroda** University of Tokyo Holographic memory is one of the candidates of next-generation optical data storages of large capacity and high transfer rate. By using the polarization diversity, we can double the capacity. In order to analyze the performance of polarization holographic memory, we have to know the precise characteristics of the reconstruction of polarization holography. We found, however, that conventional theories of polarization holography are quite unsatisfactory for this purpose. Therefore, recently we have derived general theory of polarization holography based on the tensor expression of the optical response of polarization-sensitive materials. Based on this theory, we discuss the fundamental characteristics of recording and reconstruction of polarization holography in detail. It is found that, in general, the polarization state of the reconstructed signal is different from that of the recorded signal. This fact makes the design of polarization holographic memory system complicated because we have to retrieve the polarization state of original signal from measured data. We discuss the special material condition that the signal can be faithfully reconstructed.
14h30 - 15h	**Spatio-temporal control of ultra-short pulses by using diffractive optical elements** **Lluís Martínez León** Universitat Jaume I de Castelló When dealing with ultra-short laser pulses, a thorough management of their spatio-temporal characteristics may be crucial in applications such as coherent control of chemical reactions, parallel material processing or multiphoton excitation in non-linear microscopy. In this context, diffractive optical elements (DOEs) have shown their applicability to manipulate, in a convenient manner, the few-cycle pulses emitted by commercially available ultra-short light sources. Among other advantages, DOEs can provide high efficiency, compactness and very low additional material dispersion. Moreover, real-time pulse engineering is possible by codifying DOEs in spatial light modulators. In this communication, we present the recent research of our group, GROC•UJI, on the

	field of diffractive control of ultra-short pulses. On the one hand, by means of a quasi-direct space-to-time (QDST) shaper, several temporal and spectral profiles of ultra-short pulses have been designed and implemented. Spatio-temporal management, including dispersion compensation, has demonstrated to be essential for activating non-linear processes (e.g., two-photon absorption or second harmonic generation). On the other hand, we have achieved complete spatial control of ultra-short pulses, overcoming spatial chirp effects. The methods and experiments presented in this communication illustrate the capabilities of diffractive optical systems to control ultra-short laser pulses and their suitability for a variety of applications.
15h - 15h45	COFFEE BREAK
15h45 - 16h15	**Using Wavefront Coding in presence of non symmetric aberrations** **Simon Thibault** Université Laval Wavefront coding is a hybrid technology designed to increase depth of field of conventional optics but it can also be used to compensate for other aberration and ease tolerancing. The goal of our research is to apply this technology to panoramic imager. Panoramic imagers suffer from an increase level of aberration due to the large field of view and it is also subject to a special tolerance process. These imagers also typically have a wide variation of the PSF across the field of view and suffer from non-symmetric aberration like coma and astigmatism. In order to obtain the best result with wavefront coding, the PSF should be as invariant as possible over the whole field of view. Asymmetric phase masks, when used in systems having non-negligible asymmetric aberrations, generate variation in the final image quality. Therefore, a model to predict the final image quality of wavefront coding system in presence of these aberrations is needed. Wavefront-coded systems have been simulated using aberrations combination and noise. The final results were analysed using a variance based image quality criterion. From these results, it is possible to optimize phase mask for panoramic imager and predict the resulting image quality.
16h15 - 16h45	**Robust object detection in aerial imagery** **Yunlong Sheng** Université Laval Optical pattern recognition has been the initial motivation of the information optics community. This project aimed to target detection in high-resolution (11 cm/pixel) aerial imagery. We have developed two approaches, based on the Simple Linear Iterative Clustering (SLIC), which is simple, fast and requires input only one scale parameter. It combines regional (color) and edge (space distance) information to detect superpixels,

	which are homogenous local clusters of pixels. The irregularity in size and shape of superpixels is measured with the Hausdorff distance and serves a saliency measure to determine the salient region in the very large-scale aerial images. The first approach is component-based. The superpixels are merged with statistical region merging (SRM) to represent parts of vehicles (windshield and body parts). Among them, the cast shadow superpixels are detected and removed by a radiometry based tricolor attenuation model (TAM). Detecting parts is less sensitive to occlusion, rotation, and scale, view angle and illumination changes than detecting the object as whole. The parts are then combined to a car according to unique spatial relations with a deformable object-model. Car parts are detected with the Support Vector Machine (SVM) based on their radiometric, size and shape features. The second approach is based on the invariant Scale Invariant Feature Transform (SIFT) features, which describe each superpixel as belong to vehicle or non-vehicle classes by the SVM. The classified superpixels are clustered by unsupervised Affine Propagation (AP) clustering. Experimental results show the efficiency and robustness of both proposed approaches for the detection of vehicles in urban environment.
17h – 20h	CONFERENCE WELCOME RECEPTION

Tuesday, August 21st

9h30-10h	**Advanced imaging techniques by compressive sensing** **Enrique Tajahuerce** Universitat Jaume I de Castelló Compressive sensing is an emerging theory that shows a considerable variety of applications in the field of imaging techniques. In particular, a practical challenge addressed by compressive sampling is the design of optical systems able to provide spatial information about specific optical properties of an object. As an example of this kind of advanced imaging techniques, we present an optical architecture that performs spatially resolved measurements of the Stokes parameters of the light coming from a polarization object. To this end, a commercial (single-pixel) polarimeter is used as light detector to perform CS measurements. Experimental results are presented for an object that provides an inhomogeneous polarization distribution.

10h - 10h30	**Observation of Femtosecond Light Pulse Propagation by Digital Holography** **Takashi Kakue** Kyoto Institute of Technology We demonstrate motion pictures of femtosecond light pulse propagation by use of digital holography. We adopted lightin-flight recording by holography as a technique for observationof femtosecond light pulse propagation. We successfully observed femtosecond light pulse propagation for 530 fs by using a femtosecond light pulse whose center wavelength and temporal duration were 800 nm and 96 fs, respectively.
10h30 -11h	COFFEE BREAK
11h - 11h30	**Real time CUDA implementation of the geometric sensor** **José Manuel Rodriguez Ramos** University of La Laguna The geometric sensor is a new interpretation of the curvature sensor, as van Dam & Lane[1] have introduced in 2002. The idea is to extract directly the Zernike coefficients of the incident wavefront from the two measured defocused images using the Radon Transform, instead of integrate the wavefront curvature. The algorithm needs a least squares fit that could take a lot of time, and this fact could be hard to get a real time implementation for Adaptive Optics applications. In order to avoid this speed limitation, we have implemented such algorithm in a commercial Graphic Processing Unit (GPU) using the CUDA code. Parallel calculus using multiple GPUs is also implemented. A quality and time analysis for restoring wavefront phases will be presented. The position of the defocused images is crucial to obtain enough quality in the recovered wavefronts. Fresnel and Rayleigh-Sommerfeld diffraction propagations are also implemented in CUDA code, allowing fast simulation of the Adaptive Optics observations using a geometric sensor. As an important and direct application of this development, the segments of the Extremely Large Telescopes can be co-fased using this compact and simple sensor to detect the local piston and tilt between segments. We will present the first results on such new method for co-phasing. [1] *Wave-front sensing from defocused images by use of wave-front slopes* 10 September 2002 _ Vol. 41, No. 26 _ APPLIED OPTICS

11h30 - 12h	**Full-parallax 3D image capture by scanning vertical camera array** **Masahiro Yamaguchi** Tokyo Institute of Technology For the next-generation high-quality 3D image display, the light-field information, which corresponds the high-density light-rays traveling to various directions, is required. Camera array systems and integral imaging techniques have been developed for this purpose. However, in the camera array systems, it is sometimes difficult to interpolate the images between cameras. In integral imaging, the size of lenslet array limits the viewing angle. In this paper, a system for the acquisition of high-resolution full-parallax light-field for still 3D image is presented. The system comprises the scanning vertical camera array and the vertical view interpolation processing by depth image-based rendering. Since high-resolution horizontal view images are captured with horizontal scanning, the depth estimation is less complicated in comparison with that in conventional multi-view systems. Then the vertical view images can be successfully interpolated with using the depth information. As the scanning camera array can be controlled with only a single PC, a simple system can capture huge dataset of light field. In the experiment, a vertical array of seven cameras was scanned horizontally, and after the interpolation, 577*361 images of different views, where the resolution of each image was 480*640 pixels, were obtained. Scanning time was 40seconds, where wide viewing angle, i.e., 60 degrees, was captured. The effectiveness of the proposed system was demonstrated by applying the captured full-parallax light-ray information to free-viewpoint image generation, printing of full-parallax holographic stereogram, and calculation of computer generated hologram. As a result, 3D images with gloss and view-dependent texture could be reproduced in high quality.
12h - 13h30	LUNCH
13h30 - 14h	**Single beam microscopy for quantitative cell imaging** **Arun Anand** University of Baroda A quantitative microscope for 3D imaging of biological specimen employing single beam configuration is developed. The laser beam after interaction with the object is magnified and is converted into volume speckle field using a diffuser. The complex amplitude of this wavefront at the object plane is reconstructed from multiple axially separated speckle samples using phase retrieval algorithm. The method also has the capability of interferometric comparison of wavefronts at, providing just the object phase information. This technique was tested on several objects and was found to provide accurate results with high axial resolution.

14h - 14h30	**Metrology of optical properties of tissue phantoms** **Jean-Pierre Bouchard** Institut National d'Optique Tissue phantoms are necessary for the calibration of diffuse optical spectroscopy instrumentation. Solid tissue phantoms offer the benefit of long-term stability of their optical properties and are therefore the preferred solution for instrument response standardization. In addition to being stable, the reference phantom must also be well characterized in a manner that is laboratory independent. A survey of the different characterization method will be given. The time resolved transmittance method, being the preferred method of the authors, will be presented in more details along with an uncertainty analysis. This work will be put in the context of the current global collaboration activities in the field of diffuse spectroscopy standardization.
14h30 - 15h	POSTER POP SESSION
15h - 15h45	COFFEE BREAK
15h45 – 19h	INO VISIT AND COCKTAIL
19h –22h	DINNER DOWNTOWN

Wednesday, August 22nd

9h30-10h	**Digital Holographic Microscopy applied to Neurosciences** **Pierre Marquet** École Polytechnique de Lausanne Digital holographic microscopy (DHM) has recently emerged as a powerful quantitative phase technique in the field of living cell imaging allowing to non-invasively explore dynamic cellular processes modifying cell morphology and/or content. Concretely, an accurate interferometric measurement of the phase retardation of a light wave when transmitted through a specimen is performed. This natural quantitative phase retardation contrast, allowing to visualize transparent specimen without the use of any staining, is proportional to the thickness of the observed specimen and results of the difference in refractive indices between the specimen and the surrounding medium. A distinct feature of the nervous tissue is the intricate network of synaptic connections

	among neurons of diverse phenotypes. There is little doubt that electrical activities, influencing neuronal function and connectivity on multiple time scales, play a pivotal role in the development and integrative functions. However, with the exception of specific activity-dependent mechanisms which can modulate the density of spines on dendrites, our understanding of how electrical activity affects the structure and function of neuronal network is very limited. Within this framework, we present how DHM quantitative phase signal can be efficiently used to non-invasively resolve local neuronal network activity. On the other hand, tomographic approaches, performed by recording holograms from different sample's illumination directions, have also been developed to visualize the activity-mediated dynamics of tiny neuronal processes including dendrites and spines. A combination of these different DHM approaches could provide an efficiently tool to study the relationships between spatiotemporal activity patterns and neuronal network information processing.
10h - 10h30	**Simple methods for measuring spatial coherence and their relation to the Wigner function** **Miguel A. Alonso** University of Rochester Measurements of the state of coherence of an optical field are important, for example, in the characterization of sources used for illumination in imaging systems. However, within the second order theory of coherence, this characterization amounts to the determination of a four dimensional complex distribution. Therefore, the use of traditional techniques such as Young's two-pinhole setup would require a very large set of measurements. In this presentation several alternative approaches are described, which were inspired by the description of the field in terms of what is known as phase-space distributions, such as the Wigner and ambiguity functions. In particular, the Wigner function provides an intuitive description of partially coherent fields, which resembles the radiance from the theory of radiometry, i.e. it provides a weight to each ray in the system. One technique that can be used for the characterization of the field's coherence, known as phasespace tomography, is based on the recovery of the Wigner (or ambiguity) function from measurements of the optical intensity over a region of space. We will discuss the generalization of this technique beyond the paraxial regime through the use of generalizations of the Wigner and ambiguity functions. We will also present an alternative technique where the weight distribution of the subset of rays passing through a given point is recovered through the introduction of a transparent binary mask with a phase discontinuity. This technique provides simultaneously measurements of the coherence of the field at all pairs of points centered at this discontinuity.
10h30 -11h	COFFEE BREAK

11h - 11h30	**A Layered Type Hologrphic Display** **Jung-Young Son** Hanyang University A prototype holographic display system consisted of an electro-holographic display and (an) analog hologram(s) is designed to use in advertizing. The reconstructed image from the electro-holographic display appears on that from the analog hologram. This paper describes the characteristics of the system.
11h30 - 12h	**White-light light-emitting diode to simplify color digital lensless holographic microscopy** **Jorge Garcia-Sucerquia** Universidad Nacional de Colombia An alternative to reduce the complexity of color digital lensless holographic microscopy (CDLHM) is presented. A superbright white-light light-emitting diode (LED) is spectrally and spatially filtered to produce the needed illumination by CDLHM to work. CDLHM with LED illumination is used to image at full color a section of the head of a drosophila melanogaster fly (fruit fly). The method shows the capability of imaging objects of 2μm size.
12h - 13h30	LUNCH
13h30 - 14h	**Transverse electric and magnetic beams for extreme optics** **Michel Piché** Université Laval Most laser systems deliver laser beams whose polarization states are either linear or circular. In recent years, laser beams with other polarization states have been considered for specific applications. In this presentation, we will outline how free space transverse electric or magnetic beams of minimum order (TE_{01} or TM_{01} beams) can be used for applications spanning 20 orders of magnitude in laser power. TE_{01} laser beams exhibit azimuthal polarization and they have a zero at center; the size (full width at half maximum) of the dark zone around that zero can be as small as 0.29 l, well below the classical diffraction limit. We have developed a new strategy which we call Switching Laser Mode (SLAM) microscopy where we take advantage of the size of the dark zone at center of TE_{01} laser beams to enhance the resolution of confocal and two-photon microscopes; features as small as ~ 100 nm have been resolved with scanning laser beams of microwatt power. In principle, SLAM is applicable to any modality (CARS, SHG, THG) used in optical microscopy. TM_{01} laser beams are radially-polarized and they have a strong axial electric field component at focus. Such

	a field configuration is suitable for free space electron acceleration. Using exact solutions of Maxwell's equations, we have shown that electron acceleration from rest to MeV energies is feasible with tightly focused ultrafast TM_{01} laser beams with a power in the range of tens of gigawatts. Recent experimental demonstrations have confirmed the validity of the acceleration scheme. GeV energies are predicted with TM_{01} laser beams of petawatt power.
14h - 14h30	**Complexity Analysis in Holographic 3D Video Generation** **Dongkyung Nam** Samsung Advanced Institute of Technology Realizing the very natural video by using hologra- phy technology is thought as the ultimate goal of 3D display, and it is still remained as the Holy Grail to be explored. Difficulties lie on two challenging issues: development of the Giga-pixel holographic video display, which is feasible and meaningful for commercialization and fast calculation algorithms for the real- time holographic video generation. This presentation reviews the current status in holographic video generation methods in the aspect of the latter issue. The recent algorithms can be categorized into two main concepts of the point source hologram and the Fourier transform hologram. By analyzing the complexity of the algorithms, we realized that there is a common limitation regardless of the type of algorithms. I will address this issue and discuss the research directions to move one step forward for the commercial holographic video displays.
14h30 - 15h	**Interferometric methods of 3D surface structure Analysis** **Peter de Groot** ZYGO Corporation A brief overview of modern interferometric methods of surface measurements describes basic techniques, typical applications and common performance specifications. Recent developments include model-based methods, analysis of surface structures that include transparent films and optically unresolved features, and systems designed specifically to be compatible with industrial environments and international standards.
15h - 15h30	COFFEE BREAK
15h30 - 18h	VISIT COPL (UNIVERSITÉ LAVAL)
18h– 19h30	POSTER SESSION AND COCKTAIL

19h30– 22h	CONFERENCE BANQUET

Thursday, August 23rd

9h30-10h	**Coherent Raman Fast Spectral Microscopy** **Kazuyoshi Itoh** Osaka University Stimulated Raman scattering (SRS) microscopy is a label-free biomedical 3-D imaging technique suggested recently. The SRS microscopy offers various advantages, such as the accessibility to the vibrational spectrum, quantitative image contrast. We have developed a hyper-spectral SRS microscope system with rapid spectral tunability. A series of SRS images with a different vibrational content can be acquired in a frame-by-frame manner at up to the standard video rate. We employed multivariable analysis techniques to these hyperspectral images. The results of label-free 3-D imaging of biomedical samples and those of efficient and recognizable method of data reduction are presented.
10h - 10h30	**High resolution wavefront sensing with non-interferometric techniques** **Karl-Heinz Brenner** University of Heidelberg For the measurement of wave fronts there are is a variety of methods, which can be coarsely divided into interferometric and non-interferometric techniques. Each of these methods has its advantages and disadvantages. Here we combine the Hartmann-Shack (HS) method with the multi-plane phase retrieval method by Pedrini, thus obtaining a robust technique for measuring amplitude and phase with much higher spatial resolution than the classical HS-method.
10h30 -11h	COFFEE BREAK
11h - 11h30	**Open Quests in Optical Coherence Microscopy** **Rainer A. Leitgeb** Medical University of Vienna It is now twenty years since Optical Coherence Tomography (OCT) was introduced as

	promising new biomedical imaging technology. Since then it has found entrance into many different fields of medicine and shows also interesting applications in the field of biology. In summary the presentation aims at outlining present quests in OCT, to show possible future directions to lever current limitations, and in consequence to open exciting new perspectives in the field of biology and medicine.
11h30 - 12h	**Transfer matrices for the design of complete laser systems: Applications to Digital Holography and Interferometric Laser Imaging for Droplet Sizing** **Marc Brunnel** Université de Rouen Digital In-line Holography and Interferometric Laser Imaging for Doplet Sizing experiments are described in terms of generalized Huygens-Fresnel integrals whose coefficients depend on transfer matrices. The formalism allows to predict a wide range of optical configurations, in CW or femtosecond regimes.
12h - 13h30	LUNCH
13h30 - 14h	Conference Keynote Speaker **Holographic 3D display and telepresence using photorefractive polymers** **Nasser Peyghambarian** University of Arizona A 3D holographic display and telepresence is demonstrated using nanoscale polymeric materials. This is an application for future high speed optical network. The demand for higher bandwidth is continuing and it is predicted by industry experts that by 2020 access rates for individual users will be in excess of 10Gbps. This high bandwidth would enable transformative applications such as 3D holographic video for telepresence in interactive education, telemedicine and commerce. This presentation will review our advances in 3D holographic display[1-3] using nanostructured polymers and its use in holographic 3D telepresence.

14h - 14h30	**Three-dimensional photon counting imaging** **Bahram Javidi** University of Connecticut In this paper, we overview an iterative method based on total variation constraint and Bayesian framework to restore photon counting images. A 3D photon counting integral imaging using moving array-lens technique (MALT) is also introduced to improve the visualization of a reconstructed 3D scene. Experimental results verify the feasibility of these methods to enhance the visual quality under photon starved conditions.
14h30 - 15h	**Controlled Distortion: A new tool in modern lens design** **Jocelyn Parent** Immervision An optical system producing an image with non-constant magnification across the field of view, or optical distortion, is traditionally considered as undesirable. It is unpleasant and harder to interpret for a human observer to look at a curved image when the original object is straight. However, this should not be a limiting factor as it is possible to unwrap the image at the software level as long as object to image mapping is well known. This is often used to straighten the image from a wide-angle lens because of their natural tendency to have important distortion. Since it can be advantageous in information optics to image a certain part of the field of view with higher magnification while keeping a full surrounding view, the use of controlled distortion by optical designers to voluntary create zones of different magnification is now common. In this paper, we first explain the concept of controlled distortion from an optical design point of view. Advantages and applications of static controlled distortion, by example in wide-angle lenses already on the market, are then presented. Finally, extension of this concept to dynamically controlled distortion by using active surfaces is presented. Theory, simulations and experimental results from a dynamic controlled-distortion imager using a deformable mirror are shown.
15h – 15h45	COFFEE BREAK
15h45 - 16h15	**Full view-angle computer-generated hologram by a fast calculation method based on rigorous diffraction theory** **Toyohiko Yatagai** Utsunomiya University A fast diffraction algorithm for wide view angle computer-generated holograms is proposed. A rigorous scalar diffraction equation is derived and its fast calculation method based on FFT is discussed. A numerical example is presented.

16h15 – 16h45	**Coherent Spectroscopy with Incoherent Ultra-Short Laser Pulses** **Valery Milner** University of British Columbia High peak power ultrafast lasers are widely used in nonlinear spectroscopy but often limit its spectral resolution because of the broad frequency bandwidth of ultrashort laser pulses. Improving the resolution by achieving spectrally narrow excitation of, or emission from, the resonant medium has been the focus of many recent developments in ultrafast spectroscopy. Similar to many traditional nonlinear optical methods, state-of-the-art ultrafast spectroscopy relies on the coherence of laser pulses. In my talk, I will show that contrary to the common belief that spectral noise is detrimental to coherent spectroscopic measurements, it can be used for improving the resolution, efficiency and robustness against unavoidable degradation of pulse coherence. Using the example of Coherent Anti-Stokes Raman Scattering (CARS), I will review a few novel approaches to nonlinear ultrafast spectroscopy, in which random or pseudo-random noise is deliberately introduced and successfully used for the retrieval of high-resolution spectral information about the medium of interest.
18h –22h	CONFERENCE RECEPTION SPONSORED BY IMMERVISION Louis-Jolliet, St-Lawrence River

Friday, August 24th

9h30-10h	**Evolution of the contrast with misalignment in visual cryptograph** (Part 1) **Thierry Fournel** Université Sainte-Étienne The expression of the contrast in two-out-of-two visual cryptography is derived for shadow images composed of 1 _ *m* shares with respect to a relative transverse shift of the shadow images. **Contrast-enhanced Moiré Cryptography** (Part 2) Moire´ Cryptography allows decryption directly by observing the Moire´ pattern revealed by stacking together transparencies sharing the secret message embedded in a cover picture. The contrast of the cover picture in both the individual transparencies and the stacked one is enhanced.

10h - 10h30	**Anamorphic optics for compressive imaging and compressive motion tracking** **Adrian Stern** Ben-Gurion University of the Negev We overview some of the compressive imaging techniques based on anamorphic optics that we have developed during the last six years. Using anamorphic optical elements we introduced the first megapixel compressive imaging system, first progressive optical compressive sensing system with low acquisition time, and the first compressive motion tracking system with large field of view.
10h30 -11h	**Dual-plane in line digital holographic micrsocopy** **Chandra S Yelleswarapu** University of Massachusetts Digital holographic microscopy (DHM) is becoming increasingly popular as a quantitative phase imaging technique. With recent advances, it is now possible to obtain both amplitude and phase features of biological specimens at high acquisition rate. In this talk I will present our new in-line DHM technique, based on the recording of two interferograms at slightly different planes and numerically reconstructing the object information. The technique utilizes full spatial bandwidth of the camera and requires only two interferograms recorded at two different planes, which are recorded simultaneously using two sensor arrays. Thus the hologram acquisition time can be significantly shortened. Further, we used this dual-plane in-line digital holography technique and developed a robust phase encryption method for the encoding of 2D/3D objects. Using dual-plane setup, two in-line digital holograms are recorded at two different planes and are encrypted using two different double random phase encryption configurations, independently. The process of using two mutually exclusive encryption channels makes the system more robust against attacks since both the channels should be decrypted accurately in order to get a recognizable reconstruction. Experimental results of both amplitude and phase objects reconstruction as well as preliminary data of phase encryption will be discussed.
11h - 11h30	**On discrete Fourier transform of special polynomials** **Jean-Marie Becker** **Université Sainte-Étienne**
11h30 - 12h	CONFERENCE CLOSING REMARKS

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