SBFOTON CONFERENCE 2021

May 31st to June 2nd

Keep on shining

Conference Programme

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Keep on Shining

Welcome to the SBFoton International Optics and Photonics Conference (IOPC) 2021!

Under the theme “Keep on Shining” - a touch of hope for the present and the future - SBFoton 2021 is technically supported by IEEE Photonics Society (IPS) and is the specific conference for photonics and related technologies in Brazil.

The online interactive format of the Conference includes plenary sessions and peer-reviewed technical sessions besides virtual visits to photonics’ laboratories, tutorial sessions, a students paper competition and meetings with our sponsors and other attendees.

SBFOTON CONFERENCE 2021

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Schedule

MONDAY, MAY 31st

TUESDAY, JUNE 1st

WEDNESDAY, JUNE 2nd

Plenaries

MONDAY, MAY 31st

PL-G-MON-03

Initiatives of Ministry of Science, Technology and Innovation (MCTI) in Photonics

Presented by Paulo Cesar Rezende de Carvalho Alvim

9:00-9:30 / Auditorium

This presentation aims to present the Photonics initiatives carried out within the scope of the Ministry of Science, Technology and Innovation – MCTI. Inside the Ministry, the Secretariat of Entrepreneurship and Innovation (SEMPI-MCTI) has been responsible for Public Policies in Photonics since 2017. The General Coordination of Enabling Technologies (CGTH-DETAP-SEMPI-MCTI) is the technical area responsible for carrying out Programs in the fields of Photonics. In order to assist the MCTI in technical discussions, the MCTI implemented, through the Presidential Ordinance no. 10,137/2019, an Advisory Committee of Photonics (CCFOTO), designed to formulate, and evaluate proposals related to photonics. In addition, MCTI has been working with structuring Public Policies in Photonics, such as: (i) The Brazilian Photonics Initiative (IBFóton) that was established by the Ministerial Ordinance no. 4,532/2021. IBFóton is the main strategic program to encourage Photonics in the Brazil with a focus on promoting innovation in Brazilian industry and scientific, technological, economic and social development; and (ii) the Brazilian Photonics Laboratories System (Sisfóton-MCTI) that was established by the Ministerial Ordinance nº 4,530/2021. Sisfóton-MCTI is a set of laboratories or networks of multi-user laboratories, of open access to public and private users, and directed to research, development and the provision of technological services, entrepreneurship and innovation in Photonics. For the promotion of the area, the National Council for Scientific and Technological Development (CNPq), in partnership with the MCTI, launched the Public Call 01/2021 whose objective is to finance up to 11 laboratories in Photonics.

PL-G-MON-04

Intraoperative 5-ALA photodynamic therapy for newly diagnosed glioblastoma patients: a preliminary analysis of the INDYGO clinical trial (NCT03048240)

Presented by Serge Mordon

9:30-10:15 / Auditorium

Glioblastoma (GBM) is the most aggressive malignant primary brain tumor. The unfavorable prognosis despite maximal therapy relates to high propensity for recurrence. Thus, overall survival (OS) is quite limited and local failure remains the fundamental problem.
A safety and feasibility trial after treating GBM intraoperatively by photodynamic therapy (PDT) after 5-aminolevulinic acid (5-ALA) administration and maximal resection was performed at The Lille University Hospital, France.

Ten patients with newly diagnosed GBM were enrolled and treated between May 2017 and June 2018. The standardized therapeutic approach included maximal resection (near total or gross total tumor resection (GTR)) guided by 5-ALA fluorescence-guided surgery (followed by intraoperative PDT. Postoperatively, patients underwent adjuvant therapy (Stupp protocol). Follow-up included clinical examinations and brain MR imaging was performed every 3 months until tumor progression and/or death.

There were no unacceptable or unexpected toxicities or serious adverse effects. At the time of the interim analysis, the actuarial 12-months progression-free survival (PFS) rate was 60% (median 17.1 months), and the actuarial 12-months OS rate was 80% (median 23.1 months).
PDT delivered immediately after resection as an add-on therapy of this primary brain cancer is safe and may help to decrease the recurrence risk by targeting residual tumor cells in the resection cavity

PL-G-MON-05

Advancing photonic systems through machine learning

Presented by Francesco da Ross

10:15-11:00 / Auditorium

As our current society is highly dependent on our ability to share information, optical communication systems, i.e. the backbone of our communication infrastructure need to continuously evolve. The machine learning (ML) toolbox provides an effective and necessary set of tools to enable such technological advancements, as ML excels at: 1) learning complex input-output mappings allowing for simple system optimization, 2) extracting optimal decision rules for highly nonlinear classification problems 3) performing ultra-sensitive signal detection, 4) solving inverse system design problems. These strengths of ML make it applicable from the characterization of photonic devices to the optical subsystem design and full end-to-end system optimization.

In this talk, I will review our recent efforts on applying ML for signal equalization in intensity-modulated directly-detected (IM/DD) systems as well as constellation shaping for long-haul coherent transmission. I will discuss our proposed framework for the design and optimization of Raman amplifiers, Erbium-doped fiber amplifiers (EDFAs), and hybrid Raman+EDFA amplifiers. Finally, I will show an application of Bayesian filtering enabling ultra-sensitive characterization of fiber lasers and frequency combs, with potential applications in fiber sensing and quantum communication.

PL-G-MON-06

Overcoming the Light Penetration Limits in Photodynamic Therapy of Cancer

Presented by Brian Wilson

11:10-11:55 / Auditorium

The high attenuation of light in tissue limits clinical applications. In particular, photodynamic therapy (PDT) using light-activated compounds (photosensitizers) has been unsuccessful in treating melanoma, because of its high pigmentation. Approaches to address this are optical clearing and fs laser-based 2-photon activation. For other large and deep-seated tumors, an emerging strategy is Radiodynamic Therapy, in which PDT is mediated by a low dose of deeply-penetrating high-energy X-rays as the energy source. The low activation efficiency of RDT can be circumvented by targeting the photosensitizer to the cell nucleus. These concepts are demonstrated using cell and animal tumor models.

PL-G-MON-07

Towards space division multiplexing with 1000s of spatial modes

Presented by Nicolas Fontaine

11:55-12:40 / Auditorium

Space division multiplexed communications uses fibers supporting multiple spatial modes to increase the capacity carried by a single optical fiber. In this talk, I will overview some of the research inside and outside Nokia Bell Labs to build devices supporting large mode counts and the transmission experiments using these devices. The key components include mode multiplexers, optical amplifiers, and special optical fibers.

TUESDAY, JUNE 1st

PL-G-TUE-01

From Nonlinear Optics to High-Intensity Laser Physics

Presented by Donna Strickland

9:00-9:45 / Auditorium

The laser increased the intensity of light that can be generated by orders of magnitude and thus brought about nonlinear optical interactions with matter. Chirped pulse amplification, also known as CPA, changed the intensity level by a few more orders of magnitude and helped usher in a new type of laser-matter interaction that is referred to as high-intensity laser physics. In this talk, I will discuss the differences between nonlinear optics and high-intensity laser physics. The development of CPA and why short, intense laser pulses can cut transparent material will also be included. I will also discuss future applications.

PL-G-TUE-02

Photonic Glass Ceramics

Presented by Maurizio Ferrari

9:45-10:30 / Auditorium

Looking at the literature of the last years is evident that glass-based rare-earth-activated optical structures represent the technological pillar of a huge of photonic applications covering Health and Biology, Structural Engineering, Environment Monitoring Systems and Quantum Technologies. Since the pioneering work of Tick, Borrelli, Cornelius, and Newhouse on transparent glass ceramics performed in 1995, the research regarding photonic glass-ceramics is growing fast, covering a broad spectrum of applications. In the last years, we demonstrated that SiO2-SnO2 glass ceramics, presenting a strong absorption cross section in the UV range due to the SnO2 nanocrystal, are effective rare earth ions sensitizers. Another interesting property of the SiO2-SnO2 system is its photorefractivity, demonstrated in several papers published by our consortium. It has been shown that the UV irradiation induces refractive index change allowing the direct writing of both channel waveguides and Bragg gratings. The presented results not only demonstrate the viability and outstanding properties of the SiO2-SnO2 glass-ceramics for photonic applications but also lay the foundations for the fabrication of efficient integrated lasers.

PL-G-TUE-03

Advances in Photonic Aperiodic Arrays and Circulators

Presented by Hugo Enrique Hernández Figueroa

10:30-11:15 / Auditorium

Due to their much lower losses photonic dielectric antennas are preferred, in several applications, instead of the metallic ones. However, their sizes are typically in the order of one wavelength, consequently, if single beamforming is needed, the use of aperiodic phased arrays capable of suppressing grating lobes is mandatory. On the other hand, the recent development of nonreciprocal materials without external magnetization may enable the design of compact integrated circulators. Such devices among other applications, allow the antennas to operate in the transceiver mode. In this talk, the research advances of these two key topics will be addressed in detail.

PL-G-TUE-04

Photonics and the contribution to control microorganisms

Presented by Vanderlei Salvador Bagnato

11:25-11:55 / Auditorium

Using light as the main element, and photo-reactions as actions, it is possible to develop several techniques that allow microbiological control. From the treatment of infections external to the body, through internal infections to the preparation of organs, for transplantation, these are realities within photonics today. In this presentation, we will review the work carried out by the Center for Optics and Photonics at IFSC – University of São Paulo.

PL-G-MON-07

Extreme Light Scattering

Presented by Donald Umstadter

11:55-12:40 / Auditorium

We discuss the physics and applications of nonlinear Thomson scattering. When high intensity laser light (~1018 W/cm2) scattered with electrons, the degree of polarization of the scattered light was found to depend on its intensity level. This has implications for recent tests of cosmological theories based on the polarization of the cosmic microwave background. At higher intensity (~1021 W/cm2), a novel x-ray generation mechanism was demonstrated, namely high-order multiphoton Thomson scattering (n > 500).1 Nonlinear Thomson scattering was also predicted theoretically to measure the pulse duration of attosecond electron bunches.2 A compact all-laser-driven x-ray source with synchrotron quality and gamma-ray energy was developed, based on Thomson scattering by a highly relativistic electron beam (>100 MeV), which was accelerated by a laser-wakefield plasma wave. Experiments showed that the quality of the electron beam could be improved with optical injection.3 The x-rays were applied to structural analysis via femtosecond diffraction, and to active interrogation of shielded materials. Prospects for medical applications will also be discussed..

WEDNESDAY, JUNE 2nd

PL-G-WED-01

TCAD Simulation for Optics & Photonics

Presented by Eric Guichard

9:00-9:30 / Auditorium

In this talk we will describe optical devices and technologies and the methods used to design and analyze them. It is essential to have tools that can model the complex and diverse structures found in these devices and simulate them to provide insight into their performance and behavior. These tools need to rely on advanced physics modeling that often goes down to the quantum mechanical level and at the same time need work at the macro level for predicting J-V, thermal, and optical parameters. These tools are called Technology computer-aided design (technology CAD or TCAD) are part of electronic design automation and models semiconductor fabrication and semiconductor device operation.

PL-G-WED-02

Optical fibers in life-science applications

Presented by Walter Margulis

9:30-10:15 / Auditorium

Microstructured silica optical fibers and capillaries are a useful tool for various studies in life-sciences. Although not replacing lab-on-a-chip, they exhibit unique characteristics, such as minimally invasive footprint and potential use in-vivo. In this talk we describe some fiber-based systems that include high performance flow cytometers, cell separation and cell picking devices. We also discuss recent results on the development of a fiber-based molecular diagnostic system aiming at viral detection and quantification. The system is designed to perform loop-mediated isothermal amplification (LAMP) in thousands of droplets flowing in an optofluidic fiber arrangement. Digital viral presence or absence in each droplet is assessed through fluorescence probing. The number of droplets with the virus (e.g., COVID 19) should allow for quantifying the viral load of the sample analyzed.

Co-authors: S. Etcheverry, A. Sudirman, S. Sengupta, A.V. Harisha, R.Soares, H.H. Joensson, A. Russom, and F. Laurell

PL-G-WED-03

Shining Light on Nonlinear Optics in 2D Layered Transition Metal Dichalcogenides

Presented by Anderson Stevens Leonidas Gomes

10:15-11:00 / Auditorium

2D Layered Transition Metal Dichalcogenides (LTMDs) are bi-dimensional nanostructures consisting of atomically thin monolayers of the type MX2, with M a transition metal atom and X a chalcogen atom. Besides the well-known and studied semiconducting MoS2 and WS2, semi-metallic ZrTe2 and metallic NbS2 are examples of 2D LTMDs. In this talk, I shall review the relevant properties of the four above mentioned materials, some of the fabrication methods, and will describe nonlinear optical studies covering a range of excitation regimes. Using CW or CW/ML (>1MHz repetition rate) excitation sources with linearly or circularly polarized light, we show that the intensity dependent refractive

changes are thermal in origin, ~10-6cm2/W, and lead to ring formation due to spatial self-phase modulation. Using optical sources with 1kHz repetition rate and 100fs pulse duration, we determined the intensity dependent nonlinear refraction (~10-16cm2/W) of electronic origin, besides, in some cases, the nonlinear absorption. We also show how ZrTe2 can be used as a scatterer for a colloidal dye-based random laser.

PL-G-WED-04

Photonic Sensors at UTFPR - CPGEI

Presented by José Luis Fabris

11:10-11:55 / Auditorium

This talk will present and discuss following an historical timeline, the main achievements in the field of Photonic sensing. The focus will be on the activities developed within the Graduate Program in Electrical and Computer Engineering – CPGEI at Federal University of Technology – UTFPR. In the presentation, the evolution of research will be presented. From the early developments on optical fiber grating sensors, the establishment of new Photonic sensing branches in Spectroscopy and Plasmonics will be discussed.

PL-G-WED-05

Driven Electron and X-ray Sources

Presented by Franz X. Kärtner

11:15-12:40 / Auditorium

The use of very high frequencies, in the THz region, specifically 100 – 500 GHz, enables operation of accelerators at higher field strength with lower energetic driver pulses. This opens up the possibility of compact low emittance electron sources and high-brightness fully coherent X-ray sources. In this contribution, we summarize the progress made in the ERC Synergy Grant AXSIS: Attosecond X-ray Science – Imaging and Spectroscopy in source technology. The high acceleration fields and field gradients possible in terahertz devices enables novel electron bunch manipulations, bunch diagnostic and promise ultimately fully coherent X-ray production from compact sources. Latest experimental results in the implementation of electron and X-ray sources based on this technology will be discussed.

Tutorial Sessions

MONDAY, MAY 31st

LASERS

TS-L-MON-01-01

High Intensity ultrashor laser pulses and their applications at IPEN

Presented by Ricardo Samad

14:30-15:15 / Room 3

In this work recent developments on high-intensity ultrashort pulses will be presented.

TS-L-MON-01-02

An overview on laser shock peening process: from science to industrial applications

Presented by Alexandre Cunha

15:20-16:05 / Room 3

The surface of a material plays an important role in the behavior of engineered components. Surfaces are subjected to treatments in order to enhance the material performance by modifying and controlling its physical properties. In particular, modification of mechanical properties affects the wear and corrosion resistances, fatigue strength and, therefore, the component's service lifetime. In this scenario, peening processes are employed on different industrial sectors. The term "peening" originates from the act of hitting a metallic surface with the ball-peen end of a hammer. In history, blacksmiths have used this procedure to forge weapons and tools. In the modern industry, the technique has evolved to shoot metal or ceramic particles on the metal surface. In advanced manufacturing, photonics has found its niche in peening processes via laser technology, the so-called Laser Shock Peening (LSP). It utilizes high-energy laser pulses to create high-intensity shock waves able to plastically deform the materials and impose compressive residual stresses. In this tutorial session, LSP will be addressed through its basic phenomena, laser system setup, main LSP system suppliers, types of methods, advantages, disadvantages, treated materials, control of materials properties, and the current and potential industrial applications.

TS-L-MON-01-03

An overview on laser shock peening process: Electron beam properties in self-modulated laser wakefield acceleration using TW and sub-TW pulses

Presented by Edison Puig Maldonado

16:10-16:55 / Room 3

We review the fundamentals of electron beam generation in the self-modulated laser wakefield acceleration for the case of laser pulses with peak powers on the TW and sub-TW scale. The results of particle-in-cell simulations for λ = 0.8 μm and a thin H2 gas target are shown. By scanning the peak gas density values and the peak power of the incident laser, we discuss the resulting acceleration processes, as well as the characteristics of the electron beams generated for different conditions. Our approach provides a method to optimize these beams with lasers that operate at kHz repetition rates.

OPTICS AND INSTRUMENTATION

TS-O-MON-02-01

Femtosecond pulses for nonlinear optics: temporal, spectral and polarization dependence studies

Presented by Lino Misoguti

14:30-15:15 / Room 4

Due to their unique properties, femtosecond laser pulses have many applications in several areas of applied optics. In nonlinear optics, for instance, the broad bandwidth, high intensity and short pulse duration are explored by several experimental techniques to improve the understanding of nonlinear optical effects. Nowadays, thanks to the tunable laser pulses, it is possible to determine the spectral response of several materials' nonlinear effects. Moreover, among the study of response time of ultrafast phenomena, we can use these pulses with appropriate experimental method and laser polarization state to discriminate the origin of nonlinear effects. As it is known, an effective nonlinear optical signal can arise from different origins such as nearly instantaneous bound-electronic, non instantaneous nuclear contributions and thermal effects which need to be discriminated for better materials' characterization point of view. In this context, in this tutorial, I will present how the fundamental characteristics of ultrashort pulses and new experimental techniques can be explored to study the third-order nonlinear optics properties of materials

TS-O-MON-02-02

New test and measurements concepts in 800G and terabit communications

Presented by Rodrigo Vicentini

15:20-16:05 / Room 4

With the 5G recent introduction in the market, higher speed computing and communications demand new technologies. As usual, the data rates on both data center and optical coherent systems environment evolve and require new simulation tools and laboratory testers. During this lecture we will cover about the new test and measurements technologies around 400G and 800G data rates, and the Terabit communications for the systemic analysis perspective.

TS-O-MON-02-03

Hand-held photoacoustic imaging systems for biomedical applications

Presented by Theo Zeferino Pavan

16:10-16:55 / Room 4

Photoacoustic imaging (PAI) can provide physiological and anatomical information by combining optical absorption contrast with ultrasound spatial resolution and can be obtained up to a depth of a few centimeters. In PAI, short pulses of light are absorbed by the tissue, causing a local thermal expansion and subsequent acoustic wave emission. Hand-held PAI systems usually operate in reflection mode, where optical illumination and acoustic detection are arranged on the same side. In this talk, I will give an overview of different strategies for both optical illumination and acoustic detection reported for hand-held devices. A more detailed description will be provided for strategies involving linear-array transducers, which are commonly used in clinical ultrasound imaging platforms. More specifically, bright-field, standard dark-field, and long-axis lateral illumination strategies will be described. The strengths and limitations of each approach for clinical and pre-clinical applications will be discussed.

TUESDAY, JUNE 1st

SENSORS, IMAGE AND ILLUMINATION

TS-S-TUE-01-01

Sensors based on plasmonic devices and nanostructures – Part 1

Presented by Isabel C. S. Carvalho

14:30-15:15 / Room 3

Plasmonic devices and nanoparticles have been widely used in the last decades for the development of optical sensors with application in different scientific areas, spanning from biology to material science. In this tutorial, we will show the state of art of plasmonic sensors based on both Localized Surface Plasmon Resonance (LSPR) (Part1) and Surface Plasmon Polariton (SPP) (Part 2) applied to (bio-)molecular interactions, radiation sensing and characterization of organic and nanoparticle thin films

TS-S-TUE-01-02

Sensors based on plasmonic devices and nanostructures – Part 2

Presented by Tommaso Del Rosso

15:20-16:05 / Room 3

See previous abstract..

TS-S-TUE-01-03

Nanofluids for direct absorption solar collector and solar desalination

Presented by Diego Rativa

16:10-16:55 / Room 3

The amount of energy radiated by the sun in one hour is much higher than the energy used by all human beings in a year. The average annual horizontal radiation in

the Brazilian semi-arid region is more than 2,000 kWh/m2, which, together with low precipitations, convert the region into the most populous dry region of the earth, where making the threat to water a constant factor due to droughts' repeated occurrence. Solar collectors are simple devices that usually employ a fluid circulating in a network of tubes working as heat receptors. One way to enhance the energy transfer efficiency is to use a working fluid with optical properties to directly absorb the solar radiation, usually called Direct Solar Absorption Collector (DSAC). In the last decade, working fluids composed of different kinds of nanoparticles (NPs), usually known as nanofluids, have been broadly studied and proved much more efficient. Metallic NPs have a high thermal conductivity desirable for an efficient heat transfer, necessary to transfer the solar stored energy with the external devices and water heating. Therefore, the NPs inclusions introduce changes in the working fluid's optical and thermophysical properties. New designs to collect solar radiation efficiently and cheap and stable nanofluids create new opportunities for industrial and residential applications.

OPTICAL COMMUNICATION

TS-C-TUE-02-01

Advanced Forward Error Correction for Optical Fiber Communications

Presented by Vahid Aref

14:30-15:15 / Room 4

Forward Error Correction is an essential element of today's digital communication systems to guarantee reliable data transmission. Modern high-speed optical communication systems require high-performing FEC engines with low power consumption that support throughput of multiples of 100 Gbit/s, achieving Net Coding Gains (NCGs) close to the theoretical Shannon limits at a target Bit Error Rate (BER) of 1e-15.

In this tutorial, we overview the state-of-the-art FEC schemes for fiber-optic communications, namely spatially coupled LDPC codes, oFEC and the staircase codes. The last two FEC schemes are already standardized for OpenZR+ and OIF 400G-ZR. We explain that these elaborate FEC schemes have a common feature leading to their high NCGs. They are constructed from “convolutional” of their underlying block codes, namely Low-Density Parity-Check (LDPC) codes and Product Codes. We compare these schemes in terms of performance and complexity.

TS-C-TUE-02-02

Elastic Optical Networks

Presented by Helio Waldman

15:20-16:05 / Room 4

In elastic optical networks (EON's), the old fixed wavelength grid is replaced by a flexible grid of contiguous 12.5 GHz frequency slots. Each connection is assigned a tight integer number of such slots that is customized according to the requested bitrate and distance. A spectrally efficient modulation format is then chosen to provide connectivity with zero margin.

The motivation behind EON's is the efficient use of optical spectrum. However, heterogeneity of the (bitrate, distance) demands over translucent networks means that rectangular objects with different shapes must now be dynamically assigned on a mesh of routes made from 320-slot links. Spectral fragmentation losses may then frustrate a large part of the gains awarded by coherent detection unless a very smart algorithm is designed to minimize them.

This problem is compounded by other concerns. Most connections need protection against fiber cuts due to their critical mission. This used to be done with redundancy which must now be weighed against overprovision. The need to support 5G and 6G technologies implies the provision of very low latency (1 ms) to some critical services. Security is a major concern, including and especially in the physical layer. The overall complexity is only manageable with a massive increase of intelligence enabled by machine learning.

TS-C-TUE-02-03

Security in Optical Communication Systems: Data Encryption and Beyond

Presented by Marcelo L. F. Abbade

16:10-16:55 / Room 4

Optical communication systems (OCSs) are prone to a myriad of security threats, such as fiber cutting, tapping, and jamming. However, OCSs also provide appropriate conditions for the exchange of encryption keys by quantum-based approaches and for the emergence of signal encryption. Both these strategies may lead to unprecedented levels of security. In this paper, we present a brief review on the security menaces and opportunities related to OCSs. Encryption-based solutions receive special attention.

WEDNESDAY, JUNE 2nd

INTEGRATED PHOTONICS AND OPTOELECTRONICS

TS-I-WED-01-01

How to develop your PIC-based product – from protorype to production

Presented by Giovanni B. Farias

14:30-15:15 / Room 3

Photonic Integrated Circuits technologies bring several advantages compared to traditional bulk products that are based on discrete components. In this tutorial, the workflow for the development of products based on Photonic Integrated Circuits (PIC) will be presented. The steps of a full development cycle, from system concept to test and packaging will be reviewed. The PIC platforms available for fabrication will be presented and compared, and their maturity will be discussed. Finally, a discussion about the Technology Readiness Levels (TRLs) and the requirements for each step, from prototype to pre-production will be made.

TS-I-WED-01-02

Brillouin optomechanics nanophotonics structures

Presented by Thiago P. M. Alegre

15:20-16:05 / Room 3

The interaction between light and mesoscopic mechanical degrees of freedom has been investigated under various perspectives, from long-haul optical fiber communication system penalties to gravitational-wave detector noise. In the context of integrated photonics, two topics with dissimilar origins — cavity optomechanics and guided wave Brillouin scattering — are rooted in the manipulation and control of the energy exchange between trapped light and mechanical modes. In this talk, I will review some of the key aspects of this interaction and how to use fine control over the design and fabrication of microstructures to control both the optical and acoustic spectra to shape such interaction.

TS-I-WED-02-03

Custom manufacturing of photonic ICs

Presented by Roberto Panepucci

16:10-16:55 / Room 3

Optical communication systems (OCSs) are prone to a myriad of security threats, such as fiber cutting, tapping, and jamming. However, OCSs also provide appropriate conditions for the exchange of encryption keys by quantum-based approaches and for the emergence of signal encryption. Both these strategies may lead to unprecedented levels of security. In this paper, we present a brief review on the security menaces and opportunities related to OCSs. Encryption-based solutions receive special attention.

BIOPHOTONICS

TS-B-WED-02-01

Protoporphyrin IX: Na Endogenous Theranostic Compound

Presented by Lilia Courrol

14:30-15:15 / Room 4

Porphyria, cancer, and atherosclerosis patients manifest increased concentration of protoporphyrin IX (PpIX) in tissues and blood, and PpIX fluorescence can be used to diagnose these diseases. This review will describe the role of PpIX inside the cells and organisms. Diagnosis and therapy approaches using PpIX will be described. Finally, we will also evaluate if PpIX could be used to diagnose and treat Covid-19 since an abnormal phenomenon related to hemoglobin dysfunction was observed in the patients with this disease.

TS-B-WED-02-02

Machine learning methods for micro-FTIR imaging classification of human skin tumors

Presented by Denise Zezell

15:20-16:105 / Room 4

This review presents some methods applied to micro-FTIR imaging for classification of human skin tumors. It is a collection of the pre-processing pipeline and machine learning classification models. The aim of this review is to update and summarize the current methods which are applied in our skin tumor research.

TS-B-WED-02-03

Antimicrobial Photodynamic Therapy

Presented by Cristina Kurachi

16:10-16:55 / Room 4

Antimicrobial photodynamic therapy (aPDT) uses the combination of photosensitizer, light and oxygen to induce microorganism death for the local treament of infected tissues. Its mechanism of action is based on the production of reactive species, mostly singlet oxygen, resulting in the oxidative damage of any biomolecule nearby where the photosensitizer is located. If minimal conditions of local photosensitizer and oxygen concentrations and light dose are achieved, microorganism inactivation is induced. One of the main advantages of aPDT is due to its action being non-biological site specific, so inactivation of distinct species of bacteria, fungi and virus are observed, and antimicrobial resistance is highly unfeasible. Examples of aPDT applications will be presented, discussing the strategies to individualize treatment protocols for achieving clinical efficacy and safety, including proof-of-concept, instrument development, and preclinical and clinical validations.

Technical Sessions

MONDAY, MAY 31st

ORAL SESSIONS

BIOPHONICS 1

OS-B-MON-01-01

(Invited Speaker) Fourier-Transform Infrared spectroscopy versus antibodies chemiluminescent immunoassay for COVID-19 diagnosis

Herculano da Silva Martinho, José Angelo Lauletta Lindoso, Paulo Henrique Braz da Silva, Carla Carolina Bandeira

14:30-15:00 / Room 1

COVID-19 is a World sanitary emergency. The tragedy related to this epidemic disease evolves actually more than 100 million confirmed cases and at least 2 million deaths. In this work we investigate whether FTIR operating under blood serum samples is viable option for COVID-19 diagnosis and fatality prediction. The performance of FTIR was compared to chemiluminescence immunoassay for anti-SARS-CoV-2 IgM and IgG antibodies in order to discuss vantages and advantages and viability for point-of-care applications.

OS-B-MON-01-02

Spectraloptimization for RGB skin oxygenation measurements

Antonio de Sousa Dias, Murilo S. Sampaio, Raquel Pantojo de Souza, George C. Cardoso

15:00-15:20 / Room 1

In this article we investigate the spectral properties of light and RGB systems that optimize precision for spectral quantification of chromophores melanin, oxyhemoglobin, and deoxyhemoglobin in skin images. The methodology uses the Beer-Lambert law, and the stability of the resultant system of equations is studied regarding spectral properties of the RGB channels plus illuminant. We found that a well-posed problem depends on the choice of the spectral properties of the illuminant and the RGB. Poor spectral choices lead to losses of up to three significant digits beyond in system noise. We also show the desirable spectral ranges.

OS-B-MON-01-03

Evaluation of curcumin incubation time in Staphylococcus aureus and Pseudomonas aeruginosa Photodynamic inactivation

Mariana Geraldi, Thaila Correa, José D. Vollet Filho, Cristina Kurachi, Sebastião Pratavieira, Clovis de Sousa, Vanderlei Bagnato

15:20-15:40 / Room 1

This study evaluated curcumin incubation time in photodynamic inactivation with bacteria of different wall compositions: Staphylococcus aureus and Pseudomonas aeruginosa. Bacteria samples were cultured for 24h (37°C). Curcumin was dissolved in dimethylsulphoxide and subsequently diluted for final concentrations. Fluence used was 30J/cm2 (at 460nm excitation). After incubation with photosensitizer and irradiation, ten-fold serial dilutions were plated and incubated at 37°C for 48h for CFU counting. treatment reduced approximately 7 logs of 1μM S. aureus after 30min incubation, whereas 2 logs only for P. aeruginosa at 50μM maximum concentration. Photosensitizer removed from the medium before irradiation resulted in lower reductions.

BIOPHONICS 2

OS-B-MON-02-01

(Invited Speaker) Dynamic Brillouin microscopy Imaging

Vladislav Yakovlev

16:00-16:30 / Room 1

This talk reviews the Brillouin effect applied to spectroscopy and imaging in applications of elasticity characterization on living organisms.

OS-B-MON-02-02

(Invited Speaker) Salivary infrared spectroscopy: a new horizon on diagnostic to systemic and emerging diseases

Robinson Sabino da SIlva

16:30-17:00 / Room 1

The diagnostic of chronic diseases as diabetes, breast cancer, and chronic kidney diseases is invasive, and costly. In this context, emerging diseases also need improvement in the diagnosis. Consequently, the search for a sustainable, reagent-free, more cost-effective and non-invasive diagnostic platform is critical to public health. In this way, salivary biomarkers are an attractive alternative for early detection of systemic diseases. Salivary diagnosis offers several advantages than others biofluids. The attenuated total reflection Fourier-transform infrared (ATR-FTIR) spectrometry is a global, high-sensitive and highly reproducible analytical platform that detects molecular components. Here, we propose to exploit the advances of ATR-FTIR platforms to develop a sustainable platform as n new horizon on salivary diagnostic to systemic and emerging diseases.

OS-B-MON-02-03

Hyperspectral Imaging System for Tissue Classification in H&E-Stained Histological Slides

Mateus Souza, Felipe Carvalho, Enzo Sverzut, Michelle Barreto, Raquena, Marlon Rodrigues Garcia, Sebastião Pratavieira

17:00-17:20 / Room 1

This paper presents the development of a hyperspectral imaging system for the classification of H&E-stained histological slides. The system was developed to be coupled to a conventional microscope, with software dedicated to control the instrumentation, to show a colorful life image from an RGB camera, and to acquire the hyperspectral imaging using a liquid crystal tunable filter (LCTF). Hyperspectral images of rats undergoing photodynamic therapy were classified with four different machine learning algorithms to find damaged tissues (crust). The classification results were presented, and show that this technique is promising to classify rats tissue regions.

OS-B-MON-02-04

Healing status of burn wound healing: ATR-FTIR study

Pedro Castro, Telma Zorn, Denise M. Zezell

17:20-17:40 / Room 1

The purpose of this study is to use infrared spectroscopy (FTIR) for monitoring biological changes in burned skin. Wistar rats dorsum samples were compared to healthy group samples at 7, 14, 21 days after burn. Proteins changes of burn wounds were monitored by area under the curve (AUC) of bands at 1630cm-1, 1543cm-1 and 1743cm-1. Kruskal-Wallis normality tests, unpaired t test with Welch's correction were used to evaluate the differences between AUC. These bands suggest association between collagen activity during wound healing stages. Our result indicates progressive recovery of 7,14 and 21 days tissues when compared with the healthy group.

OPTICAL COMMUNICATION 1

OS-C-MON-01-01

(Invited Speaker) Recent advances in machine learning-enabled inverse system design

Uiara Celine de Moura

14:30-15:00 / Room 2

The traditional procedure to design optical devices consists of starting with an initial set of parameters (normally based on the designer's previous knowledge) and performing some parameter sweep around the initial condition to improve the device performance. This human-controlled design approach has two key drawbacks: it is time-consuming/work-intensive and tends to ignore solutions that could have better performance but are far from the initial guess. Based on the idea that the underlying features in a given data set can be automatically learned through specific algorithms, machine learning techniques have been successfully applied in optical communication systems and integrated photonics. They are employed to learn complex functions and perform the inverse system design for optical amplifiers, optical fibers, and integrated photonic structures. In these approaches, an artificial neural network model receives the target device performance and provides an optimized set of parameters more straightforwardly when compared to the traditional design procedure. Here, we review the recent progress in machine learning-based approaches for the design and optimization of optical devices. Then, we will focus on our recent machine learning framework for the Raman amplifier inverse design and how it is applied to provide on-demand gain profiles in a controlled way.

OS-C-MON-01-02

Front-end specifications impact on Kramers-Kronig self-coherent systems

Andre Souza, Josér Helio da Cruz Jr, Tiago Sutili, Rafael C. Figueiredo

15:00-15:20 / Room 2

This work evaluates the requirements in terms of resolution and bandwidth of digital-to-analog and analog-to-digital converters and linewidth of lasers in a system with Kramers-Kronig receiver with receive-side laser and polarization multiplexing. The results indicate that spectral efficiency and lasers' linewidth requirements are close to those of coherent systems, but demanding twice the bandwidth of the analog-to-digital converter. Therefore, employing KK to replace coherent reception will require a careful analysis of energy consumption, performance and complexity trade-off, taking into account that KK demands a front-end with more complex specifications to achieve the desired performance.

OS-C-MON-01-03

Intensity modulated optical systems for next generation of data center interconnects

Tiago Sutili, Sandro Marcelo Rossi, André Souza, José Hélio da Cruz Jr, Rafael C. Figueiredo

15:20-15:40 / Room 2

This work investigates the performance of intensity modulated point-to-point optical links considering limitations from the electro-optical modulator bandwidth. All simulated scenarios considered a net transmission rate of 1 Tb/s, aiming to evaluate the feasibility of intensity modulated solutions for the next generation of short range optical links. Results indicate that, even considering a state-of-the-art electro-optical modulator, a 1-Tb/s transmission is viable only by using several wavelength-multiplexed optical subcarriers. The increase in the cost of this approach, when compared to coherent or self-coherent solutions, indicates the tendency to employ more spectrally efficient solutions on next-generation Data Center interconnects.

OPTICAL COMMUNICATION 2

OS-C-MON-02-01

(Invited Paper) FEC-assisted nonlinearity compensation for coherent optical receivers

Edson Porto da Silva

16:00-16:30 / Room 2

An overview of the FEC-assisted digital signal processing (DSP) techniques for fiber nonlinearity compensation (NLC) in coherent optical receivers is presented, with focus on DSP schemes that are able to improve the performance of NLC by using hard or soft information feedback from FEC-decoders. Challenges and new research directions are discussed.

OS-C-MON-02-02

32-GBd 16QAM optical signals wavelength conversion based on four-wave mixing phenomena in semiconductor optical amplifiers

Peterson Rocha, Tiago Sutili, Sandro Marcelo Rossi, Cristiano M. Galep, Rafael C. Figueiredo, Evando Conforti

16:30-16:50 / Room 2

A scheme based on the four-wave mixing (FWM) phenomena in semiconductor optical amplifiers (SOA) is optimized and characterized for low-penalty wavelength conversion of 16-ary quadrature amplitude modulated (16QAM) signals with symbol rates equal to 20 GBd, 28 GBd, and 32 GBd. Through an experimental optimization process, the SOA operational conditions were adjusted to avoid severe degradation of the converted signal due to nonlinear phenomena and noise insertion, while maximizing the conversion efficiency avoiding spurious FWM products. The obtained results indicate the feasibility of employing ultra-nonlinear SOAs to perform low-penalty wavelength conversion in coherent optical systems.

OS-C-MON-02-03

Nonlinear phase noise compensation in single-span digital coherent optical systems employing artificial neural networks

Lucas Marim, Rômulo de Paula, José de Oliveira, Miriam Santos, Rafael Abrantes Penchel, Gretell Perez, Marcelo Abbade, Ivan A. Aldaya

16:50-17:10 / Room 2

As digital coherent technology gets mature and its cost reduces, it is becoming a competitive solution for future implementations of high-capacity long-reach passive optical networks (LR-PON). In the case of single-channel LR-PONs, the system performance is ultimately limited by the combined effect of the receiver additive noise and the nonlinear phase noise, which in turn is a consequence of the interplay between dispersion and Kerr-induced self-phase modulation. In this paper, we show that by employing a three-layer artificial neural network (ANN) to mitigate the effect of nonlinear phase noise, the bit error rate is reduced from 7·10-4 to 5·10-4.

POSTER SESSION 1

PS-MON-01-01

Analytical formulation of na Yb-doped Tandem-pumping fiber amplifier

Pedro Bernardo Melo, Ricardo E. Samad, Claudio Motta

8:00-17:15

An analytical formulation of a multi-kilowatt ytterbium-doped double-cladding tandem-pumped fiber amplifier was developed and is reported in this paper. The model consists of a system including the laser rate, pumping and seed power equations. The model was validated by describing a fiber amplifier behavior with a 5.986kW, 1018nm pumping and a signal seed of 75W, 1080nm, yielding a maximum power output of 5.448kW, with an efficiency of 91.1%. The thermal equations are solved for the temperature distribution along the fiber with a maximum temperature of 43.24°C, when the convective coefficient of 4000W . m -2 . K -1 is used.

PS-MON-01-02

New double line architecture produced by fs laser irradiation in Nd3+ doped TeO2-ZnO glass for photonic applications

Evellyn Magalhães, Nikaus Wetter, Luciana Kassab, Wagner de Rossi

8:00-17:15

We report fabrication and passive characterization of Nd3+ doped TeO2-ZnO glass with a new configuration of double waveguides, written with fs laser. The two written lines that form the double waveguide are formed by several overlapping lines. Results of output mode profile, beam quality factor M2 (My of 24 and Mx of 14 at 632nm) and refractive index change are presented and laser writing parameters. Writing speed of 0.5mm/s and pulse energy of 15μJ demonstrated to be adequate parameters. Refractive index changes of 1x10-5 and 1x10-4 at 632nm for double waveguides written with 4/8 overlapping lines, respectively are shown.

PS-MON-01-03

Numerical simulations of gain and power of a multi-quantum well laser

Wender Gonçalves Daniel

8:00-17:15

This paper presents the results and procedures of simulations of our Multi-Quantum Well (MQW) laser in a model constructed in the commercial solvers of the Ansys/Lumerical® software. Usually, the design and fabrication of lasers MQW are challenging and expensive, thus simulations can hasten the development and give insights about design parameters. In this work, simulated power curves are compared to the measured curves, and a good agreement is obtained when the parameters are adjusted. Nonradiative recombinations and self-heating are the main effects that influence the performance of the simulated laser.

PS-MON-01-04

Refractive index change analysis in a high-power Yb-doped double-clad fiber laser

Elbis Cardoso, Ricardo E. Samad, Claudio Motta

8:00-17:15

An analytical investigation of the refractive index behavior of an ytterbium-doped optical fiber silica glass as a function of the core-clad temperature, upper-level population laser density and pumping signal intensity is presented in this paper. For the substantiation of the investigation, three fundamental expressions were used, which describe the changes in the refractive index due to these physical phenomena in the laser medium. The model was evaluated considering a 500 W steady state fiber laser, operating in a two-end pumped configuration.

PS-MON-01-05

Record optical efficiency for a diode-side-pumped Nd:YFL4 laser operating at 1053nm

Felipe M. Prado, Nikaus Wetter

8:00-17:15

Here we compare the efficiency and beam parameters of different single-bounce Nd: YLF4 resonators. A total of five cavities were made by changing both, the folding mirror and the output coupler of the resonator. The best configuration resulted in a cavity that generated a record slope efficiency of 67% and 63% of optical-to-optical efficiency with a peak output power of 64.5 W for a pumping power of 101.8 W at 797 nm.

PS-MON-01-06

Theoretical and experimental study of supersonic gas jet targets for laser wakefield acceleration

Fabio Tabacow, Armando C.F. Zuffi, Ricardo E. Samad, Edison P. Maldonado

8:00-17:15

This work reports a theoretical and experimental study of supersonic gas jet flows that work as a renewable target laser wakefield particle acceleration. A comparison between theoretical and experimental results is made in order to estimate previously the results of a real De Laval nozzle manufactured in our laboratory. The comparison between the results shows that the CFD simulations describes the phenomena of the supersonic gas jet flow for N2.

PS-MON-01-07

Diamond-based optical vector magnetometer to study current densities in 2D materials

Charlie O, Oncebay Segura, Sergio R. Muniz

8:00-17:15

We describe the construction and characterization of a high-resolution optical magnetometer to measure the full vector magnetic field on a plane just a few nanometers thick, near the surface of the device. It is a solid-state device based on atom-like quantum sensors created by an engineered layer of NV centers located less than 20 nm from the surface of an ultrapure diamond. The ensemble of quantum nanosensors provides a vector magnetometer capable of mapping magnetic fields and current densities with a submicrometer resolution, suitable to study 2D materials. Here, we show a custom-built prototype to demonstrate the principle.

PS-MON-01-08

Dynamically controlled double-well optical potential for colloidal particles

Thalyta T. Martins, Sergio R. Muniz

8:00-17:15

Here we compare the efficiency and beam parameters of different single-bounce Nd: YLF4 resonators. A total of five cavities were made by changing both, the folding mirror and the output coupler of the resonator. The best configuration resulted in a cavity that generated a record slope efficiency of 67% and 63% of optical-to-optical efficiency with a peak output power of 64.5 W for a pumping power of 101.8 W at 797 nm.

PS-MON-01-09

Surface oxidation of AISI 304 stainless steel using a 455nm diode laser

Rudimar Riva, Nathalia Jesus, Millena Contente, Romario Pinheiro, Evaldo Corat, Aline Capella, Walter Miyakawa

8:00-17:15

In this work, we investigate surface oxidation on AISI 304 stainless steel using a low-cost engraving system based on a low power 445 nm diode laser. The treated samples were analyzed by optical microscopy as well as by Raman spectroscopy. The oxides formed on the steel surface were identified, and the results show the influence of the operating parameters on the oxidation formation process.

PS-MON-01-10

Highly efficient Fermi level thunning in EO waveguide based on double layer graphene capacitor

Hilton H. Shimabuko, Ary V.R. Portes, Lucia Akemi Miyazato Saito, Jhonattan Cordoba Ramirez

8:00-17:15

The implementation of low-loss electrooptical devices in multiple areas of knowledge has been a recurring need in the scientific community since most conductive materials have high optical absorption. The graphene has been presented as a possible solution, due to its extraordinary electrical and mechanical properties and bands distribution without a bandgap, which provides the optimal conditions to tune the optical absorption of the material, varying its Fermi energy. In this work, the design of strongly confined optical mode embedded double-layer graphene capacitor, based on Fermi level control is presented.

PS-MON-01-11

Modeling of fiber Bragg gratings with different lengths for the reflectivity control for fiber lasers

Davi Nacaratii, Ricardo E. Samad, Claudio Motta

8:00-17:15

An analytical formulation and modeling of an optical fiber Bragg grating has been developed and is reported in this paper. Supported by the coupled-mode theory and considering that the mode fields of the unperturbed waveguide remain unchanged in the presence of weak perturbations, it is possible to obtain first-order differential equations which have solutions for some types of periodic perturbations. Finally, the model is applied to analyze the influence of structural parameters of fiber gratings, such as length, period and refractive index modulation on its reflectivity and bandwidth.

PS-MON-01-12

Photonic chip characterization system with layout navigation

Claudecir Ricardo Biazoli, Roberto R. Panepucci

8:00-17:15

We developed an automated system for navigating photonic chips through layout for automatic testing as well as assisted troubleshooting. The system was built to allow, in addition to standard grating-coupling measurements, top-scattering measurement along the waveguide structures for characterization of the devices/materials for each platform layout and estimate the optical loss per unit of length, making it possible to improve the next generation of devices. Micrometer resolution mapping along the digitized path of the waveguide was achieved, enabling video monitoring of scattering events and changes in the intensity map.

TUESDAY, JUNE 1st

ORAL SESSIONS

LASERS 1

OS-L-TUE-01-01

(Invited Paper) Laser wakefield electron accelerator: possible use for radiosotope production

Nilson Dias Vieira Jr. Edison P. Maldonado, Alexandre Bonatto, Roger Pizzato Nunes, Suddep Banerjee, Frederico A. Genezini, Mauricio Moralles, Armando C.F. Zuffi, Ricardo E. Samad

14:30-15:00 / Room 1

Recently, lasers with peak power on the TW level operating at 1 kHz have been used to produce quasimonoenergetic electron beams with good quality and energy in the 15 MeV range, by laser wakefield acceleration (LWFA). Due to the fast growth of the repetition rates of this class of lasers, practical applications such as the production of gamma rays to initiate photofission nuclear reactions, in order to produce medical systems, capable of matching the resonant acceleration conditions (few-fs, several-mJ pulses), are now available.

OS-L-TUE-01-02

Development of a modified Mach-Zehnder interferometer for time and space density measurements for laser wakefield acceleration

Armando V.F. Zuffi, Edison P. Maldonado, Nilson Vieira, Ricardo E. Samad

15:00-15:20 / Room 1

This work reports the development of a modified Michelson interferometer aimed at determining the density of gas targets and laser generated plasmas, in time and space. This interferometer will compose our laboratory implementations for laser wakefield acceleration, allowing the characterizations of gas jet profiles generated by submillimeter nozzles. The technique also allows us to estimate the temporal evolution of the plasma density.

OS-L-TUE-01-03

Development of dielectric de Laval nozzles for laser electron acceleration by ultrashort pulses micromachining

Bruno Britto Chiomento, Ricardo E. Samad, Fabio Tabacow, Armando V.F. Zuffi, Edison P. Maldonado, Nilson Vieira

15:20-15:40 / Room 1

This work reports the development and experimental implementation of a methodology for manufacturing sub millimetric de Laval nozzles by ultrashort laser pulses micromachining by trepanning. The use of a ceramic substrate resulted in the fabrication of nozzles with high circularity and low roughness, which should generate high-quality gas targets for accelerating electrons with ultrashort laser pulses.

LASERS 2

OS-L-TUE-02-01

(Invited Paper) Synchrotron infrared nanospectroscopy as a game changer in nanophotonics

Raul de Oliveira Freitas

16:00-16:30 / Room 1

Modern technological applications share a variety of common demands, especially the need for smaller functional devices operating with unprecedented data processing power. Hence, nanoscale devices for light traffic are promising candidates for that end. Therefore, a set of advances are required to drive research into real-world applications in this area, including disruptive advances in the available characterization tools. This work presents an overview of how synchrotron infrared nanospectroscopy has contributed to the progress of nanophotonics. Technique description, data processing, and recent studies highlight the uniqueness of the technique for accessing nano-optical phenomena in novel quantum materials.

OS-L-TUE-02-02

Measurements of spin-coherence in NV centers for diamond-based quantum sensors

Lucas N. S. de Andrade, Charlie O. Oncebay Segura, Sergio R. Muniz

16:30-16:50 / Room 1

One of the biggest challenges to implement quantum protocols and quantum information processing (QIP) is achieving long coherence times, usually requiring systems ultra low temperatures. The nitrogen-vacancy (NV) center in diamond is a promising alternative to this general problem. Due to its spin properties, easy manipulation, and the possibility to do optical state initialization and readout, it quickly became one of the best solid-state spin system for QIP at room temperature. Here, we present the characterization of the spin-coherence of an ensemble of NV centers in engineered sample of ultrapure diamond, as a testbed for quantum protocols for quantum metrology.

OS-L-TUE-02-03

Generating arbitrary laser beam shapes through phase-mapped designed beam splitting

Pedro Silva, Sergio R. Muniz

16:50-17:10 / Room 1

This paper describes a method to generate high-definition arbitrary laser beam shapes and optical potentials. The phase contrast between a binary diffraction grating and the target intensity distribution is encoded on a spatial light modulator to control the splitting of light, enabling to produce very sharp, speckles-free and smooth images at the target plane. Besides its simplicity, not requiring any additional phase-plates, this technique provides a straightforward way to encode images onto phase-only masks, through direct pixel mapping, allowing for simpler feedback schemes to correct and control light distributions and optical potentials in real-time.

INTEGRATED PHOTONICS AND OPTOELECTRONICS 1

OS-I-TUE-01-01

(Invited Speaker) New opportunities with old materials

Marko Loncar

14:30-15:00 / Room 2

Lithium niobate (LN) is an “old” material with many applications in optical and microwave technologies, owing to its strong electro-optic (EO) coefficient, second order nonlinearity, and piezoelectricity. Conventional - discrete - LN components, the workhorse of the optoelectronic industry for many decades, are reaching their limits, however. I will discuss the development of integrated LN photonic platform aimed at applications in optical communications (classical and quantum) and microwave photonics. Examples include high-performance (EO) modulators, EO and Kerr frequency combs, ad frequency converters.

Diamond is another “old” material with remarkable properties! It is transparent from the ultra-violet to infrared, has a high refractive index, strong optical nonlinearity and a wide variety of light-emitting defects of interest for quantum communication, computation and sensing. I will discuss our recent efforts focused on the control of silicon vacancy color center using nanomechanical devices including free-standing nanobeams and surface acoustic waves.

OS-I-TUE-01-02

Optical grating coupling on silicon photonics based on metallized angle-polished fibers

Luis Gustavo Riveros, Felipe Lorenzo Della Lucia, Yesica Rumaldo Bustamante, Hening Andrade, Tiago Sutili, Rafael C. Figueiredo

15:00-15:20 / Room 2

This paper describes an optical coupling method based on angle polished fiber for grating couplers on silicon photonics. Compared with classic coupling methods, this approach minimizes the difficulty of alignment accuracy and facilitates the packaging between devices and waveguides. The procedures to obtain the polishing angle to improve coupling, metallization of the fiber surface to increase reflectivity, and experimental measurement of insertion loss are described. The results show that the polished fiber coupling method increases insertion loss by only 0.8 dB when compared to the standard grating coupler vertical coupling.

OS-I-TUE-01-03

Study of mechanically exfoliated monolayer bilayer, trilayer and multilayer graphene as saturable absorber for passive Erbium-doped fiber laser mode-locking

Filipe de Freitas, David Steiberg, Thoroh de Souza

15:20-15:40 / Room 2

Using different samples of mechanically exfoliated graphene as saturable absorber in Erbium-doped fiber laser, we identified a transition in the mode-locking starting mechanism from non-self-starting (with monolayer or bilayer graphene) to self-starting (with trilayer or multilayer graphene) which is a strong indicative of fast-to-slow saturable-absorption response dependence on the number of graphene layers..

INTEGRATED PHOTONICS AND OPTOELECTRONICS 2

OS-I-TUE-02-01

(Invited Speaker) Optical properties of 2D materials and potential applications for integrated photonics

Christiano José Santiago de Matos

16:00-16:30 / Room 2

In this talk, I will review our recent work on the optical characterization of various 2D materials, with emphasis on the nonlinear optical characterization, and discuss their potential to add functionality to integrated photonic devices.

OS-I-TUE-02-02

Solar harvesting with nanofluids of Ag-nanocubes

Glaluciyevenn Guimarães, Caio V. P. Vital, Francisco Eroni, Antonio Melo, Diego Rativa

16:30-16:50 / Room 2

Metallic nanoparticles have shown great potential to efficiently convert solar radiation into thermal energy; therefore, there is a relationship between the normal oscillation mode of the free electrons of these nanoparticles and the frequency of an incident electric field. We explored the feasibility of using a nanofluid containing silver nanoparticles, through computer simulations, using the comsol software and to corroborate this, we also made experimental analyzes using a solar simulator. Therefore, we realized that the nanofluid has the potential to be applied in solar collectors, as it has the characteristics of a solar radiation absorber.

OS-I-TUE-02-03

Compact grating coupler array for multicore fiber fabricated with DUV lithography

Lucas G. Rocha, Julian Pita, Lucas H. Gabrieli

16:50-17:10 / Room 2

Using Space-Division Multiplexing (SDM) through multicore optical fibers (MCFs) can significantly increase the transmission capacity. However, compatibility with silicon photonics, a promising technology for compact, low-cost and power-efficient devices, requires integration between the two platforms. Using uniform grating couplers combined with compact tapers, two arrays -for vertical and 10°- were designed, fabricated and experimentally characterized. Simulations indicate coupling efficiencies of −4,64dB and −3,64dB for the 0° and 10° couplers, respectively, with bandwidths of 66,5nm and 127,3nm. Experimental results yielded efficiencies of −6,8dB for both designs, and corresponding bandwidths of 46,8nm and 90nm.

POSTER SESSION 2

PS-TUE-02-01

Beam diameter evaluation of clinical equipments and its implication in therapeutic procedures

Carlos Eduardo Girasol, Luciano Bachmann, Rinaldo Guirro

8:00-17:15

The objective was to evaluate and describe the diameter of the laser beam in different devices. Thus, nine different devices were recruited. The laser emitter diameters were collected using a detector sensitive to visible or infrared radiation. A Gaussian function was fitted after gauging, followed by non-linear regression to obtain beam radius, area, and diameter. This showed significant differences between the measured values and those indicated in the manufacturer's manual (45 to 595%). Thus, we conclude the need for frequent therapeutic laser equipment evaluations and a precise specification on beam parameters and data accuracy with the manufacturing companies.

PS-TUE-02-02

Chemical composition depht profile of CO2 laser irradiated enamel

Carla Regina Albino, Luismar B. Cruz Jr, Juliana J. Faraoni, Refina Palma-Dibb, Luciano Bachamann

8:00-17:15

The objective is to determine depth of modification of bovine dental enamel after irradiation with a CO2 laser with, emission at 10,600 nm and pulse width of 1 ms. The chemical composition was evaluated with an Infrared spectrometer. We measure the infrared absorption spectra of enamel at the surface and after progressive enamel wearing. Irradiating with 0.0089 J/cm2 observe a carbonate lost up to 1.25 microns, with 0.144 J/cm2 observe up to 1.75 microns and with 0.362 J/cm2 we observe a loss up to 2.25 microns depth. Microscopic images of irradiated enamel show a typical profile of a melted surface.

PS-TUE-02-03

Optical propertis in dental enamel: comparison of whitening agents with or without calcium

Denise M. Zezell, Ludmila Mendonça, Carlos Soares, Augusto Fernandes, Adamo Monte, Luis Silva

8:00-17:15

We emphasize the growth of interest in teeth whitening agents that are leading to a paradigm shift through continuous monitoring of their optical properties. The characteristics of commercial agents were investigated by monitoring the light absorption and scattering on bovine enamel fragments. The optical properties were provided by an integrating sphere. An increase of optical scattering in enamel after bleaching was observed in all analyzed samples. The use of calcium in the whitening gel did not reduce the scattering ($p<0.05$), calculated by fitting the spectra by the scattering equation model.

PS-TUE-02-04

Effects of nanosecond high-intensity IR and UV lasers on dentin erosion/abrasion progression: a pilot-study

Elisabete Ferreira, Patricia da Ana

8:00-17:15

The irradiation of dental hard tissues with high-intensity lasers can make them more resistant to demineralization. Although many wavelengths have been studied, there are no research that evaluate the potential of short-pulsed Nd: YAG laser emitted in the infrared (1064nm) or ultraviolet (355nm) wavelength to prevent the progression of erosion lesions. This in vitro study evaluated the morphological and optical changes in eroded dentin promoted by such lasers. It was concluded that Nd: YAG lasers are effective in preventing the progression of dentin erosion/abrasion lesions in dentin; however, these effects are restricted to the first days of erosive/abrasive challenge.

PS-TUE-02-05

Compositional changes promoted by Er, Cr:YSGG laser when used to inhibit dentin erosion

Denise M. Zezell, Fabrizio Rodrigues, Patricia da Ana

8:00-17:15

Lasers are used for preventing demineralization, but there are no studies that report the compositional changes on root dentin irradiated with ErCrYSGG (2.78μm) laser in an erosive process. In this in vitro study, fifty dentin slabs were distributed in 5 groups to be treated with ErCrYSGG laser associated or not with application of acidulated phosphate fluoride gel (APF-gel); then, an erosion regime was conducted for 10 days and the composition changes were monitored by Fourier transform infrared spectroscopy. The data suggest a synergistic effect between laser irradiation and APF-gel, with a greater preventive effect when APF-gel was applied after irradiation.

PS-TUE-02-06

Evaluation of the anti-caries effect beyond the critial enamel pH of preventive treatment of fluoride associated with Nd:YAG laser irradiation

Amanda Caramel-Juvino, Thais Rabelo, Nathalia Zanini, Claudia zamataro, Denise M. Zezell

8:00-17:15

This study aimed to evaluate the anti-caries effect of fluoride associated with Nd-YAG laser irradiation in the treatment of enamel. Eight groups (n = 5) were analyzed: Negative Control pH 4.5; Negative control pH 4; Fluoride pH 4.5; Fluoride pH 4; Nd-YAG pH 4.5; Nd-YAG pH 4; (Fluoride + Nd-YAG) pH 4.5 and (Fluoride + Nd-YAG) pH 4. All samples were analyzed by Scanning Electron Microscopy (SEM) before and after the cycle. Quantification of phosphorus in the cycling solutions was carried out using the colorimetric method, as an indication of enamel demineralization. The critical pH increases after Nd-YAG irradiation.

PS-TUE-02-07

Backpropagation neural network for analysis and classification of fluorescence spectroscopy of squamous cell carcinoma in animal model

João M. Nogueira, Marlon R. Garcia, Michelle B. Requena, Lilia T. Moriyama, Sebastião Pratavieira, Daniel V. Magalhães

8:00-17:15

The present study aims to evaluate the performance of a backpropagation neural network (BPNN) using the principal component analysis (PCA) of fluorescence spectra for discrimination between normal skin and skin tumor on mice. The fluorescence spectra were acquired from nude mice with induced squamous cell carcinoma (SCC). The artificial neural network (ANN) used in this study is a classical multiplayer feed-forward type with a back-propagation algorithm. The classification results show this technique as promising for healthy and unhealthy tissue classification. During the validation, the network classified 100% of the training set spectra and 90% of the test set.

PS-TUE-02-08

Evaluation of machine learning models for the classification of breast cancer hormone receptors using micro-FTIR images

Moisés O. Santos, Matheus del Valle, Sofia dos Santos, Emerson Bernardes, Denise Zezell

8:00-17:15

The breast cancer is the most incident cancer in women. Evaluation of hormone receptors expression plays an important role to outline treatment strategies. FTIR spectroscopy imaging may be employed as an additional technique, providing extra information to help physicians. In this work, estrogen and progesterone receptors expression were evaluated using tumors biopsies from human cell lines inoculated in mice. FTIR images were collect from histological sections, and six machine learning models were applied and assessed. Xtreme gradient boost and Linear Discriminant Analysis presented the best accuracies results, indicating to be potential models for breast cancer classification tasks.

PS-TUE-02-09

Associating vascular imaging with hypoxia and cell survival in vivo for Biophotonics applications

M. Atif

8:00-17:15

As oncological treatments aim to move towards personalize medicine, increase tissue response monitoring has become the focus of research. In particular, spatially resolved in vivo information of hypoxia and its relationship to cell survival is required to maximize the patient's benefit. At the same time, several preclinical imaging approaches were developed in the past years, including Photoacoustic, Bioluminescence, shown to predict blood flow/volume. Here Photoacoustic Imaging is used to study tumor hypoxia imaging and cell survival for Photodynamic Therapy monitoring. Here, the Photoaoustic and Bioluminescence signal's temporal dynamic to detect vascular changes during and post-PDT are evaluated.

PS-TUE-02-10

A methodology forperformance prediction uncompensated submarine optical systems

José Hélio da Cruz Jr, Tiago Sutili, Júlia Aline Souza Maciel, Rafael C. Figueiredo

8:00-17:15

We emphasize the growth of interest in teeth whitening agents that are leading to a paradigm shift through continuous monitoring of their optical properties. The characteristics of commercial agents were investigated by monitoring the light absorption and scattering on bovine enamel fragments. The optical properties were provided by an integrating sphere. An increase of optical scattering in enamel after bleaching was observed in all analyzed samples. The use of calcium in the whitening gel did not reduce the scattering ($p<0.05$), calculated by fitting the spectra by the scattering equation model.

PS-TUE-02-11

The LoRa –Modulation technique applied to outdoor visible light communication links

Rafael Gadens, Alexandre Pohl, Paulo de Tarso Neves Jr

8:00-17:15

In this work we employ the LoRa-based modulation technique to simulate a VLC outdoor link under different atmospheric conditions. Results show that distances longer than 15 meters can be reached under a moderate fog condition, making it possible to cover the required range within a local area network, where internet access points are attached to street poles.

PS-TUE-02-12

RoF/FSO system based on a monolithically integrated multi-wavelength transmitter

Matheus Sêda, Eduardo Sala, Nicola Andriolli, Danilo Spadoti, Juliano Oliveira, Giampiero Contestabile, Arismar Cerqueira Jr

8:00-17:15

We propose and report the implementation of a hybrid radio-over-fiber (RoF)/ free-space optics (FSO) system employing a monolithically integrated multi-wavelength transmitter. In such system, a 20-MHz bandwidth M-QAM signal is transmitted over 12.5-km optical fiber fronthaul, followed by a 1.5-m FSO access. The overall system performance is estimated by means of root mean square error vector magnitude (EVMRMS), as a function of optical power and modulation indexes. Experimental results indicate a 180 Mbit/s throughput, accomplishing the 3GPP requirements with plenty of margins, demonstrating the hybrid system applicability for fifth and sixth generation of mobile networks (5G and 6G).

PS-TUE-02-13

Peaceful coexistence between 5G NR and LTE-A over a RoF-based fronthaul

Celso Henrique, Eduardo Sala, Luiz Augusto Melo Pereira, Arismar Cerqueira Jr

8:00-17:15

This work presents the implementation and peaceful coexistence analysis between a 5G New Radio (5G NR) and Long Term Evolution-Advanced (LTE-A) signals over radio over fiber (RoF) based 25-km fronthaul, operating in the non-standalone (NSA) mode. Three signals are investigated, namely: 10-MHz bandwidth Filtered Orthogonal Frequency Division Multiplexing (F-OFDM) at 778 MHz; five 20-MHz LTE-A subbands at 2.24 GHz; 100-MHz bandwidth 5G NR signal at 2.35 GHz. The system performance is estimated measuring the root mean square error vector magnitude (EVMRMS), as a function of the optical power and the 5G NR and LTE-A frequency offset, achieving 1.4 Gbps throughput.

WEDNESDAY, JUNE 2nd

ORAL SESSIONS

SENSORS, IMAGE AND ILLUMINATION 1

OS-S-WED-01-01

(Invited Speaker) Metalenses with wide field of view and diffraction limited resolution: concepts and trade-offs

Emiliano Rezende Martins

14:30-15:00 / Room 1

Metasurfaces are nanostructured planar surfaces designed to control the phase and amplitude of an optical beam. They can be designed as a metalens, which finds widespread applications. Metalenses can be readily designed to obtain diffraction limited resolution, or as fisheye-type lenses with arbitrarily wide field of view. One of their main challenges, however, is to reduce all the aberrations in a single design. This paper compares the main physical constraints behind two of the most important monochromatic aberrations: spherical aberrations and off-axis aberrations. In the talk, novel routes to controlling the aberration will be presented.

OS-S-WED-01-02

Comparative spectroscopic studies between conventional and organic soybean oils

Carla Lopes, Heron da Silva, Lilia Courrol

15:00-15:20 / Room 1

A healthy lifestyle based on an organic diet appears to be a growing trend among young adults. Organic soybean oils are an alternative to conventional oils, but they can be the subject of fraud that worries consumers, traders, and producers. The results obtained indicate that the combination of steady-state fluorescence techniques, considering mainly the characteristics of the spectra obtained with excitation at 320, 340 and 460 nm and time-resolved fluorescence with excitation around 403 nm, demonstrates the potential to differentiate oils conventional from organic soybeans oils.

OS-S-WED-01-03

Fluorescence spectroscopy study of conventional organic soybean oil heated to 270ºC

Carla Lopes, Heron da Silva, Lilia Courrol

15:20-15:40 / Room 1

Edible vegetable oils are highly susceptible to lipid thermo-oxidation which results in the toxic substances production, with serious nutritional consequences. This work studies the fluorescence spectroscopy potential to determine oxidation status in these materials. The organic and conventional soybean oils fluorescence spectra have been studied and alterations were registered after heated at 270 ºC. Variations in chlorophyll fluorescence lifetime were analyzed to determine the pigment degradation. The results indicate that fluorescence spectroscopy is an efficient method to determine pigments degradation and increasing fatty acid oxidation products. It can be applied in the food industry and food quality control institutions.

SENSORS, IMAGE AND ILLUMINATION 2

OS-S-WED-02-01

(Invited Paper) Cascaded refractive index and corrosion sensors in a D-shaped optical fiber usiing LMR and SPR effects

Vladimir Manoel da Silva Jr, Joaquim F. Martins Filho, Jehan Nascimento

16:00-16:30 / Room 1

This article presents the proposed structure and simulation results from analytical modeling of a refractive index sensor and a corrosion sensor in a D-shaped single-mode optical fiber using the lossy mode resonance (LMR) and surface plasmon resonance (SPR) effects. The combined sensor consists of two cascaded D-shaped sensor regions. The first one, a bilayer of titanium dioxide – aluminum, operates under LMR condition. The second region, a bilayer of gold – titanium dioxide, operates under SPR condition. The sensors are interrogated by two wavelengths, 1310 and 1550 nm, in TE and TM modes. Sensor sensitivities and operating ranges are presented.

OS-S-WED-02-02

Imaging with a rigid multimode fiber bundle

Paloma Pellegrini, Claudecir Ricardo Biazoli, Paulo Jarshe, Lucas H. Gabrieli

16:30-16:50 / Room 1

A rigid multimode fiber bundle is proposed for imaging, in a experimental setup with no interferometric measurements. The great amount of propagating modes in the fiber bundle, along with high numerical aperture, enabled us to set predetermined focus targets in, approximately, 60 micrometers resolution. In order to do so, an optimization process to build transmission matrices was applied to overcome modal interference and obtain focus. Here, we also show that transmission matrices could be stored and combined, so focus could be simultaneously achieved in different locations, at the distal end of the fiber bundle.

OS-S-WED-02-03

Analysis of temperature in na air-cooled combustion motorcycle engine using sensors based on fiber Bragg gratings

Henrique Ferazza, Rodrigo Fiorin, Valmir de Oliveira, Ilda Abe, Hypolito J. Kalinowski

16:50-17:10 / Room 1

A fiber Bragg grating for monitoring the temperature of an air-cooled combustion motorcycle engine is presented in this study. The sensor is attached to the aluminum cylinder of the motorcycle and the characterization process is performed. We present the results of the heating and cooling curves during tests with the motorcycle at rest and in motion. A better understanding of the air cooling process can lead to the optimization of designs in this area.

OPTICS AND INSTRUMENTATION 1

OS-O-WED-01-01

(Invited Paper) An extended cavity diode laser constructed with additive manufacturing: contribution for a Brazilian compact atomic frequency standard with cold atoms

Eduardo Cazarini, Stela Müller, Luiz Damaceno, Richard Mascarin, Carlos Fortulan, Vanderlei Bagnato, Daniel V. Magalhães

14:30-15:00 / Room 2

The Time and Frequency Metrology field dedicated towards more compact standards has research groups dedicated to cold atoms systems, in order to improve embedded applications. Our group has been developing a compact system using 133Cs cold atoms and already showed some versions of proof-of-principle. We developed a first prototype of an extended cavity diode laser using additive manufacturing of ABS (acrylonitrile butadiene styrene) and obtained a very light and thermally isolated version with an intracavity interference filter. We will show preliminary results of this first version and discuss some aspects of the system for the new compact frequency standard.

OS-O-WED-01-02

Visible and near-infrared optical characterization of human belly skin tissue phantoms

Luismar B. Cruz Jr, Carlos Eduardo Girasol, Kaio B. Barros, Rinaldo Guirro, Luciano Bachmann, Pedro Coltro

15:00-15:20 / Room 2

Determining the optical properties of biological tissues are important for medical, technological and research applications. The main objective of this work was to determine the optical properties of biological skin tissues and phantoms from 500 to 1300 nm using integrating spheres to acquire the diffuse reflectance and transmittance light and the inverse adding doubling algorithm to compute the optical coefficients. It was acquired the optical absorption coefficients, reduced scattering and depth penetration of the human skin. Phantoms that mimic optical properties of skin were also manufactured and characterized. The skin phantoms were able to properly simulate the optical properties.

OS-O-WED-01-03

Analytical solutions for TM modes in magneto-optical planar waveguides

Licinius Dimitri Sá de Alcântara

15:20-15:40 / Room 2

From Maxwell's equations, an analytical formulation is developed to calculate the propagation characteristics and field profiles of transverse magnetic (TM) modes on magneto-optical (MO) planar waveguides. Results show nonreciprocal behavior in terms of both modal effective index and field profile analyses. The proposed model can be used as a reference to assess the nonreciprocal potentialities of such structures.

OPTICS AND INSTRUMENTATION 2

OS-O-WED-02-01

(Invited Speaker) Nonlinear imaging of biological tissues

Ana Maria de Paula

16:00-16:30 / Room 2

Precise diagnosis and prognosis are important in prevention and reduction of morbidity and mortality in all types of cancers. We present imaging of biological tissue by second harmonic generation and multiphoton excited fluorescence microscopy as a potential tool in helping with cancer diagnosis. We demonstrate a methodology to evaluate the changes caused by cancer in collagen and cellular parameters of histological biopsies using automated image analysis and machine learning techniques. The procedure allowed to separate between the healthy and cancerous tissue with an accuracy of around 90% for canine mammary cancer and for human prostate cancer. In addition the results for canine mammary gland carcinomas show that the measured tissue collagen parameters...

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OS-O-WED-02-02

Development of a portable lensfree holographic microscope to imaging cell cultures

Camila de Paula D'Almeida, Patrick Oliveira Feitosa, Natália Portes de Oliveira, Sebastião Pratavieira

16:30-16:50 / Room 2

Microscopes are important imaging tools for accessing microscale information in a variety context, including routine visual analysis for cell culture. As an alternative to traditional optical microscopic instrumentations, lensfree microscopy is an emerging modality, which is efficient to provide portable apparatus that provides images with decoupling resolution from field of view. In this paper we present an compact and easy-to-use imaging equipment, based on optical lensfree holographic microscopy, which performs amplitude and phase images from a sequence ofcaptured images at different distances from the sample, resulting in images with almost 30 squared millimeters and 4 micrometers of resolution.

OS-0-WED-02-03

Image haziness contrast scale describing optical scattering depth

André Riccieri Albinati Vitor, George C. Cardoso

16:50-17:10 / Room 2

Contrast is not uniquely defined in the literature. In particular, there is a need for a contrast measure that scales linearly and monotonically with the optical scattering depth of a translucent scattering layer that covers an image. Here, we address this issue proposing an image contrast metric, which we call haziness contrast metric, and experimentally test it using milk as a scattering medium to simulate a decline in image contrast. Compared to other contrast metrics in the literature, the proposed metric is the closest to linear, as a function of the increasing density of the scattering material on the image.

Poster Sessions' Q & A

MONDAY, MAY 31st

PS-MON-01-02

Poster Session 1 Q & A

Moderator: Lino Misoguti

17:15-18:15 / Auditorium

All presenters of the 12 videos related to Monday's posters participate in this Q&A live session .

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TUESDAY, JUNE 1st

PS-TUE-02-02

Poster Session 2 Q & A

Moderator: Sebastião Pratavieira

17:15-18:20 / Auditorium

All presenters of the 13 videos related to Tuesday's posters participate in this Q&A live session .

Photonics Lab Tour

MAY 31st to JUNE 2nd

OptMA_lab - Laboratory for Optronics and Microtechnology Applications

https://www.youtube.com/watch?v=1WrOrOBZKAI UFMG

Summary of activities

Dynamic and multidisciplinary research laboratory fostering topics as Microelectronics (IC Design, RF, digital, analog, sensors), Microfabrication (MEMS), Optical Communications (LiFi/VLC and fiber), Optical Sensors, Biosensors, Micro-Energy Harvesting, Adaptive Optics and Ophthalmic Optics.

Most outstanding results, so far

22 CMOS and MEMS chips designed and fabricated
2 fabrication processes
Many systems and prototypes
Close collaboration with companies
>200 supervised students (Post-Doc, PhD, MSc, Specialization, Undergrad scientific projects, Undergrad final projects, Internships)
>200 scientific and technical publications (journals, books, book chapters, conference papers, patents)

Most recent results

3 CMOS chips targeting LiFi/VLC Tx/Rx cryptographed communications
2 MEMS chips with dynamic micro mirrors, tunable diffraction gratings, micromotors, vibration sensors and micro-energy harvesters
1 Energy-autonomous wireless IoT systems with optical sensor and optical energy harvesting.

Team

Professors: Davies William de Lima Monteiro, Johnattan Córdoba Ramirez, Luciana Pedrosa Salles, Andrea Chiuchiarelli, Dalton Martini Colombo, Hugo Daniel Hernandez Herrera
28 students in all levels.(May 2021)

Additional information

www.optmalab.com

Contact

Davies William de Lima Monteiro
davies@ufmg.br
DEE - Department of Electrical Engineering / Av. Antonio Carlos, 6627 – Pampulha
31270-540 Belo Horizonte – MG / Brazil

Optical and Wireless Lab (OWL)
CPQD TIP Community Lab
Optical Sensing and Monitoring Lab (LSMO)
Integrated Photonics Lab

https://www.youtube.com/watch?v=YxeJAuoVa8w CPQD

Summary of activities

The **Optical Communication Lab** has infrastructure to generate, transmit, and receive optical signals for different scenarios. Our experimental capabilities are employed also to validate our DSP algorithms, including signal compensation and non-linearities mitigation, to test our different solutions for optical amplification, including EDFA, ROPA, and Raman, and to implement tools for control and management of software defined optical networks.

The **CPQD TIP Community Lab** was created in partnership with the Telecom Infra Project for experimenting new telecommunications infrastructure technologies based on open and disaggregated networks, developed by a global innovation ecosystem: operators, ISPs, manufacturers, integrators, and tech companies.

The **Optical Sensing and Monitoring Laboratory** has an advanced infrastructure dedicated to the research and development of optical sensors for applications in the electrical, mining, and oil and gas sectors.

The **Integrated Photonics Lab** is equipped with tools for manufacturing and measuring photonics integrated circuits (PICs). In a class 100 cleanroom it is possible to spin coat, metallize, etch (dry and wet) different types of films and also implement photolithography steps in an UV mask aligner. Measurement setups are also assembled to characterize PICs and package them in photonic capsules.

Most outstanding results, so far

Among the most relevant works carried out by the **Optical Communications** team in recent years, it is possible to highlight the demonstration of high-capacity and high-reach unrepeatered links, which, at the time, represented an international record through the unrepeatered transmission of 24x400G carriers over a 443-km span (73-dB span loss). More recently, the team's expertise on unrepeatered amplification techniques was applied in a market-focused project, still achieving world-class performance combined with cost-effective solutions. Besides the implementation cost restrictions required in the project, the work achieved the transmission of 128x100G carriers over a 310-km standard single-mode fiber span. In particular, this result was transferred to an industrial partner and granted with the 2019 Telesíntese award.

Currently, to continuously improve the previous results on long-reach transmissions, the team is working on artificial-intelligence-based techniques to model the optical amplifiers and digital signal processing algorithms to compensate for the Kerr-related nonlinear phenomena which impose severe degradation on these links. Specifically, in this last research field, the team already demonstrated significant gains applying digital backpropagation algorithms to compensate signal nonlinear distortion, also investigating the performance of its variants considering coupled equations, employing adaptive techniques, or artificial-intelligence-based learning.

Complementary, the team also works on the development and optimization of **photonic devices**. One of the most relevant results in this field was the demonstration of 100G per wavelength PAM4 modulated carriers employing thin-film polymer on silicon modulators. More recently, the integrated photonics team is working on applying artificial intelligence techniques on the project and optimization of silicon photonic devices, focusing on high-bandwidth modulators, superchannel multiplexers, polarization and mode converters, among other passive elements.

Finally, from a network perspective, the CPQD hosts a **TIP Community Lab**, employing its expertise to carry out field trials in partnership with telecom companies and optical equipment manufacturers, with a focus on open and disaggregated solutions. More recently, working together with Padtec, IpInfusion, Edge-core, Lumentum, and Viavi, the team demonstrated a lab trial of 100G and 200G alien wavelength transmission and management onto a 2000 km optical link

with an average span of 150 km using hybrid amplifiers.

The **Optical Sensing and Monitoring** team also has an extensive list of outstanding results, including publications and awards on several relevant journals and conferences. In 2013 we received the best article from the Intellect, Association of Proprietary Companies of Infrastructure and Private Telecommunications Systems for the demonstration of a video-monitoring and sensing system with power delivered through optical fibers in hostile environments. Following, in 2016 we were awarded as 1st place in the Smart Systems Category by the Latin American Utility Week Awards. Most recently, in 2021, the power-over-fiber system was awarded again, in this opportunity at the Optical Wireless and Fiber Power Transmission Conference.

Most recent results

In recent years, in **optical communications**, we are working in the optimization and design of high-capacity and long-reach optical links, focusing on the development of hybrid amplifiers, nonlinear compensation techniques, forward error correction techniques, **integrated photonics** employing the silicon platform, software-defined optical networks, and use of AI techniques. Among our more relevant recent works, it is possible to highlight: the optimization of optical subsystems to compensate nonlinear degradation based on phase-conjugated techniques; the investigation of the impact of clock recovery algorithms on probabilistic-shaped optical signals; the proposal of an iterative technique to design unrepeatered systems employing remote and distributed amplification; and, the design of a silicon polarization splitter and rotator employing bioinspired optimization techniques.

Also, in **optical sensing and monitoring**, we are working in FBG based sensors, spectroscopy, optical interferometer, Power-over-Fiber, and Optical Distributed Sensors such as Distributed Temperature Sensor (DTS), Distributed Strain and Temperature Sensor (DTSS), Distributed Acoustic Sensor(DAS). Among our more relevant recent works, it is possible to highlight: Alfa Sense Fence Light perimetral monitor based on the optical interferometer (powered by CPQD) received 1st Tele Síntese supply category as best innovation product award.

Team

CPQD's laboratories are formed by highly-skilled teams, where a great number has master's and doctoral degrees:

Artur de Araújo Silva, Bruno Cesar de Camargo Angeli, Carine Mineto, Claudio Floridia, Eduardo Ferreira Costa, Eduardo Rosa, Fábio Donati Simões, Fabio Renato Bassan, Felipe Lorenzo Della Lucia, Glauco Simões, Hening Almeida de Andrade, João Batista Rosolem,

João Nogueira Junior, João Paulo Vicentin Fracarolli, José Hélio da Cruz Junior, Julia Aline Sousa Maciel, Lucas Silva Schanner, Luciano Augusto Domingos, Luciano Martins, Luis Gustavo Maciel Riveros, Marcelo Lopes da Silva, Márcia Cristina Vicente, Marcos Antonio Brandão Sanches, Nadia Nassif

Niudomar Chaves, Rafael Carvalho Figueiredo, Rivael Strobel Penze, Rodrigo Peres

Romulo Aparecido de Paula Junior, Sandro Marcelo Rossi, Tiago Sutili, Valentino Corso, Wagner Rezende Cano, Yesica Raquel Rumaldo Bustamante.

Bibliographic References

- A. L. N. de Souza, J. H. Cruz Júnior, T. Sutili, and R. C. Figueiredo, "Clock Recovery Performance on Probabilistically-Shaped Transmissions," *2021 Optical Fiber Communications Conference and Exhibition (OFC)*, 2021, pp. 1-3.
- A. Felipe and A. L. N. de Souza, "Chirp-Filtering for Low-Complexity Chromatic Dispersion Compensation," in *Journal of Lightwave Technology*, vol. 38, no. 11, pp. 2954-2960, 1 June, 2020, doi: 10.1109/JLT.2020.2982831
- T. Sutili, P. F. P. Neto, F. D. Simões, G. J. Suzigan, and R. C. Figueiredo, "Cost-Effective Solution for High-Capacity Unrepeatered Transmission," *2020 Optical Fiber Communications Conference and Exhibition (OFC)*, 2020, pp. 1-3, doi: 10.1364/OFC.2020.T4I.4
- J. H. Cruz Júnior, T. Sutili, S. M. Rossi, R. C. Figueiredo, and D. A. A. Mello, "Fast Adaptive Digital Back-Propagation Algorithm for Unrepeatered Optical Systems," *2020 Optical Fiber Communications Conference and Exhibition (OFC)*, 2020, pp. 1-3, doi: 10.1364/OFC.2020.T4I.2
- P. M. Kaminski, T. Sutili, J. H. Cruz Júnior, G. C. C. P. Simões, F. Da Ros, M. P. Yankov, H. E. Hansen, A. T. Clausen, S. Forchhammer, L. K. Oxenløwe, R. C. Figueiredo, M. Galili, "All-Optical Nonlinear Pre-Compensation of Long-Reach Unrepeatered Systems," *2020 European Conference on Optical Communications (ECOC)*, 2020, pp. 1-4, doi: 10.1109/ECOC48923.2020.9333151
- A. Chiuchiarelli, S. M. Rossi, V. N. Rozental, G. C. C. P. Simões, L. H. H. Carvalho, J. C. R. F. Oliveira, J. R. F. Oliveira, and J. D. Reis, "50-GHz+ Thin-Film Polymer on Silicon Modulator for PAM4 100G-per-wavelength Long-Reach Data Center Interconnects," *2016 European Conference on Optical Communications (ECOC)*, 2016, pp. 1-3.
- J. C. S. S. Januário and A. C. Bordonalli, "High Capacity Unrepeatered Optical Transmission over Hybrid Fibers," *2019 International Conference on Transparent Optical Networks (ICTON)*, 2019, pp. 1-4, doi: 10.1109/ICTON.2019.8840497.
- J. C. S. S. Januário, A. Chiuchiarelli, S. M. Rossi, J. H. Cruz Júnior, J. D. Reis, C. Mornatta, A. Festa, and A. C. Bordonalli, "System Design for High-Capacity Unrepeatered Optical Transmission," in *Journal of Lightwave Technology*, vol. 37, no. 4, pp. 1246-1253, 15 Feb, 2019, doi: 10.1109/JLT.2019.2891078.
- Open Optical & Packet Transport, “Cassini and DCSG applications and use cases tests for E-Metro and Long-haul with Padtec Optical Layer at CPQD TIP Community Lab” available at https://telecominfraproject.com/transport-trial-test-report/
- F. L. D. Lucia and Y. R. Bustamante, "Ultra Dense Demultiplexer Using Lattice Filters for WDM Applications," in *2020 Frontiers in Optics / Laser Science (FiO/LS)*, 2020, paper JTh4B.19, doi: 10.1364/FIO.2020.JTh4B.19.
- Y. R. R. Bustamante, G. B. de Farias, H. A. de Andrade, and H. E. H. Figueroa, “Demonstration of a silicon polarization splitter and rotator based on a bow-tie structure” in *Photonics and Nanostructures - Fundamentals and Applications*, vol. 45, 2021, doi: 10.1016/j.photonics.2021.100921.

- F. R. Bassan, J. B. Rosolem, C. Floridia, B. N. Aires, R. Peres, J. F. Aprea, C. A. M. Nascimento, and F. Fruett, “Power-over-Fiber LPIT for Voltage and Current Measurements in the Medium Voltage Distribution Networks,” *Sensors*, vol. 21, no. 2, p. 547, Jan. 2021, doi: 10.3390/s21020547
- J. B. Rosolem, M. C. Argentato, F. R. Bassan, R. S. Penze, C. Floridia, A. de A. Silva, D. Vasconcelos, and M. A. Ramos Junior, “Demonstration of a Filterless, Multi-Point, and Temperature-Independent Fiber Bragg Grating Dynamical Demodulator Using Pulse-Width Modulation,” *Sensors*, vol. 20, no. 20, p. 5825, Oct. 2020, doi: 10.3390/s20205825
- J. B. Rosolem, R. S. Penze, C. Floridia, F. R. Bassan, R. Peres, E. F. da Costa, A. A. Silva, A. D. Coral, J. R. Nogueira Júnior, D. Vasconcelos, and M. A. Ramos Junior, "Dynamic Effects of Temperature on FBG Pressure Sensors Used in Combustion Engines," in *IEEE Sensors Journal*, vol. 21, no. 3, pp. 3020-3027, 1 Feb.1, 2021, doi: 10.1109/JSEN.2020.3025376
- C. Floridia, J. B. Rosolem, J. P. V. Fracarolli, F. R. Bassan, R. S. Penze, L. M. Pereira, and M. A. C. da Motta Resende, “Evaluation of Environmental Influences on a Multi-Point Optical Fiber Methane Leak Monitoring System,” *Remote Sensing*, vol. 11, no. 10, p. 1249, May 2019, doi: 10.3390/rs11101249
- J. B. Rosolem, R. S. Penze, F. R. Bassan, C. Floridia, R. Peres, D. C. Dini, D. Vasconcelos, and M. A. Ramos Junior "Electroless Nickel-Plating Sealing in FBG Pressure Sensor for Thermoelectric Power Plant Engines Applications," in *Journal of Lightwave Technology*, vol. 37, no. 18, pp. 4791-4798, 15 Sept, 2019, doi: 10.1109/JLT.2019.2920120
- A. G. de Melo, D. Benetti, L. A. de Lacerda, R. Peres, C. Floridia, A. de A. Silva, and J. B. Rosolem, “Static and Dynamic Evaluation of a Winding Deformation FBG Sensor for Power Transformer Applications,” *Sensors*, vol. 19, no. 22, p. 4877, Nov. 2019, doi: 10.3390/s19224877
- J. B. Rosolem, F. R. Bassan, D. E. de Freitas and F. C. Salgado, "Raman DTS Based on OTDR Improved by Using Gain-Controlled EDFA and Pre-Shaped Simplex Code," in *IEEE Sensors Journal*, vol. 17, no. 11, pp. 3346-3353, 1 June, 2017, doi: 10.1109/JSEN.2017.2694343
- J. B. Rosolem, F. R. Bassan, R. S. Penze, A. A. Leonardi, J. P. V. Fracarolli, and C. Floridia, “Optical sensing in high voltage transmission lines using power over fiber and free space optics”, in *Elsevier Optical Fiber Technology*, vol. 26B, pp. 180-183, December, 2015, doi: 10.1016/j.yofte.2015.09.003
- C. Franciscangelis, C. Floridia, G. C. C. P. Simões, F. Schmmidt, and F. Fruett, “On-field distributed first-order PMD measurement based on pOTDR and optical pulse width sweep”, in *OSA Optics Express*, vol. 23, pp. 12582-12594, 2015, doi: 10.1364/OE.23.012582
- C. Franciscangelis, C. Floridia, and F. Fruett, “Optical fibre intrusion detection method based on Lefevre-loop and bidirectional polarisation optical time-domain reflectometer-C technique”, in *IET Journal of Engineering*, vol. 2015, pp. 339-340, 2015, doi: 10.1049/joe.2015.0167

Additional information

CPQD is one of the main private innovation centers in Brazil. Our skills, laboratory infrastructure, and technologies enable us to act as an innovation partner for companies from different sectors and also for the government, in projects for the benefit of society.

CPQD's RD&I activities focus on the digital transformation of products and processes and in the acceleration of technology-based startups, collaborating from idea to innovation, delivering results that can both address the state of the art and meet specific challenges for customers and partners, acting in strategic areas of Information and Communication

Technologies: Optical Communications, Wireless Communications, Data Networks, Security and Privacy, Blockchain, Internet of Things, Artificial Intelligence, Sensing, and also in Energy Systems.

For more information, go to: www.cpqd.com.br.

Contact

Parque II do Polo de Alta Tecnologia, R. Dr. Ricardo Benetton Martins, 1000, Campinas - SP, 13086-902

Rafael C. Figueiredo
rafaelcf@cpqd.com.br
+55 19 3705-4665

Rivael Strobel Penze
rpenze@cpqd.com.br
+55 19 3705-7098

Photonics Group

https://www.youtube.com/watch?v=haVCm235bjo

IFSC-USP

Summary of activities

The purpose of the Photonics Group is to develop fundamental science and applied technology, besides fostering wider interdisciplinary collaborations. Programmatic efforts are focused on exploiting those applications that use the laser as a tool in many fields of inquiry. The Photonics Group engages in the following research areas: nonlinear spectroscopy of novel materials, nonlinear optics, ultrashort pulses and fs-laser processing of advanced materials and devices.

Most outstanding results, so far

In 2021: the demonstration of direct fs-laser printing of silk fibroin microstructures, published in ACS Appl. Mater. Interfaces 12, (2021) 50033-50038

Most recent results

Several new results have been obtained recently. In nonlinear spectroscopy, the second-order nonlinear optical properties of chalcone derivatives was investigated by using the sum-over-states. (Phys. Chem. Chem. Phys. 23, (2021), 6128-6140). In femtosecond laser processing, we demonstrated the fs-laser selective printing of graphene oxide and PPV on polymeric microstructures. (J. Mat. Sci. 56, (2021, 11569-11577)

Team

Three full-time faculty members (Prof. Cleber R Mendonca, Prof. Leonardo De Boni and Prof. Lino Misoguti), post-doctoral fellows, several graduate and undergraduate students, in a grand total of about 35 people.

Additional information

Please visit - http://www.fotonica.ifsc.usp.br/pagina/home/publications/

Contact

Prof. Cleber R Mendonca, Av. Trabalhador são-carlense, 400 - Pq. Arnold Schimidt, CEP: 13566-590 - São Carlos - SP - Brasil

Laboratory WOCA

https://www.youtube.com/watch?v=RcRHJknqIaM

INATEL

Summary of activities

The team from the Lab. WOCA (Wireless and Optical Convergent Access) contribute to the scientific and academic communities, as well as industry, by means of executing Research and Development (R&D) Projects on telecommunications, mainly on 5G, 6G, optical communications, microwave photonics, antennas and radars. The researchers from WOCA, coordinated by Prof. Dr. Arismar Cerqueira, works on the conception of new technological solutions and their implementation in real 5G optical-networks, geographically distributed in the Inatel Campus, frequencies up to 50 GHz. Furthermore, the Lab. WOCA offers additional 600 Km of optical fibers in spools in order to extend the open field measurements to the lab environment.

Most outstanding results, so far

65 journal papers, 36 in the last three years; 25 products transferred to the Industry; 10 Research and Development (R&D) Projects with the industry in the last years; 08 patents.

Most recent results

30 Gbps throughput in the air, using a Fiber/Wireless 5G NR System, operating at frequencies up to 50 GHz; Photonics-based RF amplification technique with gains of 27 dBi from 1 MHz to 50 GHz; Implementation of FSO (free space optical) and VLC (visible light communication) systems for 5G and 6G; Development of reconfigurable antenna arrays for MIMO-based 5G and 6G systems, including mm-waves and sub-THz.

Team

Prof. Dr. Arismar Cerqueira Sodré Junior, Dr. Ramon Maia Borges, 10 Ph.D. students; 06 Master students; 04 undergraduate students.

Bibliographic References

https://www.inatel.br/woca/publicacoes

Contact

Campus do Inatel, Santa Rita do Sapucaí-MG; Prof. Arismar Cerqueira

Lasers and Applied Biomedical Optics Laboratory

https://www.youtube.com/watch?v=844Xn0WX_II

UNIFESP

Summary of activities

The following techniques are available:

- Ultraviolet and visible electronic spectroscopy: identifies the energy levels of chromophores in materials.
- Spectral and temporal optical fluorescence: identifies electronic transitions between energy levels of materials and energy transfer processes between dopants and impurities.
- Vibrational Spectroscopy (ATR) and Raman: identifies molecular vibrations.
- Free radical detector through electrochemical sensor: measurement of different species of free radicals in the same preparation or with simultaneous measurements.

- Langmuir and Langmuir-Blodgett technique: preparation of amphiphilic monolayers at the air-water interface for the production of biomembrane models.
- Techniques for characterization of Langmuir films: tensiometry, surface potential, Brewster angle microscopy, reflection-absorption infrared spectroscopy with polarization modulation, and surface shear rheology..
- Thermoluminescence: development of a “homemade” thermoluminescence system for the characterization of materials and investigation of new sensors for ionizing and non-ionizing radiation.
- Digital Holographic Microscopy: three-dimensional object mapping, birefringence, roughness measurements, measurements of changes in structure or composition, study of dynamic processes in biological samples.
- z-scan at different time scales: measurement of non-linear terms of refractive index and non-linear absorption of different materials at different time scales.
- LIBS - Laser Induced Breakdown Spectroscopy: analytical technique for direct determination of chemical elements.
- Birefringence and light transmittance measurement.
- Photo alignment in polymeric films containing azodyes.
- Photodynamic Therapy.
- Biomedical and environmental applications.
- Non-photonic materials characterization techniques.

Most outstanding results, so far

We can cite as an example the development of theranostic materials. Therapeutics acts in the sense that a single system plays the role of diagnostic agent and therapeutic agent simultaneously. We achieve this by employing nanometric photonic systems based on a material that is a pro-drug, aminolevulinic acid (ALA), which induces the formation of porphyrins, an endogenous fluorophore. Porphyrin can be excited with light and thus produce red emission.

In highly multiplying tissues, such as in the case of cancer and atherosclerosis, it appears in an increased amount, which also reflects the amount of this material in the blood, which is even more increased when exogenous ALA is administered. Thus, through fluorescence spectroscopy, it is possible to diagnose diseases such as cancer and atherosclerosis, simply by checking the intensity of the fluorescent signal of the porphyrin extracted from the patients' blood. For the therapy of these diseases, gold nanoparticles are associated with ALA, which produce free radicals when illuminated, destroying tumor cells and atheromatous plaques through photodynamic and/or photothermal therapy. Between 2017 and 2020, 6 papers were published exploring this theme.

Team

Team :Lilia C. Courrol Alunos: Carla Borges Lopes, Karina de Oliveira Gonçalves. Colaboradores: Marcelo Vallim (Unifesp), Marcia Regina Franzolin (Instituto Butantã), Vadivel Masilamani (King Saudi University), Flávia de Oliveira Silva (IPEN)

Contact

Lilia C. Courrol, lcourrol@unifesp.br/

LabLaser – Laser Laboratory

https://www.youtube.com/watch?v=5jETTfcsr0U

UTFPR

Summary of activities

The LabLaser was founded in 1996 by professors Marcia Muller and José Luís Fabris within the Physics Department of the Universidade Tecnológica Federal do Paraná - UTFPR-CT and occupies nowadays an area of 120 m^2. The first developments were in the field of Optical Spectroscopy, shortly followed by research in optical transducers for sensing (Rocking filters, Fiber Bragg gratings - FBG and Long period gratings - LPG). From 2000 on the Laboratory began activities within the Graduate Program of Electrical Engineering and Computer Sciences - CPGEI of the University. Several national and international cooperation established along the years, as well the approved funding projects by governmental Agencies, made possible the activities of more than a hundred students, summing-up more than 20 M.Sc., 15 D.Sc. and 60 undergraduate researches up to 2020. Nowadays, LabLaser is part of the infrastructure available for the Research Group “Photonic Devices and Applications - Dispositivos Fotônicos e Aplicações” at UTFPR-CT.

Most outstanding results, so far

Research developed at LabLaser contributed for the first application of fiber sensors (LPG) in the field of quality monitoring of gasoline fuel. A patent request was deposited in 2002 and granted in 2015. From 2007 to 2013 part of the work was directed to the establishment of standards for optical fiber sensors.

Most recent results

The use of optical fiber sensors for monitoring production processes and quality standards of fossil fuel as well as renewable fuels resulted in the concession of a patent in 2020 for diesel fuel and biodiesel. Along the last years works in the field of Nanophotonics resulted in optical fiber sensors with increased sensitivity and selectivity for operation in aquatic environments for pollution monitoring

Team

Prof. Marcia Muller - head of laboratory (optical fiber sensors), Prof. José Luís Fabris - head of laboratory (nanophotonic sensors)

Researchers:

Prof. Lucas Hermann Negri, Dr. Francelli Klemba Coradin, Dr. Marcos Aleksandro Kamizi

Ph.D. Students:

Natália Soares Girão, Lays de Carvalho Seixas Costa, Franciele M. de Lima Bombardi, Deborah Deah Assis Carneiro. Elberth Manfron Schiefer, Felipe Hornung

M.Sc. Students:

Vinicius de Carvalho

Undergraduate Students:

Natália Carolina Wendt , Haleccia Victoria de Siqueira, Rodrigo Zamboni

Bibliographic References

- Cardozo da Silva, J ; ABE, I. ; CHAVES, R. C. ; FABRIS J L ; PINTO, João Lemos ; KALINOWSKI, Hypolito José ; BARBOSA, C. L. . Development of Bragg grating sensors at CEFET-PR. Optics and Lasers in Engineering, v. 39, p. 511-523, 2003.

- FALATE, Rosane ; KAMIKAWACHI, Ricardo Canute ; MULLER, M. ; KALINOWSKI, Hypolito José ; FABRIS J L . Fiber Optic Sensors for Hydrocarbon Detection. Sensors and Actuators. B, Chemical, v. 105, p. 430-436, 2005.
- Frazão, O. ; Falate, R. ; Fabris, J. L. ; Santos, J. L. ; Ferreira, L. A. ; Araújo, F. M. . Optical inclinometer based on a single long-period fiber grating combined with a fused taper. Optics Letters, Washington, DC, v. 31, n.20, p. 2960, 2006.
- FALATE, Rosane ; Nike, Karen ; COSTA NETO, Pedro Ramos da ; Cação Jr., Eduardo ; Muller, M ; KALINOWSKI, Hypolito José ; Fabris, José Luís . Alternative technique for biodiesel quality control using an optical fiber long-period grating sensor. Química Nova (Impresso), v. 30, p. 1677-1680, 2007.
- Possetti, G R C ; Kamikawachi, R C ; Prevedello, C L ; MULLER, M. ; Fabris, J L . Salinity measurement in water environment with a long period grating based interferometer. Measurement Science & Technology, v. 20, p. 034003, 2009.
- Possetti, G R C ; Côcco, L C ; Yamamoto, C I ; de Arruda, L V R ; Falate, R ; MULLER, M. ; Fabris, J L . Application of a long-period fibre grating-based transducer in the fuel industry. Measurement Science & Technology, v. 20, p. 034012, 2009.
- Oliveira, Roberson A ; Possetti, Gustavo R C ; Marques, Carlos A F ; Neves, Paulo T ; Cook, Kevin ; Kamikawachi, Ricardo C ; Bavastri, C ; Fabris, José L ; Muller, Marcia ; NOGUEIRA, Rogério N ; CANNING, John ; Pohl, Alexandre A P . Control of the long period grating spectrum through low frequency flexural acoustic waves. Measurement Science & Technology (Print), v. 22, p. 045205, 2011.
- Possetti, Gustavo R. C. ; Kamikawachi, Ricardo C. ; MULLER, M. ; Fabris, J. L. . Metrological Evaluation of Optical Fiber Grating-Based Sensors: An Approach Towards the Standardization. Journal of Lightwave Technology (Print), v. 30, p. 1042-1052, 2012.
- Possetti, G R C ; KAMIKAWACHI, Ricardo Canute ; MULLER, M. ; Fabris, J. L. . Optical fiber sensor temperature coded for concentration measurement of oil-biodiesel blends. Optical Fiber Technology (Print), v. xx, p. 1-6, 2013.
- Heidemann B. R. ; Chiamenti, I. ; Oliveira, M. M. ; MULLER, M. ; FABRIS, J . Plasmonic optical fiber sensors: enhanced sensitivity in water-based environments. Applied Optics, v. 54, p. 8192-8197, 2015.
- KAWANO, M. S. ; KAMIKAWACHI, Ricardo Canute ; Fabris, J L ; MULLER, M. . Thermally assisted sensor for conformity assessment of biodiesel production. Measurement Science & Technology (Print), v. 26, p. 025103, 2015.
- HEIDEMANN, BARBARA RUTYNA ; CHIAMENTI, ISMAEL ; OLIVEIRA, MARCELA MOHALLEM ; Muller, Marcia ; FABRIS, JOSE LUIS . Functionalized Long Period Grating-Plasmonic Fiber Sensor Applied to the Detection of Glyphosate in Water. Journal of Lightwave Technology, v. 36, p. 863-870, 2018.
- KAMIZI, MARCOS ALEKSANDRO ; LUGARINI, DIOGO ; FUSER, RUAHN ; HERMANN NEGRI, LUCAS ; FABRIS, JOSE LUIS L. ; Muller, Marcia . Multiplexing Optical Fiber Macro-Bend Load Sensors. JOURNAL OF LIGHTWAVE TECHNOLOGY, v. 37, p. 4858-4863, 2019.

Additional information

Web site (Portuguese only) https://lablaser.tk/principal.htm

Contact

Universidade Tecnológica Federal do Paraná - UTFPR-CT / Physics Department
Av. Sete de Setembro, 3165 / Curitiba – PR / 81.230-161
Phone number (LabLaser): + 55 41 3310 4642
Prof. Marcia Muller (mmuller@utfpr.edu.br)
Prof. José Luís Fabris (fabris@utfpr.edu.br)

IMBUIA BEAMLINE

(installation in progress)

https://www.youtube.com/watch?v=JrFcZdLcnvI

LNLS

Summary of activities

Sirius is one of the most advanced synchrotron light sources in the world. The beamlines are the experimental stations where the materials are analyzed. They are like complex microscopes that focus the synchrotron radiation so that it illuminates the samples being studied and allows the observation of their microscopic properties.

IMBUIA (Infrared Multiscale Beamline for Ultra-resolved Imaging Applications) is a beamline dedicated to experiments in micro and nano-infrared spectroscopy in the medium IR range. These experiments allow for compositional analysis of virtually any material and are essential for the research in new materials, with emphasis on biological and synthetic materials..

The group is also dedicated to the design of advanced sample environments and to providing post-processing interfaces for hyperspectral FTIR data. In addition, the group works on the study of nanophotonic properties of quantum materials based on few atomic layers (2D materials), and on the development of the scattering-type near-field optical microscopy technique (s-SNOM) and its application in multidisciplinary areas, such as nanobiology, new energetic materials and nanopharmacology.

Team

Raul de Freitas, Francisco C.B. Maia, Ingrid Barcelos, Rafael Mayer, Flavio Feres, Thiago M. dos Santos

Additional information

https://www.lnls.cnpem.br/facilities/imbuia-en/

Contact

Coordination: Raul de O. Freitas
Tel.: +55 19 3517 5060
E-mail: raul.freitas@lnls.br

CLA - Center for Lasers and Applications

https://www.youtube.com/watch?v=5lqA878uBG0

IPEN/CNEN

Summary of activities

Development of scientific and technological competences in Solid-state lasers, for health applications, processing in materials, environmental and nuclear monitoring. The Laser Technology Program of IPEN (Nuclear and Energy Research Institute) is located at the Centre for Lasers and Applications (CLA) and is committed to the development of new lasers based on the research of new optical materials and new resonator technologies. Laser application and research occur within several areas such as Nuclear, Medicine, Dentistry, Industry, Environment and Advanced Research. Additional goals of the Program are human resource development and innovation, in association with Brazilian Universities and commercial partners.

The Program is divided into two main areas: “Material and Laser Development” that includes crystal growth of optical materials, characterization, modeling and optical spectroscopy of solids, plasmas and biological materials and the development of compact, highly efficient, diode pumped-solid state lasers.

The other main area, “Laser Applications”, is concerned with technological laser uses such as laser processing, laser remote sensing, development of new diagnostic and therapeutic methods such as optical coherence tomography (OCT), laser Doppler flowmetry, cancer diagnosis by spectroscopy, photosensitization, prevention of dental caries and erosion, medical applications and other advanced applications of high intensity lasers

One of the biggest labs of the Center for Lasers and Applications uses a terawatt-laser for many of the above applications and also for basic research..

Most outstanding results, so far

Health

- Pioneer in development of new therapeutic processes with laser in dentistry in Brazil
- Development of new diagnostic methods for malignant neoplasms based on hyperspectral images by micro-FTIR, evaluated by machine learning;
- Pioneer uses of the optical coherence tomography technique in the health area in Brazil.
- Development of pre-clinical trials using light-based technologies to combating antimicrobial resistance
- Identification of microorganisms based on light scattering and recognition of standards
- Development of pre-clinical trials and ecological studies based on images molecular by Optical / CT, 2D and 3D bioluminescence, fluorescence and Cherenkov.

Environment

- Monitoring of bioaerosols in the atmosphere and indoors (indoor) using the technique to deal with fluorescence;
- Monitoring of Greenhouse Gases at the ocean-atmosphere interface on the coast of the state São Paulo (pre-salt and oil exploration region);
- Development of giant optical cavities for detecting air pollutants.

Industry

- Functionalization of surfaces for tribological improvement of machining tools.
- Functionalization of surfaces for biomedical applications.
- Production of microfluidic systems for the production of radiopharmaceuticals and bioreactors.
- Production of gold nanoparticles by laser ablation with ultrashort pulses.

Nuclear

- Cleaning and decontamination via laser ablation of metallic and dielectric surfaces
- Speckle standards in the analysis of CR-39 detectors

Most recent results

- State of the art of tool texturing in machining, Machado, AR; da Silva, LRR; (...); de Rossi,W; Ezugwu, EO Jul 2021 | Journal Of Materials Processing Technology
- Synergetic Aerosol Layer Observation After the 2015 Calbuco Volcanic Eruption Event, Lopes, FJS; Silva, JJ; (...); Landulfo, E Jan 2019 | Remote Sensing

- Global priority multidrug-resistant pathogens do not resist photodynamic therapy, Sabino, CP; Wainwright, M; Ribeiro, MS ; Sellera, FP, dos Anjos, C ; Baptista, MD; Lincopan, N Jul 2020 | Journal Of Photochemistry And Photobiology B-biology
- Focus Tracking System for Femtosecond Laser Machining using Low Coherence Interferometry- Raele, Marcus Paulo ; De Pretto, Lucas Ramos ; (...); Samad, Ricardo Elgul 2019 |SCIENTIFIC REPORTS
- General model for depth-resolved estimation of the optical attenuation coefficients in optical coherence tomography, Amaral, MM; Zezell, DM; (...); Freitas, AZ, Oct 2019 | Jul 2019 (Early Access) | Journal Of Biophotonics
- Evaluating biochemical differences in thyroglobulin from normal and goiter tissues by infrared spectral imaging, Pereira, TM; Diem, M; (...); Zezell, DM, Dec 21 2020 | Analyst
- Femtosecond Ti: Sa ultra short-pulse laser irradiation effects on the properties and morphology of the zirconia surface after ageing- Kiyan, VH; Rodrigues, FP; (...); Zezell, DM; Samad, R.E.; Saraceni, CHC, Feb 15 2021 | Ceramics International
- A new method for measuring pen pressure in forensic handwriting analysis - a proof of concept study- Neto, ON; Sarkis, JES; (...); Freitas, AZ, Mar 21 2021 | Analyst
- Double line Neodymium doped GeO2-PbO waveguide amplifier for the second telecom window- Wetter, NU; Da Silva, DS; (...); De Rossi, W., Conference on Optical Components and Materials XVII 2020 | Optical Components And Materials Xvii
- Effects of texturing the rake surfaces of cemented tungsten carbide tools by ultrashort laser pulses in machining of martensitic stainless steel - Bertolete, M; Barbosa, PA; (...); Vilar, R.; Viera, N.D.; de Rossi, W, Oct 2018 | International Journal Of Advanced Manufacturing Technology
- Production and characterization of (K Na)(Nb Cu)O-3 crystal fibers grown by micro-pulling-down method- Silva, MVS; Santo, AME; (...); Baldochi, SL; Lente, MH, Electric and Magnetic Ceramics Symposium (EMC) of the 7th International Congress on Ceramics (ICC). Jun 11 2019 | Ferroelectrics

Team

Researchers: Anderson Zanardi de Freitas, Denise Maria Zezell, Eduardo Landulfo, Jorge Eduardo Sarkis, Marcus Paulo Raelle, Martha Simões Ribeiro, Niklaus Ursus Wetter, Nilson Dias Viera Jr., Ricardo Elgul Samad, Sonia Licia Baldochi, Wagner de Rossi

Additional information

https://www.ipen.br/portal_por/portal/interna.php?secao_id=588

Contact

Wagner de Rossi, wderossi@ipen.br, Av. Prof. Lineu Prestes 2242

High Intensity Ultrashort Laser Pulses Laboratory

https://www.youtube.com/watch?v=iKRsgEGcvaw

IPEN

Summary of activities

At the High Intensity Ultrashort Laser Pulses Laboratory we work to develop high intensity lasers and their applications, researching from basic physics to applications that can have practical results. The lab has been working in this field for the last 2 decades, and more recently has started working towards the acceleration of particles by laser, aiming to aid in the production of radiopharmaceuticals that are currently produced at IPEN.

Most outstanding results, so far

Laser pulses with the highest peak power (1/2TW) and highest intensity (3x10^16 W/cm^2) in Brazil

Team

Ricardo E. Samad, Armando V. F. Zuffi, Bruno B. Chiomento, Fábio B. D. Tabacow, José A. S. da Matta, Nilson D. Vieira Jr

Bibliographic References

- E. P. Maldonado, R. E. Samad, A. Bonatto, R. P. Nunes, S. Banerjee, et al., "Study of quasimonoenergetic electron bunch generation in self-modulated laser wakefield acceleration using TW or sub-TW ultrashort laser pulses," AIP Advances in press, (2021).
- V. H. Kiyan, F. P. Rodrigues, R. E. Samad, D. M. Zezell, M. A. Bottino, et al., "Femtosecond Ti: Sa ultra short-pulse laser irradiation effects on the properties and morphology of the zirconia surface after ageing," Ceramics International 47, 4455-4465 (2021).
- J. H. Sierra, R. C. Rangel, R. E. Samad, N. D. Vieira, M. I. Alayo, et al., "Low-loss pedestal Ta2O5 nonlinear optical waveguides," Opt. Expr. 27, 37516-37521 (2019).
- M. P. Raele, L. R. De Pretto, W. de Rossi, N. D. Vieira, and R. E. Samad, "Focus Tracking System for Femtosecond Laser Machining using Low Coherence Interferometry," Sci. Rep. 9, 4167 (2019).
- M. O. D. Santos, A. Latrive, P. A. A. De Castro, W. De Rossi, T. M. T. Zorn, et al., "Multimodal evaluation of ultra-short laser pulses treatment for skin burn injuries," Biomed. Opt. Express. 8, 1575-1588 (2017).

Contact

Centro de Lasers e Aplicações, IPEN/CNEN, Av. Prof. Lineu Prestes 2242, Cidade Universitária, São Paulo, SP, Brazil

Ricardo Elgul Samad, +55 (11) 2810-5675 resamad@gmail.com

Photonics Packaging Lab
Product Engineering Lab
Pi-tec Labs

Br Photonics / Idea! Electronic Systems / Pi-Tecnologia

https://www.youtube.com/watch?v=JhfuHqpxepA

Summary of activities

- In the Photonics Packaging Lab, teams are responsible for the development of DFM (design for manufacturing) processes of photonics packaging orientated to volume production. It's also where the photonics packaging production process is performed for different types of optoelectronic devices produced by BrPhotonics.
- In the IDEA Product Engineering Lab, teams are responsible to develop and integrate hardware, firmware and mechanics to support photonics and microelectronics devices. Also, they perform automated testing of the products developed at IDEA (lasers, optical modulators, optical modules, ASICs) at different levels (concept, performance, integration, qualification), always targeting a pre-production process.
- In the PITEC LABS, teams are responsible for performing fine microelectronics assembly and fine mechanics and electronics hardware integration to produce and test large area x-ray detectors (PIMEGA) synchrotron applications.

Most outstanding results, so far

BR Photonics

- Implementation of a complete set of photnics packaging process to support a big variety optoelectronics devices development and production such as: optical alignment, die bonding, wire bonding, welding, epoxy, sealing, and testing.
- Establishment of a production line for the nano-ITLA, a Tunable LASER product for telecom applications, for the international market with production capacity of 400 pieces/month.
- Pilot line implementation for the TROSA-BiDi, a Silicon Photonics transceiver device for bidirectional telecom applications.

Idea

- IDEA LASER (nano-ITLA) product development, production support, and it's integration at Optical Modules (CFP2/CFP)
- Optical Amplifier (QSFP-EDFA) product development
- IDEA SiPh Transceiver device (TROSA-BiDi) product development
- Optical Modules mechanical and Thermal design

Pi-Tec

- Production of large area x-ray detectors (PIMEGA) for synchrotron applications
- Development of x-ray detectors for medical applications

Most recent results

Br Photonics

- Establishment of a production line for the nano-ITLA, a Tunable LASER product for telecom applications, for the international market with production capacity of 400 pieces/month

Idea

- Integration of IDEA SiPh Transceiver device (TROSA-BiDi) at CFP2 Optical Module
- CFP2/CFP Optical Modules Assembly and Testing

Pi-Tec

- Production line for large area detectors for synchrotron applications: 4, 12, 36, up 144 x-ray sensors

Team

BR Photonics

- 4 engineers
- 15 technicians and operators (in house trained operational team in photonics packaging)

Idea

- 15 engineers (hardware, firmware, testing, mechanics)
- 3 technicians (2 optical, 1 electronics)

Pi-Tec

- 4 engineers
- 8 technicians

Additional information

Pi-Tec: CNPEM / Sirius

www.lnls.cnpem.br/sirius/

Contact

Br Photonic: R. Dr. Ricardo Benetton Martins, 1000 - Prédio 12 - Bosque das Palmeiras, Campinas - SP - Flavio Borin

Idea: Av. Alan Turing, 776 - 1º andar - Cidade Universitária, Campinas - SP, 13083-898 - Juliano Oliveira

Pi-Tec: Rua Walter August Hadler, 325 - Cidade Universitaria, Campinas, sp, cep: 13083-837 - Paulo Bertolo

Mackenzie Photonics Laboratory @ MackGraphe

Mackenzie Presbyterian University

https://www.youtube.com/watch?v=1ghLfDx5iK8

Summary of activities

- Development of ultrafast fiber lasers based on two-dimensional materials
- Development of optical modulators and photodetectors based on two-dimensional materials for next generation optical communications systems
- Nonlinear optics in two-dimensional materials.
- Graphene-based plasmonic waveguides for biosensing
- Modelling and characterization of the electronic and photonic properties of graphene and other 2D materials.

Most outstanding results, so far

The Mackenzie Photonics Laboratory (MPL) has been active in the Brazilian photonics scenery for over 15 years, originally developing optical fiber devices for telecommunications and sensing. However, in 2012, the MPL proposed the creation of MackGraphe (the Graphene and Nanomaterials Research Center located at the Mackenzie University's São Paulo Campus). Consequently, it expanded its activities toward the study of 2D materials and its pioneering application in photonic devices. Along the years, the MPL has demonstrated some of the shortest pulses in 2D-materials-based mode locked fiber lasers and clarified some important Raman spectroscopy and nonlinear optical properties of 2D materials, especially black phosphorus

Most recent results

Currently, MPL and its partners have been active in the nonlinear optical characterization of less known lamellar and 2D materials, such as franckeite and NbS2; in the functionalization of transition metal dichalcogenides with individual noble metal atoms (and its optical characterization); and in the controlled deposition of 2D materials onto fiber optics, integrated waveguides, and photonic cavities.

Team

(in appearance order on the LabTour video)

Prof. Christiano J. S. de Matos

Prof. E. A. Thoroh de Souza

Prof. Lucia A. M. Saito

Prof. Dario Bahamon

Dr. Alisson Cadore

Dr. David Steinberg

Dr. Rodrigo Gerosa

Ms. Mateus Guitti Bonando

Ms. Alexandre Samuel Ore

Bibliographic References

- MALDONADO, MELISSA; DA SILVA NETO, MANOEL L.; VIANNA, PILAR G.; RIBEIRO, HENRIQUE B.; DE ARAÚJO, CID B.; MATOS, CHRISTIANO J. S. DE; SEIXAS, LEANDRO; JAWAID, ALI M.; BUSCH, ROBERT; RITTER, ALLYSON J.; VAIA, RICHARD A.; Gomes, Anderson S. L. Femtosecond nonlinear refraction of 2D semi-metallic redox exfoliated ZrTe at 800-nm. APPLIED PHYSICS LETTERS, v. 118, p. 011101, 2021.
- STEINBERG, DAVID ; ZAPATA, JUAN DIEGO; SAITO, LUCIA A. M.; DE SOUZA, EUNEZIO A. Study of pulse formation in an EDFL under a large dispersion variation hybridly mode-locked by graphene and nonlinear polarization rotation. IEEE Photonics Journal, p. 1-1, 2021.
- GODOY, ANNA PAULA; AMURIM, LEICE G.; MENDES, ALEXANDRE; GONÇALVES, EMERSON S.; FERREIRA, ANDERSON; DE ANDRADE, CAROLINA SANTOS; KOTSILKOVA, RUMIANA; IVANOV, EVGENI; LAVORGNA, MARINO; SAITO, LÚCIA A. M.; RIBEIRO, HÉLIO; ANDRADE, RICARDO J. E. Enhancing the electromagnetic interference shielding of flexible films with reduced graphene oxide-based coatings. PROGRESS IN ORGANIC COATINGS, v. 158, p. 106341, 2021.
- GEROSA, RODRIGO M.; SUAREZ, FELIPE G.; VIANNA, PILAR G.; DOMINGUES, SERGIO H.; DE MATOS, CHRISTIANO J.S. One-step deposition and in-situ reduction of graphene oxide in photonic crystal fiber for all-fiber laser mode locking. OPTICS AND LASER TECHNOLOGY, v. 121, p. 105838, 2020.
- MALDONADO, MELISSA; DA SILVA NETO, MANOEL L.; VIANNA, PILAR G.; RIBEIRO, HENRIQUE B.; GORDO, VANESSA O.; CARVALHO, ISABEL C. S.; DE S. MENEZES, LEONARDO; DE ARAÚJO, CID B.; de Matos, Christiano J. S.; SEIXAS, LEANDRO; JAWAID, ALI M.; BUSCH, ROBERT; RITTER, ALLYSON J.; VAIA, RICHARD A.; Gomes, Anderson S. L. Femtosecond Nonlinear Optical Properties of 2D Metallic NbS in the Near Infrared. Journal of Physical Chemistry C, v. 124, p. 15425-15433, 2020.
- GEROSA, RODRIGO M.; OSORIO, JONAS H.; LOPEZ-CORTES, DANIEL; CORDEIRO, CRISTIANO M. B.; de Matos, Christiano J. S.. Distributed pressure sensing using an embedded-core capillary fiber and optical frequency domain reflectometry. IEEE Sensors Journal, v. 21, p. 360-365, 2020.
- MALDONADO, MELISSA E.; DAS, AVISHEK; JAWAID, ALI M.; RITTER, ALLYSON J.; VAIA, RICHARD A.; NAGAOKA, DANILO A.; VIANNA, PILAR G.; SEIXAS, LEANDRO; de Matos, Christiano J. S.; BAEV, ALEXANDER; PRASAD, PARAS N.; Gomes, Anderson S. L.. Nonlinear Optical Interactions and Relaxation in 2D Layered Transition Metal Dichalcogenides Probed by Optical and Photoacoustic Z-Scan Methods. ACS Photonics, v. 7, p. 3440-3447, 2020.
- VIANNA, PILAR GREGORY; ALMEIDA, ALINE DOS S.; GEROSA, RODRIGO M; BAHAMON, DARIO ANDRES; de Matos, Christiano J. S. Second-harmonic generation enhancement in monolayer transition-metal dichalcogenides by an epsilon-near-zero substrate. Nanoscale Advances, v. 3, p. 272-278, 2020.
- SILVA NETO, MANOEL LEONARDO; SILVA, RENATO; DE ARAÚJO, CID BARTOLOMEU; de Matos, Christiano J. S.; JAWAID, ALI; RITTER, ALLYSON; VAIA, RICHARD A.; Gomes, Anderson S. L.. Hyper-Rayleigh scattering in 2D redox exfoliated semi-metallic ZrTe transition metal dichalcogenide. PHYSICAL CHEMISTRY CHEMICAL PHYSICS, p. 27845-27849, 2020.

- LIU, HE; GRASSESCHI, DANIEL; DODDA, AKHIL; FUJISAWA, KAZUNORI; OLSON, DAVID; KAHN, ETHAN; ZHANG, FU; ZHANG, TIANYI; LEI, YU; BRANCO, RICARDO BRAGA NOGUEIRA; ELÍAS, ANA LAURA; SILVA, RODOLFO CRUZ; YEH, YIN-TING; MARONEZE, CAMILA M.; SEIXAS, LEANDRO; HOPKINS, PATRICK; DAS, SAPTARSHI; de Matos, Christiano J. S.; TERRONES, MAURICIO. Spontaneous chemical functionalization via coordination of Au single atoms on monolayer MoS2. SCIENCE ADVANCES, v. 6, p. eabc9308, 2020.
- PIERETTI, JOANA C.; TREVISAN, TAYNÁ B.; DE MORAES, MARIA M. M.; DE SOUZA, EUNÉZIO A.; DOMINGUES, SERGIO H.. High capacitive rGO/WO3 nanocomposite: the simplest and fastest route of preparing it. Applied Nanoscience, v. 10, p. 165-175, 2020.
- BAHAMON, DARIO A.; GÓMEZ-SANTOS, G.; STAUBER, T. Emergent magnetic texture in driven twisted bilayer graphene. Nanoscale, v. 12, p. 15383-15392, 2020.
- FERES, FLÁVIO HENRIQUE; BARCELOS, INGRID; MAYER, RAFAEL; MIGUEL, THIAGO MIGUEL; FREITAS, RAUL DE OLIVEIRA; RASCHKE, MARKUS B; BAHAMON, DARIO ANDRES; BARBOSA MAIA, FRANCISCO CARLOS. Dipole modelling for a robust description of subdiffractional polariton waves. Nanoscale, v. 21218-, p. 21218-21226, 2019.
- PÁEZ, C J; OSPINA, R; BAHAMON, D A. An accurate and compact tight-binding model for GeS. JOURNAL OF PHYSICS. CONFERENCE SERIES (PRINT), v. 1159, p. 012008, 2019.
- BATISTA, ANDRE JAQUES; VIANNA, PILAR GREGORY; RIBEIRO, HENRIQUE BUCKER; MATOS, CHRISTIANO JOSE SANTIAGO DE; GOMES, ANDERSON STEVENS LEONIDAS. QR code micro-certified gemstones: femtosecond writing and Raman characterization in Diamond, Ruby and Sapphire. Scientific Reports, v. 9, p. 8927, 2019.
- RIBEIRO, H. B.; RAMOS, S. L. L. M.; SEIXAS, L.; DE MATOS, C. J. S.; PIMENTA, M. A. Edge phonons in layered orthorhombic GeS and GeSe monochalcogenides. PHYSICAL REVIEW B, v. 100, p. 094301, 2019.
- BARCELOS, INGRID D.; BECHTEL, HANS A.; de Matos, Christiano J. S.; BAHAMON, DARIO A.; KAESTNER, BERND; MAIA, FRANCISCO C. B.; FREITAS, RAUL O. Probing Polaritons in 2D Materials with Synchrotron Infrared Nanospectroscopy. Advanced Optical Materials, v. 2019, p. 1901091, 2019.
- TORRES, V.; SILVA, P.; DE SOUZA, E. A. T.; SILVA, L. A.; BAHAMON, D. A.. Valley notch filter in a graphene strain superlattice: Green's function and machine learning approach. PHYSICAL REVIEW B, v. 100, p. 205411, 2019.
- GODOY, ANNA P.; ECORCHARD, PETRA; BENE, HYNEK; TOLASZ, JAKUB; SMR'OVÁ, DARINA; SEIXAS, LEANDRO; PEDROTTI, JAIRO J.; DE SOUZA, EUNEZIO A.T.; EL SEOUD, OMAR A.; DONATO, RICARDO K. Ultrasound exfoliation of graphite in biphasic liquid systems containing ionic liquids: A study on the conditions for obtaining large few-layers graphene. ULTRASONICS SONOCHEMISTRY, v. 55, p. 279-288, 2019.
- DE OLIVEIRA, CAMILA F. P.; MUÑOZ, PABLO A.R.; DOS SANTOS, MICHELLE C.C.; MEDEIROS, GABRIELA S.; SIMIONATO, AMANDA; NAGAOKA, DANILO A.; DE SOUZA, EUNÉZIO A. T.; DOMINGUES, SERGIO H.; FECHINE, GUILHERMINO J. M. Tuning of surface properties of poly(vinyl alcohol)/graphene oxide nanocomposites. POLYMER COMPOSITES, v. 40, p. E312, 2019.

Contact

Prof. Lucia A. M. Saito
Rua da Consolação, 896 – São Paulo/SP
E-mail: lucia.saito@mackenzie.br

Photonicamp Labs

Photonics Research Center at Unicamp

https://www.youtube.com/watch?v=WZ7ph4WAulo

Summary of activities

At the Photonics Research Center at Unicamp we investigate fundamental properties of light and its interaction with matter, developing and engineering novel photonic materials and devices to harness light propagation.

The main research lines covered by our center are:
- Nanophotonics;
- Ultrafast spectroscopy;
- Optical fibers and communications.

Team

Professors Thiago Alegre. Felippe Barbosa, Paulo Dainese, Hugo Figueroa, Newton Frateschi, Lucas Gabrielli, Lázaro Padilha, Gustavo Wiederhecker

Additional information

https://sites.ifi.unicamp.br/photonicamp/en/

Contact

Prof. Thiago Alegre
alegre@ifi.unicamp.br

Biophotonics Lab

https://www.youtube.com/watch?v=vtkNwlBc-pE

IFSC-USP

Summary of activities

Our group has been developing photonic techniques and devices for the treatment of cancer, infectious diseases and chronic disorders. The multidisciplinary research is based on light distribution models, in vitro investigation for proof-of-concept and validation and optimization of the protocols in animal models. In collaboration with clinical partners, we also perform clinical trials for validation of efficacy and safety of the new photonic technologies.

Most outstanding results, so far

- Multicenter clinical trial of photodynamic therapy for the treatment of basal cell carcinoma with Brazilian drug and device.
- Development of photonic technologies (UVC and aPDT) for the decontamination of infected donor lungs with hepatits C vírus.
- Development of equipment and protocol for the treatment of HPV dysplastic lesions.
- Development of equipment, curcumin formulation and protocol for the treatment of onychomycosis using antimicrobial photodynamic therapy.
- Development of curcumin-PDT for the larvae control of Aedes Aegypti.

Most recent results

- Development of aPDT device and protocol for the treatment of oropharyngotonsillitis.
- First demonstration of *in vivo* application of optical clearing agents for improving optical coherence tomography imaging and photodynamic therapy eradication of cutaneous pigmented melanoma.
- Development of combined treatment using photobiomodulation and therapeutic ultrasound for fibromyalgia.
- Development of combined PDT treatment with ultrasound for cancer and biofilm.

Team

Prof. Dr. Vanderlei Bagnato,

Prof. Dr. Cristina Kurachi,

Prof. Dr. Sebastião Pratavieira.

Full list at http://cepof.ifsc.usp.br/

Bibliographic References

Look at: http://cepof.ifsc.usp.br/

Additional information

www.youtube.com/sitecepof

http://cepof.ifsc.usp.br/

www.instagram.com/cepof.usp

Contact

Prof. Dr. Vanderlei Bagnato - vander@ifsc.usp.br;

Prof. Dr. Cristina Kurachi - cristina@ifsc.usp.br;

Prof. Dr. Sebastião Pratavieira - prata@ifsc.usp.br

People

KEYNOTE SPEAKERS: PLENARIES

Anderson Stevens Leônidas Gomes

Anderson S. L. Gomes received his PhD degree from Imperial College of Science, Technology and Medicine, London, in 1986, and is presently a Full Professor of Physics at the Physics Department, Universidade Federal of Pernambuco, Recife, PE, Brazil. He is the co-author of more than 300 scientific papers, 03 international patents, supervised more than 36 Master Dissertations and 20 PhD theses.

Professor Gomes is a member of the SBFOTON, Fellow of the Optical Society of America and Member of the Brazilian Academy of Science. He has received the Brazilian Order of Scientific Merit, commander class.

His present scientific activities are in the areas of laser applications in Nanophotonics, Biophotonics and Nonlinear Photonics. He is the Director of the National Institute for Science and Technology (INCT) of Photonics, part of a Brazilian Initiative.

Brian C. Wilson

Dr. Wilson is internationally recognized for his pioneering research into various optic tools applied to minimally-invasive cancer treatment and early diagnosis.

In the early 80's, he started a program in translational research and collaborative clinical trials of photodynamic therapy for brain, prostate and gastrointestinal cancers. He has driven the development of fluorescence and other endoscopic imaging techniques and more recently developed optical imaging to guide surgery that is being evaluated in clinical trials for head and neck, prostate and brain cancers.

Nowadays, his research has expanded to include nanotechnologies in cancer treatment, diagnosis and research. He is currently head of the division of biophysics and bio-imaging at the Ontario Cancer Institute and professor of medical biophysics in the faculty of medicine at University of Toronto.

Donald Umstadter

Donald Umstadter is a professor and Leland J. and Dorothy H. Olson Chair of Atomic, Molecular and Optical Physics in the Physics and Astronomy Department at the University of Nebraska, Lincoln. He directs the *Extreme Light Laboratory*, which is dedicated to the study of the science, technology, and applications of extreme light.

The research involves the interactions of high intensity light with matter, as well as the development and applications of laser-driven electron accelerators and x-ray sources. Applications include laboratory astrophysics, high energy density physics, ultrafast phenomena, remote active interrogation, and medical therapy.

His laboratory is one of the ten host institutions of the *LaserNetUS* network of high power laser facilities in North America.

Donna Strickland

Donna Strickland is a professor in the Department of Physics and Astronomy at the University of Waterloo and is one of the recipients of the Nobel Prize in Physics 2018 for developing chirped pulse amplification with Gérard Mourou.

Strickland earned a B.Eng. from McMaster University and a PhD in optics from the University of Rochester. She was a research associate at the National Research Council Canada, a physicist at Lawrence Livermore National Laboratory and a member of technical staff at Princeton University. In 1997, she joined the University of Waterloo, where her ultrafast laser group develops high-intensity laser systems for nonlinear optics investigations.

Strickland served as the Optical Society's president (OSA) in 2013 and is a fellow of OSA, SPIE, the Royal Society of Canada and the Royal Society. She is an honorary fellow of the Canadian Academy of Engineering and the Institute of Physics and an international member of the US National Academy of Science. Strickland was named a Companion of the Order of Canada.

Eric Guichard

Dr. Eric Guichard is Vice President and General Manager of Silvaco's TCAD Division. He is responsible for managing all aspects of the TCAD division from R&D to field operations. Since joining Silvaco in 1995, he has held numerous positions including GM of Silvaco France and VP of Worldwide TCAD Field Operations. Prior to joining Silvaco, Eric Guichard was a senior SOI engineer specializing in transistor and circuit aging at LETI and Thomson Military and Space.

Dr. Guichard holds an MS in material science and a Ph.D. in semiconductor physics from Ecole National Polytechnique de Grenoble, France.

Francesco Da Ros

Francesco Da Ros received his Ph.D. in 2015 from the Technical University of Denmark (DTU) including a research stay at the Fraunhofer Heinrich-Hertz-Institute. Between 2015 and 2018, he worked within the Center for Silicon Photonics for Optical Communications at DTU, and since 2020, he is a senior researcher in the Machine Learning in Photonic Systems group at DTU.

Dr. Da Ros has co-authored 150+ papers in the fields of optical communication and nonlinear optics. He is an OSA Young Professional Volunteer, an IEEE Senior Member, and has served in the TPC of CLEO (2018 and 2021) and of OECC/PSC (2021-2022).

Franz X. Kärtner

He received his Diploma and Ph.D. degree in Electrical Engineering from Technische Universität München, Germany, in 1986, and 1989, respectively. In 1991, he carried out research at Massachusetts Institute of Technology (MIT). From 1993 to 1997, he was a principal investigator at Swiss Federal Institute of Technology, earning his Habilitation degree in Experimental Physics. After a visiting professorship at MIT in 1998, he joined Universität Karlsruhe (TH) as Professor of Electrical Engineering and held the Chair for Photonics and Terahertz Technology.

Dr Kärtner heads the Ultrafast Optics and X-Rays Group, Center for Free-Electron Laser Science, DESY, Hamburg, Germany, and is currently a Professor with the Physics Department, Universität Hamburg, Hamburg, Germany, and an Adjunct Professor in electrical engineering at MIT. His research interests include noise in electronic and optical sources, ultrashort pulse lasers, high-energy subcycle waveform synthesis, frequency combs and precision timing in advanced accelerators and light sources, attosecond physics, and compact free-electron lasers.

Hugo Enrique Hernandez Figueroa

He has a degree in Electrical Engineering (1982) and a specialization in Mathematics (1983) from the Federal University of Rio Grande do Sul, a master's degree in Electrical Engineering (1986) and a master's degree in Informatics (1988), from the Pontifical Catholic University of Rio de Janeiro, and a doctorate in Physics from Imperial College of Science, Technology and Medicine, London, GB (1992).

Full Professor at the State University of Campinas since 2005. Fellow at the Optical Society of America, 2011. Area Coordinator at FAPESP: Engenharias I, since 2014. Chief Guest Editor IEEE Journal of Selected Topics in Quantum Electronics: 2020 Special Issue on Photonic Antennas.

He has experience in Electrical Engineering, working on the following topics: integrated photonics, optical fibers, antennas, microwaves, computational electromagnetism, optical communications and telecommunications.

José Luís Fabris

José L. Fabris received the B.Sc. in Physics from the Federal University of Paraná (Paraná, Brazil) in 1986, the M.Sc. degree from the Fluminense Federal University (Rio de Janeiro, Brazil) in 1989 and Ph.D. degree from the University of São Paulo (São Paulo, Brazil), in 1994.

His research focused on color center lasers and laser spectroscopy. He is currently a full Professor at Federal University of Technology – PR - UTFPR in Curitiba, Paraná, Brazil. He is co-head of the research Group on Photonics Devices and Applications at UTFPR, and helped to found the Laser Laboratory at UTFPR in 1996, where he is a laboratory co-director nowadays.

His current main research area is photonics, with special interest in optical fiber grating based sensors and spectroscopy. Prof. Fabris is a member of OSA (The Optical Society), SBF (Brazilian Society of Physics) and SBMO (Brazilian Society of Microwaves and Optoelectronics).

Maurizio Ferrari

Maurizio Ferrari received the Doctor in Physics degree from Trento University, Italy, in 1979/1980. Until 1989, he worked as a Researcher with the Laboratoire de Physico-Chimie des Matériaux Luminescents, Lyon, France, and in 1989 he moved to Trento as a Researcher with the Institute for Photonics and Nanotechnologies, CNR.

He is currently director of research with the Trento University, where he is also head of the IFN-CNR Trento unit.

He is co-author of more than 600 publications in international journals, of several book chapters, and he is involved in numerous national and international projects concerning glass photonics.

He is an OSA and SPIE fellow.

Nicolas Fontaine

Nicolas K. Fontaine received the Ph.D. degree in electrical engineering from Next Generation Network Systems Laboratory, University of California, Davis, CA, USA, in 2010. In his dissertation, he studied how to generate and measure the amplitude and phase of broadband optical waveforms in many narrowband spectral slices.

Since June 2011, he has been a Technical Staff Member with Advanced Photonics Division, Bell Laboratories, Crawford Hill, NJ, USA. At Bell Labs, he develops devices for space-division multiplexing in multi-core and few mode fibers, builds wavelength cross-connects and filtering devices, and investigates spectral slice coherent receivers for THz bandwidth waveform measurement.

Paulo Cesar R. de Carvalho Alvim

Paulo Alvim graduated in Civil Engineering from the Federal University of Rio de Janeiro, with a Master degree in Information Science, from University of Brasília. With experience as technical analyst of transportation, energy and basic industrial technology, he has worked at SEBRAE, in the areas of technological support for small businesses, modernization and technical cooperation; at the Ministry of Foreign Affairs; and at FINEP, in the area of support to national consultancy. From 1990 to 1992 he coordinated the technological modernization of the Secretariat of Science and Technology, in the area of technological prospecting. From 2002 to 2019, he was the Manager of Access to Technology and Innovation, Agribusiness Manager, Market Access Manager, Market Access and Financial Services Manager at Sebrae acting as its representative on national and international boards and forums.
He is currently the National Secretary for Entrepreneurship and Innovation of the Ministry of Science, Technology and Innovation – MCTI.

Serge R. Mordon

Serge R. Mordon, PhD is Research Director of the French National Institute of Health and Medical Research (INSERM). He is the Head of INSERM ONCOTHAI (Laser Assisted Therapies and Immunotherapies for Oncology) and the Photomedicine Center (Lille University Hospital, France).

Since 1981, he has been involved in the medical applications of lasers, particularly in Dermatology, Plastic Surgery, Focal Laser Ablation and Photodynamic Therapy. He is an internationally recognized expert in laser-tissues interaction and laser applications in medicine. He has authored over 600 articles and book chapters.

Professor Mordon is the author of 17 issued patents. Since 2012, he holds a Master Degree in Strategy and Organization Management (University of Paris X). He is a Board Member of several professional societies. He is an associate editor for the journals, Lasers in Surgery and Medicine and Pharmaceuticals. In 2015, he was nominated Finland Distinguished Professor. In 2018, he was nominated Fellow Member of the European Alliance of Medical and Biological Engineering and Science (EAMBES).

Vanderlei Salvador Bagnato

Vanderlei Salvador Bagnato simultaneously completed his bachelor's degree in Physics - USP and Materials Engineering - UFSCar in 1981 and completed his Ph.D. in Physics - MIT in 1987.

He is currently a full professor at the University of São Paulo and coordinator of the USP Agency Of innovation. He has received several prizes and honors and has worked in the area of Atomic Physics and Applications of Optics in Health Sciences. He works with cold atoms, Bose-Einstein Condensates and photodynamic actions in cancer and microbiological control.

He is a member of the Brazilian Academy of Sciences, the Academy of Sciences for the Developing World, the Pontifical Academy of Sciences of the Vatican, and the National Academy of Sciences (USA). He coordinates a Research Center, in which basic and applied sciences coexist in harmony. It carries out several activities of Technological Innovation and diffusion of sciences.

Walter Margulis

Walter Margulis is a senior scientist at Acreo and guest professor at KTH Royal Institute of Technology, having worked for 30 years in photonics and specialty optical fibers.
Some of the research lines developed are nonlinear optics, distributed sensing and optofluidics in fibers. Expertise: Fiber Optics, Fiber Optic components, Fiber Optics in Life Science, Fiber Optics in Production Group: Fiber Bragg gratings (FBG) laboratory, Fiber optics sensors.
His present lines of research at RISE (Research Institute of Sweden) Acreo and the Royal Institute of Technology (KTH) in Sweden are: Fabrication, characterization and applications of fiber components and in particular electrically controlled fiber devices and poling of glass systems. Other main lines include the design and fabrication of specialty fiber.

KEYNOTE SPEAKERS: TUTORIAL SESSIONS

Alexandre Cunha

Alexandre Cunha holds a Doctorate in Materials Engineering by the Instituto Superior Técnico (IST)-University of Lisbon and by the Bordeaux University.

He has more than 10 years experience working on laser materials processing, with an emphasis in laser surface treatments. He has published more than 10 peer-reviewed articles, one book chapter and has given about 16 talks in national and international events on materials engineering and laser technology.

He is currently the Innovation Manager at the SENAI Innovation Institute for Laser Processing, Joinville-SC. He is also a member of the Technology Advisory Board of the USA-based startup, Genetoo Inc.

Cristina Kurachi

Cristina Kurachi has a degree in Dentistry from the University of São Paulo (1996), a master's degree in Sciences and Materials Engineering from the University of São Paulo (2000) and a PhD in Sciences and Materials Engineering from the University of São Paulo (2005).

She has experience in the field of Biophotonics, with an emphasis on the interaction of light with biological systems, optical diagnosis and photodynamic therapy, applied to cancer and infected tissues. The lines of research involve the development of biomedical instrumentation and clinical protocols applying photonic techniques.

She is currently a PhD professor at the University of São Paulo and a CNPq researcher PQ1D.

Denise Maria Zezell

She is BSc, MSc and PhD in Physics from University of Campinas, responsible for the Laboratory of Biophotonics since 1992, former Head of the Laser Applications department and former Vice-president of Brazilian Association of Laser Dentistry (ABLO).

Presently she is the Coordinator of the Professional Master in Nuclear Technology in Health Sciences (IPEN/CNEN) and a member of the Photonics Commission - Ministry of Science, Technology and Innovation (MCTI- Brazil).

Her main research activities are in the physical and chemical characterization of biological tissues irradiated by laser or ionizing radiation, aiming the development of new diagnostic and therapeutic methods in Medicine and Dentistry. Spectral histopathology for tumor diagnosis and staging using imaging micro-Fourier Transform Infrared Spectroscopy, Infrared Thermography, and Optical Coherence Tomography are the main techniques used.

Diego Rativa

Diego Rativa is an Associate Professor in the Computer Engineering course at the University of Pernambuco (UPE), a permanent member of the Graduate Programs in Systems Engineering at UPE, and Applied Physics at the Federal Rural University Pernambuco.

He also holds the position of Research Division Manager at the Polytechnic School of Pernambuco and is a technical-scientific advisor at the Institute of Technological Innovation (IIT) at UPE. He is currently the coordinator of the Optoelectronics Laboratory of the IIT.

His research themes are focused (but not limited to) on optical instrumentation, thermal and solar collectors, visual optics, adaptive optics, and intelligent algorithms for optical control systems.

Edison Puig Maldonado

Edison Maldonado graduated in Physics (1988) and Master in Physics (1991) from the University of São Paulo, USP, Brazil, and received a PhD degree in Nuclear Technology (1995) from the Institute of Energy and Nuclear Research, IPEN, Brazil.

His professional activities are in the fields of physics, electrical engineering, computer science and photonics. Specialist in instrumentation, biomedical applications of laser light, material processing and ultrashort light pulses; information technology and software development.

Besides working in superior degree education, he also holds positions as research project coordinator and councils' member.

Giovanni Beninca de Farias

Giovanni Beninca de Farias received the MS.C and Ph.D degrees from the Université de Grenoble, France, in 2010 and 2013, respectively.

From January 2014 until December 2019, he worked as senior engineer and team coordinator of the Integrated Photonics division in CPqD Foundation, Brazil, contributing to several technological transfers of optical devices to the telecom industry with photonic integrated circuit technology. He was also project coordinator of large-budget R&D projects.

Since February 2020, he works as R&D and design engineer in VLC Photonics, Spain, in the field of Photonic Integrated Circuits for a variety of applications.

Helio Waldman

HELIO WALDMAN graduated in Electronics in 1966 from ITA, Brazil; M.SC. in 1968 and Ph.D. in 1971 from Stanford University, USA.

He has been active in communication networking research since then, with a few stints in academic management. In the 1970's and 80's, he focused on digital transmission over metallic cables and optical fibers respectively; in the 1990's, he co-authored a book written in Portuguese on optical communications; in the 2000's, he supervised research on optical networking.

Since 2017, he has been leading a Fapesp Thematic Project on new strategies to confront the threat of an Internet capacity crunch.

Isabel Cristina S. de Carvalho

Isabel Carvalho graduated in Physics from the Federal University of Rio de Janeiro (1979), Master's in Physics - University of British Columbia (1984) and PhD in Physics from the Pontifical Catholic University of Rio de Janeiro (1991).

She is currently an associate professor at the Pontifical Catholic University of Rio de Janeiro. He has experience in the field of Physics, with an emphasis on Prop. Optics and Spectroscopy. from Mat. Condens; Other Inter. da Mat. with Rad. and Part., acting mainly on the following themes: glasses, optical fiber, polarization, frequency doubling and plasmonics.

Lilia Coronato Courrol

PhD in Physics - National Nuclear and Energy Research Institute - IPEN/USP in 1994.

She is currently an Associated Professor at Federal University of São Paulo. She published about 140 articles in specialized journals, 5 chapters of books and 2 books.

She directed 8 master"s theses and 3 doctoral theses in the areas of Physics, Pharmacy and Chemistry.

She works in the areas of Optical Spectroscopy and nanophotonics applied to health and the environment.

Lino Misoguti

Lino Misoguti received his Ph.D degree in Material Science and Engineering in 1999 from USP at São Carlos working with nonlinear optical properties of new organic crystals.

From 1999 to 2001, in his Postdoctoral position in the Center for Ultrafast Optical Science, University of Michigan and JILA, University of Colorado, he worked with ultrafast lasers.

Currently he is Professor at the IFSC-USP, where his main research interests lie in ultrafast laser pulse applications for nonlinear optics, fundamental understanding of nonlinear effects, developing new methods for nonlinear optical measurements, etc.

He is a member of the SBF, OSA (Senior Member) and IEEE.

Marcelo Luís Francisco Abbade

Marcelo Abbade graduated (1993) and master's degree in Physics (1996) and doctorate (2001) in Electrical Engineering from the State University of Campinas.

Since 1998, he has dedicated himself to the study and application of non-linear effects to photonic devices.

Since 2015 he has been an Associate Professor at the São João da Boa Vista Experimental Campus (CESJBV) at Universidade Estadual Paulista Júlio de Mesquita Filho (UNESP). He is a CNPq productivity scholar since 2009 and currently coordinates a Spectral Signal Cryptography project adapted to the Advanced Encryption Standard Paradigm. He is a founding member of the Brazilian Society of Optics and Photonics (SBFoton, 2017) and a member of the IEEE (since 2009) and of the Brazilian Telecommunications Society (SBrT) (2013).

Ricardo Elgul Samad

Ricardo Elgul Samad received his bachelor's degree in physics in 1993, obtained his master's degree in solid state physics in 1997, and completed his doctorate also in solid state physics in 2006, all from the USP Institute of Physics. He is currently a Researcher at the Lasers and Applications Center Institute for Energy and Nuclear Research (IPEN-CNEN / SP).

Since his Scientific Initiation, he has worked in the development and applications of solid state lasers, and in his doctorate he has started research activities with ultra-short pulse lasers.

Currently works with applications of ultrashort pulses and their interaction with matter, such as ablation and machining of solids by laser, plasma generation induced by ultrashort pulses and material modification resulting from extreme states of temperature and pressure generated by ultrashort pulses, and harmonic generation techniques to enable new light sources in the region of deep UV and soft X-rays. Recently he has been working with particle acceleration by ultrashort laser pulses.

Roberto Ricardo Panepucci

Roberto Panepucci received his Master's (1990) and Bachelor's (1989) in Applied Physics from the University of São Paulo (USP), São Carlos, and his Ph.D. from the University of Illinois at Urbana-Champaign, Illinois, USA, in 1996.

He was a post-doctor at the Device Research Laboratory at Unicamp, in Brazil, working in optoelectronics III-V. Dr. Panepucci joined the Cornell Nanofabrication Facility (CNF) in 1999 and soon after joined the startup Galayor Networks in the development of silicon photonic devices. In 2002 he joined the Nanophotonics Group in Cornell.

From 2003 to 2009 he received Tenure at Florida International University, and shortly thereafter took up the position of senior researcher at CTI, where he heads the Hardware Systems Design Division. He has experience in the field of integrated photonic circuits in silicon and in the manufacture of micro and nanosystems.

Rodrigo Vicentini

Rodrigo Vicentini has a degree in Electrical Engineering, with emphasis on Telecommunications, from USP (2002); in Project Management Lato Sensu from USP (2007); and an MBA focused on Emerging countries, Innovation and High technologies by FIA (2013). Working at Agilent since 2005, since 2020 he has served as Keysight's Application Engineering Manager at Technologies for the Latin America Region. He is responsible for pre sales of RF & Microwave, Aerospace & Defense, Digital, Power & Automotive, Optical Communication, 5G Wireless, 5G Field Test, 5G Network Test, and Visibility & Security measurement and instrumentation at Latin America Region.

Theo Zeferino Pavan

Theo Pavan received his B.Sc. degree in medical physics and his Ph.D. degree in physics applied to medicine and biology from the Universidade de São Paulo (USP), Ribeirão Preto. During his Ph.D. studies he was a visiting student at the University of Wisconsin–Madison.

He is an associate professor in the Departamento de Física, USP, Ribeirão Preto.

His research interests include photoacoustic imaging, elasticity imaging, ultrasound techniques for localizing nanoparticles, ultrasound thermometry, and magnetic hyperthermia.

In Brazil, he has pioneered the field of Photoacoustic Imaging by establishing the first dedicated laboratory (LaIF – Laboratório de Imagem Fotoacústica). He is a researcher at the Medical Instrumentation and Ultrasound Group (GIIMUS).

Thiago Pedro Mayer Alegre

Received his B.S. in Physics from Universidade Estadual de Campinas in 2003, and his Ph.D. degree in Physics from the same university in 2008. He was a postdoctoral scholar in the Department of Applied Physics at Caltech, USA, from 2008 to 2011.Between 2014 and 2018 he coordinated the LIEF, an outreach laboratory for science and education. He is also a member of the Brazilian Physical Society, the Brazilian Photonics Society and the Optical Society of America.

Thiago Alegre has held an Associate Professor position in the Department of Applied Physics at the Gleb Wataghin Institute of Physics (IFGW), University of Campinas (Unicamp) since 2011.

His research group is focused on classical and quantum interactions between light and acoustic waves in micro- and nanostructured devices. Since 2019 he is Vice-Director of the Undergraduate Committee at IFGW. He was elected an affiliated member of the Brazilian Academy of Sciences for the 2019-2024 term and has been a Member of the Editorial Advisory Board for APL Photonics journal since 2019.

Tommaso Del Rosso

Bachelor's at Fisica from Università degli Studi di Firenze (2002) and doctorate at engenharia eletrônica e telecomunicações from Università degli Studi di Firenze (2006).

His research area is Nanotechnology, with emphasis in Plasmonics. At the present his research is focused on: physical-chemical characterization and green synthesis of Metal-carbon nanocomposites and luminescent carbon dots by laser ablation in liquid, using CO2 recycling; application of the NCs in optical sensing based on surface plasmon resonance (SPR) and surface enhanced Raman (SERS) spectroscopies; (bio-)sensing and optical characterization of nanocomposites, organic materials, and 2-D materials using Dielectric Loaded Waveguides (DLWG) photonic devices; catalysis by TiO2 nanoparticles and optical sensing using meso-micro fluidic devices.

He is an Associate Professor and responsible for the Laboratory of Optical Synthesis and Characterization of Nanomaterials (NanoLaser) at the Pontifícia Universidade Católica do Rio de Janeiro. He has been awarded with the grant "Jovem Cientista do nosso Estado do Rio de Janeiro" in 2016.

Vahid Aref

Vahid Aref is a member of technical staff in IP and Optical Networks research lab within Nokia Bell Labs since 2015. He received his PhD degree in computer and communication sciences from École Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland, in March 2014.

Prior to joining Bell Labs, he was a research assistant in the communication theory laboratory (LTHC), EPFL, from 2010 until 2014. Then, he conducted post-doctoral research in the institute of telecommunications (INÜ) at University of Stuttgart in 2014. Since 2016, Dr. Aref also serves as guest lecturer at the University of Stuttgart.

Dr. Aref has received several awards for his works including the co-recipient of best journal award 2018 (ITG-Preis 2018) from German Society of Information technology (ITG).

Vahid's fields of research include coding and information theory, communications theory, machine learning and deep learning.

Ana Maria de Paula

She has a degree in Physics from the Federal University of Minas Gerais -UFMG (1985), a master's degree in physics (optics) from UFMG (1987), a doctorate in ultra-fast processes in Semiconductors from the University of Oxford-UK (1991) and a post-doctorate at UFMG (1991-1993).

She was an associate researcher at Unicamp from 1993 to 1997 and an associate professor at the University of São Francisco from 1998 to 2003, where she implemented the optical nano-spectroscopy laboratory in the Young Researchers in Emerging Centers line at Fapesp. She worked as a Research Fellow at the University of Southampton-UK, from May 2003 to September 2006, being responsible for the coordination and implementation of the experimental part for the development of new sources of coherent x-ray by laser.

She has experience in the field of optical spectroscopy in femtoseconds and in nonlinear processes for the generation of coherent x-ray by high harmonics of high power laser, and multi-photon microscopy with applications in biophotonics and nanomaterials. Since September 2006 she has been a professor at UFMG, currently in the position of associate professor. She has implemented and coordinated the multidisciplinary laboratory in time-resolved spectroscopy in femtoseconds and non-linear optical microscopy, images by second harmonic generation and fluorescence by absorption of two photons in nanomaterials and biological materials.

Christiano J. S. Matos

Christiano J. S. de Matos has an undergraduate and master's degree in physics from the Pontifical Catholic University of Rio de Janeiro (1997 and 1999, respectively) and a doctorate from Imperial College London (2004).

He is currently an adjunct professor at Universidade Presbiteriana Mackenzie and a researcher at MackGraphe.

He works in the areas of Optics, Photonics and Nanomaterials, with an emphasis on the following themes: nanophotonics, two-dimensional materials, optical fibers, nonlinear optics, microstructured fibers and photonic crystal fibers.

Daniel Varela Magalhães

He has a degree in Electrical Engineering from the Federal University of Ceará (1995), a master's degree in Physics from the University of São Paulo (IFSC-1998), a doctorate in Physics from the University of São Paulo (IFSC-2004) and a post-doctorate from the Paris Observatory (2006).

He is currently an Associate Professor at the University of São Paulo (Department of Mechanical Engineering-EESC) and director of the Advanced Center for Supporting Innovation at EESC-EESCin.

He has experience in the areas of Electronics, Physics and Instrumentation, with an emphasis on Optics and Mechatronic Systems, acting mainly on the following topics: atomic patterns of time and frequency, metrology, trapping of atoms, embedded systems and real time.

Edson Porto da Silva

Edson Porto da Silva has a Ph.D. in Optical Communications from the Technical University of Denmark, since 2017.
Since August 2018, he has been an adjunct professor at the Electrical Engineering Department of the Federal University of Campina Grande (UFCG), Paraíba, Brazil.
He is Senior Member of the IEEE and the OSA. His research topics involve digital signal processing for coherent optical receivers, mitigation of non-linear distortions in optical channels, adaptive equalization, and high-speed optical transmission.

Emiliano Rezende Martins

Dr. Emiliano R. Martins completed a degree in Electrical Engineering in 2005 (USP, Brazil). He holds a Msc in Electrical Engineering (USP, Brazil, 2008) and a Msc in Photonics (St. Andrews, UK, 2010). In 2014 he completed his PhD with a thesis entitled “Light Management in Optoelectronic Devices” (St. Andrews, UK).
He is currently a professor at the University of São Paulo (USP, Brazil).
His main research interests are in controlling light for applications in optoelectronics, biosensors and integrated optical systems.
His research activities involve photonic crystals, metamaterials and metasurfaces, plasmonics, biophotonics, photovoltaics and thin-films.

Herculano da Silva Martinho

Bachelor in Physics from State University of Campinas (1997), master and doctorate degrees in Physics from State University of Campinas (2000 and 2004, respectively).
Actually is Assistant Professor IV at the Federal University of ABC (UFABC), Santo Andre-SP, Brazil.
His research interests are glassy properties of biological macromolecules and confined water in biological systems.
He also dedicates to the development of technological applications of vibrational spectroscopy in the optical biopsy field.

Joaquim Ferreira Martins Filho

He was born in Recife, Brazil and received the B.Sc. degree in Electronics Engineering from the Federal University of Pernambuco (UFPE), in Recife, in 1989, and the M.Sc. degree in Physics from the same institution in 1991.
He received his Ph.D. degree in Electronics Engineering from the University of Glasgow, Scotland, in 1995. In 1998 he joined the Photonics Group, Department of Electronics and Systems of UFPE, in Recife, where he is currently a full professor and was the graduate program coordinator and the head of department.
His research interests are in devices, subsystems, transmission systems and networking for optical communications, and optical sensors.
He has coordinated several research projects financed by state and federal agencies as well as by industries. He published over 200 full papers in journals and conferences and advised over 30 Ph.D. and M.Sc. students. Prof. Joaquim Martins-Filho is a Senior Member of the IEEE, Senior Member of OSA, Member of SBMO, Member of SBFOTON and SBrT, as well as a Research Fellow of the National Research Council of Brazil (CNPq). He currently is the Chair of the Joint Chapter ComSoc, ComputerSoc, PhotonicSoc of the IEEE Northeast Brazil Section, the Research Director of UFPE and the coordinator of the CNPq Committee for Electrical Engineering.

Marko Loncar

Marko Lončar is Tiantsai Lin Professor of Electrical Engineering at Harvard's John A Paulson School of Engineering and Applied Sciences (SEAS), as well as Harvard College Professor. Lončar received his Diploma from University of Belgrade (R. Serbia) in 1997, and his PhD from Caltech in 2003 (with Axel Scherer), both in Electrical Engineering. After completing his postdoctoral studies at Harvard (with Federico Capasso), he joined SEAS faculty in 2006.

Lončar is expert in nanophotonics and nanofabrication, and his current research interests include quantum and nonlinear nanophotonics, quantum optomechanics, high-power optics, and nanofabrication. He has received NSF CAREER Award in 2009 and Sloan Fellowship in 2010. In recognition of his teaching activities, Lončar has been awarded Levenson Prize for Excellence in Undergraduate Teaching (2012), and has been named Harvard College Professor in 2017. Lončar is a fellow of the Optical Society of America, and Senior Member of IEEE and SPIE. Co-founder of and board member for ***HyperLight Corporation***, VC backed startup commercializing lithium niobate photonic technology.

Nilson Dias Vieira Junior

Graduation in Physics in 1975, Master In Nuclear Physics in 1979, Ph.D. in solid State Physics in 1986, all at University of São Paulo, was a visitor at AT&T Bell Labs, N.J. USA for 2 years, in the Quantum Electronics Group. Work in the following fields: lasers, laser applications, ultrafast phenomena and high intensity lasers.

The present position is full researcher at Comissão Nacional de Energia Nuclear, being in management since 1987 up to the highest position at IPEN - Instituto de Pesquisas Energéticas e Nucleares, superintendent till december, 2012.

Advisor of 11 Ph.D. thesis and 14 master dissertations, published 148 papers with more than 1869 citations, achieving a H factor of 23. In 2008 was a member of the Board of the CBPF, Brazilain Center for Research in Physics, for two mandates. He was assigned brazilian representative for the High-level Group on the Issue for Security of Supply of Medical Radioisotopes, a group of OECD - Organization for Economic Cooperation & Development, in 2012. Since 2008 is a member of the 'Conselho Fiscal das Indústrias Nucleares do Brasil S.A, being entitled Member of the State of São Paulo Academy of Sciences since october 2015.

Raul de Oliveira Freitas

Researcher at the National Synchrotron Light Laboratory (LNLS), he has been responsible for the infrared line (IR1) since its construction in 2012.

He is mainly involved in the fields of Synchrotron Infrared Nano-spectroscopy, near-field optical interferometry, line design. synchrotron infrared light and material analysis by infrared spectroscopy. He is interested in studies related to the vibrational properties of materials at the nanoscale. Before working in the field of near-field infrared and optics, he worked in the area of synchrotron X-ray diffraction, subject of his PhD with the University of São Paulo (USP) and University of Guelph (UoG-Canada) and later subject of his Post-Doc at LNLS in a collaborative project with Hewlett Packard (HP-Labs / USA). Also as a Postdoc, he briefly served as a visiting researcher at the Surface Science Lab at ESRF-France. Before his academic / scientific life, he worked as a Designer in a multinational in the fuel sector.

Robinson Sabino da Silva

Graduated in Dentistry from University of Passo Fundo (2004), Master's (2007) and Ph.D. (2010) in Sciences (Area of Concentration in Human Physiology) from University of São Paulo. He also held a postdoctoral fellowship at the Institute of Biomedical Sciences at USP and carried out technical-scientific internships in Japan (Osaka Dental University; University of Tsukuba), in the USA (Pacific University; University of Rochester Medical Center) and Scotland/United Kingdom (University of Strathclyde). He was an adjunct professor at the Federal University of Alagoas (UFAL, 2011-2014) and was also the first Coordinator of the Ethics Committee on the Use of Animals CEUA/UFAL. He is currently an adjunct professor, under exclusive dedication, at the Federal University of Uberlândia (UFU).

He is currently a Member of the UFU 4.0 Innovation Commission and is also an effective member of the UFU Innovation Policy Commission. He coordinates the Research Group on Integrative Physiology and Salivary Nanobiotechnology and is a member of the Innovation core of INCT Teranano (Teranóstica e Nanobiotecologia). His main research interests are: nanobio technological platforms with diagnostic applications of chronic-degenerative and infectious diseases through saliva.

Uiara Celine de Moura

Uiara Celine de Moura received the M.Sc. and Ph.D. degrees in electrical engineering from the University of Sao Paulo (2014) and the State University of Campinas (2017), respectively.

From 2011 to 2019, she was a Researcher at CPqD Foundation working with high-performance optical amplifiers. In 2018, she was a Postdoctoral Researcher at Imec, Leuven, Belgium. Since 2019, she has been a Marie-Curie/EuroTech Fellow at DTU Fotonik, Lyngby, Denmark.

She has co-authored around 50 journal and conference papers. As first author, she got two top-scored papers (OFC and ECOC) and a 1st-Place IEEE Student Paper Award at IMOC 2017.

Vladislav V. Yakovlev

With a Ph.D. in Physics/ Quantum Electronics, from Moscow State University – 1990, Dr. Vladislav V. Yakovlev is a professor in the Department of Biomedical Engineering at Texas A&M University and Fellow of the Optical Society of America, the American Institute of Medical and Biological Engineering and the International Society for Optics and Photonics.

His research focuses on the development of new instrumentation for biomedical diagnostics and imaging. Yakovlev's primary research interests include biomechanics on a microscale level; nanoscopic optical imaging of molecular and cellular structures; protein spectroscopy and structural dynamics; bioanalytical applications of optical technology and spectroscopy; and deep-tissue imaging and sensing.

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Alexandre de Almeida Prado Pohl

Alexandre de Almeida Prado Pohl graduated in Physics from the State University of Campinas (Unicamp) in 1982, and obtained the Master degree in 1987 from the same university. He completed the Dr-Ing at the Technische Universität Braunschweig, Germany, in 1994. From 1995 till 2000 he was with the Telecommunications Division of Furukawa Company in Brazil, participating on the design and deployment of broadband hybrid fiber coax networks. Since 2001 he is with the Federal University of Technology – Paraná (UTFPR, Curitiba), now as a full professor, where he leads a research group in Photonics and Optical Fiber Communications. In 2007 he was a visiting researcher at the University of Sydney, Australia, in the group of Prof. John Canning and in 2019 a visiting researcher at the Institute of Telecommunications – Aveiro, Portugal, in the group of Prof. Paulo Monteiro. He is a member of The Optical Society, OSA, since 1996. In Brazil he is a member of the Brazilian Optics and Photonics Society, SBFoton, the Microwave and Optoelectronics Society, SBMO, and of the Telecommunications Society, SBrT. From 2021 till 2023 he will serve as the president of SBFoton.

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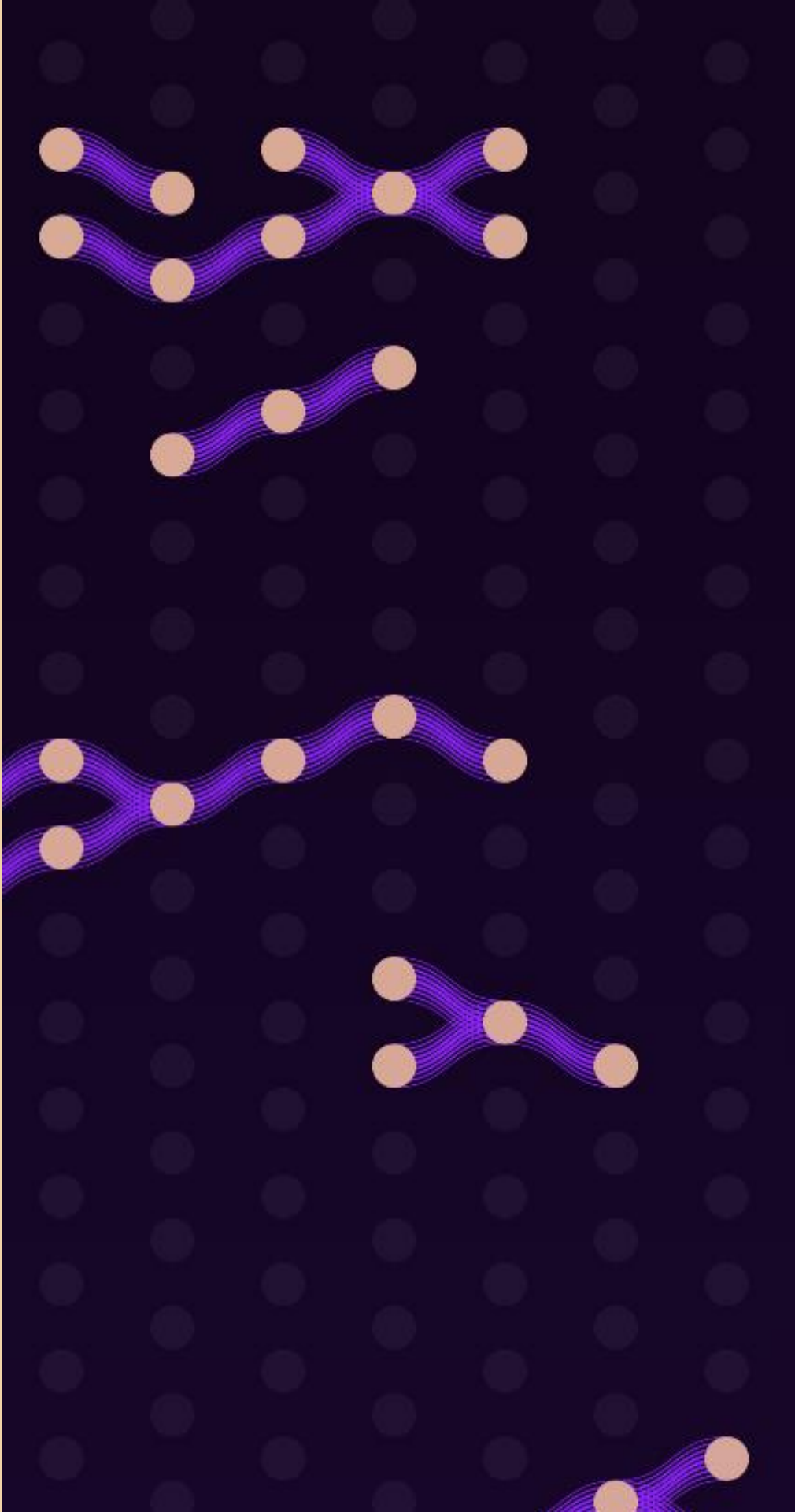

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