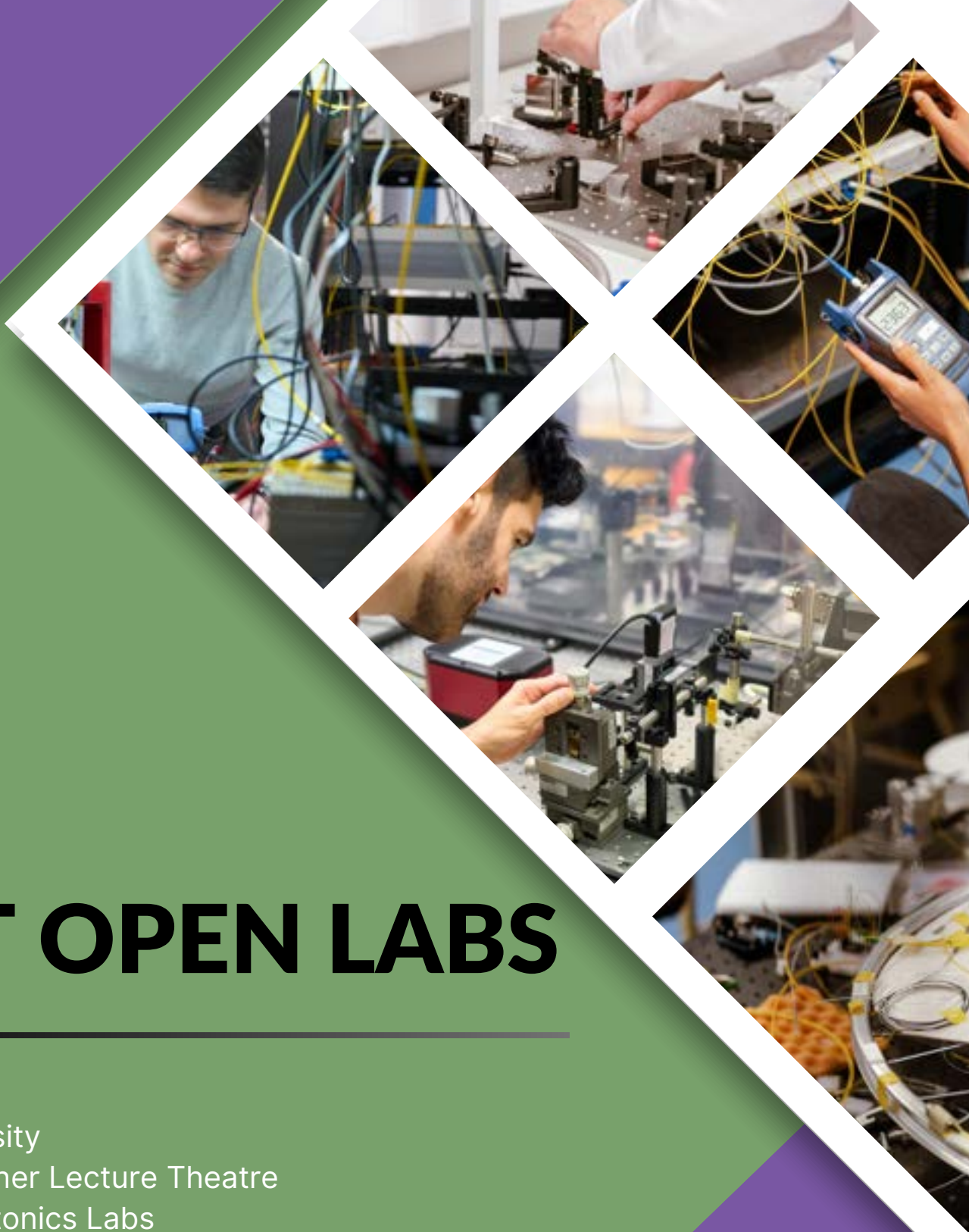


AiPT OPEN LABS

5 June 2024
Aston University
MB651 Sumpner Lecture Theatre
LG floor, Photonics Labs

Aston University
BIRMINGHAM UK

AiPT
Aston Institute of
Photonic Technologies

About the event

Following the successful **AiPT Open Labs 2023**, we welcome you to our second Open Labs event at AiPT. This event will feature presentations by AiPT researchers on their latest work, interactive poster sessions, and live demonstrations of innovative technologies in our laboratories.

The Open Labs session aims to foster interaction among AiPT members and to showcase our research activities. It provides an opportunity for senior management, university colleagues, and industry collaborators to learn about our work and explore potential collaborations.

Researchers will be available during the Open Labs session to discuss their research, demonstrate technologies, and explain key concepts. Presentations will be designed to be accessible to non-experts, focusing on the motivation, principles, and impacts of each research topic.

Agenda

12:00 -12:30
Pre-event coffee
Location: PGR room MB652C

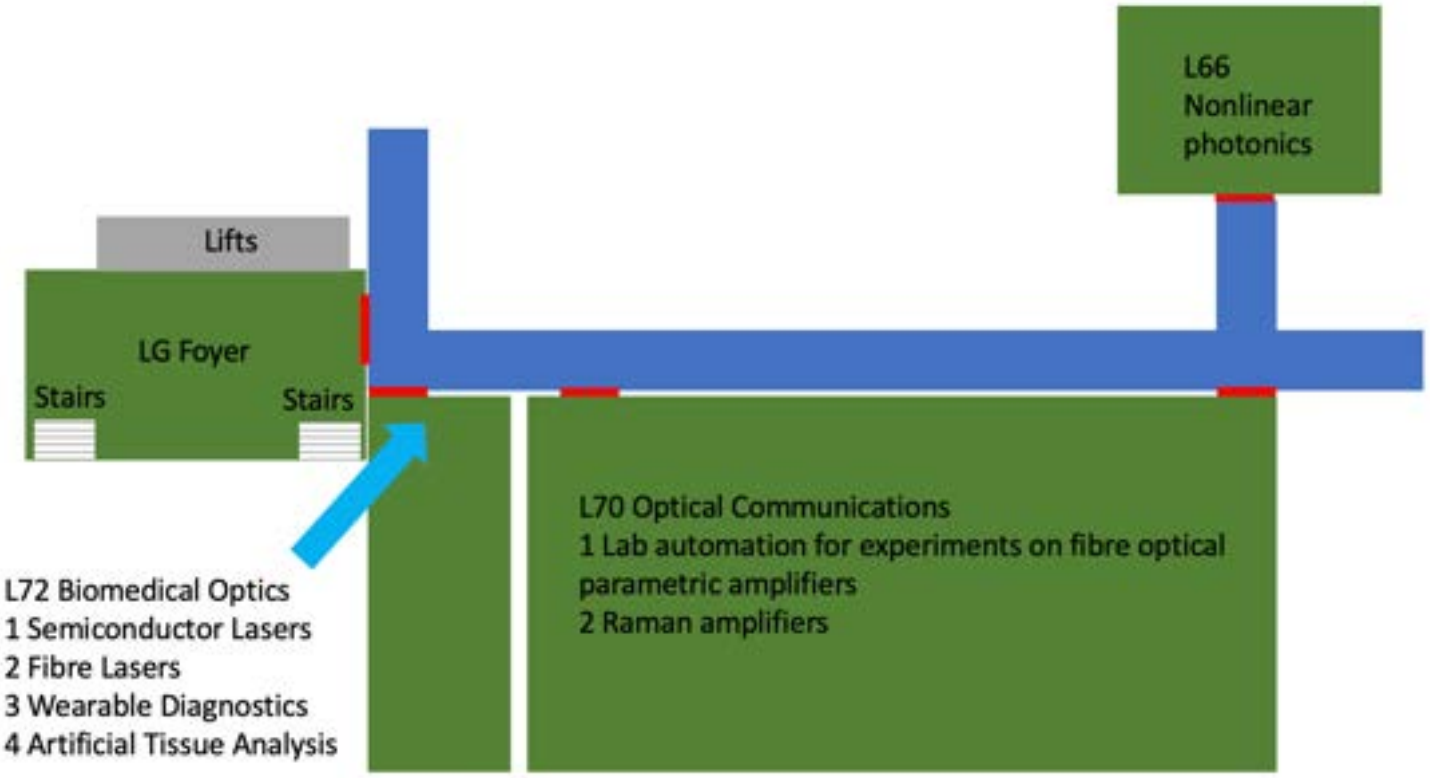
12:30 -13:30
AiPT News and research talks
Location: Sumpner Lecture Theatre MB651
Chair: Prof David Webb

- Opening Remarks by Prof. Michael Caine, Pro Vice-Chancellor Research and Enterprise
- Welcome & News by Prof. Sergei Turitsyn, AiPT Director
- Dr. Vladimir Gordienko: “Fibre Optical Parametric Amplifiers for Optical Communications”
- Dr. Harris Alexakis: “Optical Technologies for Resilient Infrastructure: New Research Opportunities for AiPT”
- Dr. David Benton: “Developments in Multi-Spectral LIDAR Using a DMD Streak Camera”
- Ms. Aisha Bibi: “Optica & SPIE Student Chapter at AiPT”

13:30-16:30
Lab demonstrations. PGR Poster Session. Impact posters
Location: LG floor Main Building, AiPT labs
Coffee will be served in the Kitchen of the LG Photonics labs

16:30-19:30
BBQ, PGR Poster competition award. Networking
Location: Conference Aston restaurant area

Photonics West Corridor



L66/L67 Nonlinear Photonics and Fibre Lasers

Vladislav Dvoyrin, Hani Kbashi

The Fibre Lasers group conducts R&D of fibre lasers and amplifiers – compact devices demonstrating a wide range of photonic phenomena. Its applied activity includes R&D of various novel fibre lasers and laser-based optical sensors for applications such as spectroscopy (especially, trace gas detection), strain, vibration, and temperature detection, ranging and imaging including LIDARs and hyperspectral imaging, etc. The group actively develops lasers and telecommunications amplifiers based on novel bismuth-doped fibres.

Deep fundamental research provides a solid foundation for the development of cutting-edge applied techniques and includes the experimental and theoretical study of nonlinear light-matter interaction in fibres, optical frequency combs, novel laser spectroscopy approaches, AI for lasers and lasers for AI, principles of future optical communications.

L70 Bay6B

Lab automation for experiments on fibre optical parametric amplifiers

Vladimir Gordienko, Mariia Bastamova

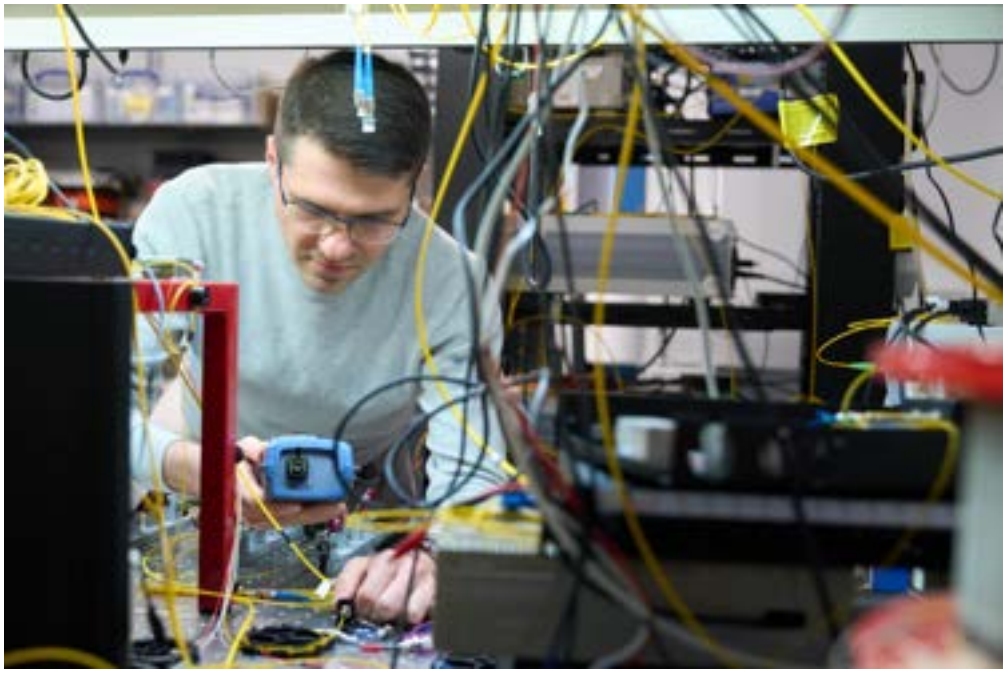
Fibre optical parametric amplifiers (FOPAs) have a great potential to revolutionise optical communications with their unique features enabled by the underlying optical Kerr effect. FOPAs have a particular synergy with such hot topics as free space communications, quantum communications, access networks and hollow core fibres for FOPAs' flexible theoretically unconstrained operation wavelength range and ability of noiseless amplification. Due to complexity of FOPA experiments we employ lab automation to set and adjust experimental parameters in the automated regime. In this demonstration we will show our experimental setup and demonstrate how our equipment is controlled by MATLAB to perform routine tasks.

L70 Bay3A

Raman amplifiers

Dini Pratiwi, Pratim Hazarika, Shabnam Noor, Mingming Tan

Due to exponential traffic growth over the years in optical fibre communications, research on Ultra-Wideband (UWB) optical amplification techniques such as Discrete Raman Amplifiers (DRA) has gained traction, as a promising approach for high data rate transmission. A fully loaded channelised input spectrum covering the S-, C-, and L-bands is amplified by cascaded dual-stage DRA. The signal and pumps are separated into two cascaded stages, with S-band amplification followed by C+L band amplification, using 7.5 km Inverse Dispersion Fibre (IDF) as the gain medium in each stage. For the entire band, the average net gain is 13.9 dB and the average noise figure is 6.5 dB. Wavelength Division Multiplexed (WDM) transmission is validated using 200 G signals over 50 km SSMF.



L72

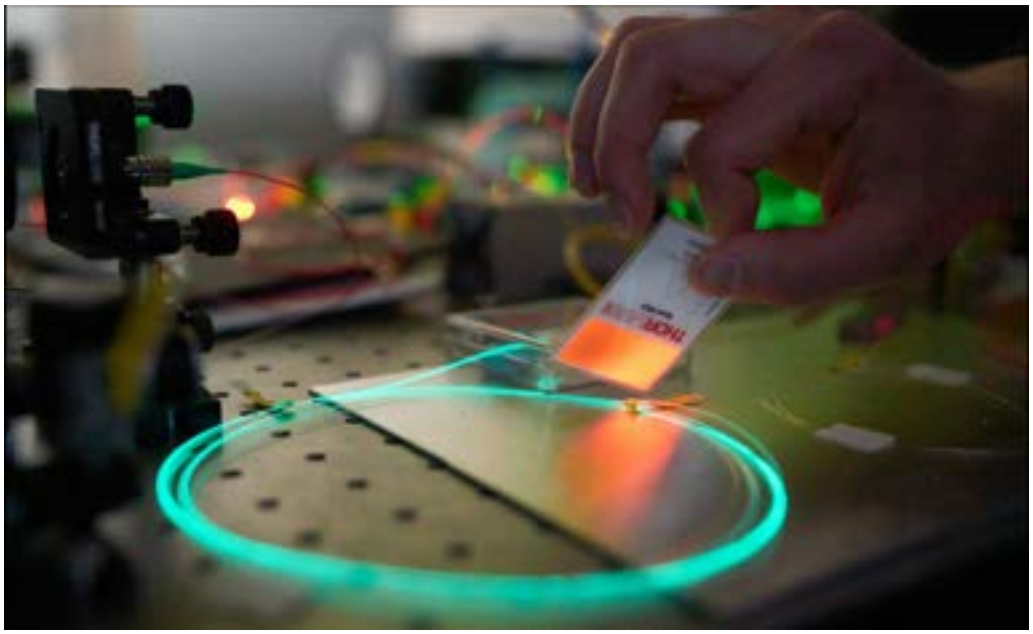
Biomedical Photonics

Edik Rafailov, Diana Galiakhmetova, Viktor Dremin, Amit Yadav

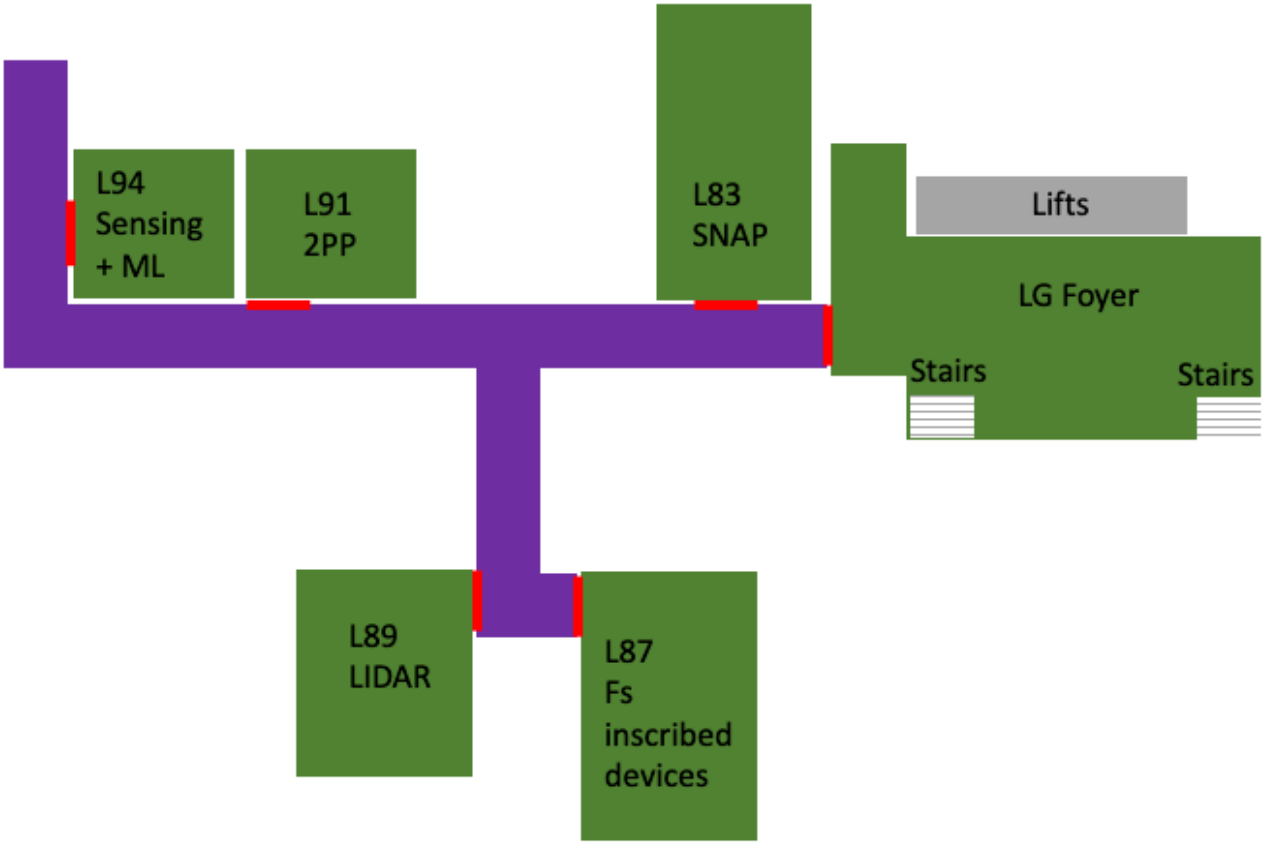
The Optoelectronics and Biomedical Photonics Group (OBPG) conducts cutting-edge experimental and theoretical research on high-power and ultrashort-pulse compact semiconductor and fibre lasers, emitting in the visible, near-IR, mid-IR and THz spectra ranges, nanostructures, nonlinear and integrated optics and biophotonics.

The main developments to be presented are:

- Semiconductor lasers: compact CW and ultrafast quantum-dot and quantum-well-based lasers in the 1-1.3 μm spectral region and quantum cascade lasers (2.7-3.4 μm), their nonlinear frequency conversion to the visible, mid-IR and THz spectral regions for safety and security applications, quality control, biophotonics and medical imaging.
- Fibre lasers: ultrafast mode-locked fibre lasers, noise-like lasers, and Q-switched pulsed lasers at specific wavelengths to meet the demands of various applications, including multiphoton imaging and optogenetics applications.
- Wearable diagnostic devices: VCSEL-based device allows evaluation of the blood perfusion, oscillatory processes in the microcirculatory systems, tissue metabolism (oxidation-reduction reactions), and advanced glycation end-products accumulation in the skin.
- Metabolic and morphological evaluation of artificial tissues: we have the competence to generate customisable and definable 3D models of skin. Along with that, OBPG provides a multimodal photonic system that will facilitate a compact and cost-effective universal, comprehensive, and reliable approach for monitoring printed tissues in time course development.



Photonics East Corridor



L83

SNAP

Misha Sumetsky, Gabriella Gardosi, Manuel Crespo

SNAP technology enables fabrication of resonant structures and devices at the optical fibre surface with unprecedented sub-angstrom precision for applications ranging from telecommunications and microwave photonics to quantum technologies and microfluidic sensing. Our most important results in 2021-23 include:
(i) development of the slow cooking approach for ultraprecise fabrication of SNAP microresonators and demonstration of a nonlocal microfluidic sensor;
(ii) proposal and theory of transportation of light by light at the microscale;
(iii) experimental demonstration of bat microresonators possessing modes with exceptional field uniformity and discovery of the fundamental limit of this uniformity;
(iv) proposal of SNAP microwave photonic filters with outstanding performance;
(v) discovery and experimental demonstration of high quality factor tuneable SNAP microresonators induced by side coupled optical fibres.

L87

Fs inscribed fibre devices

Kaiming Zhou, Lukman Kamarudin

In L87, we use an 80 fs pulse width laser (800nm, 7mJ energy, at 1kHz) for microfabrication of fibre optical devices, mainly fibre Bragg gratings (FBGs). Unlike UV lasers, femtosecond lasers don't require fibre photosensitivity, allowing us to work with various fibres, including normal silica, polymer, and mid-infrared fibres. Femtosecond inscription can also be carried out without removing the fibre's acrylic jacket.We use two main methods for fabricating FBGs: point-by-point and phase mask methods. The point-by-point method is flexible for different Bragg wavelengths but can suffer from high loss due to Mie scattering. We are developing an improved method to reduce this loss. The phase mask method offers higher quality but is more costly and inflexible in wavelength.

L89

Multi-spectral KIDAR with a camera and a projector

David Benton (2nd half of Open Labs session only)

Some projectors have at their heart an array of tilting micro-mirrors that can flip between an 'on' and an 'off' state at a rate of 10kHz. These flipping mirrors can scan a reflected beam across a camera sensor, leaving a track that represents the temporal evolution of the light source. When using a pulsed laser the position of the pulse relates to when the pulse arrived and is therefore a LIDAR. The combination of micromirror array and camera forms a streak camera system. The micromirror array is actually a dynamic blazed diffraction grating and can hence give spectral information as well as temporal information.
The demonstration shows 3 coloured pulses lasers combined to a white output beam directed at a target. Multiple optical collectors direct the collected light via a fibre array towards the streak camera system and the displayed camera image shows the captured light distributed across diffraction orders that result.

L91

2PP

Vladimir Osipov, David Webb (1st half of Open Labs session only)

Conventional additive manufacturing processes – "3D printing" – can be used to create components with a minimum feature size of somewhere around 0.1mm. Two photon polymerisation (2PP) is a technology that can be used to create structures with a minimum feature size approximately 1,000 times smaller. In 2PP, very tightly focussed light is used to initiate polymerisation of a photopolymer; the highly non-linear nature of the two photon process used means that with careful control of the optical power, polymerisation can be made to occur in a region (a voxel) smaller than the diffraction limit of the light used. We seek to exploit this technology to create miniature opto-mechanical devices on the tips of optical fibres.

L94.1

Biochar characterisation by combining spectroscopy and machine learning

Hong Pham Thi, Steve Daniels

Biochar is typically waste organic matter that has beeen decomposed at high temperature in the absence of oxygen. The process releases useful oils and gasses and leaves behaind a solid containing typically 80% carbon. This biochar has a growing number of potential uses, ranging from CO2 capture to soil improvement. In collaboration with colleagues in EBRI, we are investigating the potential of combining spectroscopic measurement techniques on the biochar with machine learning approaches in order to characterize biochar. We have found that spectroscopic features are linked to the type of material used to produce the biochar, the processing conditions used and the final composition of the material.

L94.2

Hyperspectral imaging of honey

Alex Rozhin, Raghavan Chinnambedu-Murugesan, Stephen Daniels

Several researchers in AiPT are exploring the combination of spectroscopic analysis with machine learning techniques which are able to reveal subtle correlations between spectral features and key parameters of the sample under investigation. An excellent example of this approach is provided by Alex Rozhin, Raghavan Chinnambedu-Murugesan and Steve Daniels, who have been working with The Scottish Bee company to combat honey fraud - an all too frequent practice whereby honey is adulterated by the addition of cheaper substances, such as sugar syrup. The team are using Fluorescence Excitation Emission spectroscopy coupled with machine learning techniques to detect the presence of these contaminants

PGR Poster Session

Aisha Bibi
Controlled Agglomeration of Gold Nanoparticles for SERS-based Detection of Nanoplastics in Water

Alberto Rodriguez Cuevas
Multi-Day Stability in Single Cavity Dual-Comb Lasers with Polarization Multiplexing

Alice Duque Belfort De Oliveira
Impact of Noise in Analogue Neural Networks

Arooj Arooj
3D Human Skin Tissue Modelling for Closeup Research in Melanoma Treatment

Dini Pratiwi
High Gain Incoherently Pumped Discrete Raman Amplifiers for U-band Coherent Transmission Systems

Fatima Khanom
Harnessing the Power of Orbital Angular Momentum of Light for Retinal Diseases Diagnosis and Treatment

Geraldo Gomes De Luna Junior
Clustered Filter for Simplified Digital Chromatic Dispersion Compensation in Optical Fiber Communications

Long Hoang Nguyen
Online Phase and Amplitude Distortion Compensation in FOPA Transmission Systems

Lukman Kamarudin
Advanced Femtosecond Laser Inscription of Fibre Bragg Grating

Mariia Bastamova
Optimization of Fiber Optical Parametric Amplifiers for QAM Signal Amplification

Minji Shi
Amplifier Enhanced Gain-Through-Filtering Instability in a Hybrid Kerr Cavity

PGR Poster Session

Nawal Mohamed
Modelling Orbital Angular momentum of light in complex media

Negar Shaabani Shishavan
Low Footprint Computation Through Light

Nelson Castro Salgado
Design Aspects of Frequency-Domain Learned MIMO Volterra Equalisers

Safiya Dabwan
Machine Learning for Future Passive Optical Networks

Stepan Bogdanov
Complexity Reduction of Neural Networks for Nonlinear Fourier Transform in Optical Transmission Systems

Impact Posters

Optoelectronics and Biomedical Photonics

- Optoelectronics and Biomedical Photonics: Semiconductors
- Optoelectronics and Biomedical Photonics

Nonlinear Photonics and Fibre Lasers

- TM-Doped All-Fibre Ultrafast Laser For Efficient Mid-IR Optical Supercontinuum Generation

Optical Sensing

- Optical Sensing and Devices Impact

Optical Communications

- Ultra-wideband Optical Fibre Communications

Machine Learning and Unconventional Computing

- Machine Learning in Optical Communication

Contact us

We welcome collaboration opportunities with academia, research institutes and industry around the world.

For general enquiries, please contact us on:
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For more about the Aston Institute of Photonic Technologies, please visit:

- Aston official AiPT page: https://www.aston.ac.uk/research/eps/aipt
- LinkedIn page: https://www.linkedin.com/company/aston-institute-of-photonic-technologies
- AiPT events page: https://events.astonphotonics.uk
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