Non-invasive Polarimetric diagnostics of biological tissues aided by Artificial Neural Networks

A Seminar by Dumont d'Urville NZ-France Science & Technology Catalyst Fund Programme: Victoria University of Wellington and École Polytechnique

WHEN: Wednesday, 18th December 2019
WHERE: Computational Media Innovation Centre (CMIC), 40 Taranaki street, 3rd flour
TIME: 9.00 am – 5.30 pm

Invited Speakers:

Dr. Tatiana Novikova, Group Director, Applied Optics and Polarimetry, Lab de Physique des Interfaces et des Couches Minces, Ecole Polytechnique, Institut Polytechnique de Paris, Palaiseau, France

Bio: Dr. Novikova leads the Group of Applied Optics and Polarimetry at the Laboratory of Physics of Interfaces and Thin Films of CNRS, Ecole Polytechnique, Institut Polytechnique de Paris, France. Her areas of expertise include: optical polarization, fundamentals of Mueller polarimetry, modeling of interaction of polarized light with structured and random media, innovative polarimetric instrumentation, cutting-edge metrological and biomedical applications of polarized light.

Professor Mike Eccles, Developmental Genetics and Pathology Group, Department of Pathology, Dunedin School of Medicine, University of Otago, Dunedin, New Zealand

Bio: Prof. Eccles specializes in molecular cancer research, with expertise in cancer genetics, human molecular genetics, and developmental genetics. His research background involves gene and chromosome mapping, epigenetic studies of gene regulation, and impacts on cell behaviour of gene expression. He is the head of Developmental Genetics and Pathology Laboratory in the Pathology Department, Dunedin School of Medicine, and currently very interested in genetic, environmental, and epigenetic mechanisms of cancer in relation to developmental biology and cancer / overgrowth diseases.

Professor Vladislav V. Yakovlev, Department of Biomedical Engineering, Texas A&M University, College Station, USA

Bio: Prof. 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. Dr. 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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Tentative Schedule and Abstracts:

9:00 – 9:20 am	*Morning Tea (CMIC)*	12:00 – 1:00 pm	*Lunch (CMIC)*
9:20 – 10:00 am	**Prof. Eccles**	1:00 – 2:00 pm	Exec and Research Office meeting
10:10 – 10:50 am	**Dr. Novikova**	3:00 – 4:00 pm	CMIC presentations and lab tours
11:00 – 11:40 am	**Prof. Yakovlev**	4:00 – 5:30 pm	*Free time*

Dr. Tatiana Novikova, "*Studies of Structured and Random Media with Mueller Polarimetry: from Metrology to Biomedicine"*

Abstract: Probing a sample with polarized light provides valuable information about its properties, which can be used in various applications. The basic advantages of optical polarimetric techniques consist in being relatively low-cost, fast and non-destructive, thus, allowing the measurements for *in-situ* applications. The Mueller matrix polarimeters based on liquid crystals and operating in either spectroscopic or imaging mode were developed and used in LPICM, Ecole Polytechnique (France) during the last two decades. Our theoretical and experimental studies prove that having access to the complete set of polarimetric data, namely, spectrally or angularly resolved Mueller matrices, is crucial for the accurate characterization of complex media (layered, patterned, scattering, and absorbing). In this talk I will present the results demonstrating the potential of Mueller polarimetry for cancer detection and metrology in microelectronics.

***Professor Mike Eccles**, "Can optical properties of a tumour in the body be used clinically? – Investigations of the scattering of circular polarised light in cancer and normal tissues"*

Abstract: Optical properties of tumours underpin clinical imaging (e.g. MRI, CT, PET, multiphotonic imaging) used to detect or diagnose tumours. However, these techniques require relatively large equipment and/or may not be easily adapted for "real-time" detection. For instance, in Moh's skin cancer surgery, or surgical excision of primary melanoma, small amounts of remaining cancer tissue (such as might be missed in Moh's surgery), lead to eventual re-growth of the tumour. During surgery it would be beneficial to have a cancer imaging device that could be used in "real-time" in the operating room to ensure complete tumour resection. In this regard, we hypothesized that circular polarised light could be used to identify tumour tissue versus normal tissue, and that this would have the potential to be used as a "real-time" system to identify tumour tissue. Using formalin fixed paraffin-embedded human tumour tissue to investigate scattering of circular polarised light, we detected differences associated with tumour tissue versus adjacent non-tumour tissue. In this talk, I will discuss this and other examples using polarimetry to analyse biological tissues, and whether scattering of circular polarised light could be used in real-time in the clinic to detect tumour tissue.

Professor Vladislav V. Yakovlev, *"Seeing life in a new light"*

Abstract: The progress of biomedical sciences depends on the availability of advanced instrumentation and imaging tools capable of attaining the state of biological systems in vivo without using exogenous markers. Mechanical forces and local elasticity play a central role in understanding physical interactions in all living systems. We demonstrate a novel way to image microscopic viscoelastic properties of biological systems using Brillouin microspectroscopy. In my talk, I will discuss the ways how an old spectroscopic tool can be used for real time microscopic imaging and provide possible solutions to long standing problems in Life Sciences and Medicine.

Please RSVP (for catering purposes): **Siyun Thompson**, CMIC, **siyun.thompson@vuw.ac.nz**
Host (seminar-related inquiries): **Alex Doronin**, ECS, **alex.doronin@vuw.ac.nz**