Welcome to the Hamlyn Winter School on Surgical Imaging and Vision

Surgical Imaging and Vision is a growing area of research and an integral part of every endeavour in Robotic Surgery. It has advanced from a pre-operative planning and post-operative assessment tool to emerging platforms for intra-operative guidance and navigation.

Advances in imaging have enabled the development of new modalities beyond the conventional whole-body techniques such as MR, CT and US to enable in vivo, in situ tissue characterisation by the use of biophotonics techniques that can be integrated with robotic instruments.

The development of 3D vision facilitates structural-functional fusion, accurate focused energy delivery, large-area in vivo microscopic imaging, motion adaptation, visual servoing, and navigation under dynamic active constraints. All these are important for the development of new surgical robots for minimally invasive surgery.

The Hamlyn Winter School focuses on both the technical and clinical aspects of Surgical Imaging and Vision. Through invited lectures, workshops, and mini-projects, the purpose of our winter school is to help researchers familiarise with the cutting edge research of this rapidly expanding field covering key areas of:

- Fundamentals and current state-of-the-art in surgical imaging;
- Vision algorithms for tracking, 3D scene reconstruction and surgical navigation;
- Intra-operative registration and retargeting;
- Multi-modal image fusion and real-time augmented reality systems based on inverse realism;
- Robot assisted large area microscopic imaging and mosaicing;
- Dynamic active constraints with real-time vision;
- Vision enabled surgical robot design and miniaturisation.

ORGANISING COMMITTEE

Dr. Stamatia (Matina) Giannarou

Stamatia (Matina) Giannarou received the MEng degree in Electrical and Computer Engineering from Democritus University of Thrace, Greece in 2003, the MSc degree in communications and signal processing and the Ph.D. degree in object recognition from the department of Electrical and Electronic Engineering, Imperial College London, UK in 2004 and 2008, respectively.

Currently she is a Royal Society University Research Fellow at the Hamlyn Centre for Robotic Surgery, Imperial College London, UK. Her main research interests include visual recognition and surgical vision.

Baoru Huang

Baoru Huang is a PhD student and researcher in the Hamlyn Centre for Robotic Surgery, Imperial College London, UK.

Her PhD is on the development of surgical navigational and visualisation tools to enable surgeons to intuitively use a “tethered laparoscopic molecular probe” and optical biopsy device for accurate identification of prostate cancer and image-guided surgery.
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<td>10:00</td>
<td>INTRODUCTION</td>
<td>&quot;Design &amp; control of modern lightweight robots &amp; their impact on surgery&quot; Alin Albu-Schäffer</td>
<td>&quot;Laparoscopic Augmented Reality from Preoperative Image Data&quot; Adrien Bartoli</td>
<td>&quot;Technological advances for keyhole transcranial endoscopic microsurgery&quot; Hani Marcus</td>
<td>&quot;Automated Anomaly Detection for Medical Image Analysis&quot; Bernhard Kainz</td>
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<td>&quot;Clinically relevant computer vision in surgery&quot; Daniel Hashimoto</td>
<td>&quot;Surgical skill analysis&quot; Pierre Jannin</td>
<td>&quot;Pixel level semantic understanding of motion and content in ophthalmic surgery&quot; Christos Bergeles</td>
<td>&quot;Flexible machine learning approaches for computer-assisted surgery&quot; Tom Vercauteren</td>
<td>&quot;Neuromechanics: Insects to in-vivo mechatronics&quot; Ravi Vaidyanathan</td>
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<td>INDUSTRY BOOTH - INTUITIVE</td>
<td>INDUSTRY BOOTH - DIGITAL SURGERY</td>
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SPEAKER BIOGRAPHIES

Professor Alin Albu-Schäffer

The research field of Professor Albu-Schäffer is in the area of design, sensor based programming and control of complex robotic systems for manipulation and locomotion. In particular, he is interested in robots and algorithms for direct, safe and intuitive interaction with humans and unknown environments. A major emphasis of this research work is the processing and feedback of heterogeneous sensor information within ultra-lightweight, compliant robots inspired by biological systems. The main areas of application are robotic assistance in space, industrial manufacturing, health-care and home environments.

Professor Adrien Bartoli

I'm a Professor of Computer Science at Université Clermont Auvergne and a member of Institut Universitaire de France, currently on leave as research scientist at the University Hospital of Clermont-Ferrand and as Chief Scientific Officer at SurgAR.

I'm leading the EnCoV research group jointly with gynecologist surgeon Prof. Michel Canis. My main research interests are deformable 3D reconstruction in computer vision and computer-aided diagnosis and surgery. I'm an Associate Editor for the International Journal of Computer Vision and for the Journal of Artificial Intelligence Research.

Dr. Christos Bergeles

Christos Bergeles received the Ph.D. degree in Robotics from ETH Zurich, Switzerland, in 2011. He was a postdoctoral research fellow at Boston Children’s Hospital, Harvard Medical School, Massachusetts, and the Hamlyn Centre for Robotic Surgery, Imperial College, United Kingdom.

He was an Assistant Professor at the Wellcome/EPSRC Centre for Interventional and Surgical Sciences (which he co-founded) at University College London. He is now a Senior Lecturer (Associate Professor) at King’s College London, leading the Robotics and Vision in Medicine Lab.

SPEAKER BIOGRAPHIES

Professor Daniel Elson

Daniel Elson is a Professor of Surgical Imaging and Biophotonics in the Hamlyn Centre for Robotic Surgery, Institute of Global Health Innovation and Department of Surgery and Cancer at St. Mary’s Hospital.

Research interests are based around the development and application of photonics technology to medical imaging, including multispectral imaging, ultrasound mediated optical tomography, structured lighting, light sources in endoscopy and scattering spectroscopy.

Dr. Stamatia (Matina) Giannarou

Stamatia (Matina) Giannarou received the MEng degree in Electrical and Computer Engineering from Democritus University of Thrace, Greece in 2003, the MSc degree in communications and signal processing and the Ph.D. degree in object recognition from the department of Electrical and Electronic Engineering, Imperial College London, UK in 2004 and 2008, respectively.

Currently she is a Royal Society University Research Fellow at the Hamlyn Centre for Robotic Surgery, Imperial College London, UK. Her main research interests include visual recognition and surgical vision.

Dr. Daniel Hashimoto

Daniel Hashimoto is the Associate Director of Research at the Surgical Artificial Intelligence and Innovation Laboratory at the Massachusetts General Hospital. He earned his MD from the University of Pennsylvania. He also obtained an MS in Translational Research with a focus on technology and surgical education for which the majority of his research was conducted at the Imperial College London.

He completed the Surgical Education Research Fellowship and the Surgical Artificial Intelligence and Innovation Fellowship at MGH and Harvard Medical School.
SPEAKER BIOGRAPHIES

Professor Pierre Jannin

Pierre Jannin is an INSERM Research Director. From 2012, he has been heading the INSERM Research group MediCIS (Modeling Surgical Knowledge and Processes). He was awarded the PhD degree from the University of Rennes in 1988 on multimodal 3D imaging in neurosurgery. He was awarded the Habilitation in 2005 on Information guided Surgery. He is the Past President of the International Society of Computer Aided Surgery (ISCAS), was the President of ISCAS from 2014 to 2018 and the General Secretary from 2004 to 2014.

Dr. Bernard Kainz

I am Reader in the Department of Computing at Imperial College London. I am head of the human-in-the-loop computing group and I am one of four academics leading the Biomedical Image Analysis, BioMedIA collaboratory. I co-create intensively with King’s College London, Division of Imaging Sciences and Biomedical Engineering, St. Thomas Hospital London and the department of Bioengineering at Imperial.

I am scientific adviser for ThinkSono Ltd. I am stream lead for the EPSRC Centre for Doctoral Training in Smart Medical Imaging and involved in the UKRI Centre for Doctoral Training in Artificial Intelligence for Healthcare.

Mr. James Kinross

Dr. Kinross is a Senior Lecturer in Colorectal Surgery and a Consultant Surgeon at Imperial College London. His clinical interest is in robotic surgery and minimally invasive surgery for colorectal cancer. He performs translational research in the fields of early colorectal cancer detection and prevention and in surgical technology transfer.

During his training, James was an NIHR Clinical Lecturer in Surgery and an Ethicon Laparoscopic Fellow in Colorectal Surgery. He is a visiting Professor at the Royal College of Surgeons of Ireland.

SPEAKER BIOGRAPHIES

Professor Lena Maier-Hein

Lena Maier-Hein received the PhD degree (Dr.-Ing.) from Karlsruhe Institute of Technology with distinction in 2009 and conducted her postdoctoral at the German Cancer Research Center (DKFZ) and at the Hamlyn Centre for Robotic Surgery at Imperial College London.

As full professor at the DKFZ, she is now working in the field of computer assisted medical interventions with a focus on surgical data science and computational biophotonics.

Mr. Hani Marcus

Mr Marcus is an academic consultant neurosurgeon, and was among the first cohort of trainees to be selected for a Walton Integrated Academic Training Pathway, with rotations at the University of Cambridge, Imperial College London, and University College London.

His clinical interest is in “keyhole” endoscopic neurosurgical approaches. To this end, he completed fellowships in endoscopy and anterior skull base surgery (including pituitary surgery) at the Klinik Hirslanden, Zurich and the National Hospital for Neurology and Neurosurgery.

Professor Parvin Mousavi

My research interests are in Computer-aided diagnosis and interventions. These include: Machine learning techniques for in silico inference and prediction Analysis of ultrasound images and signals for enhancement of cancer detection Image-aided, computer-assisted diagnosis of disease Ultrasound-guided interventions Knowledge discovery from high throughput biological data Quantitative modeling and reverse engineering of gene regulatory networks Analysis, segmentation and classification of fluorescence microscopy images Chromosome and cell imaging.
### SPEAKER BIOGRAPHIES

#### Professor Tim Salcudean

Sevastian (Tim) E. Salcudean is a Professor in the Department of Electrical and Computer Engineering at UBC. He received his BEng and MEng from McGill University and his PhD from the University of California, Berkeley, all in electrical engineering.

From 1986 to 1989, he was a Research Staff Member in the robotics group at the IBM T.J. Watson Research Center. He then joined UBC, where he holds the Laszlo Chair in Biomedical Engineering and a Canada Research Chair. In 1996 Dr. Salcudean held a Killam Research Fellowship and spent one year at ONERA in Toulouse, France.

#### Professor Dan Stoyanov

I work on robotics and artificial intelligence problems in minimally invasive surgery especially related to vision and computational imaging. My work is applied towards developing image guidance, computational biophotonic imaging modalities and quantitative measurements during robotic assisted minimally invasive procedures.

I am founder and programme director of the the MSc Robotics and Computation and MRes in Robotics for which I teach the advanced MSc course in Robotic Systems Engineering.

#### Professor Raphael Sznitman

Raphael Sznitman graduated in cognitive systems from the University of British Columbia (Canada) in 2007. He received his PhD in computer science from Johns Hopkins University (USA) in 2011. In 2015, he joined the faculty of the ARTORG Center at the University of Bern (Switzerland), where he is now a full professor in AI for Medical Imaging and the director of the ARTORG Center for Biomedical Engineering.

His research interests are primarily in computational vision, probabilistic methods and statistical learning, applied to applications in medical imaging.

#### Dr Ravi Vaidyanathan

Dr Ravi Vaidyanathan is a Reader in Biomechatronics in the Department of Mechanical Engineering at Imperial College London where he leads the Biomechatronics Laboratory. He earned his Ph.D. in biologically inspired systems at Case Western Reserve University (USA) and subsequently worked in industry, holding two directorships in control systems and medical engineering.

His academic research has translated in a range industrial projects including several new ventures based on principles established in his laboratory.

#### Professor Tom Vercauteren

Tom Vercauteren is Professor of Interventional Image Computing at King’s College London since 2018 where he holds the Medtronic/Royal Academy of Engineering Research Chair in Machine Learning for Computer-assisted Neurosurgery. From 2014 to 2018, he was at UCL as Deputy Director for the Wellcome / EPSRC Centre for Interventional and Surgical Sciences (2017-18).

His research focuses on translational medical image computing, machine learning and interventional imaging devices with a specific interest in their development for surgery and interventional sciences.