

**Imperial College
London**

Hamlyn Winter
School on Surgical
Imaging and Vision
2022

HAMLIN CENTRE FOR
ROBOTIC SURGERY





Hamlyn Winter School on Surgical Imaging and Vision

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.

A MICCAI Society Endorsed Event



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.

She is a Royal Society University Research Fellow at the Hamlyn Centre for Robotic Surgery, Imperial College. 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.

TUTORS

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PROGRAMME: 5th - 9th December 2022

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|---------------|---|--|--|---|--|
| | Monday 05/12 | Tuesday 06/12 | Wednesday 07/12 | Thursday 08/12 | Friday 09/12 |
| 09:00 - 09:45 | Registration/Introduction | Tom Vercauteren "Image Computing for Computer-assisted Surgery in the Wild" | Christos Bergeles "Development of an Image-Guided Vitreoretinal Surgery Robot: Research and Commercialisation Considerations" | Dan Leff "Technology for Precision Breast Cancer Surgery" | Federico Tombari "Semantic scene and object understanding" |
| 9:45 - 10:30 | Industry Talk Intel Corporation: Eugene Liu, Claire Hogg, Thomas Burgoyne, Mathieu Bottier | | | Industry Talk Canon Medical: Patrick Schempf | |
| 10:30 - 11:00 | Coffee Break | Coffee Break | Coffee Break | Coffee Break | Coffee Break |
| 11:00 - 11:45 | Stefanie Speidel "Human-machine collaboration in surgery - bridging the gap between robotics and data science" | Matt Clarkson "Image-Guided Abdominal Surgery – Current Challenges" | Sophia Bano "Context-aware Surgical Guidance for Next-generation Interventions" | Matina Giannarou "Cognitive Vision in Robot-Assisted Neurosurgery" | Pietro Mascagni "Computer vision in minimally invasive surgery" |
| 11:45 - 12:30 | | | | | |
| 12:30 - 14:00 | Lunch Break | Lunch Break | Lunch Break | Lunch Break | Lunch Break |
| 14:00 - 14:45 | Ben Glocker "Safety nets in medical imaging AI" | Dan Elson "Surgical Imaging and Endoscopy" | Hands-on Session | Group Project | Group Project |
| 14:45 - 15:30 | | | Hands-on Session | Group Project | Group Project |
| 15:30 - 16:00 | Coffee Break | Coffee Break | Coffee Break | Coffee Break | Project Evaluation |
| 16:00 - 16:45 | Raphael Sznitman "Towards detecting surgical instruments in the wild" | Hani Marcus "Technological advances for endoscopic pituitary surgery" | Hands-on Session | Group Project | Project Evaluation |
| 16:45 - 17:30 | | Industry Talk Caranx Medical: Pierre Berthet-Rayne "Building a Surgical Robotics Startup" | Hands-on Session | Group Project | Closing Ceremony |
| 18:30 | | | Winter School Dinner | | |

SPEAKER BIOGRAPHIES

Dr. Sophia Bano

Dr Sophia Bano is an Assistant Professor in Robotics Artificial Intelligence at UCL East Robotics, Department of Computer Science, since November 2022 and is also affiliated with the Wellcome/EPSRC Centre for Interventional and Surgical Sciences (WEISS) and the Surgical Robot Vision group at University College London (UCL).

Previously, Dr Bano worked as a Senior Research Fellow at WEISS where she contributed to the GIFT-Surg (Wellcome/EPSRC Guided Instrumentation for Fetal Therapy and Surgery) project.



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.

Professor Matt Clarkson

I am a Professor in the Department Of Medical Physics and Biomedical Engineering, a Deputy Director of the Wellcome / EPSRC Centre for Interventional and Surgical Sciences (WEISS) and a member of the Centre for Medical Image Computing (CMIC).

My research interests are focussed on the development of systems for image-guided surgery, including image registration, computer graphics, visualisation, image processing and software architectures. I have previously received a BSc in Computer Science from Nottingham University (1996) and a PhD from King's College London (2000).



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.

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

Professor Ben Glocker

I am Professor in Machine Learning for Imaging co-leading the Biomedical Image Analysis Group. I lead the HeartFlow-Imperial Research Team and I am also Head of ML Research at Kheiron Medical Technologies.

My research is at the intersection of medical imaging and artificial intelligence aiming to build safe and ethical computational tools for improving image-based detection and diagnosis of disease.



SPEAKER BIOGRAPHIES

Mr Daniel Leff

Daniel is currently a Reader in Breast Surgery working in the Departments of BioSurgery and Surgical Technology and Hamlyn Centre for Robotic Surgery at Imperial College London. He is an Honorary Consultant in Oncoplastic Breast Surgery working within the Breast Unit at Imperial College Healthcare NHS Trust.

Daniel received his PhD in Surgery from Imperial College London in 2009. Daniel's primary research interest is in the field of "surgical neuroergonomics" - optimising clinical performance through investigations of brain function in surgeons.



Mr. Hani Marcus



Mr Marcus is an academic consultant neurosurgeon, and was among the first cohort of trainees to be selected for a Walport 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.

Dr. Pietro Mascagni

Dr Pietro Mascagni is Resident in General Surgery, Catholic University of Sacred Heart, Rome, Italy. He did his PhD at the Catholic University of Sacred Heart, Rome, Italy.

His PhD was on "Surgical Data Science for safe laparoscopic cholecystectomy", and was co-supervised by Prof. Guido Costamagna (Catholic University of Sacred Heart, Rome, Italy) and Prof. Nicolas Padoy (University of Strasbourg, France). Dr Mascagni is a Visiting researcher at CAMMA, ICube, University of Strasbourg, France.



SPEAKER BIOGRAPHIES

Professor Stefanie Speidel

Stefanie Speidel is a professor for "Translational Surgical Oncology" at the National Center for Tumor Diseases (NCT) Dresden since 2017 and one of the speakers of the DFG Cluster of Excellence CeTI since 2019.

She received her PhD from Karlsruhe Institute of Technology (KIT) with distinction in 2009 in the context of the research training group "Intelligent Surgery" (KIT, University of Heidelberg, DKFZ) and had a junior research group "Computer-Assisted Surgery" from 2012 – 2016 at KIT.



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. Federico Tombari

I am a Research Scientist and Manager at Google, and a Lecturer (PD) at TU Munich. At the CAMP Chair?, I help coordinating the computer vision team and its research activities and projects.

I am particularly active in the area of 3D/RGB-D perception and applications of deep learning to computer vision. The fields of application of my research are mostly in robotics, healthcare, augmented reality and autonomous driving.



SPEAKER BIOGRAPHIES

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.





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