The Hamlyn Symposium on Medical Robotics

2022

Programme

26 - 29th June 2022

Contents

Programme at a Glance: Workshops

Hamlyn Symposium Workshops

Programme at a Glance - Sunday 26th June 2022

Time						
07:30 - 08:00	On-Site Registration	Coffee & Registration				
		Workshop	Poster Set Up / Workshop	Workshop Opportunities and challenges	Workshop	Workshop
10:20 - 10:40		Coffee Break				
		Human Augmentation	Low Cost Medical	in deploying robotic applications in a healthcare related setting	Recent Advances in Autonomous Surgery:	Sensing and biophotonics for surgical
12:00 - 13:00		Lunch Break				
		for Medical Robotics	and Surgical Robotics	Workshop Clinical applications	emerging AI technologies towards machine	robotics and in vivo diagnostics
14:20 - 14:40		Coffee Break				
				of robotic navigation in Cardiology	consciousness and robotic awareness in the surgical field	
16:00 - 20:00		Exhibitor Set-Up				

Hamlyn Symposium Workshops

Programme at a Glance - Wednesday 29th June 2022

Time						
08:30 - 09:00	On-Site Registration	Coffee & Registration				
		Workshop	Workshop	Workshop	Workshop	Workshop
10:50 - 11:10		Coffee Break				
		Autonomy and Shared Autonomy in	Human-Centric Data-Driven	Image-Guided and	Micro/Nanorobots	Towards Versatile and
13:00 - 14:00		Lunch Break				
		Endoluminal Approaches	Perception, Cognition and	Collaborative Medical Robotics	for Medicine	Seamless Surgical
15:20 - 15:40		Coffee Break				
		for Soft Surgical Robots	Action in the Operating Theatre			Technologies
17:00						

Hamlyn Symposium 2022

Programme at a Glance - Symposium Sessions

	Time	Monday 27th june
On-Site Registration	08:00	Coffee & Registration
	08:30	Wellcome Address
	08:45	Keynote: Prof. Jaydev Desai
	09:30	Session 1: Smart Devices
	10:50	Coffee Break
	11:00	Session 2: Soft and Conitnuous Robotics
	13:00	Lunch Break
	14:00	Poster Teaser Session 1
	14:45	Funder's Forum
	15:20	Coffee Break
	16:15	Keynote: Prof. Laura Marcu
	17:00	Session 3: Magnetic Technology
	18:00	Welcome Reception

	Time	Tuesday 28th June
On-Site Registration	08:00	Coffee & Registration
	08:30	Session 4: Surgical Guidance
	09:30	Keynote: Prof. John Skinner
	10:15	Coffee Break
	10:45	Session 5: Neurosurgery
	12:45	Lunch Break
	13:45	Poster Teaser Session 2
	14:30	Industry Forum
	15:30	Coffee Break
	16:00	Session 6: Clinical Insights
	17:00	Keynote: Prof. Alex Golby
	17:45	Awards & Closing Ceremony

Monday 27th June 2022

08:00	**Registration & Coffee**

Ondaatje Lecture Theatre

08:30	**Welcome Address: Professor The Lord Ara Darzi**
08:45	**Introduction: Professor The Lord Ara Darzi**
08:45	**Keynote Lecture: Professor Jaydev Desai, Georgia Institute of Technology,** *Robotic Transcatheter and Endovascular Interventions* 

09:30 – 10:30 Session 1: Smart Devices

Chairs: Marcia O'Malley (Rice University) and Paolo Fiorini (UNIVR)

09:30 **Robotic System with Intuitive Control for Endoscopic Bone Cyst Surgery**
Presenter: Subin Lee
S. Lee [1], S. Kim[1], R.M. Solzbacher [1], H. Kim[1], S. Joung [2], J. Hong[1]
[1]*Department of Robotics Engineering, DGIST*
[2]*AIRS Inc.*

09:42 **Design and experimental evaluation of the SOFTScreen capsule system in a colon phantom** Presenter: Vanni Consumi
Vanni Consumi[1], Lukas Lindenroth[1], Danail Stoyanov[1], Agostino Stilli[1]
[1]*Wellcome/EPSRC Centre for Interventional and Surgical Sciences, University College London, UK*

09:54 **Answering the FDA's Call To Action: Using Steerable Sheaths and Mirrors to Prevent ERCP Infections** Presenter: Joshua Gafford
J. B. Gafford[1], S. J. Webster[1], P. A. Anderson[1], S. D. Herrel[1,2,4], K. L. Obstein[2,4], D. C. Rucker[1,3] and R. J. Webster III[1,2,4]
[1]*EndoTheia, Inc.*
[2]*Vanderbilt University Medical Centre*
[3]*The University of Tennessee, Knoxville, Mechanical Engineering*
[4]*Vanderbilt University, Mechanical Engineering; Institute for Surgery and Engineering (VISE)*

10:06 **Validation of a Proof-of-Concept System for Personalised Computer-Assisted Treatment of Knee Osteochondral Lesions** Presenter: Fabio Tatti
F. Tatti[1], B. Jaramaz[2], and F. Rodriguez y Baena[1]
[1]*Mechatronics in Medicine Laboratory, Imperial College London, UK*
[2]*Smith & Nephew Inc., USA*

10:18 **Design and Characterization of Robotically-Guided Ultrasonic Bone Cutting for Laminectomies and Facetectomies** Presenter: Luke Maclean
L.J. MacLean[1, 2], N Theodore[2]
[1]*Whiting School of Engineering, Johns Hopkins University, USA*
[2]*Department of Neurosurgery, Johns Hopkins University School of Medicine, USA*

10:30	**Coffee Break**
11:00 – 13:00	**Session 2: Soft and Continuum Robotics**
	Chairs: Bob Webster (Vanderbilt University) and Sanja Dogramadzi (Sheffield)
11:00	**Pop-up Soft Robot for Minimally Invasive Surgery** Presenter: Mark Runciman Mark Runciman, James Avery, George Mylonas*[1] *[1]The Hamlyn Centre for Robotic Surgery, Imperial College London*
11:12	**A simple and powerful instrument for robotic flexible endoscopy** Presenter: Giuliano A. Giacoppo Giuliano A. Giacoppo, Ada L. Bachmann, Peter P. Pott*[1] *[1]Institute of Medical Device Technology, University of Stuttgart*
11:24	**Shape Sensing for a Soft Continuum Manipulator using Electrical Impedance Tomography (EIT)** Presenter: Emilia Zari A. Alian, E. Zari, J. Avery, E. Franco, M. Runciman, F. Rodriguez y Baena, and G. P. Mylonas*[1] *[1]The Hamlyn Centre for Robotic Surgery, Imperial College London*
11:36	**A Haptic Feedback Glove for Minimally Invasive Surgery** Presenter: Arincheyan Gerald Arincheyan Gerald[1], Rukaiya Batliwala[1], Jonathan Ye[1], Patra Hsu[2], Hiroyuki Aihara[3], and Sheila Russo[1,4] *[1]Department of Mechanical Engineering, Boston University* *[2]Department of Biomedical Engineering, Boston University* *[3]Brigham and Women's Hospital, Harvard Medical School* *[4]Materials Science & Engineering Division, Boston University*
11:48	**Design and validation of zero-slack separable manipulator for Intracardiac Echocardiography** Presenter: Christian Debuys Christian DeBuys[1, 2], Florin Ghesu[1], Reza Langari[2], and Young-Ho Kim[1] *[1]Siemens Healthineers, Digital Technology & Innovation, Princeton, NJ, USA* *[2]Texas A&M University, College Station, TX, USA*
12:00	**Multifunctional hybrid module for manipulators** Presenter: Linda Paterno Canberk Sozer[1], Sujit Kumar Sahu[2,3,4], Linda Paterno[2,3], Arianna Menciassi[2,3] *[1]Department of Automatic Control and Systems Engineering, The University of Sheffield, UK* *[2]The BioRobotics Institute, Scuola Superiore Sant'Anna Pisa, Italy* *[3]Department of Excellence in Robotics & AI, Scuola Superiore Sant'Anna Pisa, Italy* *[4]ICube, CNRS, University of Strasbourg, INSA Strasbourg, Strasbourg, France*
12:12	**Finite Element Dynamics of a Concentric Tube Robot Motion and Interaction with Environment Using SOFA-framework** Presenter: Katie Zuo Katie Zuo, Benjamin Jackson, Ross Henry, Christos Bergeles, S.M.Hadi Sadati*[1] *[1]School of Biomedical Engineering & Imaging Sciences, King's College London, UK*
12:24	**A Sensorized Needle-Insertion Device for Characterizing Percutaneous Thoracic Tool-Tissue Interactions** Presenter: Rachael L'Orsa Rachael L'Orsa[1,2,3], Kourosh Zareinia[4], David Westwick[1], Garnette Sutherland[2] and Katherine J. Kuchenbecker[3]

[1]*Department of Electrical and Software Engineering, University of Calgary,*
[2]*Surgical Performance Laboratory, Project neuroArm, University of Calgary,*
[3]*Haptic Intelligence Department, Max Planck Institute for Intelligent Systems,*
[4]*Department of Mechanical and Industrial Engineering, Ryerson University*

12:36 **Toward Bipolar Electrosurgery with Concentric Tube Robots**
Presenter: Jesse d'Almeida
Jesse F. d'Almeida[1], Margaret Rox[1], and Robert J. Webster III[1]
[1]*Department of Mechanical Engineering, Vanderbilt University, Nashville, TN, 37212*

12:48 **Design of a Robotic Traction Device for Endoscopic Submucosal Dissection**
Presenter: Flora Fung Leung
Flora Fung LEUNG[1], Chun Ping LAM[1], Lap Wing CHEUNG[1], Donald Ngo Fung IP[1], Yeung YAM[1,3,4], Philip Wai Yan CHIU[2,3,4], Ka Chun LAU[1,4]
[1]*Department of Mechanical and Automation Engineering*
[2]*Department of Surgery*
[3]*Chow Yuk Ho Technology Centre for Innovative Medicine*
[4]*Multi-scale Medical Robotics Centre, The Chinese University of Hong Kong*

12:00 – 13:00 ***LBR Med Users Group Meeting – Drayson Room***
Markus Finke, Software Architect Medical Robotics, KUKA

13:00 **Lunch & Exhibition: Marquee and Education Centre**

13:00 – 14:00 ***Realizing digital surgery: Turning buzzwords into business – Sunley Room***
Alex Maret, Vice President, Robotics, Cambridge Consultants

14:00 – 14:45 **Poster Teasers 1 –** *Chair: Ana Cruz Ruiz (Imperial College)*

14:00 P1 **Understanding Different Inflated Balloon Catheter Behaviours via Computational Modelling** Presenter: Junke Yao
J. Yao[1], G.M. Bosi[1], G. Burriesci[1,2], and H. Wurdemann[1]
[1]*Mechanical Engineering, University College London, UK*
[2]*Bioengineering at Ri.MED Foundation, Palermo, Italy*

14:02 P2 **Robotic Surgery – Implications for Informed Consent** Presenter: Jessica Henley
Jessica Henley, M.Eng, Simon Kirby, MD*[1]
[1]*Memorial University of Newfoundland – Faculty of Medicine*

14:04 P3 **Generalization for Deep Reinforcement Learning for Inverse Kinematics of Concentric Tube Robots** Presenter: Keshav Iyengar
K. Iyengar[1], S. Spurgeon[2], and D. Stoyanov[1]
[1]*Department of Computer Science, University College London*
[2]*Department of Electronic and Electrical Engineering, University College London*

14:06 P4 **Towards Autonomous Robotic Ultrasound Scanning Using Pneumatically Attachable Flexible Rails** Presenter: Aoife McDonald-Bowyer
A. McDonald-Bowyer[1], S. Dietsch[1], E. Dimitrakakis[1], J. Coote[1], L. Lindenroth[1], D. Stoyanov[1], and A. Stilli[1]
[1]*Wellcome/EPSRC Centre for Interventional and Surgical Sciences (WEISS)*

14:08 P5 **Automatic Vessel Recognition and Segmentation: a novel Deep Learning Architecture with Transfer Learning Approach** Presenter: Giovanni Faoro

Giovanni Faoro, Stefano Pane, Veronica Iacovacci, Sara Moccia, Arianna Menciassi
The BioRobotics Institute, Scuola Superiore Sant'Anna, Pisa, Italy Department of Excellence in Robotics and AI, Scuola Superiore Sant'Anna, Pisa, Italy

14:10 P6 **A Novel, Research-Orientated Organ Perfusion Platform**
Presenter: Morenike Magbagbeola
M. Magbagbeola[1], K. Doyle[1], Z.L. Rai[1,2,3], L. Lindenroth[1], G. Dwyer[1], A. Stilli[1], B.R. Davidson[1,2,3], D. Stoyanov[1]
[1]*Wellcome/EPSRC Centre for Interventional and Surgical Sciences (WEISS), University College London*
[2]*Centre for Surgical Innovation, Organ Repair and Transplantation (CSIORT), University College London*
[3]*Royal Free Hospital NHS Trust, London*

14:12 P7 **A Temporal Learning Approach to Inpainting Endoscopic Specularities and Its effect on Image Correspondence** Presenter: Rema Daher
Rema Daher[1], Francisco Vasconcelos[1], and Danail Stoyanov[1]
[1]*Computer Science Department, Surgical Robot Vision Group, University College London*

14:14 P8 **Detector-Free Dense Feature Matching for Fetoscopic Mosaicking**
Presenter: Sophia Bano
Sophia Bano[1], Francisco Vasconcelos[1], Anna L. David[2], Jan Deprest[3], and Danail Stoyanov[1]
[1]*Wellcome/EPSRC Centre for Interventional and Surgical Sciences & Department of Computer Science, University College London, UK*
[2]*Fetal Medicine Unit, University College London Hospital, UK*
[3]*Department of Development and Regeneration, University Hospital Leuven, Belgium*

14:16 P9 **Deep Learning-based Plane Pose Regression towards Training in Freehand Obstetric Ultrasound** Presenter: Chiara Di Vece
Chiara Di Vece[1], Brian Dromey[12], Francisco Vasconcelos[1], Anna L. David[2,3], Donald Peebles[2,3] and Danail Stoyanov[1]
[1]*Wellcome/EPSRC Centre for International and Surgical Sciences, University College London*
[2]*Elizabeth Garrett Anderson Institute for Women's Health, University College London*
[3]*NIHR UCL Hospitals Biomedical Research Centre, University College London*

14:18 P10 **Deep Reinforcement Learning Based Semi-Autonomous Control for Robotic Surgery** Presenter: Ruiqi Zhu
Ruiqi Zhu[1], Dandan Zhang[12], and Benny Lo[1]
[1]*The Hamlyn Centre, Imperial College London*
[2]*Department of Engineering Mathematics, University of Bristol*

14:20 P11 **Human Machine Interfaces for robot-assisted colonoscopy: a clinical survey**
Presenter: Martina Finocchiaro
M. Finocchiaro[1,2,3], A. Arezzo[4], A. Menciassi[2,3], A. Casals[1], A. Hernansanz[1]*, G. Ciuti[2,3]*
[1]*Center of Research in Biomedical Engineering, Universitat Politècnica de Catalunya*
[2]*The BioRobotics Institute*
[3]*Department of Excellence in Robotics & AI, Scuola Superiore Sant'Anna,*
[4]*Department of Surgical Sciences, University of Torino*

**These senior authors equally contributed to this work*

14:22 P12 **A Soft Palpation Sensor for Early Detection of Biological Tissue Abnormalities based on Electrical Impedance Tomography** Presenter: Saina Akhond
S. Akhond, J. Avery, and G. Mylonas
The Hamlyn Centre, Imperial College London, London, UK

14:24 P13 **Proof-of-concept investigation of an instrument-mounted markerless tracking system for robot-assisted orthopaedic surgery** Presenter: Fabio Tatti
F Tatti, X Hu, and F Rodriguez y Baena
Mechatronics in Medicine Laboratory, Imperial College London, U.K.

14:26 P14 **A Physical Simulator Integrated with Soft Sensing for Mastering the Manipulation of Vascular Structures in Robotic Surgery** Presenter: Andrea Mariani
A. Mariani, D. Galeazzi, S. Tognarelli, A. Menciassi
The BioRobotics Institute, Scuola Superiore Sant'Anna, Pisa, Italy

14:28 P15 **Robotic Telemanipulation System for Minimally Invasive Surgery using a Passive Universal Joint and Inertial Sensors** Presenter: Max B. Schäfer
Max B. Schäfer, Moritz Hemmer, Anja M. Glöckner, Peter P. Pott
Institute of Medical Device Technology, University of Stuttgart, Germany

14:30 P16 **Dense 3D Reconstruction Through Lidar: A New Perspective on Computer-Integrated Surgery** Presenter: Guido Caccianiga
Guido Caccianiga and Katherine J. Kuchenbecker
Haptic Intelligence Department, Max Planck Institute for Intelligent Systems

14:32 P17 **Development of a wearable fluorescence sensor for non-invasive monitoring of gut permeability** Presenter: Elena Monfort-Sanchez
Elena Monfort Sánchez, James Avery, Ara Darzi, Alex J. Thompson
Hamlyn Centre, Imperial College London, London, UK,

14:34 P18 **Nonlinear Trajectory Following Control for a Bio-Inspired Steerable Needle** Presenter: Zejian Cui
Zejian Cui[1], Abdulhamit Donder[1], and Ferdinando Rodriguez Y Baena[1]
[1]Department of Mechanical Engineering, Imperial College London,

14:36 P19 **Multi Jet Fusion of Nylon-12: A Viable Method to 3D-print Concentric Tube Robots?** Presenter: Kalani Picho
K. Picho, B. Persons, J.F. d'Almeida, N.E. Pacheco, C. Reynolds, L. Fichera
Department of Robotics Engineering, Worcester Polytechnic Institute, USA

14:38 P20 **Design, realization and preliminary validation of an active physical simulator for the study of pelvic floor damages during childbirth** Presenter: Sabina Maglio
G. Modarelli[1], S. Maglio[2], S. Tognarelli[2], A. Menciassi[2]
[1]University of Pisa, Pisa, Italy
[2]The BioRobotics Institute, Scuola Superiore Sant'Anna, Pisa, Italy

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14:45 – 15:45 Funders' Forum

Moderators:
Professor Pietro Valdastri, *University of Leeds*
Dr Christos Bergeles, *King's College London*

Funders' Forum Speakers

Ms Philippa Hemmings
Head of Healthcare Technologies EPSRC, United Kingdom

Dr. Françoise J. Siepel
Operational Coordinator
Digital Innovation Hubs in Healthcare Robotics (DIH HERO, H2020)

Mr Michael Wolfson
Program Director,
Discovery Science & Technology (Bioengineering), NIH, USA

Related Content:
EPSRC UK RAS 2021 White Paper: "Surgical Robotics: Towards Measurable Patient Benefits and Widespread Adoption" https://tinyurl.com/yc47ruth

15:45 **Coffee Break**

16:15 **Introduction: Dr Matina Giannarou**

16:15 **Chen Foundation Lecture: Professor Laura Marcu, University of California at Davis,** *FLIM-guided robotic surgery*

17:00 – 18:00 Session 3: Magnetic Technology

Chairs: Cameron Riviere (Carnegie Melon) and Arianna Menciassi (Sant'Anna)

17:00 **Mechanical Reinforcement Towards Fully Soft Magnetic Endoscopic Endonasal Surgical Manipulators** Presenter: Zaneta Koszowska
Z Koszowska[1], G Pittiglio[1], J H Chandler[1], M Brockdorff[1], and P Valdastri[1]
[1]*School of Electronic and Electrical Engineering STORM lab, University of Leeds*

17:12 **Magnetic Endoluminal Devices Can Assist In Their Own Insertion**
Presenter: Nicholas Posselli
Nicholas R. Posselli, Emma K. Pinegar, and Jake J. Abbott*[1]
[1]*Department of Mechanical Engineering and Robotics Center, University of Utah*

17:24 **Dual-Arm Platform for Control of Magnetically Actuated Soft Robots**
Presenter: Michael Brockdorff
M. Brockdorff[1], G. Pittiglio[1], T. da Veiga[1], J. H. Chandler[1], and P. Valdastri[1]
[1]*STORM Lab UK, University of Leeds*

17:36 **A Navigation Console to Steer Magnetic Instruments Under Radiological Guidance for Neuro-Vascular Interventions** Presenter: Roland Dreyfus

	R. Dreyfus[1], Q. Boehler[1], C. Chautems[1], B.J. Nelson[1] *[1]Multi-Scale Robotics Lab, ETH Zurich*
17:48	**Toward Targeted Therapy in the Brain by Leveraging Screw-Tip Soft Magnetically Steerable Needles** Presenter: Alan Kuntz Trevor J. Schwehr[1], Adam J. Sperry[1], John D. Rolston[2], Matthew D. Alexander[2,3], Jake J. Abbott[1], and Alan Kuntz[4] *[1]Department of Mechanical Engineering* *[2]Department of Neurosurgery* *[3]Department of Radiology and Imaging Sciences* *[4]School of Computing, University of Utah*
18:00	**Welcome Reception**
19:30	**Programme Committee Dinner (Invitation Only)** *Venue: 170 Queen's Gate, Kensington, London*

Tuesday 28th June 2022

08:00	**Registration & Coffee**

Ondaatje Lecture Theatre

08:30 – 10:15	**Session 4: Surgical Guidance**
	Chairs: Kevin Cleary (Children's National) & Stefanie Speidel (Tumour Diseases Centre)
08:30	**Studying the Usability of Forbidden Region Virtual Fixtures for Safer Robotic Assisted Minimally Invasive Surgery** Presenter: Martina Favaretto Martina Favaretto[1], Aldo Marzullo[2], and Elena De Momi[1] *[1]Department of Electronics, Information and Bioengineering, Politecnico di Milano,* *[2]Department of Mathematics and Computer Science, University of Calabria*
08:42	**iSurgeon: Augmented Reality Telestration for Improved Surgical Training** Presenter: Thomas Fuchs T.E. Fuchs[1], E.A. Felinska[1], A. Kogkas[2,3], G.P. Mylonas[2,3], B.P. MüllerStich[1], F. Nickel[1] *[1]Department of General, Visceral and Transplantation Surgery, Heidelberg University Hospital, 69120 Heidelberg, Germany* *[2]Hamlyn Centre for Robotic Surgery, Imperial College London, London* *[3]Department of Surgery and Cancer, Faculty of Medicine, Imperial College London, London*
08:54	**The Design of a Biomimetic Whisker-based System for Clinical Gastrointestinal Diseases Screening** Presenter: Zeyu Wang Zeyu Wang, Junhong Chen, Ruiyang Zhang, and Benny Lo*[1] *[1]The Hamlyn Centre/ Dept of Surgery and Cancer, Imperial College London*
09:06	**Vision-Based Robot Localisation for Ductoscopic Navigation** Presenter: Rema Daher Rema Daher[1], Connah Kendrick[2], Moi Hoon Yap[2], Daniel Leff[1], and Stamatia Giannarou[1] *[1]Department of Surgery and Cancer, Imperial College London* *[2]Department of Computing and Mathematics, Manchester Metropolitan University*
09:18	**A Mixed Reality System for Human Teleoperation in Tele-Ultrasound** Presenter: David Black D. G. Black[1] and S. E. Salcudean[1] *[1]Robotics and Control Lab, University of British Columbia*
09:30	**Introduction: Professor Ferdinando Rodriguez y Baena**
09:30	**Keynote Lecture: Professor John Skinner, University College London,** *The Adoption of Robotic Technology for Orthopaedic Surgery in Healthcare Systems* 
10:15	**Coffee Break**
10:45 – 12:45	**Session 5: Neurosurgery**

Chairs: William Anderson (Johns Hopkins) and Pierre Dupont (Harvard University)

10:45 **Collaborative Robotic Ultrasound Tissue Scanning for Surgical Resection Guidance in Neurosurgery** Presenter: Michael Dyck

Alistair Weld*[1], Michael Dyck*[2,3], Julian Klodmann[2], Giulio Anichini[4], Luke Dixon[4], Sophie Camp[4], Alin Albu-Schäffer[2,3], and Stamatia Giannarou[1]

[1]Hamlyn Centre for Robotic Surgery, Imperial College London

[2]Institute of Robotics and Mechatronics, German Aerospace Center

[3]Department of Informatics, Technical University of Munich

[4]Department of Neurosurgery, Charing Cross Hospital, Imperial College London, UK

10:57 **Head-Mounting Surgical Robots for Passive Motion Compensation**

Presenter: Nicholas Posselli

Nicholas R. Posselli[1], Paul S. Bernstein[2], and Jake J. Abbott[1]

[1]Dept. of Mechanical Engineering and Robotics Center, University of Utah

[2]Dept. of Ophthalmology and Visual Sciences, Moran Eye Center, University of Utah

11:09 **Towards an MRI-Conditional Robot for Intracerebral Hemorrhage Evacuation**

Presenter: Kevin Cleary

A.L. Gunderman[1], S. Sengupta[2], D. Sigounas[3], K. Cleary[4], Y. Chen[1]

[1]Department of Biomedical Engineering, Georgia Institute of Technology/Emory University

[2]Institute of Imaging Science, Vanderbilt University Medical Centre

[3]George Washington University 4Children's National Hospital

11:21 **Bimanual Endoscopic Robot for Neurosurgery** Presenter: Pierre Dupont

Karl Price[1], Joseph Peine[1], Yash Chitalia[1], Margherita Mencattelli[1], Ashkan Pourkand[1], Thomas Looi[2], James Drake[2], Pierre E. Dupont[1]

[1]Cardiac Surgery, Boston Children's Hospital, Harvard Medical School, Boston, MA USA

[2]Neurosurgery Department, Sick Kids Hospital, Toronto, Canada

11:33 **Towards a Procedure Optimised Steerable Microcatheter for Neurosurgical Laser Ablation** Presenter: Ayhan Aktas

A. Aktas[1], A. A. Demircali[2], R. Secoli[3], B. Temelkuran[2] and F. Rodriguez y Baena[1]

[1]The Mechatronics in Medicine Lab, Imperial College London

[2]Department of Metabolism, Digestion and Reproduction, Imperial College London

[3]The Hamlyn Centre for Robotic Surgery, Imperial College London

11:45 **Design of a Meso-Scale Grasper for Robotic Pediatric Neuroendoscope Tool**

Presenter: Jaydev P. Desai

T.A. Brumfiel[1], K.K. Yamamoto[1], A. Rashid[2], A. Shigematsu[1], C. Chapman[2], S.N. Melkote[2], J.J. Chern[3], J.P. Desai[1]

[1]The Medical Robotics and Automation Lab, Georgia Institute of Technology [2]George W. Woodruff School of Mechanical Engineering, Georgia Institute of Technology

[3]Children's Healthcare of Atlanta

11:57 **Robotic Curvilinear Laser Thermal Therapy Probe for Transforamenal Hippocampotomy** Presenter: Daniel Esser

Daniel S. Esser[1], John E. Peters[1], Abby M. Grillo[1], Sarah J. Garrow[2], Tyler Ball[3], Robert Naftel[3], Dario J. Englot[3], Joseph Neimat[4], William A. Grissom[2], Eric J. Barth[1], and Robert J. Webster III[1]

[1]*Department of Mechanical Engineering, Vanderbilt University*
[2]*Department of Biomedical Engineering, Vanderbilt University*
[3]*Department of Neurological Surgery, Vanderbilt University Medical Centre*
[4]*Department of Neurological Surgery, University of Louisville*

12:09 **A Steerable Guide for MRI-guided Laser Interstitial Thermal Therapy**
Presenter: Doyoung Chang
J.S. Kim[1], R. Fischer[2], I. Cajigas[3], M. Ivan[3], D. Chang[2]
[1]*Department of Mechanical Engineering, Johns Hopkins University*
[2]*Department of Interventional Radiology, University of Miami*
[3]*Department of Neurological Surgery, University of Miami*

12:21 **In Vitro Navigation of a Magnetic Sphere using a Model Predictive Controller for Neurovascular Targeted Drug Delivery Applications**
Presenter: Derick Sivakumaran
D. Sivakumaran[1,2], F. C. Landers[2], Q. Boehler[2], C. Chautems[2], S. Pané[2], and B. J. Nelson[2]
[1]*MagnebotiX AG, Zurich Switzerland*
[2]*Multi-Scale Robotics Lab, ETH Zurich*

12:33 **An MRI Compatible MR-Guided High-Intensity Focused Ultrasound Neonatal Neurosurgery Platform for Intraventricular Hemorrhage**
Presenter: Hrishikesh Raghuram
H. Raghuram[12], B. Keunen[2], N. Soucier[1,2], T. Looi[1,2], S. Pichardo[3] A.C. Waspe[1,2], J.M. Drake[1,2]
[1]*The Hospital for Sick Children, Canada*
[2]*University of Toronto, Canada*
[3]*University of Calgary, Canada*

12:45 **Lunch & Exhibition**

13:45 – 14:30 **Poster Teasers 2** *Chair: Ana Cruz Ruiz (Imperial College)*

13:45 P21 **The Fulcrum Effect in the Control of Electromechanical Articulated Laparoscopic Instruments** Presenter: Amir Szold
Amir Szold[1,2]
[1]*Medical Director, Assia Medical Group, Tel Aviv, Israel*
[2]*CMO, Human Xtensions LTD, Kfar Neter, Israel*

13:47 P22 **Inexact Multi-Task Learning for Fetal Anastomoses Detection**
Presenter: Alessandro Casella
Alessandro Casella[1,2], Gaia Romana De Paolis[2], Elena De Momi[2], Dario Paladini[3], Sara Moccia[4], and Leonardo S. Mattos[1]
[1]*Department of Advanced Robotics, Istituto Italiano di Tecnologia, Genoa, Italy* [2]*Dept of Electronics, Information and Bioengineering, Politecnico di Milano, Milan*
[3]*Dept of Fetal and Perinatal Medicine, Istituto "Giannina Gaslini", Genoa, Italy*
[4]*The BioRobotics Institute and Dept of Excellence in Robotics & AI, Scuola Superiore Sant'Anna, Pisa, Italy*

13:49 P23 **EndoVine: Soft Robotic Endoscope for Colonoscopy** Presenter: Ameya Pore
Ameya Pore, Nicola Piccinelli, Giacomo De Rossi Matteo Piano, Daniele Meli, Diego Dall'Alba, Riccardo Muradore, and Paolo Fiorini∗[1]

[1]*University of Verona, Italy*

13:51 P24 **Development and Control of a Robotic Simulator for Peristaltic Motion**
Presenter: Jarrett Ten
Jarrett Ten[1], Quentin Lahondes[1], Shuhei Miyashita[1,2], Dana Damian[1,2]
[1]*Automatic Control and Systems Engineering Department, University of Sheffield,*
[2]*Insigneo Institute for in silica Medicine, University of Sheffield, UK*

13:53 P25 **Envisioning Robotic Exoscope: Concept and Preliminary Results**
Presenter: Alessandro Casella
Alice Valeria Iordache[1], Alessandro Casella[1,2], Elisa Iovene[1], Junling Fu[1], Federico Pessina[3], Marco Riva[3], Giancarlo Ferrigno[1], Leonardo S. Mattos[2] & Elena De Momi[1]
[1]*Dept of Electronics, Information and Bioengineering, Politecnico di Milano, Milan*
[2]*Department of Advanced Robotics, Istituto Italiano di Tecnologia, Genoa, Italy*
[3]*Humanitas Research Hospital, Milan, Italy*

13:55 P26 **Minimum-parameter Adaptive Propulsion Matrix of Screw-type Magnetic Capsule Endoscopes** Presenter: Adam J. Sperry
Adam J. Sperry and Jake J. Abbott*[1]
[1]*Department of Mechanical Engineering and Robotics Center, University of Utah*

13:57 P27 **Cable-Driven Linear Haptic Display for Medical Interventions**
Presenter: Max B. Schäfer
Max B. Schäfer, Julia Nawratil, Moritz Hemmer, Sophie Weiland, Peter P. Pott*[1]
[1]*Institute of Medical Device Technology, University of Stuttgart, Germany*

13:59 P28 **Comparison of Performance Metrics for Real-Time Haptic Feedback in Surgical Skill Training** Presenter: Lianne R. Johnson
L.R. Johnson[1], M.D. Byrne[2], and M.K. O'Malley[1]
[1]*Department of Mechanical Engineering, Rice University*
[2]*Department of Psychological Sciences, Rice University*

14:01 P29 **Predictable therapeutic microswarm dispersion for targeted drug delivery application** Presenter: Kiana Abolfathi
Kiana Abolfathi[1], Mohammad Reza Hairi Yazdi[2,3], and Ali Kafash Hoshiar[1]
[1]*School of Computer Science and Electronic Engineering, University of Essex*
[2]*School of Mechanical Engineering, University of Tehran*
[3]*Dept of Mechanical Engineering, Lassonde School of Engineering, York University, Toronto, Canada*

14:03 P30 **Modeling Telescoping Tendon-actuated Continuum Robots**
Presenter: Yash Chitalia
Yash Chitalia, Abdulhamit Donder, and Pierre E. Dupont*[1]
[1]*Department of Cardiovascular Surgery, Boston Children's Hospital, Harvard Medical School, Boston*

14:05 P31 **Preliminary Findings of a Multimodal Sensor System for Measuring Surgeon Cognitive Workload** Presenter: Ravi Naik
Ravi Naik[1,2], Kaizhe Jin[1,2], Alexandros Kogkas[1,2], Hutan Ashrafian[1], Ara Darzi[1,2], George Mylonas[1,2]
[1]*Department of Surgery and Cancer, St Mary's Hospital, Imperial College London*
[2]*Hamlyn Centre for Robotic Surgery, Imperial College London*

14:07 P32 **Reinforcement Learning for Path Generation for Surgical Robot Maneuver**
Presenter: Ruiyang Zhang
Junhong Chen[1], Zeyu Wang[1], Ruiqi Zhu[2], Ruiyang Zhang[1], Weibang Bai[1], and Benny Lo, Senior Member, IEEE[1]
[1]Hamlyn Centre for Robotic Surgery, Imperial College London
[2]King's College London

14:09 P33 **Augmented Reality for Seamless Human Robot Interaction in Surgery**
Presenter: Hisham Iqbal
H. Iqbal[1] and F. Rodriguez y Baena[1]
[1]Mechatronics in Medicine, Imperial College London

14:11 P34 **A Modular ROS-based dVRK Teleoperation Controller Architecture**
Presenter: Radian Gondokaryono
R. Gondokaryono[1,2], M. Haiderbhai[1,2], A. Munawar[3], T. Looi[2], J. Drake[2], L. A. Kahrs[1,2]
[1]Department of Computer Science, University of Toronto
[2]The Wilfred and Joyce Posluns CIGITI, SickKids, Toronto
[3]Department of Computer Science, John Hopkins University

14:13 P35 **fMRI and MEG Compatible Hand Motion Sensor** Presenter: James Avery
L Lyu, E Monfort Sanchez, M Runciman, G Mylonas, J Avery*[1]
[1]The Hamlyn Centre, Imperial College London, London, UK

14:15 P36 **Signature Robot: A Miniature Robot for Orthopaedic Surgery**
Presenter: Spyridon Souipas
Spyridon Souipas, Stephen G. Laws, Ferdinando Rodriguez y Baena, Brian L. Davies*[1]
[1]Mechatronics in Medicine Laboratory, Imperial College London, UK

14:17 P37 **Optimizing Continuum Robot Tendon Routing for Minimally Invasive Brain Surgery**
Presenter: Margaret Rox
Margaret Rox[1], Aidan Copinga[2], Robert P. Naftel[3], Robert J. Webster III[1], and Alan Kuntz[2]
[1]Department of Mechanical Engineering, Vanderbilt University
[2]School of Computing and Robotics Centre, University of Utah
[3]Department of Pediatric Neurosurgery, Vanderbilt University Medical Centre

14:19 P38 **Design, Fabrication, and Evaluation of a Biomimetic Soft Peristaltic Pump for Biomedical Applications** Presenter: Sina Najjari
Sina Najjari, Peter Culmer, and Ali Alazmani*[1]
[1]University of Leeds, UK

14:21 P39 **Distal Joint Rotation Mechanism for Endoscopic Robot Manipulation**
Presenter: Lap Wing Cheung
L.W. Cheung[1], *K.C. Lau[1,2], Flora F. Leung[1], Donald N.F. Ip[1], Henry G.H. Chow1, Philip W.Y. Chiu[2,3], and Y. Yam[1,2]
[1]Department of Mechanical and Automation Engineering
[2]Multi-scale Medical Robotics Center
[3]Department of Surgery, The Chinese University of Hong Kong

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14:30 – 15:30	**Industry Forum**

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Moderators:

- Prof Alister Hart, *Royal National Orthopeadic Hospital and Chair of Orthopeadics, University College London*
- Mr Johann Henckel, *Royal National Orthopeadic Hospital*
- Prof Ferdinando Rodriguez y Baena, *Hamlyn Centre Co-Director, Imperial College London*

15:30	**Coffee Break**

16:00 – 17:00	**Session 6: Clinical Insights**
	Chairs: Amir Szold (Assia Medical Group) and Duke Herrell (Vandebilt University)
16:00	**3D Printed Cups for Acetabular Reconstruction: a 3D-CT Implant Study** Presenter: Anna Di Laura Anna Di Laura[1,2], Johann Henckel[1], Martin Belzunce[1], Harry Hothi[1,2], Alister Hart[1,3] *[1]Royal National Orthopaedic Hospital, Stanmore, UK* *[2]Department of Mechanical Engineering, University College London, UK* *[3]Division of Surgery and Interventional Science, University College London, UK*
16:12	**Results of In-Vivo Cardiac Arrhythmia Ablations with an Electro-Magnetic Navigation System** Presenter: Christophe Chautems C. Chautems[1], C. On2, N. Cesarovic[4], P. Bode[5], B.J. Nelson[1], F. Duru[2,3] *[1]Multi-Scale Robotics Lab, ETH Zurich* *[2]Arrhythmia and Electrophysiology Division, University Heart Center Zurich*

[3]*Center for Integrative Human Physiology, University of Zurich*
[4]*Division of Surgical Research, University Hospital Zurich*
[5]*Institute of Surgical Pathology, University Hospital Zurich*

16:24 **A Drop-in Robotic Gamma Probe for Minimally Invasive Radioguided Surgery**
Presenter: Manish Chand
T. Pampiglione[1], L. Fumado[2], M.R. Grootendorst[3], K. Vyas[4], M. Chand[1]
[1]*Department of Surgery and Interventional Sciences, GENIE Centre, University College London, UK*
[2]*Department of Urology, Hospital Del Mar, Barcelona, Spain*
[3]*Department of Clinical Affairs, Lightpoint Medical Ltd., Amsterdam, The Netherlands*
[4]*Department of Research and Development, Lightpoint Medical Ltd., Chesham, UK*

16:36 **The Virtuoso Surgical System: First Live Animal Experience**
Presenter: Robert Webster III
R. J. Hendrick[1], N. P. Dillon[1], L. M. Branscombe[1], T. J. Bruns[1], E. J. Blum[1], M. Oresi[1], S. Amack[1], S. D. Herrell III[1,2,3,4], and R. J. Webster III [1,2,3,4]
[1]*Virtuoso Surgical, Inc.*
[2]*Vanderbilt University Medical Center*
[3]*Vanderbilt University, Department of Mechanical Engineering*
[4]*Vanderbilt Institute for Surgery and Engineering (VISE)*

16:48 **Neurosurgical Robotics: Pushing the Boundaries with a Single Platform for the Sacrum to the Cranium** Presenter: Brendan F. Judy
Brendan F. Judy, M.D.[1], A. Daniel Davidar, M.B.B.S.[1], Andrew Hersh, B.S.[1], Carly Weber-Levine, M.S.[1], Amanda N. Sacino, M.D.[1], Brian Y. Hwang, M.D.[1], Tej D. Azad, M.D.[1], Ann Liu, M.D.[1], Joshua Materi, B.S.[1], Tara Dedrickson, B.S.[1], William S. Anderson, M.D.[1], Nicholas Theodore, M.D.[1]
[1]*Department of Neurosurgery, Johns Hopkins Hospital, Baltimore, Maryland, USA*

17:00 **Introduction: Professor Ferdinando Rodriguez y Baena**

17:00 **Karl Storz - Harold Hopkins Golden Telescope Lecture: Professor Alex Golby, Harvard Medical School**
Optimizing surgery for patients with brain tumors: The right information at the right time in the right place

17:45 – 18:00 **Awards & Closing Ceremony**
Poster Awards Chair: Elena De Momi (Politecnico di Milano)
Podium Awards Chair: Dan Elson (Imperial College London)
Surgical Robot Challenge: Robert Merrifield (Imperial College London)

Sponsor-Led Events

Monday 27th June

Realizing digital surgery: Turning buzzwords into business

Alex Maret, Vice President Robotics, Cambridge Consultants

Sunley Room 13:00 – 14:00 *(Lunch will be provided in the room)*

The healthcare industry is eagerly awaiting the reduced costs and improved outcomes that digital surgery is promising, but are we taking the right steps to bring it to life? Are our legacy systems, methods, and strategies well suited to deliver digital transformation? Though the ambitious goals of this revolution are relatively easy to articulate, the roadmap to realizing this vision is clouded with uncertainty and the obstacles can seem daunting. This presentation explores the changes that are coming in surgery and the changes to our legacy thinking and methods that will be required to create products and technologies today to form the foundation of the digital future.

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Monday 27th June

LBR Med Users Group Meeting

Markus Finke, Software Architect Medical Robotics, KUKA

Drayson Room 12:00 – 13:00

- Presentation of the New Generation KUKA Sunrise.OS Med 2.6
- Improvements and new feature available with the latest version
- New feature: increased stiffness
- Libraries of offline planning of collision free paths
- New interfaces of FRI
- Absolute accuracy
- Some insides into the architecture of the system
- Upcoming Features

KUKA

Hands-on Demo:

Markus Finke, Software Architect Medical Robotics, KUKA

Education Centre (Exhibition) 15:30 – 17:00

- presenting some of the features that are not already shown by the demonstrator
- answering additional questions directly on the system

HSMR22: Workshops

Sunday 26th June 2022

Human Augmentation for Medical Robotics

Full Day Workshop (07:30 – 16:00)

Organisers:

Professor Etienne Burdet
Dr. Jonathan Eden
Dr. Yanpei Huang

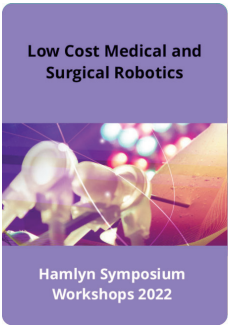
*Accredited by the Royal College of Surgeons for **6 CPD** points.*

Royal College of Surgeons of England

07:30 – 08:00	**Registration and Coffee**
08:00	**Welcome & Introduction:** *Professor Etienne Burdet, Imperial College London*
08:20	**Three-hand surgery: hand-free control strategies in robotic surgery to command the third surgical tool** *Dr Yanpei Huang, Imperial College London*
09:00	**Third tool control in robotic assisted surgery** *Professor Guillaume Morel, Sorbonne University*
09:40	**Robotic augmentation in surgery: the surgical perspective** *Professor Brice Gayet, University Paris Descartes (Remote)*
10:20 – 10:40	**Coffee Break**
10:40	**Movement augmentation: What exists in nature and how to extend that to artificial devices** *Professor Carsten Mehring, University of Freiburg*
11:20	**Non-invasive signals for movement augmentation through motor unit decomposition** *Professor Dario Farina, Imperial College London*
12:00 – 13:00	**Lunch Break**
13:00	**Sensory feedback for movement augmentation** *Mattia Pinardi, Campus Bio-Medico di Roma*
13:40	**Muscular null space in motor learning and for motor augmentation** *Professor Andrea D'Avella, University of Messina and IRCCS Fondazione Santa Lucia*
14:20 – 14:40	**Coffee Break**
14:40	**Human sensorimotor augmentation via wearable interfaces and supernumerary robotic limbs: the intrinsic kinematic nullspace** *Professor Domenico Prattichizzo, Istituto Italiano di Tecnologia (IIT)*

15:20	**Adaptation, Learning and Retention for Human Augmentation of Postural Balance in Standing and Walking** *Professor Dagmar Sternad, Northeastern University College of Science*
15:55 – 16:00	**Closing Remarks:** *Dr. Jonathan Eden, Imperial College London*

Sunday 26th June 2022



Low Cost Medical and Surgical Robotics

Full Day Workshop (08:00 – 16:00)

Organisers:

Professor Paolo Fiorini
Professor Pietro Valdastri
Dr. Tim Horeman
Dr. James Chandler

*Accredited by the Royal College of Surgeons for **6 CPD** points.*

Royal College of Surgeons of England

08:00 – 08:30	**Registration and Coffee**
08:30 – 09:00	**Poster Set Up - Marquee**
09:00	**Welcome & Introduction:** *Professor Pietro Valdastri, University of Leeds*
09:05	**Keynote: Frugal innovation in surgical technology: our experience in the field** *Professor David Jayne, Leeds Teaching Hospital (Remote)*
09:35	**A low-fidelity box trainer for laparoscopic training** *Dr. Manish Chauhan, University of York*
09:50	**Soft and continuum robotics for affordable upper gastrointestinal endoscopy** *Dr. James Chandler, University of Leeds*
10:05	**Poster Pitches**
10:20 – 10:40	**Coffee Break**
10:40	**Keynote: Design and prototyping of a surgical robot for resource constrained environments** *Professor Asokan Thondiyath, Indian Institute of Technology Madras*
11:10	**The future of advanced laparoscopic surgery; what sustainability?** *Assistant Professor Tim Horeman, TU Delft*
11:25	**Expanding the reach of robotic surgery to low-cost procedures** *Professor Paolo Fiorini, University of Verona*
11:40	**The RAIS device for global surgery: navigating the translational pathway from clinical-need to clinical-use** *Associate Professor Peter Culmer, University of Leeds*
11:55	**Additional Poster Pitches** (if needed)
12:00 – 13:00	**Lunch Break**
13:00	**Keynote: Cost and functionality trade-offs – when are complex machines useful for society?** *Professor Sanja Dogramadzi, The University of Sheffield*

13:40	**Keynote: Low-cost soft neuroprosthetics and neurovascular surgery** *Professor Xuanhe Zhao, MIT*
14:10 – 14:30	**Coffee Break**
14:30	**Round Panel Discussion – All Speakers** *Chair: Professor Paolo Fiorini, University of Verona*
15:30 – 16:00	**Closing Remarks**

Sunday 26th June 2022

Opportunities and challenges in deploying robotic applications in a healthcare related setting

Half Day Workshop (07:30 – 12:00)

Organiser:

Maren Boding

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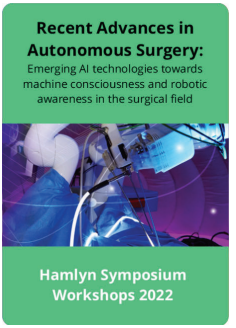
Royal College of Surgeons of England

07:30 – 08:00	**Registration and Coffee**
08:00	**Welcome & Introduction** *Ana Cruz Ruiz (Imperial College London), Selene Tognarelli (SSSA) and Maren Bodding (University of Twente)*
08:05	**The clinical reality of scaling robotics technologies into real world healthcare settings** *Mr James Kinross – Clinical Senior Lecturer in Colorectal Surgery, Imperial College London, Department of Surgery and Cancer, St. Mary's Hospital* *Dr Su-Lin Lee – Head of Operations, Wellcome / EPSRC Centre for Interventional and Surgical Sciences (WEISS), University College London* *Dr Gernot Kronreif – Chief Scientific Officer, Research Area Manager Autonomy in Surgery, Austrian Center for Medical Innovation and Technology*
10:20 – 10:40	**Coffee Break**
10:40	**Panel discussion** *Ana Cruz Ruiz (Imperial College London), Selene Tognarelli (SSSA) and Maren Bodding (University of Twente)*
11:15	**Overview of the DIH-HERO Services offered** *Ana Cruz Ruiz (Imperial College London), Selene Tognarelli (SSSA) and Maren Bodding (University of Twente)*
11:55	**Closing Remarks** *Ana Cruz Ruiz (Imperial College London), Selene Tognarelli (SSSA) and Maren Bodding (University of Twente)*
12:00 – 13:00	**Lunch**

Sunday 26th June 2022



Recent Advances in Autonomous Surgery: emerging AI technologies towards machine consciousness and robotic awareness in the surgical field

Full Day Workshop (08:00 – 16:00)

Organisers:

Dr. Veronica Penza, Dr. Leonardo Mattos, Dr. Anh Nguyen, Maria Koskinopoulou, Baoru Huang, Xiao-Yun Zhou

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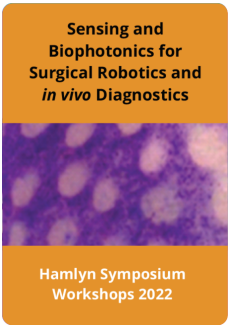
Royal College of Surgeons of England

08:30 – 09:00	**Registration and Coffee**
09:00	**Welcome & Introduction**
	Session 1: Machine consciousness and robotic awareness in the surgical field
09:05	**The approach of cognitive science in HRI: the basis for effective shared awareness** *Professor Agnieszka Wykowska, Istituto Italiano di Tecnologia*
09:50	**Autonomous surgery and surgical awareness: bridging the gaps of surgical knowledge** *Professor Paolo Fiorini, University of Verona*
10:20 – 10:40	**Coffee Break**
10:40	**Complementing Surgeons with Situation Awareness using Computer Vision** *Professor Duygu Sarikaya, Gazi University*
11:10	**Artificial Intelligence-assisted Surgery for Next Generation Intervention** *Dr. Sophia Bano, University College London*
11:40	**Poster Session**
12:00 – 13:00	**Lunch Break**
	Session 2: Emerging AI technologies for autonomous surgery
13:00	**Exploring Autonomy in Robotic Colonoscopy** *Professor Pietro Valdastri, University of Leeds*
13:40	**AI in Robotic-Assisted Surgery and Related Fields: Our Experience in The Mechatronics in Medicine Laboratory** *Dr. Hadi El Daou, Imperial College London*
14:10 – 14:30	**Coffee Break**
14:30	**Automatic segmentation of surgical instrument using AI** *Professor Thiusius R. Savarimuthu, University of Southern Denmark*

15:00	**Applications of sensors, AI and Deep Learning for enhanced awareness during medical procedures** *Dr. Leonardo De Mattos, Istituto Italiano di Tecnologia*
15:30	**Poster Session & Final Discussion**
15:55 – 16:00	**Closing Remarks**

Sunday 26th June 2022



Sensing and biophotonics for surgical robotics and in vivo diagnostics

Full Day Workshop (08:00 – 16:00)

Organisers:

Dr. Alex Thompson, Dr. Diego Dall'Alba, Dr. Michael Hughes, Dr. Zhuoqi Cheng, Dr. Khushi Vyas, Professor Paolo Fiorini, Elena Monfort-Sanchez, Dr. Thiusius Rajeeth Savarimuthu

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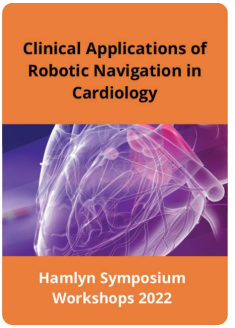
Royal College of Surgeons of England

08:00 – 08:30	**Registration and Coffee**
08:35	**Welcome & Introduction:** *Dr. Alex Thompson, Imperial College London and Dr. Diego Dall'Alba, University of Verona*
08:45	**Robot Assisted Electrical Impedance Sensing for Intraoperative Tissue Recognition** *Dr Zhuoqi Cheng, University of Southern Denmark*
09:15	**Intra-operative sensing and biophotonics for oncological margin control in breast conserving surgery** *Mr Daniel Leff, Imperial College London*
09:45	**Poster Teasers**
10:20 – 10:40	**Coffee Break**
10:40	**TBC** *Professor David Sampson, University of Alberta*
11:15	**Computational approaches to high resolution fibre-based endoscopic imaging** *Dr. Michael Hughes, University of Kent*
12:00 – 13:00	**Lunch Break**
13:00	**Cognitive Vision for Surgical Guidance during Cancer Resection** *Dr. Matina Giannarou, Imperial College London*
13:30	**Optimizing spectral endoscopy for early cancer visualisation** *Dr. Graham Spicer, University of Cambridge*
14:10 – 14:30	**Coffee Break**
14:30	**Lighting up the lung: Developing optical tools for real-time, point-of-care detection of lung disease in the clinic** *Dr. Beth Mills, The University of Edinburgh*
15:00	**Tactile Perception in Minimally Invasive Surgery** *Dr. Dominic Jones, University of Leeds*

15:30	**Panel Discussion:** *All Speakers*
15:50 – 16:00	**Poster Prize Awards & Closing Remarks** *Dr. Alex Thompson, Imperial College London and Dr. Diego Dall'Alba, University of Verona*

Sunday 26th June 2022



Clinical applications of robotic navigation in Cardiology

Half Day Workshop (12:00 – 16:00)

Organisers:

Dr. Sabine Ernst
Dr. Peter Weiss
Dr. Jonathan Hill

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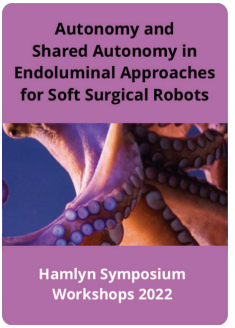
Royal College of Surgeons of England

12:00 – 13:00	**Registration and Lunch**
13:00	**Welcome & Introduction**
13:05	**Opportunities and Challenges for Robotics in Cardiovascular Interventions** *Assistant Professor Ali Tavallaei, Ryerson University*
13:25	**Simultaneous mapping system for AF ablation: ACUTUS** *Dr. Tamas Szili-Tolok, Erasmus Medical Centre, Rotterdam*
13:45	**Robotics and PFA** *Dr. Peter Weiss, Banner University of Arizona Medical Center Phoenix*
14:10 – 14:30	**Coffee Break**
14:30	**Non-invasive 3D mapping in combination with magnetic navigation** *Dr. Jack Griffiths, Imperial College London*
14:45	**Automation- future for hands and human error free ablation and transvascular procedures** *Dr. Peter Weiss, Banner University of Arizona Medical Center Phoenix*
15:05	**Telerobotics for complex procedures** *Professor Sabine Ernst, Royal Brompton Hospital*
15:20	**Robotics for coronary interventions** *Professor Jonathan Hill, Royal Brompton Hospital*
15:30	**Panel Discussion:** *All speakers*
15:55 – 16:00	**Closing Remarks**

Wednesday 29th June 2022



Autonomy and shared autonomy in endoluminal approaches for soft surgical robots

Full Day Workshop (09:00 – 17:00)

Organisers:

Alice Segato, Mouloud Ourak, Professor Elena DeMomi, Professor Arianna Menciassi, Dr. Emmanuel Vander Poorten, Dr. Emiliano Votta, Dr. Arnau Garriga Casanovas, Dr. Enrico Franco

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08:30 – 09:00	**Registration and Coffee**
09:00	**Welcome & Introduction:** *Professor Arianna Menciassi, Pisa University*
Session 1: Barriers for endoluminal robot navigation	
09:15	**Keynote: Understanding clinical needs for autonomy and shared autonomy in endoluminal approaches** *Professor Alberto Arezzo, University of Torino (Remote)*
09:45	**Surgical and Transcatheter Mitral valve repair. Where Robotics will improve outcomes** *Professor Paolo Denti, University of Cape Town (Remote)*
10:00	**Vision-based estimation and control for endoluminal interventions** *Dr. Benoit Rosa, University of Strasbourg*
10:15	**MorphGI: a self-propelling soft robotic endoscope** *Dr. Hongbin Liu, King's College London (Remote)*
10:30	**Poster Pitches**
10:50 – 11:10	**Coffee Break**
Session 2: Applications in Autonomous Control and Shared Autonomy	
11:10	**Keynote: Autonomy in Transendoscopic Robotic Surgery** *Professor Robert Webster, Vanderbilt University*
11:40	**IVUS-based control of a distally actuated continuum robot** *Dr. Mouloud Ourak, Katholieke Universiteit Leuven*
11:55	**Texting a surgical procedure: can the robot read it** *Professor Paolo Fiorini, University of Padova*
12:10	**AI based control of steerable needles for surgery** *Alice Segato, Politecnico di Milano*
12:25	**Learning-based sensing and control for image-guided surgical robotic device** *Dr. Ka-Wai Kwok, The University of Hong Kong (Remote)*

12:40	**Poster Pitch**
13:00 – 14:00	**Lunch Break**

Session 3: Best Practices in modeling, actuation, sensing, imaging, powering

14:00	**Robotically Steerable Guidewire for Endovascular Interventions** *Professor Jaydev Desai, Georgia Institute of Technology*
14:15	**Soft robots and/or soft sensors** *Professor Kaspar Althoefer, Queen Mary University*
14:30	**A high-performance actuation and sensing solution for cable-driven manipulators** *Dr. Izadyar Tamadon, Scuola Superiore Sant'Anna*
14:45	**Miniaturised soft robotic manipulators for MIS** *Professor Helge Wurdemann, University College London*
15:00	**Capsule robots in GI endoscopy: wired or wireless?** *Professor Gastone Ciuti, Scuola Superiore Sant'Anna*
15:15	**Poster Pitch**
15:20 – 15:40	**Coffee Break**

Session 4: Usability, regulatory aspects, industry challenges, time to market

15:40	**Balancing simplicity and complexity in the translation of soft medical robots** *Professor James Chandler, University of Leeds*
15:55	**Therapy Development and Market Access** *Dr. Andrea Guidotti, University Hospital Zurich*
16:10	**Mixed reality as a novel human-friendly tool for patient-specific surgeries: from planning to intra-operative guidance** *Filippo Piatti, Politecnico di Milano (Remote)*
16:25	**Round table** *Professor Emmanuel Vanderpoorten, KU Leuven* *Associate Professor Emiliano Votta, Politecnico di Milan* *Dr. Enrico Franco, Imperial College London*
16:55 – 17:00	**Closing Remarks:** *Professor Elena De Momi, Politecnico di Milano*

Wednesday 29th June 2022

Human-Centric Data-Driven Perception, Cognition and Action in the Operating Theatre

Full Day Workshop (09:00 – 17:00)

Organisers:

Dr. George Mylonas, Mr Daniel Leff
Professor Fabio Cuzzolin, Mr James Kinross

*Accredited by the Royal College of Surgeons for **6 CPD** points.*

Royal College of Surgeons of England

08:30 – 09:00	**Registration and Coffee**
09:00	**Welcome & Introduction:**
09:10	**Multi-sensed AI environments for surgical task and role optimisation** *Dr. George Mylonas, Imperial College London*
09:30	**Measuring cognitive workload in surgery** *Dr. Ravi Naik, Imperial College London*
09:50	**Surgical Data for Optimized Therapy** *Dr Gernot Kronreif – Chief Scientific Officer, Research Area Manager Autonomy in Surgery, Austrian Center for Medical Innovation and Technology*
10:10	**OpenICE: An Operating Theatre Integrated Clinical Environment** *Professor Marco Zenati, Brigham & Women's Hospital of Harvard Medical School*
10:30	**Computer vision for intraoperative assistance: from proof of concept to clinical value** *Dr. Pietro Mascagni, University of Strasburg*
10:50 – 11:10	**Coffee Break**
11:10	**Trade-off between AI and Supervisory Control in the Next Generation of Semi-Autonomous Surgical Robots** *Dr. Riccardo Muradore, University of Verona*
11:30	**TBC** *Professor Andreas Melzer, University Leipzig*
11:50	**Ad-hoc data analysis strategies for surgical neuroergonomics; a historical perspective** *Dr. Felipe Orihuela-Espina, Imperial College London*
12:10	**The digital surgeon – the realities of digital surgery in an analogue world** *Mr James Kinross, Imperial College London*
12:30	**Building visual perception of the surgical site** *Professor Dan Stoyanov, University College London*

13:00 – 14:00	**Lunch Break**
14:00	**Clinical Neuroergonomics – From Expertise Development to Cognitive Burden Detection** *Mr. Daniel Leff, Imperial College London*
14:20	**Human Factors: Leaving our monochrome perspective of safe systems for a technicolour future** *Mr. Paul Stretton, Head of Innovation and Research MedLed*
14:40	**Surgical Translation of Computer Vision: Integrating Data Streams for Augmented Decisions** *Dr. Daniel Hashimoto, University Hospitals Cleveland Medical Center*
15:00	**Human-machine collaboration in surgery - bridging the gap between robotics and data science** *Professor Stefanie Speidel, National Center for Tumour Diseases (NCT)*
15:20 – 15:40	**Coffee Break**
15:40	**Eye hand coordination in image-guided MIS procedures** Professor Roman Bednarik, University of Eastern Finland
16:00	**Wearable technology for biomechanical analysis in minimally invasive surgery** *Dr. Juan A. Sanchez-Margallo, Jesús Usón Minimally Invasive Surgery Centre in Cáceres*
16:20	**The SARAS surgical action detection challenges** *Professor Fabio Cuzzolin, Oxford brookes University*
16:40	**TBC** *Mr. Sanjay Purkayastha, Imperial College London*
17:00	**Closing Remarks**

Wednesday 29th June 2022

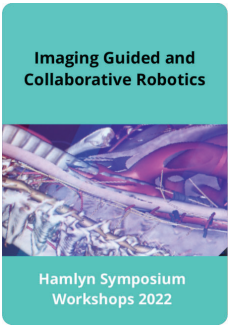


Image-Guided and Collaborative Medical Robotics

Full Day Workshop (09:00 – 17:00)

Organisers:

Professor Andreas Melzer, Professor Kevin Cleary
Dr. Riccardo Muradore, Professor Kawal Rhode

*Accredited by the Royal College of Surgeons for **6 CPD** points.*

Royal College of Surgeons of England

08:30 – 09:00	**Registration and Coffee**
09:00	**Welcome & Introduction:** *Professor Andreas Melzer, University Leipzig*
	Part I: Imaging Robotics
Session 1 Chair: Professors Andreas Melzer / Kevin Cleary	
09:05	**Historical overview and state of the art of Imaging Robotics** *Professor Andreas Melzer, University Leipzig and IMSaT University Dundee*
09:35	**Robotically-Assisted MRI-Guided Interventions** *Professor Kevin Cleary, Children's National Hospital*
10:05	**How I Learned to Stop Worrying and Love the MRI** *Professor Robert Webster, Vanderbilt University*
10:50 – 11:10	**Coffee Break**
Session 2 Chair: Professors Kevin Cleary / Andreas Melzer	
11:10	**Automated robotic ultrasound** *Professor Shuangyi Wang, Chinese Academy of Sciences* *Professor Kawal Rhode, King's College London*
11:35	**Robotic assisted Ultrasound guided Biopsy** *Professor Jan Stallkamp, University Manheim*
12:00	**Tracking, Navigation and Positioning in Interventional Operating Rooms** *Professor Zion Tse, University of York*
12:25	**CT-guided imaging robotics** *Professor Joachim Kettenbach, Inselspital Bern*
12:50	**Summary of morning programme and overall discussion** *Professors Andreas Melzer / Kevin Cleary*
13:00 – 14:00	**Lunch Break**
	Part II: Collaborative Robotics

Session 3 Chairs: Professor Kawal Rhode and Dr. Riccardo Muradore

14:00	**State of the art of Surgical Robotics and unmet needs** *Professor Prokar Dasgupta, King's College London*
14:25	**The convergence of Robotics and AI in the collaborative medical robots of the future** *Dr. Riccardo Muradore, University of Verona*
14:50	**Collaborative Robotics Integration through SDC in the OR** *Johann Berger, ICCAS University Leipzig*
15:20 – 15:40	**Coffee Break**

Session 4 Chairs: Professor Kawal Rhode and Riccardo Muradore

15:40	**Gaze-controlled robotic scrub nurse and endoscopes** *Dr. George Mylonas, Imperial College London*
16:10	**Requirements for Flexible and Intraluminal Robotics** *Dr. Luigi Manfredi, University of Dundee*
16:40 – 17:00	**Afternoon Discussion:** *Professor Kawal Rhode and Dr. Riccardo Muradore*

Wednesday 29th June 2022

Micro/Nanorobots for Medicine

Full Day Workshop (09:00 – 17:00)

Organisers:

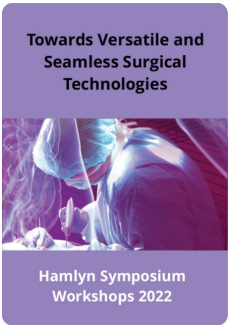
Dr. Alex Thompson, Dr. Meysam Kershavaz, Daniel Bautista, Dr. Larisa Florea

*Accredited by the Royal College of Surgeons for **6 CPD** points.*

Royal College of Surgeons of England

08:30 – 09:00	**Registration and Coffee**
09:00	**Welcome & Introduction:** *Dr. Alex Thompson, Imperial College London*
09:15	**Engineering micro- and nanorobots for medicine** *Dr. Simone Schürle, ETH Zürich, Switzerland*
09:45	**Trends in medical microrobotics: future outlook and challenges** *Dr. Amirreza Aghakhani, Newcastle University*
10:50 – 11:10	**Coffee Break**
11:15	**Origami robot approach to foreign body removal** *Dr. Shuhei Miyashita, University of Sheffield*
11:45	**Medical magnetic microrobots from individual to swarm control** *Dr. Ali Hoshiar, University of Essex*
12:15	**Surface tension forces toward compact microrobotic devices** *Dr. Antoine Barbot FEMTO-ST, France*
13:00 – 14:00	**Lunch Break**
14:00	**Responsive Micro-actuators and sensors fabricated by direct laser writing** *Dr. Larisa Florea, Trinity College Dublin*
14:30	**Nanodrones for mending the body** *Dr. Nazila Kamaly, Imperial College London*
15:00	**Nanotech approaches to cell-selective delivery** *Dr. Nuria Oliva-Jorge, Imperial College London*
15:30 – 15:50	**Coffee Break**
15:50	**Panel Discussion:** *All speakers*
16:20 – 16:25	**Closing Remarks:** *Dr. Alex Thompson, Imperial College London*

Wednesday 29th June 2022



Towards Versatile and Seamless Surgical Technologies

Full Day Workshop (09:00 – 17:00)

Organisers:

Dr. Dandan Zhang, Professor Sanja Dogramadzi
Professor Chenguang (Charlie) Yang, Dr. Dana D. Damian

*Accredited by the Royal College of Surgeons for **6 CPD** points.*

Royal College of Surgeons of England

08:30 – 09:00	**Registration and Coffee**
09:00	**Welcome & Introduction:** Professor Sanja Dogramadzi, The University of Sheffield & Dr. Dana Damian, The University of Sheffield
09:05	**I,robot** Mr. Anthony Kouparis, North Bristol NHS Trust
09:25	**Motor Learning in Surgical Skill Acquisition** *Yarden Sharon, University of the Negev*
09:45	**Challenges towards the automation of the surgical gesture** *Dr. Fanny Ficuciello, University of Naples Ferderico II (Remote)*
10:05	**Soft surgical devices and implants** *Dr. Canberk Sozer, The University of Sheffield*
10:25	**Toward intelligent autonomous endoscope robots for minimally invasive surgery** *Dr. Zheng Li, The Chinese University of Hong Kong, CUHK (Remote)*
10:55 – 11:10	**Coffee Break**
11:10	**Self-growing robotic endoscope** *Dr. Lin Cao, The University of Sheffield*
11:30	**Deep learning for autonomous vascular access** *Dr. Anh Nguyen, The University of Liverpool*
11:50	**Ingestible/non-invasive robots** *Dr. Shuhei Miyashita, The University of Sheffield*
12:10	**Cognitive control of surgical robots** *Dr. Francesco Setti, Italian National Research Council (CNR)*
12:30	**Shared control and autonomous control, the surgeon-in-the loop in robotic surgery** *Professor, Elena De Momi, Politecnico di Milano*
13:00 – 14:00	**Lunch Break**

14:00	**Introduction** *Dr. Dandan Zhang, University of Bristol & Prof. Chenguang Yang, University of Bristol*
14:05	**Organ sparing surgery for the lower GI tract** *Professor Alberto Arezzo, University of Torino (Remote)*
14:35	**Soft robotics for body implants** *Dr. Assunta Fabozzo, CRAL Azienda Ospedaliera di Padova (Remote)*
14:55	**Teleoperation and Human-Robot Cooperative Control for Robotic Surgery** *Dr. Hang Su, Politecnico di Milano (Remote)*
15:15 – 15:30	**Coffee Break**
15:30	**Tele-mentoring for needle insertion** *Professor Ann Majewics-Fey, University of Texas (Remote?)*
16:00	**Practical Machine Learning for Autonomous Surgery: the Real-to-Sim-to-Real Paradigm** *Professor Michael Yip, UC San Diego (Remote)*
16:30	**Panel Discussion** *All Speakers*
16:45 – 16:50	**Closing Remarks**

A big thank you to our Sponsors!

Sponsor Profiles

Intuitive Surgical

Website:
https://atracsys-interactive.com/

In 2020, we celebrated a quarter century of pioneering minimally invasive robotic-assisted surgery focused on helping physicians improve the lives of people around the world. As we move forward, our commitment to innovation and further developing minimally invasive robotic-assisted technologies with research-driven clinical benefits will continue to guide our work.

Intuitive designs and manufactures state-of-the-art robot-assisted systems that have been used in more than 10+ million minimally-invasive surgical procedures in over 69 countries worldwide with 6730 systems installed. The da Vinci® Surgical System enables surgeons to operate with high precision and dexterity through a few small incisions, by using cutting edge telerobotics, vision, and human-computer interface technologies. And the innovation continues with a new generation of integrated systems, smart instruments, single port and endoluminal platforms, as well as advanced analytics, guidance, intelligent systems, and much more to come. These systems are revolutionizing the way in which surgery is being done, and offer unique platforms for exploring the potential of intelligent interventions to reduce variability in clinical outcomes and to help deliver better care.

Cambridge Consultants

Website:
https://www.cambridgeconsultants.com/

Cambridge Consultants is a partner to the ambitious applying market insight and technical expertise to transform our clients' businesses. We unite an extraordinary breadth of talent to expand the boundaries of technology innovation - and together passionately overcome the toughest, most urgent, and essential challenges to change patients' lives.

We believe in a future unconstrained by current thinking with a global team of 800+ engineers, strategists, and market experts to harness our client's ambition into radical and brilliant ideas that are new to people, to business, and to the world. We were founded with the goal of combining the highly innovative work in academia with the product innovation urgency needed to support winning businesses. In the 60 years since, our development expertise has spanned projects from medical device and industrial applications to wireless connectivity and defense.

Tianqiao and Chrissy Chen Institute

Website:
https://www.cheninstitute.org/

The Tianqiao and Chrissy Chen Institute (TCCI®) was created in 2016 by Tianqiao Chen and his wife Chrissy Luo, the founders of Shanda Group, with a US $1 billion commitment to help advance fundamental brain research around the world.

The organization's vision is to improve the human experience by understanding how our brains perceive, learn and interact with the world.

KUKA

Website:
https://www.kuka.com/en-gb

KUKA is a global automation corporation with sales of around 3.3 billion euro and roughly 14,000 employees. The company is headquartered in Augsburg, Germany.

As one of the world's leading suppliers of intelligent automation solutions, KUKA offers customers everything they need from a single source: from robots and cells to fully automated systems and their networking in markets such as automotive, electronics, metal & plastic, consumer goods, e-commerce/retail and healthcare. (As at December 31, 2021)

KINOVA

Website:
https://www.kinovarobotics.com/

Kinova has been a leader in innovative robotics in Montreal since 2006. The company designs and manufactures robots for various markets, including medical robotics, assistive robotics, research and education, and industrial automation.

Kinova's ingenious technology improves the capabilities of customers with a human-first approach to serve the growing need for robotics across complex industries.

AURIS

Website:
https://www.aurishealth.com/

With the MONARCH® Platform, Auris, a subsidiary of Ethicon, seeks to leverage the power of flexible robotics to enable new possibilities in endoscopy.

By integrating the latest advancements in robotics, micro instrumentation, endoscope design, sensing, and data science, MONARCH® is designed with the goals of improving patient outcomes and reducing hospital costs in both bronchoscopy and kidney procedures.

Touch Surgery™

Website:
https://www.medtronic.com/covidien/en-us/products/digital-surgery.html

Touch Surgery™ Enterprise now makes it easy to connect your OR to the cloud so you can seamlessly record and upload your video, securely grow your library and uncover new insights.

Experience a full ecosystem of digital solutions that support every stage of surgery, in and out of the OR. Empower surgical teams with next-generation computing, visualization, and artificial intelligence technology.

CMR Surgical

Website:
https://cmrsurgical.com/

CMR Surgical is dedicated to transforming surgery with Versius®, a next-generation surgical robot. We are committed to working with surgeons and hospitals to provide an optimal tool to make robotic minimal access surgery universally accessible and affordable. Our mission is to redefine surgical robotics with practical, innovative technology and data.

ClaroNav Inc.

Website:
https://www.claronav.com/

Claronav is dedicated to the development of surgical navigation solutions. It provides both components like MicronTracker, software framework for navigation and complete surgical navigation systems. We are introducing this year the most powerful next generation MicronTracker with unprecedented accuracy, measurement rate and robotic functionalities.

MicronTracker can be used in a variety of guided procedures performed manually or using robotics. MicronTracker gives complete access to video images and depth information, providing “eyesight” to a medical robot.

BBZ Srl

Website:
https://www.bbzsrl.com

BBZ is a spin off of the University of Verona focused on the development of training systems for minimally invasive surgery and on the design of customised hardware and software solutions for robotic surgery

Smith & Nephew & Atracsys

Website:
http://www.smith-nephew.com

Smith & Nephew plc (LSE:SN, NYSE:SNN) in 2019 acquired Atracsys Sàrl the Switzerland-based provider of optical tracking technology used in computer-assisted surgery.

Atracsys’ fusionTrack 500 optical tracking camera is a core enabling technology for Smith & Nephew’s next-generation robotics platform. The fusionTrack 500 offers superior measurement speed and latency performance, supporting reduced procedure times, as well as increased accuracy resulting in finer precision surgical tasks, such as bone cuts, compared to existing tracking technology.

FAULHABER

Website:
www.ems-limited.co.uk

FAULHABER precision drives for medical devices and robotic surgery, where high performance, reliability and small packaging are critical features.

DC, BLDC and stepper motors from just 3mm diameter, together with gearheads, encoders and full customisation for optimised performance in the smallest package size.

CASCINATION

Website:

https://www.cascination.com

CASCINATION is a Swiss medical device company with a mission to bring certainty to medical treatment outcomes.

Our robotic and image-guided solutions enable clinicians to perform reproducible and efficient interventions, that deliver quality outcomes from minimally invasive therapies across a range of disciplines from cancer treatment to the treatment of hearing disorders.

Virtuoso Surgical

Website:
https://www.virtuososurgical.net

Virtuoso Surgical, Inc. is a Nashville, Tennessee startup developing a robotic tool for rigid endoscopy. Founded in 2016, Virtuoso anticipates a first-in-human clinical study in 2023.

The Virtuoso system deploys two 1-mm robotically controlled surgical arms through an 8mm rigid endoscope, providing bi-manual dexterity with precision and force at this small scale.

KARL STORZ-ENDOSCOPE

Website:
https://www.karlstorz.com

KARL STORZ has a strong reputation for exceptional imaging products including the latest 3D and imaging technology which can be integrated into the OR1TM Operating Theatre to give an unparalleled theatre experience.

WITTENSTEIN

Website:
https://www.wittenstein.de

WITTENSTEIN specializes in high-end drive systems, sensors and software solutions.
Want to unlock unprecedented levels of robotic stiffness, precision and smallest footprint? Come to our booth and experience our brand-new „Axial-Galaxie®“ gearbox, see the world‘s most compact haptic feedback sensor and discover our safety critical „SAFERTOS®“ real time operating system.

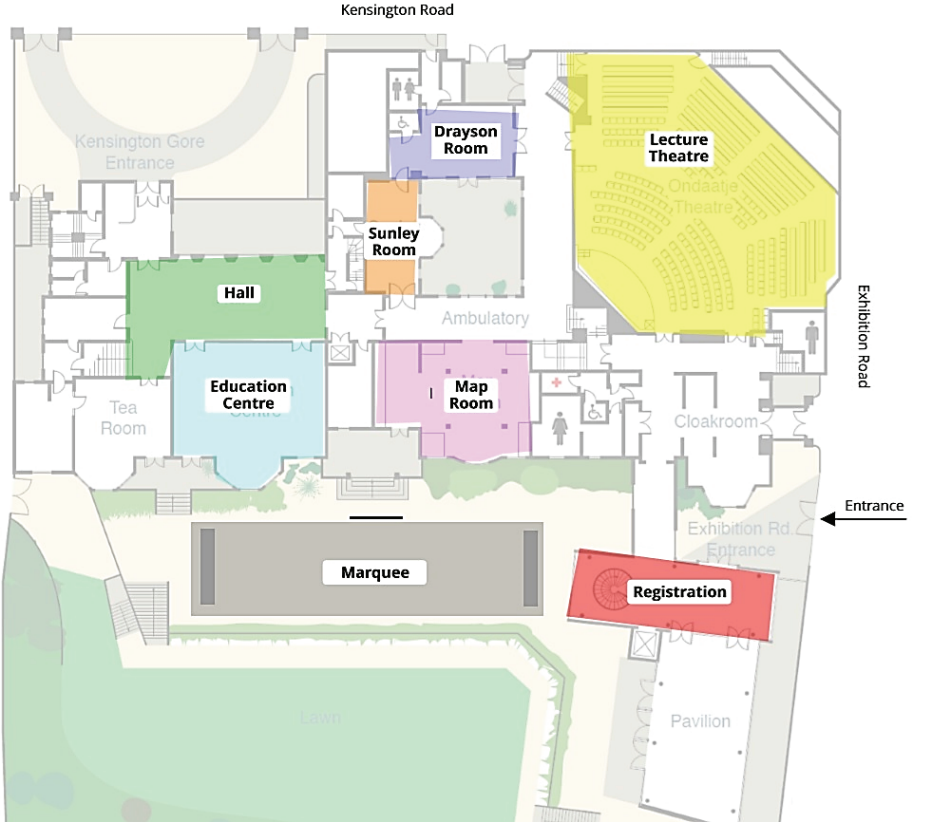
Exhibition Map

Education Centre, Royal Geographical Society

1 metre

Venue Map

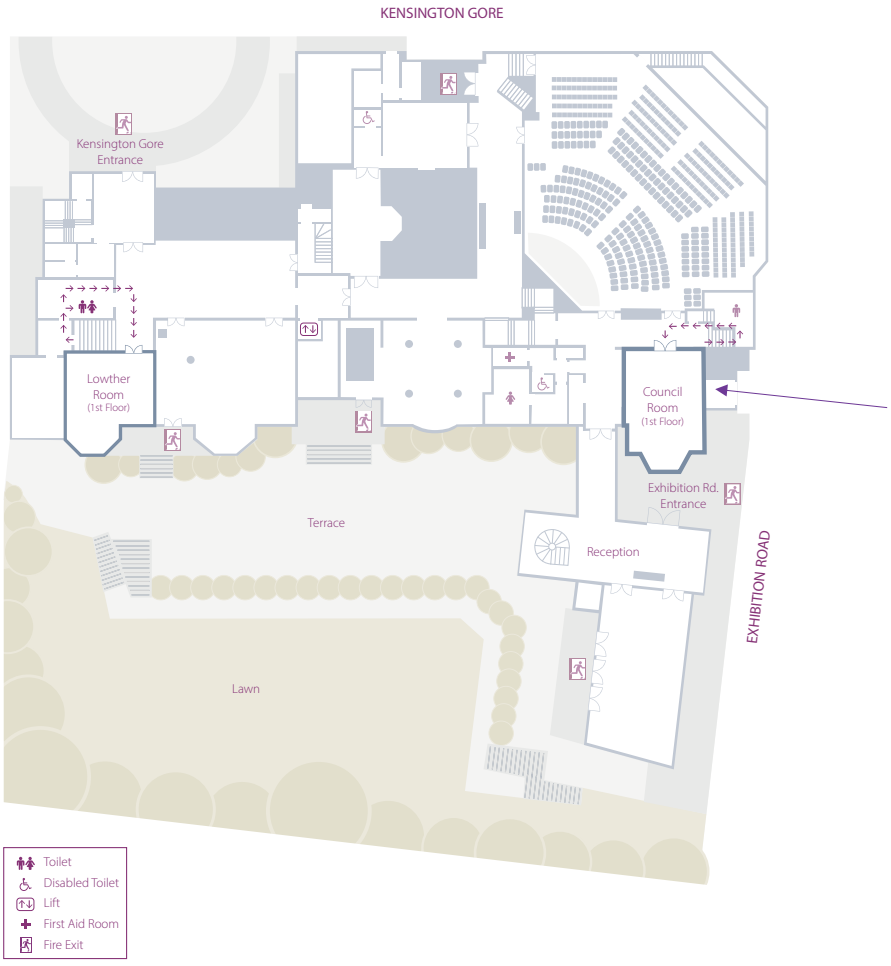
Royal Geographical Society
1 Kensington Gore, London, SW7 2AR



Venue Map – Council Room for AV set Up

Royal Geographical Society
First Floor Plan

Royal Geographical Society Enterprises
Commercial activities supporting the charity



The Hamlyn Symposium on Medical Robotics

26 - 29th June 2022
Imperial College London and
the Royal Geographical Society, London