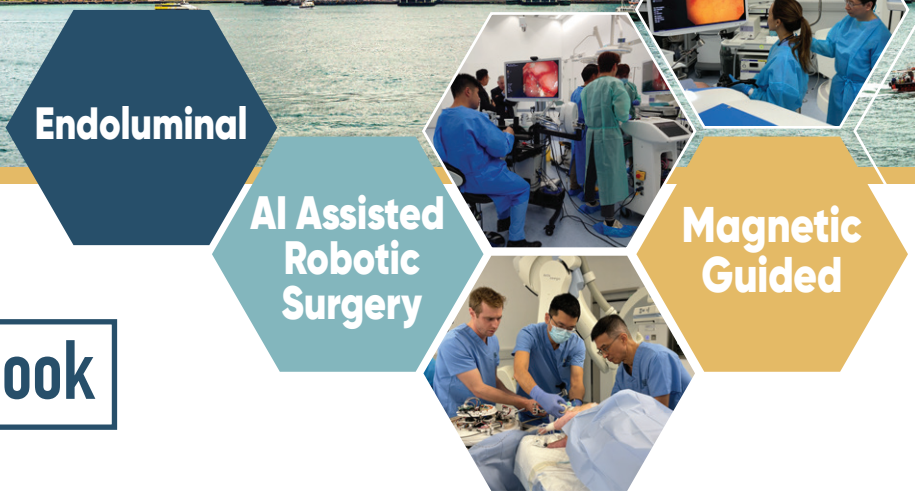
MRC SYMPOSIUM

Multi-Scale Medical Robotics Center (MRC) Symposium 2024

9th–11th May 2024 · Hong Kong

Hands-on workshop on advanced surgical robotic systems



e-Programme Book

Main Symposium - CUHK Medical Centre
Hands-on Workshop -MRC R&D Lab, Hong Kong Science Park

Organizer:

MULTI-SCALE MEDICAL ROBOTICS CENTER

Multi-Scale Medical Robotics Center (MRC) Symposium 2024

9th–11th May 2024 · Hong Kong

Hands-on workshop on advanced surgical robotic systems

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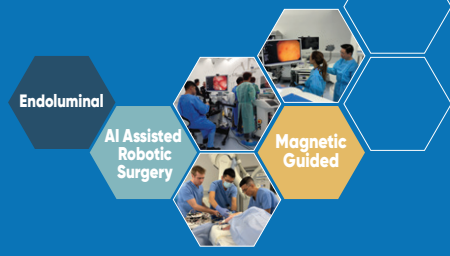


Organizing Committee

Symposium Co-Chairs

Prof. Philip Wai Yan CHIU
Faculty of Medicine
The Chinese University of Hong Kong

Prof. Samuel Kwok Wai AU
Department of Mechanical and Automation Engineering
The Chinese University of Hong Kong

Steering Committee

Prof. Lord Ara DARZI
Faculty of Medicine
Imperial College London

Prof. Bradley NELSON
The Institute of Robotics and Intelligent Systems
ETH Zurich

Prof. Ferdinando RODRIGUEZ Y BAENA
Department of Mechanical Engineering,
Imperial College London

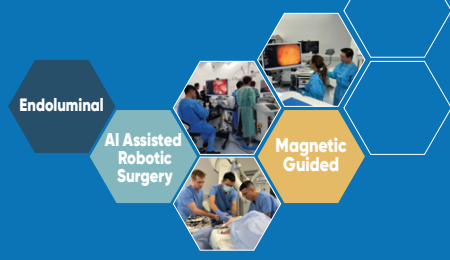
Prof. Russell H. TAYLOR
Department of Computer Science
Johns Hopkins University

Organizing Committee

Prof. Philip Wai Yan CHIU (The Chinese University of Hong Kong)
Prof. Samuel Kwok Wai AU (The Chinese University of Hong Kong)
Prof. Simon Siu Man NG (The Chinese University of Hong Kong)
Prof. Chi Fai NG (The Chinese University of Hong Kong)
Prof. Danny Tat Ming CHAN (The Chinese University of Hong Kong)
Prof. Hon Chi YIP (The Chinese University of Hong Kong)
Prof. Jeremy Yuen Chun TEOH (The Chinese University of Hong Kong)

Executive Sub-committee

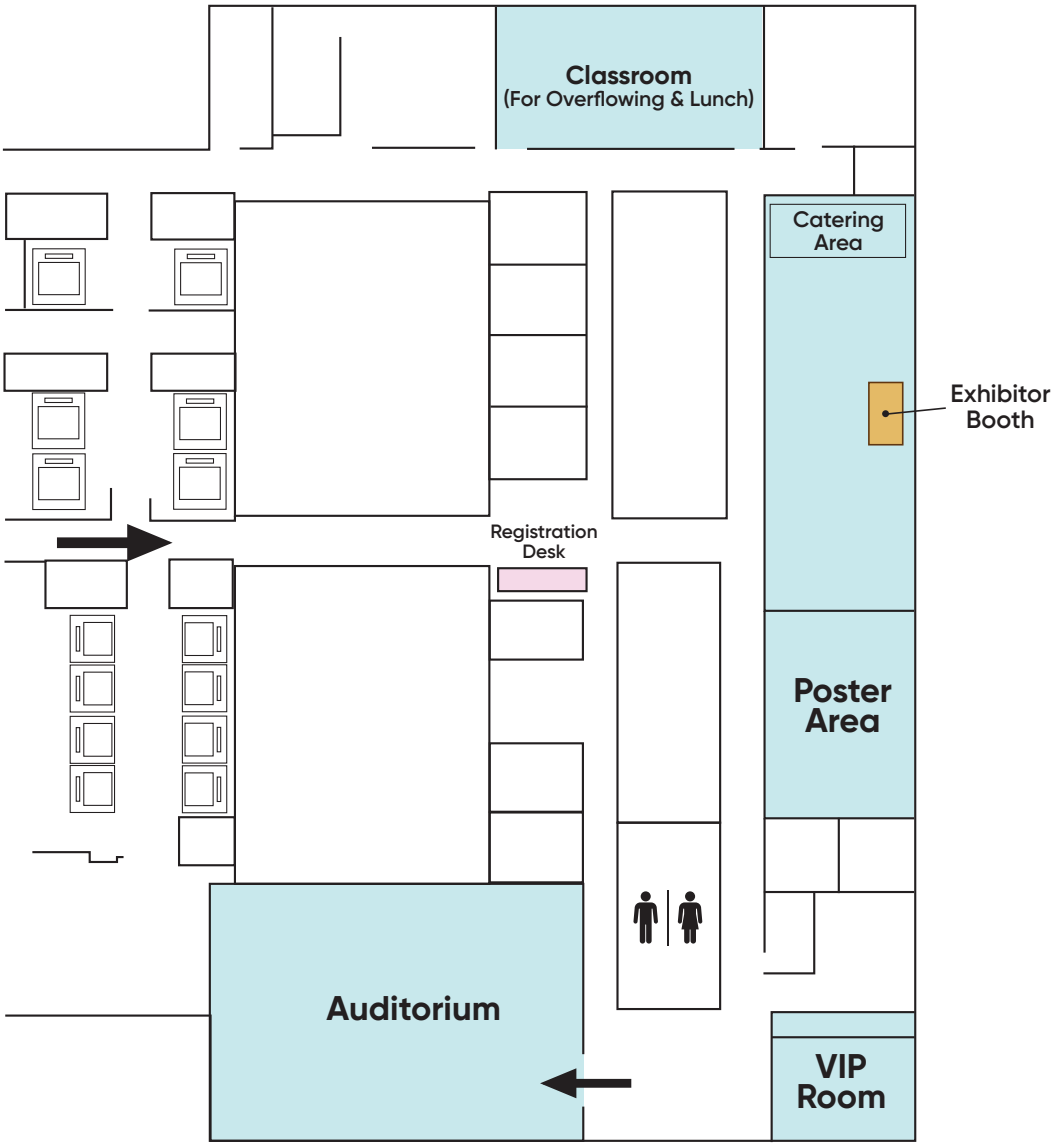
Prof. Samuel Kwok Wai AU (The Chinese University of Hong Kong)
Prof. Zhang LI (The Chinese University of Hong Kong)
Prof. Ka Wai KWOK (The Chinese University of Hong Kong)
Prof. Dou QI (The Chinese University of Hong Kong)
Prof. Bernard Shing Shin CHENG (The Chinese University of Hong Kong)
Dr. Steffi Kar Kei YUEN (Prince of Wales Hospital)
Dr. David Kai Wing LEUNG (Prince of Wales Hospital)



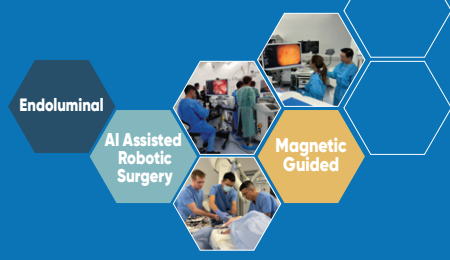
Exhibition & Floor Plan

Symposium Venue:

Auditorium, 10/F, CUHK Medical Centre, 9 Chak Cheung Street, Shatin, New Territories, Hong Kong



Exhibitor
Olympus Hong Kong and China Limited



Symposium Information

Symposium & Workshop Venue

- Symposium Venue: Auditorium, 10/F, CUHK Medical Centre, 9 Chak Cheung Street, Shatin, New Territories, Hong Kong
- Workshop Venue: MRC R&D Lab, G01-G03, G/F, Building 20E, Phase Three, Hong Kong Science Park, Pak Shek Kok, New Territories, Hong Kong

Opening Hours of Registration Desk

Function	Venue	Opening Hours
Main Symposium	Reception Area of Auditorium, 10/F, CUHK Medical Centre	10th May 2024, 08:00-17:30 11th May 2024, 08:30-17:30
Workshop 1	Foyer Area of MRC R&D Lab, 20E, Hong Kong Science Park	9th May 2024, 09:00-12:30
Workshop 2		9th May 2024, 13:00-17:00
Workshop 3		10th May 2024, 14:00-17:30
Workshop 4		11th May 2024, 09:00-12:30

Official / Social Program

Function	Venue	Date & Time
Cocktail Reception (For Registered Guests only)	MRC R&D Lab, 20E, Hong Kong Science Park	9th May 2024, 17:00-20:00
Opening Ceremony	Auditorium, 10/F, CUHK Medical Centre	10th May 2024, 09:00-09:30
Poster Presentation	Foyer Area, 10/F, CUHK Medical Centre	10th May 2024, 10:30-17:30 11th May 2024, 08:30-17:30
Dinner (For Invited Guests only)	ClubONE PARC88 (Shop S040A, G/F, Lakeside 2, Phase 2, Hong Kong Science Park)	10th May 2024, 17:30-21:00
Closing Ceremony	Auditorium, 10/F, CUHK Medical Centre	11th May 2024, 17:00-17:30

Coach Transfer

Coach transfer for attending Workshop at MRC R&D Lab on 10-11 May

Click HERE

Coach transfer for attending Cocktail Reception on 9 May

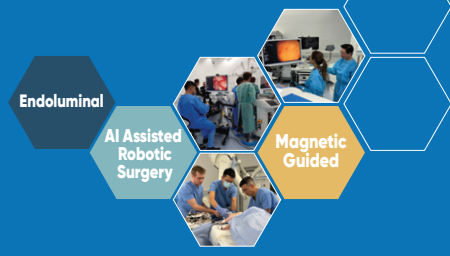
Click HERE

Language

English is the official language of the Symposium.

Certificate of Attendance

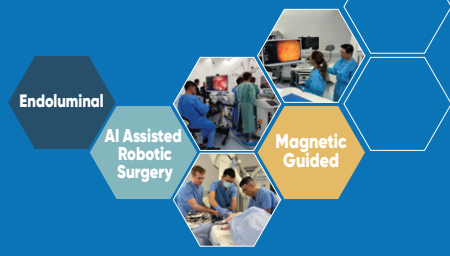
E-Certificate of attendance will be sent by email after the Symposium.



Detailed Programme

9th May 2024 (Thursday)

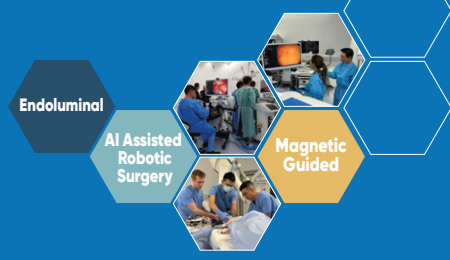
Time	Programme
AM Session	***(MRC R&D Lab, HK Science Park)***
09:00-09:30	Registration
09:30-12:30	Workshop 1: Endoscopic Robot for Gastrointestinal Tumor Dissection
	Performance Demonstration of EndoR Surgical System in Lower GI: In Live Porcine Model EndoR **Prof. Philip Chiu** *Faculty of Medicine, The Chinese University of Hong Kong* **Prof. Hon Chi Yip** *Department of Surgery, Faculty of Medicine, The Chinese University of Hong Kong* **Dr. Ka Chun Lau** *Multi-Scale Medical Robotics Center*
12:30-14:00	Lunch Break
PM Session	***(MRC R&D Lab, HK Science Park)***
14:00-17:00	**Workshop 2: Robot-assisted Bimanual Procedures through Laparoscopic and Endoluminal Approaches** *(2 Parallel Sessions)*
	1. Cornerstone Robotics - Forging Accessibility in Robotic Surgery Cornerstone Robotics **Prof. Hon Chi Yip** *Department of Surgery, Faculty of Medicine, The Chinese University of Hong Kong* **Prof. Samuel Au** *Department of Mechanical and Automation Engineering, Faculty of Engineering, The Chinese University of Hong Kong* **2. En-bloc Resection of Bladder Tumours (ERBT) in an Ex-vivo Model with a Novel Endoluminal Robotic System** Agilis Robotics **Prof. Jason Chan** *Department of Surgery, Faculty of Medicine, The Chinese University of Hong Kong* **Prof. Ka Wai Kwok** *Department of Mechanical Engineering, Faculty of Engineering, The University of Hong Kong*
17:00-20:00	**Cocktail Reception**



Detailed Programme

10th May 2024 (Friday) – AM Session

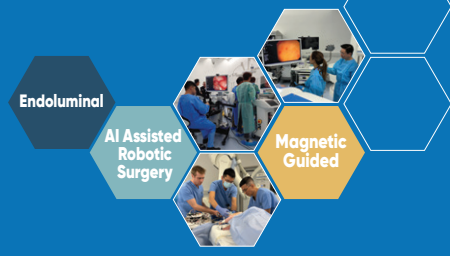
Time	Programme
AM Session **Moderators: Prof. Hon Chi Yip and Prof. Zhang Li**	***(Auditorium, CUHKMC)***
08:30-09:00	Registration
09:00-09:30	Opening Ceremony
09:30-10:00	**Keynote Presentation A** Cognitive Revolution in Surgery: AI, Robotic Surgery, Digital Surgery **Prof. Mehmet Mahir Özmen** *Faculty of Medicine, Istanbul Bahçeşehir University* *Faculty of Medicine, Sapienza University of Rome*
10:00-10:30	**Keynote Presentation B** Adoption of Innovation in Medical Robotics **Prof. Lord Ara Darzi** *Faculty of Medicine* *Imperial College London*
10:30-10:50	Coffee Break
10:50-11:10	**Invited Presentation 1** Magnetic Surgical Robots: A "Fantastic Voyage" Deep Inside the Human Body **Prof. Pietro Valdastri** *Chair in Robotics & Autonomous Systems,* *School of Electronic and Electrical Engineering,* *University of Leeds*
11:10-11:30	**Invited Presentation 2** Enabling Technology for Autonomous Robotic Retinal Surgery **Prof. Iulian I. Iordachita** *Whiting School of Engineering,* *Johns Hopkins University*
11:30-12:00	**Panel Discussion** Prof. Samuel Au, Prof. Philip Chiu, Prof. Iulian I. Iordachita, Prof. Mehmet Mahir Özmen, Prof. Pietro Valdastri
12:00-13:00	**Review & Discussion for Hands-on Workshops 1 & 2** **Chairpersons for Review Discussion:** Prof. Charles Chang & Prof. Hon Chi Yip **Panelists:** Prof. Jason Chan, Prof. Samuel Au, Prof. Philip Chiu, Prof. Ka Wai Kwok, Dr. Ka Chun Lau
13:00-14:30	Lunch Break



Detailed Programme

10th May 2024 (Friday) – PM Session

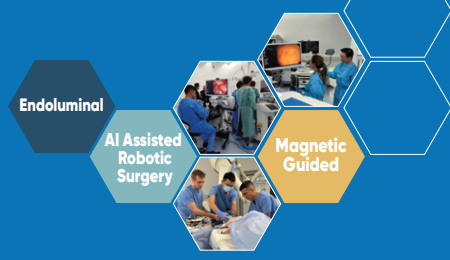
Time	Programme	Time	Programme
PM Session	***(Auditorium, CUHKMC)***	PM Session	***(MRC R&D Lab, HK Science Park)***
Moderators: Prof. Qi Dou and Prof. Bernard Cheng			
14:30-15:10	**Keynote Presentation C** Remote Magnetic Navigation for Precision Telesurgery **Prof. Bradley Nelson** *The Institute of Robotics and Intelligent Systems, ETH Zurich*	14:00-14:30	Registration
15:10-15:35	**Invited Presentation 3** The Hamlyn Centre for Robotic Surgery: Overview and MIM Lab Developments **Prof. Ferdinando Rodriguez y Baena** *Imperial College London*	14:30-17:30	**Workshop 3: Image-guided Flexible Robotic Catheterization Platforms** *(3 Parallel Sessions)* **1. Robotic Assisted Ventricular Intervention** Centre for Artificial Intelligence and Robotics **Prof. Danny Chan** *Department of Surgery, Faculty of Medicine, The Chinese University of Hong Kong* **Prof. Hongbin Liu** *Centre for AI and Robotics, Hong Kong Institute of Science & Innovation, Chinese Academy of Sciences* **2. Robotic Vascular Intervention with a Remote Electromagnetic System** **Prof. Hongsoo Choi** *Department of Robotics and Mechatronics Engineering, Daegu Gyeongbuk Institute of Science & Technology (DGIST)* **3. Robotic Bone-Drilling of Cadaver Trial Procedures** **Prof. Jason Chan** *Department of Surgery, Faculty of Medicine, The Chinese University of Hong Kong* **Prof. Samuel Au** *Department of Mechanical and Automation Engineering, Faculty of Engineering, The Chinese University of Hong Kong*
15:35-16:00	Poster Session & Coffee Break		
16:00-16:25	**Invited Presentation 4** The Future of Surgery: AI-assisted Interventions **Prof. Sophia Bano** *Department of Computer Science, University College London*		
16:25-17:00	Poster Session		
17:00-17:25	**Invited Presentation 5** Robotic RIRS with Zamenix **Prof. Dong-Soo Kwon** *Department of Mechanical Engineering, Korea Advanced Institute of Science and Technology (KAIST)*		



Detailed Programme

11th May 2024 (Saturday) - AM Session

Time	Programme	Time	Programme
AM Session	***(Auditorium, CUHKMC)***	AM Session	***(MRC R&D Lab, HK Science Park)***
Moderators: Prof. Danny Chan and Prof. Tony Chan			
09:00-09:30	Registration	09:00-09:30	Registration
09:30-10:10	**Keynote Presentation D** Autonomy and Semi-Autonomous Behavior in Surgical Robot Systems **Prof. Russell H. Taylor** *Department of Computer Science, Johns Hopkins University*	09:30-12:30	**Workshop 4: Endoluminal Robotic Navigation and Endoscopy** *(3 Parallel Sessions)* **1. The BellowScope: a Low-cost Disposable Soft Endoscope for Upper Gastrointestinal Tract Screening** **Prof. Pietro Valdastri** *Chair in Robotics & Autonomous Systems, School of Electronic and Electrical Engineering, University of Leeds* **2. A POV Magnetically Guided Endoscope for Telesurgery** **Prof. Shannon Chan** *Department of Surgery, Faculty of Medicine, The Chinese University of Hong Kong* **Prof. Bradley Nelson** *The Institute of Robotics and Intelligent Systems, ETH Zurich* **3. Micron-precision Robot for Assisting Ophthalmic Surgeons** **Prof. Kelvin Chong** *Department of Ophthalmology and Visual Sciences, The Chinese University of Hong Kong* **Prof. M. Ali Nasseri** *Department of Robotics and Embedded Systems, Technical University of Munich*
10:10-10:35	**Invited Presentation 6** Evaluation of a Novel Robotic Platform for Transoral Surgery (TORS) **Dr. Jason Fleming** *Institute of Systems, Molecular and Integrative Biology, University of Liverpool*		
10:35-11:00	**Invited Presentation 7** Bringing Engineering to Patients: It is Possible **Dr. Henry Ho** *Division Chairman & Senior Consultant, Division of Surgery & Surgical Oncology, Singapore General Hospital*		
11:00-11:30	Poster Session & Coffee Break		
11:30-11:55	**Invited Presentation 8** **Prof. Jim Khan** *University of Portsmouth*		
11:55-12:20	**Invited Presentation 9** Surgical Education and Innovation, 16 Years of Ircad Taiwan Experience **Dr. Wayne Huang** *Academy of Circular Economy, National Chung Hsing University*		
12:20-12:45	**Invited Presentation 10** Our Experiences in Clinical Implementation of the Newly Launched Surgical Robots **Prof. Koichi Suda** *Department of Surgery, Fujita Health University*		
12:45-14:20	Lunch Break		

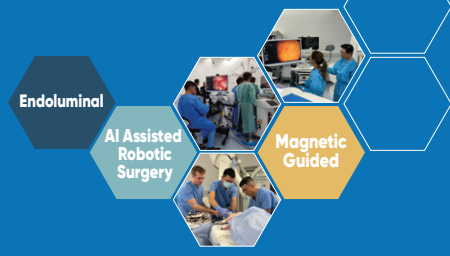


Detailed Programme

11th May 2024 (Saturday) - PM Session

Time	Programme
PM Session	***(Auditorium, CUHKMC)***
Moderators: Prof. Shannon Chan and Prof. Charles Cheng	
14:20-14:45	**Invited Presentation 11** Electromagnetic Controllable Micro/Nanorobots to Improve Cell Therapy **Prof. Hongsoo Choi** *Department of Robotics and Mechatronics Engineering,* *Daegu Gyeongbuk Institute of Science & Technology (DGIST)*
14:45-15:45	**Review & Discussions for Hands-on Workshops 3** **Chairpersons for Review Discussion:** Dr. James Chandler and Prof. Ka Wai Kwok **Panelists:** Prof. Danny Chan, Prof. Samuel Au, Prof. Hongsoo Choi, Prof. Hongbin Liu
15:45-16:00	Poster Session & Coffee Break
16:00- 17:00	**Review & Discussions for Hands-on Workshops 4** **Chairpersons for Review Discussion:** Prof. Danny Chan and Prof. Ka Wai Kwok **Panelists:** Prof. Shannon Chan, Prof. Kelvin Chong, Prof. Mohammad Ali Nasseri, Prof. Bradly Nelson, Prof. Pietro Valdastri
17:00-17:30	Closing Remarks & Award Presentation

** The scientific programme and workshops are subject to change without prior notice.*



Faculty

Keynote Speakers

Prof. Lord Ara DARZI
(United Kingdom)

Prof. Bradley NELSON
(Switzerland)

Prof. Mehmet Mahir Özmen
(Turkey)

Prof. Russell H. TAYLOR
(United States)

Invited Speakers

Prof. Sophia Bano
(United Kingdom)

Prof. Hongsoo Choi
(South Korea)

Dr. Jason Fleming
(United Kingdom)

Dr. Henry Ho
(Singapore)

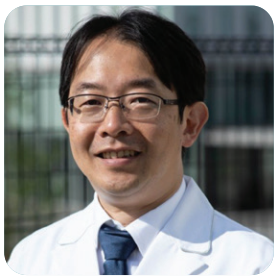
Prof. Wayne Huang
(Chinese Taipei)

Prof. Iulian I. Iordachita
(United States)

Prof. Jim Khan
(United Kingdom)

Dr. Dong-Soo Kwon
(South Korea)

Prof. Ferdinando Rodriguez y Baena
(United Kingdom)



Prof. Koichi Suda
(Japan)

Prof. Pietro Valdastri
(United Kingdom)

Faculty

Workshop Facilitators

Prof. Samuel Au
(Hong Kong SAR)

Prof. Danny Chan
(Hong Kong SAR)

Prof. Jason Chan
(Hong Kong SAR)

Prof. Shannon Chan
(Hong Kong SAR)

Prof. Philip Chiu
(Hong Kong SAR)

Prof. Kelvin Chong
(Hong Kong SAR)

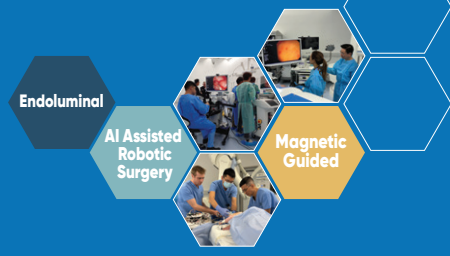
Prof. Ka Wai Kwok
(Hong Kong SAR)

Dr. Ka Chun Lau
(Hong Kong SAR)

Prof. Hongbin Liu
(Hong Kong SAR)

Prof. M. Ali Nasseri
(Germany)

Prof. Hon Chi Yip
(Hong Kong SAR)



Hands-on Workshops

Workshop 1: Endoscopic Robot for Gastrointestinal Tumor Dissection

Prof. Philip Chiu
Faculty of Medicine,
The Chinese University of Hong Kong

Prof. Hon Chi Yip
Department of Surgery,
Faculty of Medicine,
The Chinese University of Hong Kong

Dr. Ka Chun Lau
Multi-Scale Medical Robotics Center

Performance Demonstration of EndoR Surgical System in Lower GI: In Live Porcine Model

EndoR

EndoR Surgical System

Workshop 2: Robot-assisted Bimanual Procedures through Laparoscopic and Endoluminal Approaches

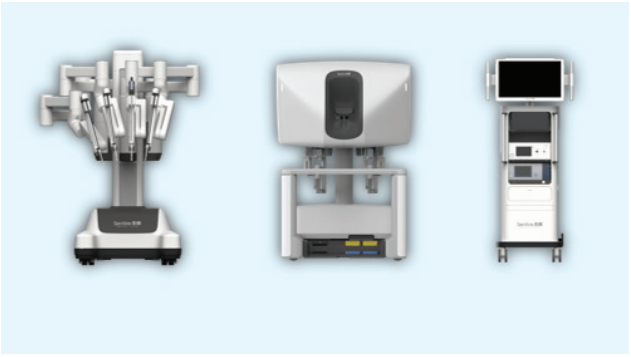
(2 Parallel Sessions)

Prof. Hon Chi Yip
Department of Surgery,
Faculty of Medicine,
The Chinese University of Hong Kong

Prof. Samuel Au
Department of Mechanical and Automation Engineering, Faculty of Engineering,
The Chinese University of Hong Kong

1. Cornerstone Robotics - Forging Accessibility in Robotic Surgery

Cornerstone Robotics



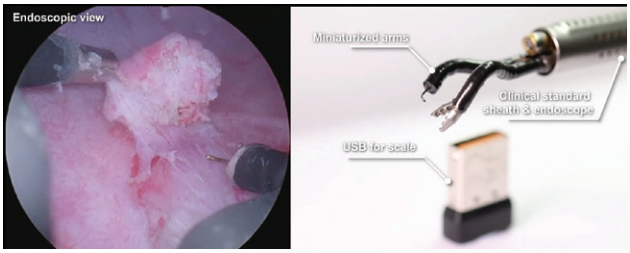
Sentire Endoscopic Surgical System

Prof. Jason Chan
Department of Surgery, Faculty of Medicine,
The Chinese University of Hong Kong

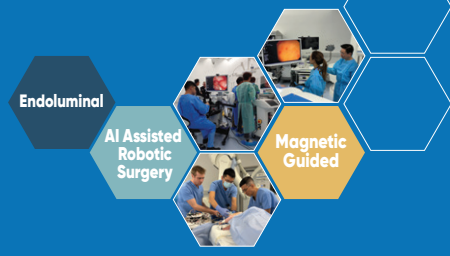
Prof. Ka Wai Kwok
Department of Mechanical Engineering,
Faculty of Engineering,
The University of Hong Kong

2. En-bloc Resection of Bladder Tumours (ERBT) in an Ex-vivo Model with a Novel Endoluminal Robotic System

Agilis Robotics



Ultra-thin Flexible Robotic Instruments for Endoluminal Surgery



Hands-on Workshops

Workshop 3: Image-guided Flexible Robotic Catheterization Platforms

(3 Parallel Sessions)

Prof. Danny Chan
Department of Surgery, Faculty of Medicine, The Chinese University of Hong Kong

Prof. Hongbin Liu
Centre for AI and Robotics, Hong Kong Institute of Science & Innovation, Chinese Academy of Sciences

1. Robotic Assisted Ventricular Intervention

Centre for Artificial Intelligence and Robotics

MicroNeuro

Prof. Hongsoo Choi
Department of Robotics and Mechatronics Engineering, Daegu Gyeongbuk Institute of Science & Technology (DGIST)

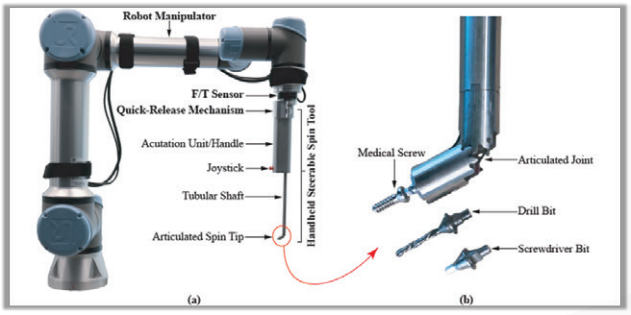
2. Robotic Vascular Intervention with a Remote Electromagnetic System

Comprehensive Vascular Models and Remote Magnetic Intervention System

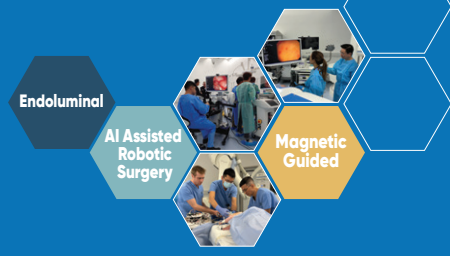
Prof. Jason Chan
Department of Surgery, Faculty of Medicine, The Chinese University of Hong Kong

Prof. Samuel Au
Department of Mechanical and Automation Engineering, Faculty of Engineering, The Chinese University of Hong Kong

3. Robotic Bone-Drilling of Cadaver Trial Procedures



(a) Overall Surgical Robotic System
(b) Miniaturized Articulated Spin Tip with Various Exchangeable Tip Bits



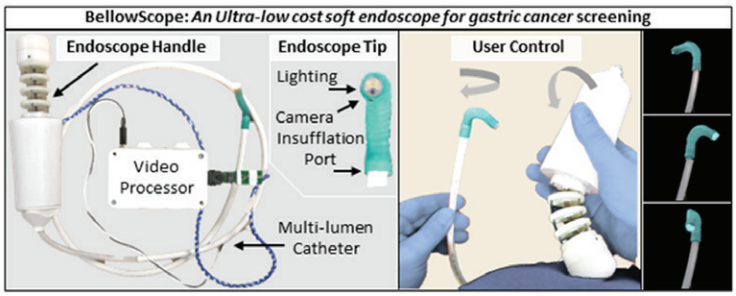
Hands-on Workshops

Workshop 4: Endoluminal Robotic Navigation and Endoscopy

(3 Parallel Sessions)

1. The BellowScope: a Low-cost Disposable Soft Endoscope for Upper Gastrointestinal Tract Screening

Prof. Pietro Valdastri
Chair in Robotics & Autonomous Systems,
School of Electronic and Electrical Engineering,
University of Leeds



The BellowScope

2. A POV Magnetically Guided Endoscope for Telesurgery

Prof. Shannon Chan
Department of Surgery, Faculty of Medicine,
The Chinese University of Hong Kong

Prof. Bradley Nelson
The Institute of Robotics
and Intelligent Systems,
ETH Zurich

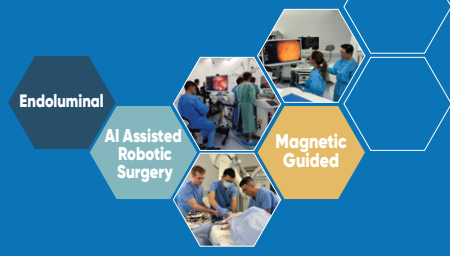
The Navion electroMagnetic Navigation System

3. Micron-precision Robot for Assisting Ophthalmic Surgeons

Prof. Kelvin Chong
Department of Ophthalmology
and Visual Sciences,
The Chinese University of Hong Kong

Prof. M. Ali Nasseri
Department of Robotics
and Embedded Systems,
Technical University of Munich

Oculotronics Robotic System



Speaker Abstracts

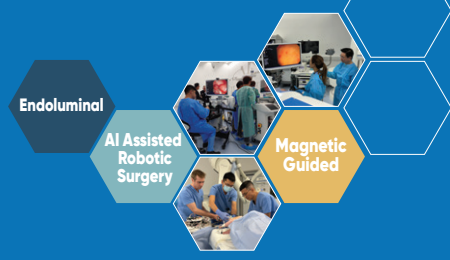
Keynote Presentation A 10th May 2024, 09:30–10:00

Prof. Mehmet Mahir Özmen
Faculty of Medicine, Istanbul Bahçeşehir University
Faculty of Medicine, Sapienza University of Rome

Cognitive Revolution in Surgery: AI, Robotic Surgery, Digital Surgery

The dramatic changes in surgery at the beginning of 20th century by introduction of anesthesia, asepsis-antisepsis, move forward with the invention of endoscopy, laparoscopy and minimal invasive surgery and new surgical devices like staplers, which all created the modern surgery. However, aproximately 30% of patients still suffer complications which could not be overcome.

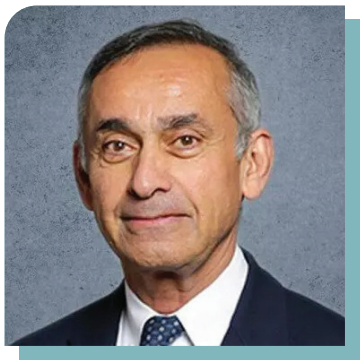
Recent progress in every areas of science related to artificial intelligence(AI) since beginning of the millenium has created the promises of revolution in cognition. Cognition is actually the action of knowing. Therefore, we can call these changes as cognitive revolution as there is a dramatic change in conditions of knowledge. Artificial intelligence has subfields like machine learning, natural language porcessing, artificial neural network-deep learning and computer vision. These distinct branches of AI play crucial roles in revolutionizing healthcare from predictive analytics and diagnostics to surgical precision and the interpretation of medical imaging. Their applications promise to significantly enhance patient care, diagnosis, and treatment, ultimately improving outcomes in healthcare settings. Robotic surgery in its current form is a form of AI surgery and a necessary step towards fully autonomous actions in surgery. AI has the potential to improve outcomes, doctor-patient relationships and job satisfaction for surgeons at all stages of surgical care. Surgeons should be aware of all those changes and be responsive to transformation.



Speaker Abstracts

Keynote Presentation B 10th May 2024, 10:00–10:30

Prof. Lord Ara Darzi
Faculty of Medicine
Imperial College London

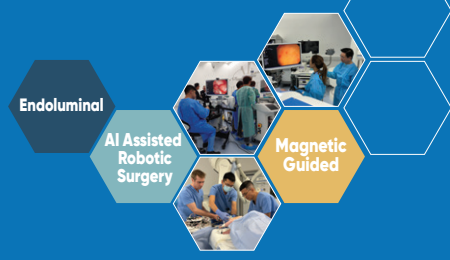


Adoption of Innovation in Medical Robotics

Lord Darzi is a pioneer in the field of medical robotics. Since he performed the first robotic surgery in the United Kingdom in 2000, Lord Darzi has been at the forefront of surgical innovation. His leadership has been instrumental translating surgical robotics from that first surgery to become today's standard of care across a multitude of surgeries. As co-director of the Hamlyn Centre at Imperial College London, Lord Darzi has built a boundary breaking hub whose innovations continue to shape the field.

Lord Darzi's extensive technical expertise in the field of surgical robotics is eclipsed only by his talent for driving the adoption of these technologies into the healthcare environment. In the United Kingdom, Lord Darzi has been a champion for innovation within the National Health Service, while his academic achievements have cemented his place a thought leader in the field. He has mobilised diverse professionals from patients to surgeons, and policy makers to industry experts, all toward driving the uptake of medical robotics innovation.

In his presentation, Lord Darzi will share of his extensive experience in the U.K. and beyond. He will present on how he broke through siloes of traditional academics to build an ecosystem that inspired innovation through cross disciplinary research. His presentation describes the importance of having the user at the heart of developing innovation. Additionally, he will share his expertise in orchestrating all the necessary stakeholders, including from the to ensure the uptake of proven innovations.



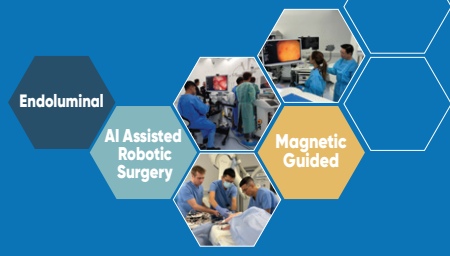
Speaker Abstracts

Invited Presentation 1 10th May 2024, 10:50–11:10

Prof. Pietro Valdastri
Chair in Robotics & Autonomous Systems
School of Electronic and Electrical Engineering
University of Leeds

Magnetic Surgical Robots: A "Fantastic Voyage" Deep Inside the Human Body

Magnetic fields offer the possibility of manipulating objects from a distance and are ideal for medical applications, as they penetrate human tissue without inflicting any harm on the patient. Magnetic fields can be harnessed to actuate surgical robots, enhancing the capabilities of surgeons in reaching deep into the human anatomy through complex winding pathways, thus providing minimally invasive access to organs that are out of reach with current technologies. In this talk, we will explore various robotic architectures based on magnetic control, specifically designed for lifesaving clinical applications. These architectures include a magnetic flexible endoscope for painless colonoscopy, soft magnetic tentacles personalized for reaching peripheral areas of the lung and navigating the pancreatic duct, magnetic vine robots for endoluminal exploration, and magnetic "fusilli" robots designed for collaborative bimanual tasks in a confined workspace. We will also discuss enabling technologies, intelligent control, potential levels of computer assistance, the path to first-in-human trials, and highlight the future challenges associated with this ongoing Fantastic Voyage.



Speaker Abstracts

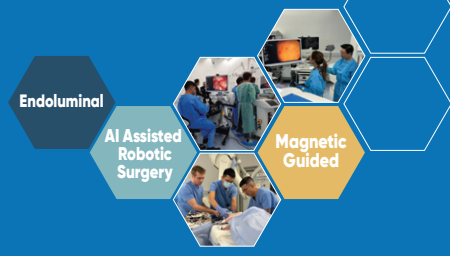
Invited Presentation 2 10th May 2024, 11:10–11:30

Prof. Iulian I. Iordachita
Research Professor
Whiting School of Engineering
Johns Hopkins University

Enabling Technology for Autonomous Robotic Retinal Surgery

At present there is no longer a question of whether artificial intelligence (AI) will revolutionize the practice of modern surgery. There are now numerous substantial advancements in practice that utilize AI for diagnosis, imaging, tool navigation, surgical instrument utilization as well as for interfacing with robotics. Artificial intelligence, and more specifically machine learning, are integrated into surgical robotic platforms for environment perception and understanding, real-time decision-making, and to increase precision, safety, and efficiency of the performed surgical tasks. Moreover, advanced machine learning techniques and algorithms can increase the level of robotic autonomy for even more complicated tasks notably when considering interactions with complex and dynamic surgical environments. AI-based autonomous surgical robots are the surgeons of the future. Vitreoretinal surgery, a type of intraocular microsurgery, may be the most technically challenging eye surgery, and deals with the surgical treatment of retinal and posterior segment diseases. Retinal surgery is performed by an ophthalmic surgeon using miniaturized instruments and an operative stereomicroscope, for fine and highly precise tasks. These minimally invasive procedures require staggering accuracy, precision, steadiness, and other specialized skills and capabilities, that typical humans are able to achieve only through extensive training. Following the trend in microsurgery, robotic assistance, enhanced by artificial intelligence and combined with advanced imaging has the potential to fundamentally change and advance the field of intraocular surgery and enable higher levels of autonomy in retinal surgery.

Generally, surgical robotics are able to use artificial intelligence techniques for: (1) perception, (2) localization and mapping, (3) system modelling and control, and (4) human-robot interaction. Considering the overlap between intraoperative guidance and robot localization and mapping, the most relevant benefits of AI in autonomous intraocular robotic microsurgery are perception and system modelling and control. This talk will reveal the last developments concerning the AI-based technology for safe autonomous robotic assistance in retinal microsurgery.



Speaker Abstracts

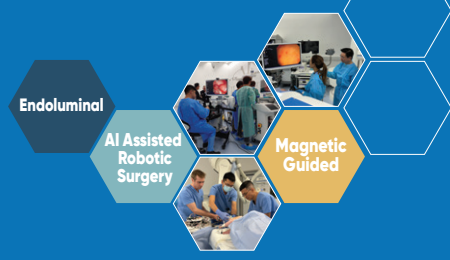
Keynote Presentation C 10th May 2024, 14:30–15:10

Prof. Bradley Nelson
The Institute of Robotics and Intelligent Systems
ETH Zurich

Remote Magnetic Navigation for Precision Telesurgery

An inherent advantage of remote magnetic navigation (RMN) is that the approach effectively addresses the non-collocation problem for many medical robotics procedures that use flexible devices, such as catheters, guidewires, and endoscopes. Collocated control means that the sensors and actuators, essential components of any control system, are located near one another. For many endoluminal devices this is impossible with the traditional approach in which the distal end is observed using, for example, fluoroscopy but is controlled from the proximal end by a surgeon pushing, pulling, and twisting the device. The sensing and actuation can be located over a meter from each other with a long, flexible catheter serving as a transmission between the actuation and the endpoint where the task is being performed. This represents a classic non-collocation problem, and control theorists are well familiar with the challenges this presents. RMN addresses this by collocating the sensed distal end with torques that are applied directly to this end with magnetic fields.

While addressing the non-collocation problem with RMN makes it easier to control endoluminal devices for surgeons in the operating room, a less recognized but perhaps more important advantage is that it creates an opportunity for improving teleoperator control during telesurgery. By simply looking at the x-ray image of the in vivo device, or observing the visual image from an endoscope, the surgeon can directly control device motion without having to account for the difficult-to-model flexibility of the entire catheter, guidewire, or endoscope. This provides the surgeon with a more intuitive and effective control of the device so that the working end of the device can be guided to the location of interest, such as a blood flow blocking thrombi or an aneurysm to be treated with an endoluminal approach. Endoscopes can also be intuitively controlled using a point-of-view (POV) approach. I will discuss our recent work in using remote magnetic navigation to guide devices for performing remote mechanical thrombectomies to treat ischemic stroke and intracoronary thrombi as well as treatment of twin-to-twin transfusion syndrome.



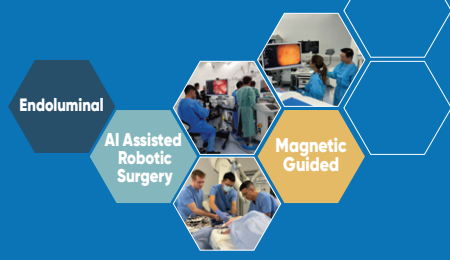
Speaker Abstracts

Invited Presentation 3 10th May 2024, 15:10–15:35

Prof. Ferdinando Rodriguez y Baena
Hamlyn Centre Engineering Co-director
Imperial College London

The Hamlyn Centre for Robotic Surgery: Overview and MIM Lab Developments

The lecture will offer an overview of the field. It will start with the Hamlyn Centre's role in medical robotics, highlighting key structures and projects. The narrative will then move to the Mechatronics in Medicine Laboratory, discussing its contributions to surgical and diagnostic robotics. Past and present experiences in these areas are examined to showcase the development and application of these technologies. The lecture will also touch on current trends and future outlooks in medical robotics, emphasising the ongoing research and potential advancements at both the Hamlyn Centre and the Mechatronics in Medicine Laboratory.



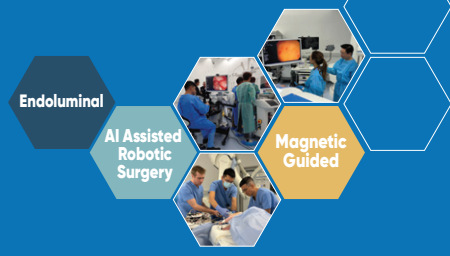
Speaker Abstracts

Invited Presentation 4 10th May 2024, 16:00–16:25

Prof. Sophia Bano
Assistant Professor in Robotics and AI
Department of Computer Science
University College London

The Future of Surgery: AI-assisted Interventions

Recent trends in Artificial Intelligence (AI) and Surgical Data Science have revolutionized the field of surgery, paving the way for a new era of AI-assisted robotic interventions. These cutting-edge technologies offer tremendous potential to enhance imaging, surgical navigation, and robotic interventions, ultimately reducing cognitive load on surgeons and optimizing procedural efficiency, hence leading to improved surgical outcomes. This talk will highlight our team's developments towards context awareness and machine consciousness in different surgical procedures and where we stand in terms of their clinical translation for moving towards a future of AI-assisted surgical intervention.



Speaker Abstracts

Invited Presentation 5 10th May 2024, 17:00–17:25

Prof. Dong-Soo Kwon
Department of Mechanical Engineering
Korea Advanced Institute of Science and Technology (KAIST)

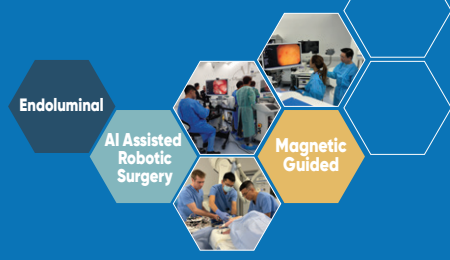
Robotic RIRS with Zamenix

The successful clinical adaptation of the da Vinci system in laparoscopic surgeries demonstrated the benefits of robotic assistance such as precise and dexterous instrument motion and intuitive and ergonomic manipulation. The trend of surgery from open surgery to minimally invasive surgery (multi-port, single port, single site), and to non-invasive surgery is being accelerated by several innovative surgical robots. In particular, the non-invasive endoluminal surgery has been highlighted with flexible endoscopic surgery robots. We have been researching several technical issues of flexible endoscopic surgery robots to reach the surgical site via narrow and tortuous pathways and conduct the surgery.

This talk presents how "ZAMENIX" has been developed and commercialized; the endoluminal non-invasive surgery robot for kidney stone treatment. ZAMENIX is for ureter and renal stone removal that is capable of teleoperation of a flexible ureteroscope, a laser fiber, and a stone basket. The surgeon can select whether laser dusting or stone retrieval technique depending on the surgical condition or preference. The system can equip commercial flexible ureteroscopes. The system provides intuitive and comfortable remote manipulation of the ureteroscope and instruments by a single operator without wearing an X-ray protection lead gown. Moreover, the system provides assistive functions for enhanced surgical efficiency and safety. One is an automation capability that can record and replay the ureteroscope motion, making the repetitive task of stone retrieval easy and efficient. Another is the detection of oversized stone retrieval to prevent ureteral injury. The other is the respiratory motion compensation which allows precise positioning of the laser while the kidney of the patient is moving by breathing. A first-in-human trial for approval by the Korean Ministry of Food and Drug Safety has finished with a favorable stone-free rate and without any major complications. Further validation is being concentrated to ascertain how much this robotic assistance improves patient treatment outcomes.

For the commercialization of medical devices, we experienced many challenges such as approval of GMP, and ISO13485, and the product had to go through mechanical/electrical safety tests, electromagnetic compatibility, and biological safety assessments. All development and manufacturing information must be documented to be traceable. Another challenge is we had to acquire the funds to support the organization, R&D, clinical trials, production, and sales. The ultimate challenge was to acquire the reimbursement code from the NECA (National Evidence-based Healthcare Collaborating Agency, Korea)

Even though the business development of medical devices is very challenging, takes various specialties, and requires enormous financial support and time, the author believes it is worthwhile to try as a medical robot researcher.



Speaker Abstracts

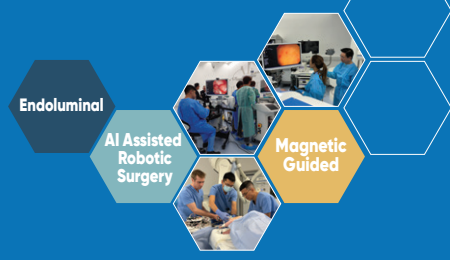
Keynote Presentation D 11th May 2024, 09:30–10:10

Prof. Russell H. Taylor

John C. Malone Professor of Computer Science With Joint Appointments
In Mechanical Engineering, Radiology, Surgery, And
Otolaryngology Head-and-neck Surgery
Department of Computer Science
Johns Hopkins University

Autonomy and Semi-Autonomous Behavior in Surgical Robot Systems

This talk will discuss an emerging three-way partnership between physicians, technology, and information to improve treatment processes. Computer-integrated interventional medicine (CIIM) systems combine innovative algorithms, robotic devices, imaging systems, sensors, and human-machine interfaces to work cooperatively with surgeons in the planning and execution of surgery and other interventional procedures. Two crucial issues in managing this partnership are 1) how can the human physician specify what the robot is to do and 2) how can the computer controlling the robot ensure that the robot performs the specified task correctly and safely. This talk will discuss several common paradigms for approaching these questions and will illustrate the approaches with examples drawn from our past and current work.



Speaker Abstracts

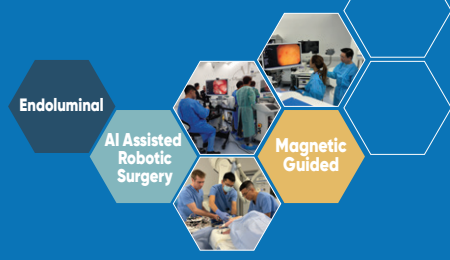
Invited Presentation 6 11th May 2024, 10:10–10:35

Dr. Jason Fleming
Associate Professor
Institute of Systems
Molecular and Integrative Biology
University of Liverpool

Evaluation of a Novel Robotic Platform for Transoral Surgery (TORS)

Traditional surgical approaches to the oropharynx mandated open surgery, with significant morbidity due to the extent of tissue damage required for access. The advent of minimally invasive techniques, most notably with transoral robotic surgery [TORS], has brought renewed interest in primary surgical treatment for cancers of the upper aerodigestive tract to optimise long term function. TORS is used to excise lesions of the head and neck through the mouth, benefitting from high-definition optics, hand tremor removal, and over 360o range of motion to access tight anatomical spaces of the upper aerodigestive tract. It can also achieve excellent rates of oncologic control in patients, without the need for adjuvant treatment in early-stage disease, or as part of a de-escalation treatment strategy through late phase clinical trials. Index procedures in oropharyngeal surgery include diagnostic tongue base mucosectomy, and ablative tongue base resection, lateral oropharyngectomy and partial supraglottic laryngectomy.

CMR Surgical has developed a Robotically-Assisted Surgical Device to aid surgeons in performing minimal access surgery: the Versius® Surgical System. It has been designed to address some of the unmet needs currently faced by the surgical community, for example, dexterity and precision of movements, with fully wristed 5mm instruments and an ergonomic console. With an open console design, and ease of mobility between operating theatres, the device offers novel features to the market and has been used across specialties, amassing over 20,000 procedures globally to date. We will present our novel experiences of Versius® for use in TORS from our tertiary centre case series, that have resulted in the recent opening of a world first Phase II trial.



Speaker Abstracts

Invited Presentation 7 11th May 2024, 10:35–11:00

Dr. Henry Ho
Division Chairman & Senior Consultant
Division of Surgery & Surgical Oncology
Singapore General Hospital

Bringing Engineering to Patients: It is Possible

Pending

Speaker Abstracts

Invited Presentation 8 11th May 2024, 11:30–11:55

Prof. Jim Khan
University of Portsmouth

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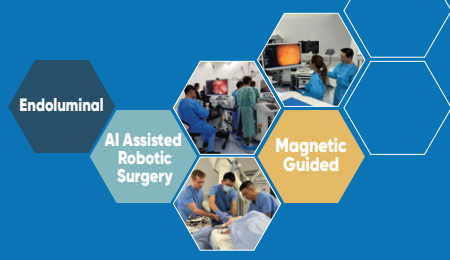


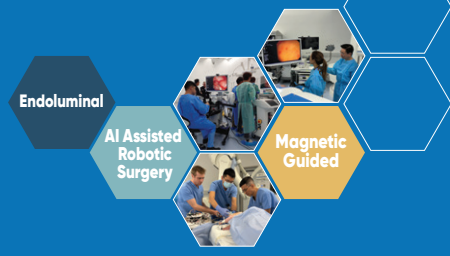
Speaker Abstracts

Invited Presentation 9 11th May 2024, 11:55–12:20

Dr. Wayne Huang
Director
Academy of Circular Economy
National Chung Hsing University

Surgical Education and Innovation, 16 Years of Ircad Taiwan Experience

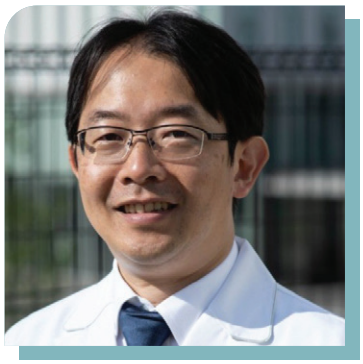
As technology advances at an accelerated rate, the way surgery is performed is also undergoing revolution. Combining robotics, AI, IoT, ,AR, MR, into the operating room will become more common place, as the dream of automated surgery is pursued. IRCAD has been training surgeons worldwide since 1994, and has now become the largest network of training centers globally. As an aggregate of teachers, students, and medical device companies, IRCAD is becoming an ideal platform where not only new technology is developed, but also the marketing and education of surgeons is taking place. IRCAD-Taiwan has also partnered with local IT companies, venture funds, MedTech accelerators, in an effort to cultivate the ecosystem where MedTech startups can succeed.



Speaker Abstracts

Invited Presentation 10 11th May 2024, 12:20–12:45

Prof. Koichi Suda
Professor & Head
Department of Surgery
Fujita Health University



Our Experiences in Clinical Implementation of the Newly Launched Surgical Robots

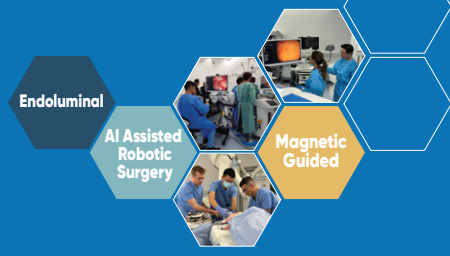
Background: We have demonstrated that active use of the surgical robot based on the appropriate surgical theory may help reduce morbidity and even improve prognosis following minimally invasive radical gastrectomy for gastric cancer.

Methods: Setups for newly launched surgical robots, including hinotori™ Surgical Robot System (Medicaroid), Hugo™ RAS System (Medtronic), and da Vinci SP Surgical System (Intuitive Surgical), were determined based on our original da Vinci's plane theory and monitor quadrisection theory. The operating surgeon conducted outermost-layer oriented lymph node dissection using the double-bipolar method, with the aid of LigaSure™ Maryland Jaw Sealer (44cm, Medtronic) and DS Titanium Ligation-Clips (B BRAUN AESCULAP) given by the assistant surgeon, regardless of the type of robot used.

Results: Twenty-four, 6, and 10 patients with gastric cancer underwent robotic gastrectomy (RG) with hinotori™, Hugo™, and SP, respectively. All but one patient underwent distal gastrectomy (DG). No patient had postoperative complications of Clavien–Dindo classification IIIa or higher. No intraoperative adverse events were observed. All patients received R0 resection. The median operative time, console time, blood loss, and the number of dissected lymph nodes in hinotori™-RG were 400 min, 305 min, 14.5mL, and 51.5, respectively. The median operative time, console time, blood loss, and the number of dissected lymph nodes in Hugo™-DG were 382.5 min, 236 min, 47 mL, and 57.5, respectively. The median operative time, console time, blood loss, and the number of dissected lymph nodes in SP-DG were 313 min, 243 min, 10 mL, and 65, respectively.

Conclusions: This study found that RG with the outermost layer-oriented lymphadenectomy for gastric cancer using hinotori™, Hugo™, and SP can be safely performed based on the same concepts for surgical robot setup and dissection technique as we have developed in RG using da Vinci S, Si, and Xi.

Key words: Minimally invasive surgical procedures, Robotic surgical procedure, Stomach neoplasms



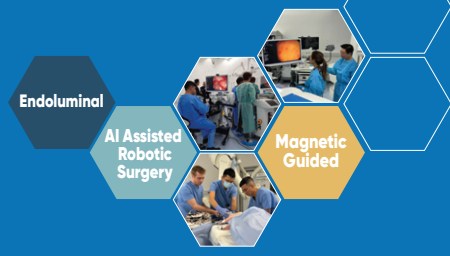
Speaker Abstracts

Invited Presentation 11 11th May 2024, 14:20–14:45

Prof. Hongsoo Choi
Professor
Department of Robotics and Mechatronics Engineering
Daegu Gyeongbuk Institute of Science & Technology (DGIST)

Electromagnetic Controllable Micro/Nanorobots to Improve Cell Therapy

Medical micro/nanorobots are tiny robots, often smaller than a millimeter, designed to perform specific tasks in the field of medicine. Integrating electromagnetic systems with medical micro/nanorobots could bring a new era of healthcare characterized by unparalleled precision and innovative control methods. The discussion will cover magnetically actuated untethered micro/nanorobots, highlighting their ability to achieve selective neurite alignment, establish neuronal connections, and perform in vitro/ex vivo/in vivo cell delivery, underscoring their potential applications in translational research. For example, a magnetic neurospheroid microrobot (Mag-Neurobot), which integrates primary neuronal cells with superparamagnetic iron oxide nanoparticles (SPIONs), demonstrates both morphological and functional neural connections, paving the way for artificial neural networks. The presentation will conclude with a brief introduction to a machine learning approach in a virtual reality environment for the adaptable control of microrobots, offering a novel control methodology. These advancements suggest promising new directions for minimally invasive medical technologies, including enhanced cell therapy, next-generation cancer treatments, and beyond.



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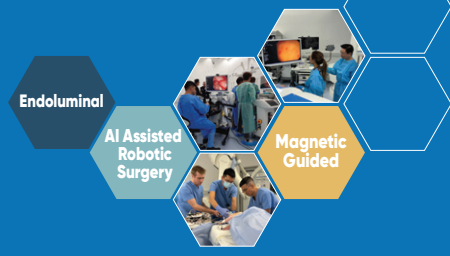

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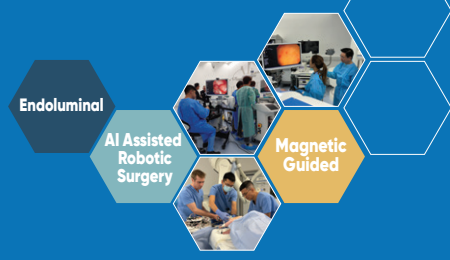

Acknowledgement

The Organizing Committee would like to extend their sincere thanks to the following Sponsor for unfailing support and generous contribution towards the success of the Multi-Scale Medical Robotics Center (MRC) Symposium 2024.

Exhibitor

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