Institution of MECHANICAL ENGINEERS

Proceedings of The Institution of Mechanical Engineers, Part I: Journal of Systems & Control Engineering

Call for Papers

SPECIAL ISSUE ON:

AI & Robotics in Healthcare: The Future of Robots in Medicine

Medical robots can reduce the invasiveness of medical procedures, accelerate recovery, and raise the quality of life for patients. Robust robotic control and positioning can increase the accuracy and precision of medical procedures to improve diagnosis and treatment outcomes.

Since the first successful application of Arthrobot in orthopedic surgery in 1983, the field of medical robotics has seen explosive growth. In particular, the introduction of the da Vinci system in 2000 triggered the wide adoption of robotics in routine clinical care. Medical robots are ubiquitous in hospitals today and are part of the standard of care in many procedures. They have also provided benefits amidst the COVID-19 pandemic. During the peak of the pandemic, using remotely controlled surgical robots when possible was advantageous because it allowed surgeons to maintain a safe distance from patients.

Currently, numerous advances in medical technologies are being made thanks to breakthroughs in AI, robotics, sensing, and imaging. However, many of these advances have yet to be implemented in clinical practice. One of the major challenges to gaining clinical approval for robotics is designing suitable control systems. There is no one-size-fits-all solution for controlling medical robots because their designs and requirements vary so widely. One control challenge common to most medical robots is the need for extremely high precision, accuracy, and reproducibility. Another is the need for proper safety measures in case of system failures. Furthermore, control systems are critical for ensuring smooth human–computer interactions between clinician and robot, such as by accurately translating the clinician's input into the robot's output and compensating for communication delay. Soft, smart, and high-dimensional robots are becoming more and more popular, and these designs bring additional complexity to control systems.

The goal of this special issue is to highlight major recent advancements in systems and control, AI, sensing, imaging, and advanced software and hardware designs for medical robotics. In this issue, we will highlight innovations in systems and control, including control strategies, system architecture, and integrated frameworks encompassing the design, analysis, and control of medical robots. Papers relevant to the call might introduce novel control methods, AI algorithms, or software and hardware that enable autonomy, collaborative trajectory planning between robot and surgeon, endoscopic navigation, haptics, or minimally invasive surgical techniques, to name a few examples. Additionally, we will feature translational work from bench to bedside and from code to clinic. Papers of interest will address unmet clinical needs, facilitate the path to clinical adoption (such as by addressing the integration of AI and medical robotics with streamlined clinical workflows or putting forth safety measures), or demonstrate successful clinical adoption. Furthermore, we will consider up-to-date reviews on surgical robotics in this special issue.

TOPICS OF INTEREST

Topics include (but are not limited to):

- MRI, CT, cone beam CT, ultrasound, and PET guided robotic systems and devices;
- Robot-assisted needle and catheter steering;
- Robotic endoscope and its medical image processing;
- Medical soft robotics;
- Steering of continuum-style robots for minimally-invasive surgery;
- Artificial intelligence and machine learning applications in image-guided therapies and image-based diagnosis;
- Image processing for needle and tissue visualization;
- Augmented reality, mixed reality, haptics, and smartphone applications in image-guided therapies and image-based diagnosis;
- Actuators and sensors for needle and catheter deflection;
- Design of workflow, control, sensors, actuators, and materials for specific clinical applications;
- Path planning and feedback control for needle and catheter steering;
- Needle modeling, tissue modeling, and needle-tissue interaction modeling;
- Modeling, design, and fabrication of steerable needles;
- Clinical translation issues;
- Adaptive control, co-operative control, and robot control;
- Intelligent systems modeling;
- Micro robots and micro-manipulation;
- Visual servoing;
- Robot sensing and data fusion;
- Localization, navigation, and mapping;
- Human centered systems;
- Dexterous manipulation;
- Regulatory issues on machine learning and artificial intelligence as medical devices

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IMPORTANT DATES

November 31, 2022: Submission deadline
March 31, 2023: Notification of the first-round review
June 30, 2023: Revised submission due
July 15, 2023: Final notification of acceptance/rejection
August 31, 2023: Publication date

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