ROB-GY 6423: Interactive Medical Robotics
NYU Tandon, Spring 2021

Description: The topic of medical robotics has attracted a great deal of interest during the last decade. Several major medical and non-medical companies (e.g., Google, Philips, J&J, Medtronics, Stryker, Intuitive Surgical) have invested significantly in this area as it has shown great potential to revolutionize diagnosis and treatment, and eventually the quality of healthcare services. The course is transdisciplinary and provided students with specific training to augment their knowledge related to existing medical robotic technologies (in particular, various modalities of surgical robotics and rehabilitation robotics) besides haptics, control, and signal/data processing. This course is designed to train engineers and allowing them to enhance their theoretical and technological knowledge to address the unified transdisciplinary problem. In this course, we will investigate the application, functionality, and theoretical aspects of the state-of-the-art computerized interactive medical robotic technologies. Technological aspects, such as functionality, instrumentation, actuation, mechanisms, will be introduced. Also, theoretical aspects related to control, dynamics, kinematics, haptics, stability, transparency, passivity, human-robot interaction, teleoperation, and bio-signal processing will be discussed in the context of medical robotic systems. Students will also learn how to simulate telerobotic systems in MATLAB-SIMULINK. This course provides students (mainly EE, CE, ECE, MAE, and BME) with an opportunity to learn about an advanced core area of robotics while augmenting, connecting, and mobilizing their knowledge of robotics toward a transdisciplinary area, i.e., Computer-Assisted Medical Intervention (CAMI).

Topics Covered:

1) Telerobotic-assisted Minimally Invasive Surgery	2) Grounded Assistive Robotic Surgery
3) Hand-held Robotic Surgery	4) Capsular Robotic Surgery
5) Rehabilitation and Telerehabilitation Robotics	6) Robotic Prostheses and Human-Machine Interfacing
7) Adaptive Tremor Compensation in Medical Robotics	8) Dynamics and Inverse Dynamics of Robotics Systems
9) Impedance Control in Human-Robot Interaction (HRI)	10) Telerobotic Architectures (2channel, 3channel,4channel)
11) Internet-based Telerobotic (delay, jitter, packet loss)	12) Transparency versus Stability in HRI
13) Passivity and Lyapunov Stability in Medical Robotics	14) Wave Variables Transformation in Medical Robotics
15) Intelligent Time-domain Passivity Control (I-TDPC)	16) Excess of Passivity in Human Biomechanics
17) Variable Structure Predictive Passivity Control for HRI	18) Simulation tools in MATLAB for Robotics and Haptics
19) Patent Reading	20) Research Paper Review

Schedule
Class: Wednesdays 2:00pm to 4:30pm

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