

Course Number: 28905
Course Name: Robotic Surgery

Course Type: Theory
Prerequisite: Nothing
Level: Graduate
Group: Applied mechanics

Type & Max Unit: Constant 3
Corequisite: Nothing.
First Presentation: 2011-2
Last Edition: 2016-2.

Objectives:

The course presents an overview of the field of surgery robotic. For this purpose, a short review on the history of the field is presented and the development of different paradigms of the robotic surgery is discussed. The applications of different branches of robotic science in the surgery are introduced including design and analysis of mechanisms, kinematics, dynamics, control and Navigation.

Topics:

1. Basics of medical robotics
What, why, pros and cons, examples (miniature surgery, MIS, image-based, navigation), categories, CIS, main concepts: registration, MIS, telerobotic, preoperative planning
Acceptance factors, safety, sterility
2. Paradigms of medical robotics
Process, assistance, support tools, auxiliary tools, examples
3. Robotics at a glimpse
Kinematics of a rigid body/multibody, forward and inverse kinematics, dynamics, motion planning, control
4. Remote Center of motion in minimally invasive surgery (MIS)
What's RCM, How to obtain, mechanical or control based, case study – design optimization, case study – control based RCM
5. Navigation
Computer-integrated-surgery, Imaging, Registration, Navigation techniques
6. Port placement in MIS
The port placement problem, approaches, case study – object removal
7. Collision detection and untangling for MIS robots
Prediction methods, prevention methods
8. Dynamics
Concept, methods of modeling, details on Lagrange method, Examples
9. Trajectory generation
Joint space vs. Cartesian space motion planning, path planning, path parameterization, trajectory planning
10. Haptic teleoperation:
Linear control, control architectures, two port networks, stability and transparency,

References:

1. Medical Robotics and Computer-Integrated Surgery, Russell H. Taylor, Arianna Menciassi, Gabor Fichtinger and Paolo Dario, SpringerLink, 2008
2. Springer Handbook of Robotics by Bruno Siciliano and Oussama Khatib, 2008
3. Haptics For Teleoperated Surgical Robotic Systems (New Frontiers in Robotics) by M. Tavakoli, 2008
4. Introduction to Robotics: Mechanics and Control (3rd Edition) by John J. Craig, 2004

5. Taylor, R.H.; Stoianovici, D;., "Medical robotics in computer-integrated surgery", IEEE Transactions on Robotics and Automation, Vol. 19, No. 5, 2004