PKU Globex Julmester®

Compliant Robotics: Humanoids to Soft Robots (3 Credits)

柔性化机器人：从类人到软体

Instructor	**Hongbin LIU**, Centre for Robotics Research, Department of Informatics King's College London, UK (Hongbin.liu@kcl.ac.uk)
Synopsis	Traditional industrial robots have been designed to be as rigid as possible to ensure good motion precision; however, because of the massive rigidity, it can make them dangerous when operating in close proximity with humans. Further, as robots expand their domain into healthcare and home service, the issues of safety, adaptability and energy efficiency become a primary concern. To address these challenges, scientists are developing a new generation of compliant robots by adopting flexible and soft materials in their construction. This course aims to provide students with an essential knowledge for compliant robotic modeling, perception, interactive control and path planning. The topics covered include compliant robotic systems such as robot hands with compliant fingers and soft fingertips, flexible snake robot and soft octopus robot. This course involves a hands-on coding exercise to facilitate the implementation of algorithms for solving real-world problems.
Offering	2018 July Semester (Julmester)
Audience	Year 3 & 4 Undergraduate and Graduate Students
Classroom	Room TBA, Teaching Bldg. No. TBA, Peking University
Schedule	Class: 8-11 AM, M-F, July 2–20, 2018 | Final Exam: 8-11 AM, Sat, July 21, 2018 | Total Contact Hours: 45

Objectives

- Introduction of the state of the art robotic technology from humanoids to soft and flexible robots
- Understand and develop kinematic and mechanical models for robotic systems
- Understand and implement different methods for estimating and control the robot position and the interaction force
- Understand and implement probabilistic robot perception and path planning

Topics

Modeling of Different Robot Systems

- Rigid-link robot models
- Forward/Inverse Kinematics
- Continuum/flexible robot model
- Mechanics for continuum robots

Robot Controls

- Position control
- Redundancy control
- Force / Impedance control
- Real-time path planning with potential field

Probabilistic Robot perception

- Kalman filtering
- Bayesian filtering

Project 3 project assignments that include a final team project presentation

Text Course Notes – will be provided by the instructor

References

- Sebastian Thrun, Wolfram Burgard, Dieter Fox, *Probabilistic Robotics*, The MIT Press, 2005.
- Bruno Siciliano, Lorenzo Sciavicco, Luigi Villani, Giuseppe Oriolo, *Robotics: Modelling, Planning and Control,* Springer-Verlag London, 2009.

Grading

2 Individual Projects @ 15% each	30%
1 Final Teamwork Project (Team Presentation)	30%
Final Exam	40%
Total	**100%**