


ROBOTICS AND CONTROL: THEORY AND PRACTICE

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PRE-REQUISITES : Basic Mathematics

INTENDED AUDIENCE : Electrical Engineering, Computer Science Engineering, Mechanical Engineering,Electronics and Communication Engineering, Mathematics students

COURSE OUTLINE :

Robotics has stimulated an growing interest among a wide range of scholars, researchers and students due to its interdisciplinary characteristics. The development of this field of science is boosted by various domains which are not limited to Cybernetics, Controls, Computers, Mechanics, Bio-Engineering, and Electronics. Among these areas, modelling, control, planning play a fundamental role not only in the growth of industrial robotics, but also towards the advanced fields including healthcare and field robotics.

Through this course the participants will acquire the ability to conduct research, develop innovative designs in the field of systems engineering and control of robots and to direct the development of engineering solutions in new or unfamiliar environments by linking creativity, innovation and transfer of technology.

ABOUT INSTRUCTOR :

Prof. N. Sukavanam received his Ph. D from the Indian Institute of Science, Bangalore in 1985. He served as a Scientist-B at Naval Science and Technological Laboratory, DRDO for two years (1984-86). Then joined as a Research Scientist in the Department of Mathematics, IIT Bombay (1987-90). Worked as a Lecturer at BITS Pilani from 1990 to 1996. Currently he is a Professor in the Department of Mathematics IIT Roorkee and heads the department.

Prof. M. Felix Orlando received his Ph.D. from Electrical Engineering Department at Indian Institute of Technology Kanpur (IITK) in 2013. In 2015, he completed his post doctoral fellowship at Case Western Reserve University, USA on Medical robotics. Dr. Felix Orlando has been working as an Assistant Professor in the Department of Electrical Engineering at the Indian Institute of Technology Roorkee (IITR) from November 2015 onwards.

COURSE PLAN :

Week 1: Simple manipulators: Two /three arm manipulators and their kinematics equations, Work space Homogeneous Transformation: Rotation, Translation, Composition of homogeneous transformations
Week 2: Danavit-Hartimber Algorithm: D-H procedure for fixing joint coordinate frames, Robot parameters, Arm matrix, Inverse Kinematics for PUMA, SCARA manipulators.

Week 3: Introduction to Robotic Exoskeletons ,Optimal Design of a Three Finger Exoskeleton for Rehabilitation Purpose

Week 4: Differential transformation and velocity of a frame: Derivative of a frame, Velocity, Jacobian, Inverse Jacobian,Trajectory Planning: Polynomial trajectory, Biped trajectory

Week 5: Dynamics: Lagrangian method, Robot dynamics equation,Control: Robot dynamics equation as a control system, Trajectory tracking control, PD controller, Neural network control design

Week 6: Redundancy Resolution of Human Fingers using Robotic Principles ,Manipulability Analysis of Human Fingers during Coordinated Object Rotation ,Kinematics of Flexible Link Robots

Week 7: Robot Assisted Needling System for Percutaneous Intervention-An Introduction ,Smart Robotic Needles for Percutaneous Cancerous Interventions

Week 8: Robust Force Control of a Two Finger Exoskeleton during Grasping ,Neural Control of an Index Finger Exoskeleton