ROBOT MOTION PLANNING

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TYPE OF COURSE : New | Elective | UG/PG
COURSE DURATION : 8 weeks (21 Feb' 22 - 15 Apr' 22)
EXAM DATE : April 24, 2022

PRE-REQUISITES : Basic Mathematics : matrices, differential equations

INTENDED AUDIENCE : Students (UG 3 rd /4 th year in Mechanical/Electrical/Computer Science/Aerospace engineering), Teachers of engineering colleges, Industry professorial

INDUSTRIES APPLICABLE TO : All Manufacturing and automation companies (TATA motors, Mahindra, Maruti, Hyundai, GE, GM, etc), IT companies (TCS, Infosys, etc), Amazon, Flipcart, process industries using robotics, aerospace, etc.

COURSE OUTLINE :
The course is intended as a first level introduction to robot motion planning for students, teachers and industry personal. Historically, robot motion planning deals with the design of algorithms that can find collision free paths (if they exist) to take a robot from an initial point to a goal point. Due to recent interests in developing autonomous robotic systems, the subject has become extremely broad and covers not only the traditional areas of finding collision free paths, but automatic assembly, warehouse automation, multi robot cooperation, robotic surgery, etc. The course would cover the fundamental concepts and mathematics required to understand, analyze, and design algorithms required for motion planning of serial robotic arms and mobile robots. After taking this course, students could then take more advanced courses/topics in focused areas like, AI in Motion Planning, unmanned vehicles, probabilistic motion planning, etc. Teachers could use this course to lay the foundation of other courses involving mobile robots like, manufacturing automation, AI, Computer vision applications, etc.

ABOUT INSTRUCTOR :
Prof. Ashish Dutta obtained his PhD in Systems Engineering from Akita University, Japan, M.Tech from Jadavpur University and B.Tech from NIT Calicut. From 1994 to 2000 he was with the Bhabha Atomic Research Center, Mumbai where he worked on telemanipulator design and control for nuclear applications. Since 2002 he is with the department of mechanical engineering at IIT Kanpur, India. He was also a visiting professor in Nagoya University, Japan in 2006 and is currently a visiting professor at Kyushu Institute of Technology, Japan (2015 -). His research interests are in the areas of humanoid robotics, motion planning in 3D, intelligent control systems and rehabilitation engineering. Prof. Dutta has also served as advisory board member of ISRO Chandrayan II Lunar mission (2009), member of Task force on AI of the Ministry of Commerce and Industry (2017), Secretary of The obotics Society of India (2011-2017), member Bureau of Indian Standards (Robotics Section), Chairman India-South Korea robotics working group (2013-) , Chairman IEEE Robotics and Automation section (UP, UK section), etc.

COURSE PLAN :

Week 1**:** Introduction to Robot Motion Planning, Basics of Serial robotic arms and Mobile robots, Transformations

Week 2**:** Earliest Bug Algorithms, Configuration Space, Manifold, Topology of Configuration Space

Week 3**:** C-Space Obstacles, C-Space for mobile robots

Week 4**:** C- Space for Serial robotic arms

Week 5**:** Road Map methods, Cell decomposition methods, sampling based methods

Week 6**:** Potential field based methods, wave front planners.

Week 7**:** Non-holonomic systems and planning with kinematic constraints.

Week 8**:** Motion planning for Multi robotic systems, motion planning in 3D.