PCAC2013 ROBOTICS : MOBILITY & DESIGN (3-0-0)

OVERALL COURSE OBJECTIVES: To develop a comprehensive understanding of robotic mobility and perception, by learning to design efficient robotic bodies, implementing concepts of kinematics and dynamics, developing sensorimotor programs, and utilizing visual and sensory information for manipulation and navigation tasks.

LEARNING OUTCOMES: On successful completion of the course the students shall be able to:

1. Understand how to design robotic bodies and behaviors for efficient and reliable mobility in a dynamic world.
2. Apply the concept of kinematics and dynamics in designing legged machines and robots.
3. Develop sensorimotor programs through simple dynamical abstractions.
4. Comprehend the transformation process of images and videos into 2D representations for efficient grasping and navigation.
5. Identify the calculation of 3D posing of objects to facilitate manipulation tasks.
6. Comprehend visual odometry and landmark-based localization for effective navigation.

COURSE CONTENT:

Module 1: Robotics: Mobility [19 Hours]

How can robots use their motors and sensors to move around in an unstructured environment? You will understand how to design robot bodies and behaviors that recruit limbs and more general appendages to apply physical forces that confer reliable mobility in a complex and dynamic world. We develop an approach to composing simple dynamical abstractions that partially automate the generation of complicated sensorimotor programs. Specific topics that will be covered include: mobility in animals and robots, kinematics and dynamics of legged machines, and design of dynamical behavior via energy landscapes.

Sub-Topics
Anchors: Embodied Behaviors
Behavioral (Templates) & Physical (Bodies)
Composition (Programming Work)

Formative Assessments:
23 quizzes

Module 2: Robotics: Perception [33 Hours]

How can robots perceive the world and their own movements so that they accomplish navigation and manipulation tasks? In this module, we will study how images and videos acquired by cameras mounted on robots are transformed into representations like features and optical flow. Such 2D representations allow us then to extract 3D information about where the camera is and in which direction the robot moves. You will come to understand how grasping objects is facilitated by the

computation of 3D posing of objects and navigation can be accomplished by visual odometry and landmark-based localization.

Sub-Topics
Geometry of Image Formation
Glimpse on Vanishing Points
Rotations and Translations
Multi-View Geometry
Pose Estimation
RANSAC: Random Sample Consensus
Projective Transformations

Formative Assessments:
20 quizzes and 4 coding/lab assignments.

ASSESSMENT:

For summative assessments, Coursera will provide question banks for which exams can be conducted on the Coursera platform or the faculty will create their own assessments.

Note: If a Course or Specialization becomes unavailable prior to the end of the Term, Coursera may replace such Course or Specialization with a reasonable alternative Course or Specialization.