Introduction to Robotics Simulation with PyBullet

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- Robots are programmable machines capable of carrying out tasks autonomously or semi-autonomously.
- Robotics integrates mechanical engineering, electrical engineering, computer science, and control systems.
- The goal of robotics is to assist, automate, and perform tasks that are difficult, dangerous, or repetitive for humans.

Course Outline

- Introduction to Robotics and Simulation

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- Getting Started with PyBullet

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- Environment Interaction and Collision Detection
- Reinforcement Learning with PyBullet
- Capstone Project: Build and Simulate a Robotic System

Simple PyBullet Simulation

Steps to Create Simulation

- **Import libraries:**

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- **Load the ground plane:**

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p.loadURDF("plane.urdf")
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- A URDF file is an XML file that describes the robot's physical structure.
- It is widely used in robotics simulators like PyBullet, ROS, and Gazebo.
- It provides a complete description of the robot for visualization and physics simulation.

Key Components of a URDF File

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- Joints: Define the movable connections between links.
- Visual Elements: Control how the robot appears in the simulation.
- Collision Elements: Specify the physical boundaries for collision detection.
- Inertial Properties: Include mass, center of mass, and moment of inertia for dynamic simulations.

Simple PyBullet Simulation

Steps to Create Simulation (Continued)

- Set gravity:
  `p.setGravity(0, 0, -9.8)`

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Steps to Create Simulation (Continued)

- **Set gravity:**

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- **Run simulation (loop):**

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for i in range(1000):
  p.stepSimulation()
  time.sleep(1.  / 240.)
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- **Disconnect:**
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p.disconnect()
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- It visually resembles the Star Wars character R2-D2.
- Used for learning how to load URDF files and for basic robot simulations.
- It includes visual and collision shapes but has no active joint control by default.
- Helpful for practicing robot placement, gravity effects, and simple movement environments.

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