Navneet Paul

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Robotics and machine learning researcher at Robert Bosch Center for Cyber Physical Systems (RBCCPS), IISc, Bangalore. Current research relates to fusion of machine learning techniques (Reinforcement learning and generative adversarial networks) & control theory in the domain of robot manipulations.

Research Experience

Robert Bosch Center for Cyber Physical Systems **Bangalore, Karnataka**
Project Assistant *August 2018–Present*

Currently working as a Robotics and Machine Learning Researcher. Research domain of implementing machine learning techniques (such as reinforcement learning, imitation learning, generative adversarial networks, etc) for robot manipulation tasks in industrial automation environment. The research project is funded and in collaboration with Yaskawa Electric Corporation, Japan.

Aerospace Engineering Division, IISc **Bangalore, Karnataka**
Project Assistant *August 2017–July 2018*

I worked for almost an year at the Computational Intelligence Laboratory & Advanced Flight Simulation Laboratory, Dept. of Aerospace Engineering, IISc, under the guidance of Dr. S N Omkar (Chief Research Scientist). My research focused on developing simulation frameworks for implementing several reinforcement learning algorithms such as Q-Learning and DDPG for autonomous navigation of UAVs and bipedal walking robots. I also worked on human motion analysis using optical motion capture systems and surface electromyographic (sEMG) sensors.

Mechanical Engineering Division, IISc **Bangalore, Karnataka**
Summer Research Intern *May 2016–July 2016*

I interned at the Surface Interaction and Manufacturing (SIAM) Laboratory at the Dept. of Mechanical Engineering, IISc under the guidance of Dr. Satish V Kailash. I worked in the domain of friction stir welding(FSW) for butt-joint of pure aluminium with pure copper using a 3-axis horizontal FSW machine and analyzing several welding parameters associated (like feed-rate, tool configuration, etc.

Professional Experience

ABB Robotics Motion Division **Bangalore, Karnataka**
Graduate Engineer Trainee *April 2017–August 2017*

Was part of the mechanical design & simulation team, designing, mechanism simulation fabrication of auxiliary units of an industrial robot, viz; grippers, actuators, etc., depending on various customer specifications requirements. Involved in the Anthropomorphic Robotic Arm(A.R.A.) project wherein our team fabricated a 3D printed humanoid robotic arm interfaced it with an IRB1600 robot, actuated by servo motors controlled by Arduino Uno Micro-controller connected to the ABB IRC5 industrial robot controller.

GAIL India Limited.) **Auraiya, Uttar Pradesh**
Industrial Intern *December 2014 –January 2015*

The key area of training focused on vibrational conditional monitoring of the steam turbine unit at the natural gas power plant. Vibrational monitoring is among the key NDT methods to evaluate the possible defects or excess vibrations caused during regular operations. Responsibilities:

- Making on-site inspection,
- Data acquisition & pattern-analysis interpretation,
- Online Conditional monitoring analysis of fault detection through FFT(Fast Fourier Transformation) enabled software,
- Suggesting possible counter-active measures.

Education

VIT University   **Vellore, Tamil Nadu**
B.Tech Mechanical Engineering , GPA: 8.30/10.0   *2013–2017*

St. Joseph's Senior Secondary School   **Auraiya, Uttar Pradesh**
AISSCE (CBSE), Percentile: 88.32   *2012–2013*

St. Joseph's Senior Secondary School   **Auraiya, Uttar Pradesh**
AISSE (CBSE), GPA: 9.0/10.0   *2010–2011*

Projects

- **Learning Peg-in-hole insertions from human demonstrations - an imitation learning approach:** Using Generative Adversarial Imitation Learning (GAIL) for training an industrial robot to learn complex manipulation tasks such peg in hole insertions from prior human demonstrations. The initial phase is development of simulation framework using ROS and Gazebo. Later aiminig for simulation to real world transfer through domain randomization, sim2real approaches, etc. The project is funded by & in collaboration with Yaskawa Electric Corp **(Ongoing project)**.
- **Deep Deterministic Policy Gradient for Bipedal walking robot:** A bipedal walking robot was developed in **Gazebo** simulation environment and Reinforcement learning algorithm, Deep Deterministic Policy Gradient based on actor-critic learning framework was implemented for generating a stable planar bipedal walking patter. The frame work is open-sourced via github.
- **Q-Learning for autonomous navigation of UAVs in indoor environments:** Q-Learning with a simple PID tuned control was adopted for the autonomous navigation of an ArDrone in a 5x5 grid space (simulation environment: **Gazebo**). Check the github repository for the project details.
- **Anthropomorphic Robot Arm:** A 3D printed humanoid arm(with 5 DOF) is attached to the ABB IRB 1600 ID industrial robot, actuated using servomotors controlled using an Arduino Uno microcontroller which is interfaced to the ABB IRC5 controller via a custom build step-down voltage regulator circuit board. Project carried out at the **ABB Robotics Motion Division**, Bangalore.

Publication(s):

- Kumar, Arun, **Navneet Paul**, and S. N. Omkar. "**Bipedal Walking Robot using Deep Deterministic Policy Gradient.**" arXiv preprint arXiv:1807.05924 (2018).

Technical skills

- **Programming Languages:** C, Python, Matlab,TeX.
- **Framework(s):** Robot Operating System(ROS), OpenAI Gym.
- **Libraries:** TensorFlow, Pytorch
- **Simulation:** Gazebo, Moveit, Mujoco (basics), ABB RobotStudio, Ansys Workbench.
- **Microcontroller:** Arduino.
- **Designing & other** SolidWorks, Catia, Blender, MS-Office.