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Date of Birth : 23 June 1991

## Education

- Georgia Institute of Technology** Atlanta, GA  
• *Ph.D. in Robotics* August. 2016 - Present  
*Advisor : Dr. Karen Liu and Dr. Sehoon Ha*
- University of Washington** Seattle, WA  
• *Master of Science in Mechanical Engineering* Sep. 2014 - Jun. 2016

## Research Interests

- Deep Reinforcement Learning for continuous control of robots, Sim2Real transfer of policies, Virtual human agents, Physics based simulation

## Research Experience

- **Research Assistant** Atlanta, GA  
*IC, GaTech* August. 2016 - Present
  - **Learning a unified control policy for safe falling** - Implemented a Deep Reinforcement Learning algorithm using a mixture of actor-critic networks to enable a humanoid robot to fall in a safe manner by minimizing impact.
  - **Expanding motor skills using relay networks** - Developed an algorithm to decompose a MDP into smaller MDP's and build a directed graph of policies to simplify a complex task into smaller simpler tasks that is more sample efficient than standard Open AI gym baselines.
  - **Learning agile locomotion from motion capture demonstrations** - Implemented a deep reinforcement learning algorithm in PyDart simulator to learn agile locomotion tasks for a high-dimensional humanoid from motion capture data (Similar to DeepMimic algorithm).
  - **Sim-2-Real transfer for biped-locomotion** - Helped develop a sim-2-real algorithm to transfer locomotion policies trained in simulation to Darwin-OP2 robot in the real world.
  - **Learning a Control Policy for human-exoskeleton interaction** - Using Deep Reinforcement Learning, designed an algorithm that helps fall prevention using an assistive device when there is an external perturbation during walking.
  - **Error-Aware Control Policy** - Currently developing an algorithm to train a policy for zero-shot transfer to target environment. The policy has the expected state error as an input which enables the policy to take better actions in the target environment compared to baselines like Universal Policy or Domain Randomization.
- **Research Intern** Redmond WA  
*Nvidia Research* May 2020 - August 2020
  - **Learning Joint Space Control Policies for Robot Manipulators** - Worked on Baxter robot to develop a curriculum learning based reaching control policy that achieves high accuracy (less than 1.0cm). The policy can be adapted to control orientation and avoid obstacles.
- **Research Intern** Seattle, WA  
*Nvidia Research* May 2019 - August 2019
  - **Contextual Reinforcement Learning of Visuo-Tactile Multi-Fingered Grasping Policies** - Worked on Kuka-Allegro robot system to learn grasping policies for multi-fingered robots. Using vision and touch sensors as contextual inputs the learnt policy is capable of grasping upto 5 different objects in the YCB dataset.

- Lab Associate** Pittsburgh, PA  
*Disney Research* *May. 2017 - August. 2017*
  - Developed a curriculum learning algorithm to improve Model Based humanoid balance controller using Deep Reinforcement learning and Adaptive Sampling.
- Research Assistant** Seattle, WA  
*CSE Dept, UW* *Dec. 2015 - June. 2016*
  - System Identification and Model Predictive control of pneumatic cylinder actuators for Adroit Hand.
  - Calibrated and identified parameters of Adroit hand, 24 DoF anthropomorphic hand using kinematic extensions and numerical optimization methods implemented in Matlab with Mujoco physics engine.
  - Designed a simple gesture controlled 2-DoF Robotic third arm using Myo armband EMG sensor.
  - Identified inertial parameters of 4 -DoF pneumatically actuated Adroit robotic arm using accurate CAD modelling approach in Solidworks.
- Research Assistant** Bangalore, India  
*M2D2 Lab, Indian Institute of Science* *Sept 2013 - August 2014*
  - Designed, fabricated and analysed Electro-magnetic actuated Micro-Flow pump for drug-delivery purposes.
  - Achieved a flow rate of 150 microliter/min at pressure head of 2 KPa.
  - Design considerations included small size, dealing with working fluid and bio-compatibility.

## Teaching Experience

- Teaching Assistant** Prof. Karen Liu  
*CS 7496 Computer Animation* *Fall 2018*
  - Course covered concepts on physics based animation, teaching students how to write C++ code to simulate rigid bodies with contacts and constraints. Responsibilities included grading homework assignments and exams as well as giving a guest lecture.
- Teaching Practicum Student** Prof. Wayne Whiteman  
*ME 2202 Rigid Body Dynamics* *Current*
  - In progress, responsibilities include grading homework assignments, teaching few classes and developing a problem set for exam.

## Selected Course Projects

- Neural Control of Exoskeleton Assisted Human Upper Limb** Oct 2018. - Nov 2018  
*Wearable Robotics*
  - Modelled the muscle dynamics of the human upper limb and the assistance provided by a simple passive exoskeleton. The resulting dynamics model was used to learn a control policy that can follow a trajectory in the end-effector space.
- Sensor Fusion for Control of Self - Balancing Robot** March 2015 - June 2015  
*Optimal State Estimation*
  - Implemented sensor fusion of accelerometer and gyroscope using kalman filter to get accurate state information for control of self-balancing robot.
- Learning a control policy for Robobee fly robot via Reinforcement Learning** Sept 2015 - Dec 2015  
*Bio-inspired Robotics*
  - Implemented a Policy gradient Reinforcement Learning technique for Robobee robot to perform simple control tasks such as angle stabilization, altitude and lateral movement control.

## Publications

- **Kumar, V.**, S, Ha., Liu, C.K., "Learning a unified control policy for Safe Falling", IEEE/RSJ IROS, 2017. [Link to paper](#)
- **Kumar, V.**, S Ha, K Yamane, "Improving Model-Based Humanoid Balance Controllers using Reinforcement Learning and Adaptive Sampling", ICRA 2018. [Link to paper](#)
- **Kumar, V.**, S, Ha., Liu, C.K., "Expanding Motor Skills using Relay Networks", CORL, 2018, Zurich Switzerland. [Link to paper](#)
- Yu, W., **Kumar, V.**, Turk, G., Liu, C.K., "Sim-2-Real transfer of Biped-locomotion", IROS, 2019, Macao China. [Link to paper](#)
- **Kumar, V.**, Ha, S., Sawicki, G., Liu, C.K., "Learning a Control Policy for Fall-Prevention using an Assistive Device", under review, ICRA 2020. [Link to paper](#)
- **Kumar, V.**, Hermans, T., Fox, D., Birchfield, S. and Tremblay, J. "Contextual Reinforcement Learning of Visuo-Tactile Multi-Fingered Grasping Policies.", NeurIPS workshop 2020. [Link to paper](#)
- **Kumar, V.**, Hoeller, D., Sundaralingam, B., Tremblay J, Birchfield, S. "Joint Space Control via Deep Reinforcement Learning", under review, ICRA 2021. [Link to paper](#)

## Manuscripts

- "High performance pneumatics using Model Predictive Control", Vikash Kumar, **Visak C V**, Emanuel Torodov [Link](#)
- Precise Calibration of Robots with small link lengths using Kinematic Extensions, **Visak C** and Vikash Kumar [Link](#)

## Skills

**Deep Learning:** Tensorflow, Pytorch

**Physics Simulators:** MuJoCo, DART, PyDART, Bullet, PyBullet, Physx, Flex

**Languages:** C++, MATLAB, Mathematica, Python

**CAD Software:** Solidworks, Autodesk Inventor

**FEM Simulation Packages:** Ansys, Comsol

**Control System Packages:** Matlab Control System ToolBox, Simulink, LabView

**Microcontroller Programming:** Arduino, Raspberry Pi, NI DAQ