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Shrinath Deshpande

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Education

Stony Brook University — Stony Brook, NY
Ph.D. (Major: Mechanical, Minor: Computer Science), GPA 3.88 — *Aug. 2015 – Present*

- **Relevent Coursework :** Artificial Intelligence, Computer Vision, Machine Learning, Analysis of Algorithms, Advanced Control Systems, Robotics, Advanced Dynamics, Computational Geometry, Geometric Modeling, Product Design Optimization
- Developing an ML-based framework for Mechanical Design, under the guidance of Dr. Purwar; funded by $450K NSF grant.

Experience

Stony Brook University — Stony Brook, NY
Research Assistant — *May 2016 – Present*

Machine Learning

- Developing Deep Generative Models (VAE's and GAN's) for computational creativity and conceptual machine design.
- Working on Deep Reinforcement Learning for Machine Design; Developed an OpenAI-gym Environment for a design task.
- Variational autoencoders for representation learning of Linkage Trajectories; Trained classifiers for Mechanism Type-Synthesis
- Implemented fast and efficient motion queries for nearest neighbors in compact feature space; Implemented using Scikit-learn.

Optimization

- Developed Lagrange Optimization routine for four-bar linkage synthesis; Reduces constrained optimization into a polynomial system. Solved the system by gröebner basis method; implemented using GIAC npm package on node.js server.
- Lead Author of an award winning publication for solving practical synthesis problems (doi: 10.1115/1.4037801)

MotionGen: Web, iOS and Android App for Linkage Synthesis

- Developed smart-synthesis, motion interpolation functionalities for the cross platform app based on MVC architecture; url: http://cadcam.eng.sunysb.edu/. Used Apache Cordova framework for iOS and Android implementations.
- Implemented multi-core computations for synthesis using *Cluster* node package.

Stony Brook University — Stony Brook, NY
Teaching Assistant — *Aug 2015 – May 2016*

MEC101 (Mechanical Design Innovation), MEC 262 Engineering Dynamics

- Involved in creating assignment, exams and conducting recitation sessions for 200+ students in each course.
- Developed modular robotic kits for MEC101 students; Conducted Hands-On tutorials on Arduino programming.

Skills

- **Languages :** Proficient in Python, Javascript, MATLAB, Mathematica. Competent with C++, HTML, CSS
- **Tools & Technologies :** Tensorflow, OpenCV, Simulink, ROS, Vim, Scikit-learn, Unix/Linux, GCP, STL, Apache Cordova

Publications

- Deshpande S, Purwar A. **Computational Creativity via Assisted Variational Synthesis of Mechanisms using Deep Generative Models**, ASME Journal of Mechanical Design 2019; Paper No: JMD-19-1152 (Submitted)
- Loya A, Deshpande S, Purwar A. **Machine Learning Driven Individualized Gait Rehabilitation: Classification, Recognition and Mechanism Design**, ASME Journal of Mechanisms and Robotics 2019; Paper No: JMR-19-1093 (Submitted)
- Deshpande S, Purwar A. **A Machine Learning Approach to Kinematic Synthesis of Defect-Free Planar Four-Bar Linkages**, ASME Journal of Computing and Information Science in Engineering 2019;19(2):021004-021004-10. Paper No: JCISE-18-1078; doi:10.1115/1.4042325.
- Deshpande S, Purwar A. **A Task-Driven Approach to Optimal Synthesis of Planar Four-Bar Linkages for Extended Burmester Problem**, ASME. Journal of Mechanisms and Robotics. 2017;9(6):061005-061005-9. Paper No: JMR-17-1048; doi:10.1115/1.4037801
- Purwar A, Deshpande S, Ge QJ. **MotionGen: Interactive Design and Editing of Planar Four-Bar Motions for Generating Pose and Geometric Constraints**. ASME. Journal of Mechanisms and Robotics. 2017;9(2):024504-024504-10. Paper No: JMR-16-1317; doi:10.1115/1.4035899
- Ge QJ, Purwar A, Zhao P, Deshpande S. **A Task-Driven Approach to Unified Synthesis of Planar Four-Bar Linkages Using Algebraic Fitting of a Pencil of G-Manifolds**. ASME. Journal of Computing and Information Science in Engineering 2017;17(3):031011-031011-11. Paper No: JCISE-12-1235; doi:10.1115/1.4035528.
- Deshpande S, Bakse A, Wabale S, Deshmukh A, Patil D. **Wall-climbing robot with mechanically synchronized gait**, Industrial Instrumentation and Control (ICIC), 2015 International Conference IEEE, Pune, India.

Select Projects

Deep Reinforcement Learning for Continuous Control Tasks CSE 537 AI, Prof. N Balasubramanian
Tensorflow, OpenAI-Gym https://github.com/deshpandeshrinath/deepDGP *Jan 2018 – May 2018*

- Implemented Deep DPG algorithm to learn continuous control policies; Compatible with all OpenAI-Gym environments.
- Implemented Hindsight Experience Replay for learning goal-oriented tasks with sparse binary rewards.

Visual Odometry with Deep Learning CSE527 Computer Vision, Prof. Roy Shilkrot
Python, Tensorflow, OpenCV https://github.com/sladebot/deepvo *Oct 2017 – Dec 2017*

- Built deep Recurrent Convolutional Neural Network for pose estimation of a car; CNN was derived from pretrained FlowNet2.0
- Trained and tested on KITTI visual odometry dataset (grayscale); Supported by Human Interaction Lab, Stony Brook.

Computing Central Trajectory CSE555 Computational Geometry, Prof. Joseph Mitchell
CGAL, OpenGL, Boost, C++ *March 2017 – May 2017*

- Developed an algorithm to find valid representative trajectory among n time stamped trajectories; works in d dimensional space.
- Algorithm builds a weighted DAG on input; designed heuristics for assigning weights. Output is dijkstra's shortest path on DAG.

Optimal Control of a Drifting Car MEC560 Advanced Control Systems, Prof. Vivek Yadav
MATLAB, GPOPS-II *Oct 2016 – Dec 2016*

- Designed Ext. Kalman Filter for Observer; Modeled governing dynamics; Used empirical tire friction model for drift simulations.
- Computed shortest path using Dynamic Programming. Obtained Optimal Control via Direct Collocation; Implemented in MATLAB using optimal control solver GPOPS II.
- Used high gain PID controller to follow optimal control. Results match with empirical drifting techniques used by race drivers.

Motion Planning of Baxter Arm MEC529 Robotics, Prof. N. Chakraborty
MATLAB *March 2016 – May 2016*

- Computed smooth B-Spline motion for pushing. Computed Jacobian matrix; Applied approximate Inverse Position Kinematics
- Obtained manipulator joint angles and rates for the task. Performed simulations to validate the results.

Interactive Manipulation of NURBS Surfaces MEC572 Geomtric Modelling, Prof. Anurag Purwar
C++, OpenGL *March 2016 – May 2016*

- OpenGL based implementation in C++ for interactive manipulation of Non Uniform Rational B-Spline Surfaces.

Wall Climbing Robot Senior Design Project
MATLAB, Simulink, Solidworks *Jan 2015 – May 2015*

- Designed a noval mechanism inspired by Gecko; mechanically synchronized gait; used vacuum technology for adhesion
- Developed robust feedback system; autonomous climbing; square shaped robot with area 1 ft^2 has climbing speed of 3 inch/sec

Awards

A.T. Yang Award in Theoretical Kinematics Aug 2017

- Awarded $1000 for the Best Paper at ASME Mechanisms and Robotics Conference, Cleveland, OH, August, 2017