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RESEARCH INTERESTS

- Physics Aware Motion Planning of High Degree of Freedom Systems
- Artificial Intelligence for robot task and motion planning
- Machine Learning
- Non-linear optimization

EDUCATION

PhD in Mechanical Engineering*Aug 2016 - Present*

University of Southern California, Los Angeles, CA

Bachelor of Technology in Mechanical Engineering*Jul 2010 - May 2014*

Indian Institute of Technology Bombay, India

Master of Technology in Mechanical Engineering*Jul 2014 - May 2015*

Indian Institute of Technology Bombay, India

RESEARCH PROJECTS

Time-Optimal Trajectory Planning with a Mobile Manipulator*Aug 2016 - Present*

Realization of Robotic Systems Lab, AME, USC

Advisor: Dr. S. K Gupta

- Designed a search based algorithm for trajectory planning of mobile manipulators for time optimal pick-up and transport of objects
- Developed an SVM based active machine learning approach to construct a meta-model for estimating the probability of successful part pick-up for uncertainty in the part pose estimate with a moving gripper
- Developed an optimization based framework to generate time-optimal trajectories for picking-up parts that satisfy the given level of success probability threshold for part pick-up
- Implemented the above algorithms on a physical platform consisting a mobile base mounted with a UR5 manipulator using Robot Operating System (ROS)

Constrained Trajectory Generation for High DOF Robots*Feb 2018 - Present*

Realization of Robotic Systems Lab, AME, USC

Advisor: Dr. S. K Gupta

- Implemented Jacobian based control for following end-effector trajectories for high-DOF robotic arms and non-holonomic mobile manipulators
- Formulated a seed generation technique by finding the best fit spline for inverse kinematic (IK) solutions along the desire end-effector path
- Developed a successive refinement based optimization algorithm using the above generated seed for trajectory generation of high DOF robotic systems
- Formulated an efficient technique for computing IK solutions of high DOF redundant manipulators using non-linear optimization

Guidance Logic for UAV Path Following*Aug 2015 - Apr 2016*

Autonomous Vehicles Lab, IISc Bangalore, India

Advisor: Dr. Ashwini Ratnoo

- Designed a guidance logic for path following of a UAV using a virtual target, such that with respect to the line-of-sight, the UAV maintains an equal and opposite lead angle as that of the virtual target.
- A linear analysis of the resulting error dynamics presented a faster (greater than 100%) convergence to straight line path with no overshoot as compared to existing methods and resulted in smooth trajectory following

Non-holonomic Navigation of a Spherical Robot*May 2014 - Jul 2015*

Master's Thesis, IIT-Bombay

Advisors: Dr. Leena Vachhani & Dr. Abhishek Gupta

- Designed and built a double pendulum and yoke actuated autonomous robot spherical robot with digital servo actuators
- Developed an online non-holonomic motion planning algorithm citing the discrete and erroneous position measurements from the indoor navigation system for the spherical robot by estimating the yaw.
- Formulated theoretical continuous curvature trajectories for navigation of this spherical robot based on Dubin's path approach using the steady state steering dynamic equations of the system.

COMPUTER AND INDUSTRIAL ROBOT SKILL

- **Software:** Robot Operating System (ROS), Gazebo, VREP, Solidworks
- **Programming :** Python, MATLAB, C++, LUA, JAVA, Julia
- **Robots:** Kuka LWR iiwa 7 and iiwa 14, EPSON C3, S5, Rethink Robotics Baxter, Clearpath Robotics Husky, Universal Robots UR5, InspectorBots Super Mega Bot, ABB IRB

RELATED COURSEWORK

Deep Learning, Artificial Intelligence, Machine Learning, Advanced Engineering Dynamics, Manufacturing Automation, Optimization: Theory and Algorithms, Mobile Robotics, Modelling and Identification of Dynamical Systems, Non-linear System Analysis and Control, Automatic and Feedback Control, Embedded Control Systems

INTERNSHIP

Design and control of a robotic arm

May 2013 - Jul 2013

AIRBUS Innovation Cell, Bangalore, India

Advisor: Mr. Ajit Krishnamohan

- Designed and fabricated a prototype of a 5 Dof dexterous robotic arm to project aircraft manuals for pilot reference in the cockpit. Used proximity sensing to enable manual maneuvering. Implemented search based algorithm motion planning to ensure contact avoidance with the complex cockpit environment
- Resulted in Patent application: Aircraft part with robot arm; International Patent Application no. PCT/IN2013/000803; 26 December 2013; Applicants: Airbus Engineering Center India, Airbus (France)

AWARDS AND ACHIEVEMENTS

- Awarded the Provost PhD Fellowship from The Viterbi School of Engineering, USC
- Awarded the J. N TATA fellowship for Higher Education
- Finalist for the Kuka Innovation Award 2017, Hannover Messe, Germany

PUBLICATIONS

- **S. Thakar**, V. Annem, A. Kabir, P. Rajendran and S. K Gupta; “Accounting for Part Pose Estimation Uncertainties during Trajectory Generation for Part Pick-Up Using Mobile Manipulators ”; (Accepted) IEEE International Conference on Robotics and Automation (ICRA) 2019, Montreal, Canada
- **S. Thakar**, L. Fang, B. Shah and S. K Gupta; “Towards Time-Optimal Trajectory Planning for Pick-and-Transport Operation with a Mobile Manipulator”; In IEEE 14th International Conference on Automation Science and Engineering (CASE) 2018, pp. 981-987, Munich, Germany
- **S. Thakar** and A. Ratnoo; “A Tangential Guidance Logic for Virtual Target Based Path Following”; AIAA Guidance, Navigation and Control Conference (GNC) 2017, Grapevine, Texas, AIAA 2017-1042
- **S. Thakar** and A. Ratnoo; “ Rendezvous Guidance Laws for Aerial Recovery using Mothership-Cable-Drogue System”; 4th IFAC Conference on Advances in Control and Optimization of Dynamical Systems (ACODS) 2016: Tiruchirappalli, India
- A. Kabir, **S. Thakar**, A. Kanyuck, R. Malhan, A. Shembekar, B. Shah and S. K Gupta; “Generation of Synchronized Configuration Space Trajectories of Multi-Robot Systems ”; (Accepted) IEEE International Conference on Robotics and Automation (ICRA) 2019, Montreal, Canada
- N. Kumbla, **S. Thakar**, K. Kaipa, J. Marvel and S. K Gupta; “Simulation Based On-Line Evaluation Of Singulation Plans to Handle Perception Uncertainty In Robotic Bin Picking”; ASME 12th International Manufacturing Science and Engineering Conference (MSEC) 2017, Los Angeles, California
- N. Kumbla, **S. Thakar**, K. Kaipa, J. Marvel and S. K Gupta; “Handling Perception Uncertainty in Simulation based Singulation Planning for Robotic Bin Picking”; Journal of Computing and Information Science in Engineering, JCISE-17-1115; doi: 10.1115/1.4038954
- V. Reddy, **S Thakar**, A. Kumar and L. Vachhani; “Discrete time position feedback based steering control for autonomous homing of a mobile robot”; IEEE International Conference on Control & Automation, Kathmandu, Nepal, 2016; doi 10.1109/ICCA.2016.7505372