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Shubham Singh

A roboticist skilled in dynamic locomotion, optimization, estimation, controls & effective communication. Quickly adapts to the needs of the task, enjoys working in a team, likes to lead.

Education

Expected June'23 **PhD in Aerospace Engineering**, *Dynamics & Control*, **The University of Texas at Austin**, TX
Relevant Courses: Human Centered Robotics, Optimal Control Theory, Statistical Estimation

2016 **MS in Aerospace Engineering**, **Purdue University**, IN

2014 **B.Tech in Mechanical Engineering**, **Delhi Technological University**, India

Research/Work Experience

May –Aug'22 **Robotics Research Intern**, *Flexiv Robotics, CA*
- Benchmarked a contact-aware MPC controller on a 7-DoF manipulator
- Simulation using PyBullet, GramPC, Pinocchio, and communication using the LCM tool.
- Skills used- Trajectory Optimization, Model Predictive Control, C++, Python

June'20– July'20 **Data Scientist**, *AI Research Lab, Dell, Austin*
- Worked towards automation of Data-Driven Data Centers
- Skills used- Reinforcement Learning, Deep Learning, Tensorflow, DockerHUB

August'18– **Graduate Research Assistant**, *The University of Texas at Austin*
- Theoretical and algorithmic contribution to the dynamic modeling of robots using Featherstone's Spatial-Vector Algebra
- Developed analytical expressions for first/second-order derivatives of Inverse/Forward dynamics for modeling robotic motion
- Working on developing model-based control algorithms for legged robots. Contributed code to open-source C++ library Pinocchio
- Skills used- Trajectory Optimization, Spatial Vector Algebra, C++, Fortran

June'15– December'17 **Graduate Research Assistant**, *Rapid Design of Systems Lab, Purdue University*
- Implementing indirect trajectory optimization methods for Hypersonic mission design
- Skills used- Hypersonic Missile Trajectory Optimization, Mission Design

June'13– August'13 **Summer Research Intern**, *Turbulence Research Lab, University of Toronto*
- Skills used- LABview, Hardware/software integration

Publications

1. **Singh, S.**, Russell, R. P., & Wensing, P. M., *On Second-Order Derivatives of Rigid-Body Dynamics: Theory & Implementation*, Under Review, 2023. Pre-print
2. **Singh, S.**, Russell, R. P., & Wensing, P. M., *Analytical Second-Order Partial Derivatives of Rigid-Body Inverse Dynamics*, 2022 IEEE/RSJ IROS, pp. 11781-11788. Pre-print, Code
3. **Singh, S.**, Russell, R. P., & Wensing, P. M. , *Efficient Analytical Derivatives of Rigid-Body Dynamics using Spatial Vector Algebra.*, in IEEE RA-L, vol. 7, no. 2, pp. 1776-1783, April 2022, presented at ICRA 2022. Pre-print, Code
4. Russell, R., **Singh, S.**, & Wensing, P. (2019). *Advancing the Runtime and Robustness of Differential Dynamic Programming.* Workshop: Toward Online Optimal Control of Dynamic Robots, ICRA, Montreal, Canada.

5. **Singh, S.**, & Grant, M. (2018). *The use of Homotopy Analysis Method for indirect trajectory optimization.* Scitech AIAA, Kissimmee, Florida. Paper
6. O'Neill, W., Guariniello, C., Das-Stuart, A., Mall, K., **Singh, S.**, & Delaurentis D., (2017). *Application Of A Top Down System-of Systems Approach To Enable Human Mars Exploration Missions.* International Astronautical Congress, Adelaide, Australia. Paper
7. **Singh, S.** (2016). Applications of the homotopy analysis method to optimal control problems. Purdue University. Thesis
8. **Singh, S.**, & Zunaid, M. (2014). Numerical Study of the Generic Sports Utility Vehicle Design with a Drag Reduction Add-On Device. Journal of Computational Engineering, Hindawi. Paper

Achievements & Awards

March,Sept'22 **IEEE RAS Travel Award (ICRA, IROS 2022)**, *IEEE, Robotics & Automation Society*

Feb, Sept'22 **UT Austin Graduate Professional Travel Award**, *Graduate School, UT Austin*

August'21, July'22 **Warren A. and Alice L. Meyer Endowed Scholarship in Engineering**, *Cockrell School of Engineering Scholarship, UT Austin*

May'17 **AIAA Graduate Mission Design Competition 2016-17** , *Third Place for Mid-Tier Defense Against Hypersonic Glide Vehicles (Team-Lead, Purdue University)*

June'13 **MITACS Globalink Scholarship, Canada**, *Summer Research Intern, University of Toronto*

May'11 **Merit Scholarship, Mechanical Engineering**, *Undergraduate Student, Delhi Technological University*

Professional Activities/Volunteering

Nov'22 **Reviewer**, *IEEE ICRA 2023*

Nov'22- **Reviewer**, *IEEE Robotics and Automation Letters*

Skills

, *Programming Skills:*

- **Fortran 90/77 (Libraries-BLAS,MKL), C++ (Libraries-Eigen), Python (Tensorflow, Numpy)**
- **Mathematica, Maple**: Symbolic Manipulators
- **SOLIDWORKS, CATIA, Pro-Engineer, AutoCAD**: CAD Tools
- **STK-AGI,MATLAB & Simulink, LATEX**: Engineering/Type-setting Software

, *Technical Skills:*

- Expertise in Design Optimization (IPOPT/SNOPT), Optimized based Robotics, Dynamic Locomotion, Machine/Reinforcement Learning, ROS, Physics simulation engines (PyBullet), Version control (Git).

, *Non-Technical Skills:*

- Public Speaking and Effective Communication- Member of UT Science Toastmasters

References

1. Dr. Ryan P. Russell (Ph.D. Supervisor)- Professor, Aerospace Engineering & Engineering Mechanics, The University of Texas at Austin, contact - ryan.russell@austin.utexas.edu
2. Dr. Patrick M. Wensing - Assoc. Professor, Aerospace & Mechanical Engineering, University of Notre Dame, contact - pwensing@nd.edu
3. Dr. Michael J. Grant (M.S. Supervisor) - Sandia National Laboratory, contact - mjgrant@purdue.edu