HARSHIT KHURANA

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Chemin du Bochet 29, 1025, St. Sulpice
https://harshitk95.github.io/

SKILLS

Analysis packages and languages	MATLAB, C++, ROS, python, OpenGL
Design-Analysis, Simulation Packages	Gazebo, pybullet, SolidWorks, Blender
Robotic Platforms	Quadrotors, KUKA iiwa lbr

EDUCATION

EPFL (August, 2020 - Present) - Impact Aware non-prehensile manipulation
PhD in Electrical Engineering (Expected 2024)
Learning Algorithms and Systems Laboratory - *Prof. Aude Billard*

ETH Zurich (Sept, 2016 - Sept, 2019)
M.Sc. Robotics, Systems and Control (**Excellence Scholarship and Opportunity Program**)

University of British Columbia (Sept, 2014 - Dec, 2014)
Undergraduate Exchange Semester (**UBC Go Global Scholarship**)

Indian Institute of Technology Delhi (July, 2012 - June, 2016)
B.Tech. Mechanical Engineering (**Institute Silver Medalist**)

RESEARCH EXPERIENCE

Impact Aware Manipulation Aug, 2020 - Present
Learning Algorithms and Systems Laboratory, EPFL *Lausanne*

- Working on manipulation algorithms for robotic arms using dynamical systems for applications involving high speed robot environment contact. - *I.AM EU PROJECT*
- Research on physics inspired learning methods, physically based simulation, multi-task and collaborative learning of dynamical systems to leverage intentional impacts - Robot object high speed contact with predictable outcome.

3D painting simulator June, 2018 - Dec, 2018
Internship, Disney Research Zurich *Zurich*

- Developed a real time 3D world painting simulator from the gound up using open source software
- Worked on a virtual reality setup to enable a user to paint rockworks in real time in Virtual reality - *published in IEEE RAL 2019*

Model Predictive Control for Morphing Quadrotor Feb 2019 - August 2019
Masters' Thesis (Prof. Davide Scaramuzza) *Robotics and Perception Group, University of Zurich*

- Physically based simulation for morphing quadrotor with 13 moving parts with a nonlinear model predictive control scheme to optimize shape and trajectory tracking of a morphing quadrotor

Human Interaction with a path following Quadrotor March 2017 - August 2017
Semester Project (Prof. Raffaelo D'Andrea) *Institute of Dynamic Systems and Controls, ETH Zurich*

- Developed a **path following control** system with admittance controllers to make quadrotors force compliant, thus enabling human interaction through different force estimation techniques - **implemented and demo-able** in the *Flying Machine Arena (FMA), ETH Zurich.*

Smart Suspension System Development June 2015 - May 2016
Bachelor Thesis (Prof. J.K. Dutt) *Department of Mechanical Engineering, IIT Delhi*

· Simulation of 4-wheeler on random road profiles, Variable current controllers for damping vibrations

WORK EXPERIENCE

Doctoral Assistant Aug, 2020 - Present
Learning Algorithms and Systems Laboratory, EPFL *Lausanne*

· Working on manipulation algorithms for robotic arms using dynamical systems for applications involving high speed robot environment contact. - *I.AM EU PROJECT*
· Developed an algorithm for accurately placing objects outside physical workspace of a fixed robot with high speed contact - *presented in IROS 2021*
· Further research on physics inspired learning methods, physically based simulation, multi-task and collaborative learning of dynamical systems to leverage intentional impacts

Graduate Research Assistant Jan, 2020 - March, 2020
Computational Robotics Lab, ETH Zurich *Zurich*

· Investigated motion planning algorithms and leg designs for quadrupeds

Research Intern June, 2018 - Dec, 2018
Disney Research Zurich *Zurich*

· Developed a real time 3D world painting simulator from the gound up using open source software
· Worked on a virtual reality setup to enable a user to paint rockworks in real time in Virtual reality - *published in IEEE RAL 2019*

Robotics Intern Sept, 2017 - Feb, 2018
Perspective Robotics AG *Zurich*

· Developed a real time simulation software running alongside PX4 stack enabling SITL simulation with in house estimation techniques for the Fotokite drone - *now used for development of flight algorithms*
· Sensor calibration, drones and propeller testing, flight data analysis

TALKS

· **Keynote speaker** - Control and learning for industrial applications (adaptive polishing and robotic package handling) 'The lab of the future, today' – Laboratory Automation Workshop 2022 - EPFL

PUBLICATIONS

Journals

· **H. Khurana** and A. Billard. Learning hitting with different joints of a robotic manipulator. In *preparation for IEEE RA-L*, 2024
· **H. Khurana** and A. Billard. Learning inverse hitting problem. In *preparation for IEEE RA-L*, 2024
· **H. Khurana** and A. Billard. Motion planning and inertia based control for impact aware manipulation. *IEEE Transactions on Robotics*, 2023 - *paper*
· A. S. Vempati, **H. Khurana**, V. Kabelka, S. Flueckiger, R. Siegwart, and P. Beardsley. A virtual reality interface for an autonomous spray painting uav. *IEEE Robotics and Automation Letters*, 4(3):2870–2877, July 2019 - *paper*

Conferences

· **H. Khurana**, J. Hermus, and A. Billard. Impact aware extended kalman filter. In *review for ICRA@40*, 2024

· S. Birjandi, **H. Khurana**, A. Billard, and S. Haddadin. Stable adaptive extended kalman filter for estimating robot link velocity and acceleration. *IEEE/RSJ IROS*, 2023 - *paper*

· **H. Khurana**, M. Bombile, and A. Billard. Learning to hit: A statistical dynamical system based approach. *IEEE/RSJ IROS*, 2021 - *paper*

Workshops

· **H. Khurana** and A. Billard. Hitting with different joints of a robotic manipulator. In *ICRA 2024 Workshop on Agile Robotics: From Perception to Dynamic Action*, 2024 - *paper*

STUDENT SUPERVISION

· Geometrical Dynamical System based obstacle avoidance, *Baudouin Bosc (EPFL)*
· Impact Aware Kalman Filtering for object trajectory prediction, *Julien Mollard (EPFL)*
· Validation of numerical simulations for planning robot motions with impacts, *Daan Stokbroekx (TU/e)*
· Impact Aware object placement through principles of golf, *Andre Schakkal (EPFL)*
· Kalman filter v/s Particle filter for impacts, *Amine Tourki, Emna Tourki (EPFL)*
· Development of AirHockey setup to understand object behaviour upon impact, *Daan Stokbroekx (TU/e)*

TEACHING EXPERIENCE

Teaching Assistant

· **EPFL** - Applied Machine Learning (Fall 2021), Machine Learning Programming (Fall 2022, Fall 2023), Learning and adaptive control for robots (Spring 2022, Spring 2023)
· **ETH Zurich** - Linear System Theory (Fall 2017), Game Theory And Control, Autonomous Mobility on Demand (Spring 2018), Dynamics I (Fall 2016)
· **IIT Delhi** - Kinematics and Dynamics of machines, Mechanical Engineering Drawing

ROBOTICS COMMUNITY SERVICE

- Reviewer for ICRA, IROS, RA-L, T-RO, IJRR

AWARDS

- **2016: ETH Excellence Scholar (ESOP)**: Awarded to **53** incoming masters students at ETH Zurich
- **2016: IIT DELHI Institute Silver Medal** (Mechanical Engineering), for class standing: **1/102**
- **2016: Rhodes Scholarship Indian Finalist**
- **2014, 2015: O.P. Jindal Engineering and Management Scholar**
- **2014: University of British Columbia Go Global International Learning Programs Awardee**
- **2013: Singapore Technologies Engineering Indian Scholar**
- **2012: CBSE District Rank 1**: Awarded INSPIRE fellowship from Central Board of Secondary Education.
- **2010: KVPY** (Kishore Vaigyanik Protsahan Yojana) / **Young Scientist** fellow

DESIGN THINKING

- ETH Week 2019 participation - "**Rethinking Mobility**"

NON-ACADEMIC INTERESTS

- *Music*: Indian Classical Music - Bansuri (Indian Classical Flute)
- *Dancing*: Argentine Tango, Swing, Latin, Tap.
- *Sports*: Ultimate frisbee (Club: Flyhigh Lausanne), Table tennis, Badminton