

Somil Bansal

CONTACT	EEB 324, University of Southern California Los Angeles, CA 90089	somilban@usc.edu https://viterbi.usc.edu/faculty/Somil
CURRENT POSITION	University of Southern California <i>Assistant Professor</i> <i>Department of Electrical and Computer Engineering and Department of Computer Science</i> <i>Director, Safe and Intelligent Autonomy Laboratory</i>	Fall 2021 - Present
RESEARCH INTERESTS	I am broadly interested in robotics and autonomous systems. Specifically, my research focuses on understanding how machine learning methods can be combined with classical, model-based planning and control methods with the goal of: 1. enabling robots to make intelligent decisions in a data-efficient manner, especially when they rely on perception and vision sensors; 2. assuring robot safety while it relies on learning for decision-making.	
EDUCATION	University of California, Berkeley <i>Ph.D. in Electrical Engineering and Computer Sciences</i> Advisor: Claire Tomlin Thesis: <i>Safe and Data-Efficient Learning for Robotics: A Control Theoretic Approach</i>	2015 - 2020
	University of California, Berkeley <i>MS in Electrical Engineering</i> Advisor: Claire Tomlin	2012 - 2014
	Indian Institute of Technology, Kanpur <i>B.Tech. in Electrical Engineering</i>	2008 - 2012
AWARDS & HONORS	National Science Foundation CAREER Award	2023
	Eli Jury Award “For outstanding achievement in the area of systems, control, or signal processing.”	Department of EECS, UC Berkeley, 2020
	RSS Pioneer “A cohort of the world’s top early career researchers in robotics.”	RSS, 2019
	Outstanding Graduate Student Instructor Award	UC Berkeley, 2019
	Graduate Student Gold Fellowship	Department of EECS, UC Berkeley, 2013
	Excellence Award in Community Services “For outstanding work in various aspected of community services.”	IIT Kanpur, 2012
	Academic Excellence Award	IIT Kanpur, 2010, 2011.
	MITACS Globalink Fellowship For undergraduate research at University of Western Ontario, London, Canada.	IIT Kanpur, 2011
	Amit Saxena Memorial Award	IIT Kanpur, 2011

WORK EXPERIENCE	<p>Waymo, Mountain View September 2020 - July 2021 <i>Research Scientist</i></p> <p>Skydio, Redwood City May 2018 - Aug 2018 <i>Computer Vision and Planning Intern</i> Developed and experimentally evaluated algorithms that combine machine learning and planning for autonomous drone navigation in <i>a priori</i> unknown environments.</p> <p>Applied Predictive Technologies, San Francisco Aug 2014 - Sep 2015 <i>Business Consultant</i> Led data-driven analyses to design business initiatives/promotions and to forecast their performance.</p> <p>Broadcom, Sunnyvale Summer 2013 <i>Performance Engineering Intern</i> Conducted quantitative analyses to identify performance bottlenecks in existing products.</p> <p>University of Western Ontario, London, Canada Summer 2011 <i>Research Intern</i> Proposed a novel approach for vector-fitting in the presence of noise for high-frequency applications.</p>
TEACHING EXPERIENCE	<p>EE599: Learning and Control for Safety-Critical Robotic Systems USC, Spring 2023 Instructor</p> <p>EE482: Linear Control Systems USC, Fall 2021, 2022, 2023 Instructor</p> <p>EE598: Electrical Engineering Research Seminar USC, Fall 2022, Spring 2023, Fall 2023 Instructor</p> <p>EE221A: Linear System Theory UC Berkeley, Fall 2016, 2018 Graduate Student Instructor Received the <i>Outstanding Graduate Student Instructor Award</i>.</p>
PROFESSIONAL ACTIVITIES	<p>Award Committee Learning for Dynamics & Control Conference, 2022</p> <p>Program Committee (Associate Editor, Area Chair) RA-L 2023; CoRL 2020, 2021; ICRA 2021; HSCC 2020</p> <p>External Reviewer for Conferences, Journals, and Grant Panels</p> <ul style="list-style-type: none"> • <i>Robotics</i>: RA-L, TRO, RSS, ICRA, CoRL, IROS • <i>Control Theory</i>: CDC, ACC, HSCC, IFAC, L4DC, TAC, TCST, LCSS • <i>NSF Proposal Panelist and Reviewer</i> <p>Organized Workshops and Tutorials</p> <ul style="list-style-type: none"> • Deployable Decision Making in Embodied Systems, NeurIPS 2021. • Safe Real-World Robot Autonomy, IROS 2021. • Robust Autonomy: Safe Robot Learning and Control in Uncertain Real-World Environments, RSS 2019, 2020. • Hamilton-Jacobi Reachability: A Brief Overview and Recent Advances, CDC 2017. • Design of Robotics and Embedded systems, Analysis, and Modeling (DREAM) Seminar, UC Berkeley 2017-2019.

MEDIA
ATTENTION

- [AI helps robots navigate around humans in offices](#) , VentureBeat 2020.
- [A framework for indoor robot navigation among humans](#), TechXplore 2020.
- [A new approach for robot navigation in novel environments](#), TechXplore 2019.

INVITED
TALKS

Safety for Learning-Based Robot Control

Controls & Dynamics Seminar, University of California, San Diego, 2023.

Scaling Safety Analysis for Robotics: High-Dimensional Systems to Real-Time Computation

Control, Dynamical Systems, and Computation Seminar, University of California, Santa Barbara, 2022.

Safe and Data Efficient Visual Learning for Robotics

Swiss Federal Institute of Technology Lausanne (EPFL), 2021.

Scaling Safety Analysis for Robotics

Workshop on Safe Autonomous Systems, Seoul National University, 2021.

Scaling Hamilton-Jacobi Reachability Analysis for Robotics

Princeton University, 2021.

Semiautonomous Seminar, UC Berkeley, 2021.

University of California, San Diego, 2020.

Safe and Data-Efficient Learning for Robotics

GRASP Student Faculty Industry (SFI) Seminar Series, University of Pennsylvania, 2021.

Safe and Data-Efficient Learning for Robotics

Google Robotics Seminar, 2020.

Waymo, 2020.

Facebook AI Research Seminar, 2020.

Scaling Hamilton-Jacobi Reachability Analysis for Robotics: Multi-agent Systems to Real-time Computation

Institute for Pure & Applied Mathematics (IPAM), 2020.

Safe and Data-Efficient Learning for Robotics

Yale University, Department of Mechanical Engineering and Materials Science, 2020.

Georgia Tech University, School of Electrical and Computer Engineering, 2020.

Cornell University, Department of Electrical and Computer Engineering, 2020.

Cornell University, Department of Computer Science, 2020.

Harvard University, School of Engineering And Applied Sciences, 2020.

University of British Columbia, Department of Computer Science, 2020.

University of Southern California, Department of Electrical and Computer Engineering, 2020.

Safe Learning-Enabled Decision Making for Robotics in Novel Environments

ETH Zurich, Department of Mechanical and Process Engineering, 2019.

Safe Learning-Enabled Decision Making for Autonomous Navigation in Novel Environments

University of Toronto, UTIAS, 2019.

CITRIS/CPAR Control Theory and Automation Symposium, 2019.

Workshop on Algorithms and Architectures for Learning-in-the-loop Systems in Autonomous Flight, ICRA 2019.

Combining Optimal Control and Learning for Visual Navigation in Novel Environments

Simons Institute Annual Industry Day, 2019.

Deep Learning Quadrotor Dynamics for Flight Control

CITRIS-Honeywell Drones: Technology, Policy and Society Conference, 2018.

Overcoming Model Bias in Model-Based Learning

Berkeley Artificial Intelligence/ Berkeley Deep Drive Workshop, UC Berkeley, 2016.

ADVISING & MENTORSHIP

Current PhD Students

Kaustav Chakraborty, Javier Borquez, Hao Wang, Albert Lin, Zeyuan Feng

Current MS Students

Shuang Peng

Current Undergraduate Students

Kyle Woo, Xingpeng Xia, Wenhao Tang, Luke Raus, Adrian Faust, Aryaman Gupta, Jay Park, Tianhao (Stan) Wu

Past MS Students

Varun Tolani (Research scientist at Zipline), Chuck Tang (Software engineer at Mosaic ML), Anjian Li (PhD student at Princeton), Ted Xiao (Researcher at Google Brain)

Past Undergraduate Students

Albert Lin (PhD student at USC), Kensuke Nakamura (PhD student at CMU), Khalil Sarwari (Founder & CEO at Netvyne), Lucas Medino (Computer vision engineer at Neurobots), Eli Bronstein (PhD student at UC Berkeley), Nathan Blair (PhD student at UC Santa Barbara), Jonathan Lee (PhD student at Stanford), Frank Jiang (PhD student at KTH), Kevin Lin (MS student at Stanford)

OUTREACH

Viterbi Women in Science and Engineering Program Committee

2023

Providing leadership support to the WiSE program to advance women in science and engineering at USC.

USC CS Speaker Series Program

2022-Present

Collaborate with the Los Angeles County Office of Education (LACOE) and high school teachers to develop a series of robotics modules for high school students, focused on safety and ethics in robotics.

Girls in Engineering Camp

2019

Organizing a week-long summer camp for middle school students to explore different aspects of what it means to be an engineer.

Inclusion@RSS

2019

Mentored early career graduate students who belong to traditionally underrepresented groups in robotics.

Berkeley School Volunteers

2017-2018

Volunteer teacher for middle school students in public schools.

National Social Service Volunteer (Prayas Program)

2008-2012

Taught underrepresented and underprivileged K-12 students who could not afford quality education. I was awarded the **IIT Kanpur excellence award in community services** for my efforts.

PEER-REVIEWED CONFERENCE PUBLICATIONS

Online Update of Safety Assurances Using Confidence-Based Predictions

Kensuke Nakamura, *Somil Bansal*

International Conference on Robotics and Automation (ICRA), 2023

Parameter-Conditioned Reachable Sets for Updating Safety Assurances OnlineJavier Borquez, Kensuke Nakamura, *Somil Bansal**International Conference on Robotics and Automation (ICRA), 2023***Generating Formal Safety Assurances for High-Dimensional Reachability**Albert Lin, *Somil Bansal**International Conference on Robotics and Automation (ICRA), 2023***DeepReach: A Deep Learning Approach to High-Dimensional Reachability***Somil Bansal*, Claire J. Tomlin*International Conference on Robotics and Automation (ICRA), 2021***A Hamilton-Jacobi Reachability-Based Framework for Predicting and Analyzing Human Motion for Safe Planning***Somil Bansal*, Andrea Bajcsy, Ellis Ratner, Anca D. Dragan, Claire J. Tomlin*International Conference on Robotics and Automation (ICRA), 2020***Generating Robust Supervision for Learning-Based Visual Navigation Using Hamilton-Jacobi Reachability**Anjian Li, *Somil Bansal*, Georgios Giovanis, Varun Tolani, Claire J. Tomlin, Mo Chen*Conference on Learning for Dynamics and Control (L4DC), 2020***Combining Optimal Control and Learning for Visual Navigation in Novel Environments***Somil Bansal*, Varun Tolani, Saurabh Gupta, Jitendra Malik, Claire J. Tomlin*Conference on Robot Learning (CoRL), 2019***An Efficient Reachability-Based Framework for Provably Safe Autonomous Navigation in Unknown Environments**Andrea Bajcsy, *Somil Bansal*, Eli Bronstein, Varun Tolani, Claire J. Tomlin*IEEE Conference on Decision and Control (CDC), 2019***Reachability-Based Safety Guarantees Using Efficient Initializations**Sylvia Herbert, *Somil Bansal*, Shromona Ghosh, Claire J. Tomlin*IEEE Conference on Decision and Control (CDC), 2019***Closed-Loop Model Selection for Kernel-based Models Using Bayesian Optimization**Thomas Beckers, *Somil Bansal*, Claire J. Tomlin, Sandra Hirche*IEEE Conference on Decision and Control (CDC), 2019***A New Simulation Metric to Determine Safe Environments and Controllers for Systems with Unknown Dynamics**Shromona Ghosh, *Somil Bansal*, Alberto Sangiovanni-Vincentelli, Sanjit Seshia, Claire Tomlin*ACM International Conference on Hybrid Systems: Computation and Control (HSCC), 2019***Goal-Driven Dynamics Learning via Bayesian Optimization***Somil Bansal*, Roberto Calandra, Ted Xiao, Sergey Levine, Claire Tomlin*IEEE Conference on Decision and Control (CDC), 2017***Hamilton-Jacobi Reachability: A Brief Overview and Recent Advances***Somil Bansal*, Mo Chen, Sylvia Herbert, Claire Tomlin*IEEE Conference on Decision and Control (CDC), 2017***FaSTrack: a Modular Framework for Fast and Guaranteed Safe Motion Planning**Sylvia Herbert, Mo Chen, Soojean Han, *Somil Bansal*, Jaime F. Fisac, Claire Tomlin*IEEE Conference on Decision and Control (CDC), 2017***Safe Sequential Path Planning of Multi-Vehicle Systems Under Disturbances and Imperfect Information**

Somil Bansal, Mo Chen, Jaime F. Fisac, Claire Tomlin
American Control Conference (ACC), 2017

Learning Quadrotor Dynamics Using Neural Network for Flight Control
Somil Bansal, Anayo K. Akametalu, Frank Jiang, Forrest Laine, Claire Tomlin
IEEE Conference on Decision and Control (CDC), 2016

Plug-and-Play Model Predictive Control for Electrical Vehicle Charging and Voltage Control in Smart Grids
Somil Bansal, Melanie Zeilinger, Claire Tomlin
IEEE Conference on Decision and Control (CDC), 2014

JOURNAL
PUBLICATIONS

Discovering Closed-Loop Failures of Vision-Based Controllers via Reachability Analysis
Kaustav Chakraborty, *Somil Bansal*
IEEE Robotics and Automation Letters (RA-L), 2023

Computation of Regions of Attraction for Hybrid Limit Cycles Using Reachability: An Application to Walking Robots
Jason Choi, Ayush Agrawal, Koushil Sreenath, Claire J. Tomlin, *Somil Bansal*
IEEE Robotics and Automation Letters (RA-L), 2022

Visual Navigation Among Humans with Optimal Control as a Supervisor
Varun Tolani, *Somil Bansal*, Aleksandra Faust, Claire J. Tomlin
IEEE Robotics and Automation Letters (RA-L), 2021

Provably Safe and Scalable Multi-Vehicle Trajectory Planning
Somil Bansal, Mo Chen, Ken Tanabe, Claire Tomlin
IEEE Transactions on Control Systems Technology (TCST), 2020

A Robust Control Framework for Human Motion Prediction
Andrea Bajcsy, *Somil Bansal*, Ellis Ratner, Claire J. Tomlin, Anca D. Dragan
IEEE Robotics and Automation Letters (RA-L), 2020

FaSTrack: a Modular Framework for Real-Time Motion Planning and Guaranteed Safe Tracking
Mo Chen, Sylvia Herbert, Haimin Hu, Ye Pu, Jaime F. Fisac, *Somil Bansal*, SooJean Han, Claire Tomlin
IEEE Transactions on Automatic Control (TAC), 2020

Robust Sequential Path Planning Under Disturbances and Adversarial Intruder
Mo Chen, *Somil Bansal*, Jaime F. Fisac, Claire Tomlin
IEEE Transactions on Control Systems Technology (TCST), 2017

Decomposition of Reachable Sets and Tubes for a Class of Nonlinear Systems
Mo Chen, Sylvia Herbert, Mahesh Vashishtha, *Somil Bansal*, Claire Tomlin
IEEE Transactions on Automatic Control (TAC), 2017

Plug-and-Play Model Predictive Control for Load Shaping and Voltage Control in Smart Grids
Caroline L. Floch, *Somil Bansal*, Claire Tomlin, Scott Moura, Melanie Zeilinger
IEEE Transactions on Smart Grid, 2017

BOOK
CHAPTERS

Control and Safety of Autonomous Vehicles with Learning-Enabled Components
Somil Bansal, Claire Tomlin
Safe, Autonomous and Intelligent Vehicles, Springer, Page 57-75, 2019.

WORKSHOP
PUBLICATIONS**Combining Optimal Control and Learning for Visual Navigation in Novel Environments**

Somil Bansal, Varun Tolani, Saurabh Gupta, Jitendra Malik, Claire Tomlin
Workshop on Deep Learning for Visual Navigation
Conference on Computer Vision and Pattern Recognition (CVPR), 2019

Safe Learning-Enabled Decision Making for Autonomous Navigation in Novel Environments

Somil Bansal, Claire Tomlin
Workshop on Algorithms and Architectures for Learning-in-the-loop Systems in Autonomous Flight
International Conference on Robotics and Automation (ICRA), 2019

Advancing the Runtime of Hamilton-Jacobi Reachability Analysis

Somil Bansal, Claire Tomlin
Workshop on Towards Online Optimal Control of Dynamic Robots
International Conference on Robotics and Automation (ICRA), 2019

TECHNICAL
REPORTS**SPEC: An Approach to Determine Safe Environments and Controllers for Systems with Unknown Dynamics**

Somil Bansal, Shromona Ghosh, Alberto Sangiovanni-Vincentelli, Sanjit Seshia, Claire Tomlin
Technical report, May 2020

Context-Specific Validation of Data-Driven Models

Somil Bansal, Shromona Ghosh, Alberto Sangiovanni-Vincentelli, Sanjit Seshia, Claire Tomlin
Technical report, March 2018

Safe and Resilient Multi-vehicle Trajectory Planning Under Adversarial Intruder

Somil Bansal, Mo Chen, Claire Tomlin
Technical report, November 2017

MBMF: Model-Based Priors for Model-Free Reinforcement Learning

Somil Bansal, Roberto Calandra, Kurtland Chua, Sergey Levine, Claire Tomlin
Technical report, June 2017

DISSERTATION

Safe and Data-Efficient Learning for Robotics: A Control Theoretic Approach

Somil Bansal
Ph.D. Dissertation; EECS Department, University of California, Berkeley, August 2020

Model Predictive Control Approach to Electric Vehicle Charging in Smart Grids

Somil Bansal
MS Dissertation; EECS Department, University of California, Berkeley, May 2014