Samarth Brahmbhatt

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perception, policy learning, sim-to-real for contact-rich manipulation simulation for embodied agents

EDUCATION

Doctor of Philosophy, Robotics (advisor: James Hays, co-advisor: Charles C. Kemp) School of Interactive Computing, Georgia Institute of Technology, GA

May 2020

Master of Science in Engineering, Robotics (advisor: Kostas Daniilidis) University of Pennsylvania, PA.

May 2014

Bachelor of Technology, Electronics & Communication Engineering Nirma University, Ahmedabad, India.

May 2012

REFEREED PUBLICATIONS

- 1. "Zero-Shot Transfer of Haptics-based Object Insertion Policies" Samarth Brahmbhatt, Ankur Deka, Andrew Spielberg, and Matthias Müller, International Conference on Robotics and Automation (ICRA) 2023
- 2. "Pressure Vision: Estimating Hand Pressure from a Single RGB Image" Patrick Grady, Chengcheng Tang, Samarth Brahmbhatt, Christopher D. Twigg, Chengde Wan, James Hays, and Charles C. Kemp, The European Conference on Computer Vision (ECCV) 2022 (oral)
- 3. "Visual Pressure Estimation and Control for Soft Robotic Grippers" Patrick Grady, Jeremy A. Collins, Samarth Brahmbhatt, Christopher D. Twigg, Chengcheng Tang, James Hays, and Charles C. Kemp, IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) 2022
- 4. "ContactOpt: Optimizing Contact to Improve Grasps" Patrick Grady, Chengcheng Tang, Minh Vo, Christopher D. Twigg, Samarth Brahmbhatt, and Charles C. Kemp, *IEEE Conference on Computer Vision and Pattern Recognition (CVPR) 2021 (oral)*
- 5. "ContactPose: A Dataset of Grasps with Object Contact and Hand Pose" Samarth Brahmbhatt, Chengcheng Tang, Christopher D. Twigg, Charles C. Kemp, James Hays, The European Conference on Computer Vision (ECCV) 2020
- 6. "Towards Markerless Grasp Capture" Samarth Brahmbhatt, Charles C. Kemp, and James Hays, Third Workshop on Computer Vision for AR/VR, CVPR 2019
- 7. "ContactGrasp: Functional Multi-finger Grasp Synthesis from Contact" Samarth Brahmbhatt, Ankur Handa, James Hays, and Dieter Fox, *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) 2019*
- 8. "ContactDB: Analyzing and Predicting Grasp Contact via Thermal Imaging" Samarth Brahmbhatt, Cusuh Ham, Charles C. Kemp, James Hays, IEEE Conference on Computer Vision and Pattern Recognition (CVPR) 2019 (oral, best paper finalist)
- 9. "MapNet: Geometry-Aware Learning of Maps for Camera Localization" Samarth Brahmbhatt, Jinwei Gu, Kihwan Kim, James Hays, Jan Kautz, *IEEE Conference on Computer Vision and Pattern Recognition (CVPR) 2018 (spotlight)*
- 10. "DeepNav: Learning to Navigate Large Cities" Samarth Brahmbhatt, James Hays, IEEE Conference on Computer Vision and Pattern Recognition (CVPR) 2017
- 11. "StuffNet: Using 'Stuff' to Improve Object Detection" Samarth Brahmbhatt, Henrik Christensen and James Hays, IEEE Winter Conference on Applications of Computer Vision (WACV) 2017
- 12. "Occlusion-Aware Object Localization, Segmentation and Pose Estimation" Samarth Brahmbhatt, Heni Ben Amor and Henrik Christensen, British Machine Vision Conference (BMVC) 2015

- 13. "Single Image 3D Object Detection and Pose Estimation for Grasping" Menglong Zhu, Kosta Derpanis, Yinfei Yang, Samarth Brahmbhatt, Mabel Zhang, Cody Phillips and Kostas Daniilidis, IEEE International Conference on Robotics and Automation (ICRA) 2014
- 14. "RoboCup 2013 Humanoid Kidsize League Winner" Daniel D. Lee, Seung-Joon Yi, Stephen McGill, Yida Zhang, Larry Vadakedathu, **Samarth Brahmbhatt**, Richa Agrawal and Vibhavari Dasagi, RoboCup 2013: Robot World Cup XVII, Springer Berlin Heidelberg 2014
- 15. "Practical OpenCV" Samarth Brahmbhatt, book published by Apress Media LLC

PAPERS UNDER REVIEW

- 16. "OpenBot-Fleet: A System for Collective Learning with Real Robots" Matthias Müller, **Samarth Brahmbhatt**, Ankur Deka, Quentin Leboutet, David Hafner, Vladlen Koltun.
- 17. "The Un-Kidnappable Robot: Acoustic Localization of Sneaking People" Mengyu Yang, Patrick Grady, Samarth Brahmbhatt, Arun Balajee Vasudevan, Charles C. Kemp, and James Hays.

WORK EXPERIENCE

Intel Labs

May 2022 - present

Research Scientist

- Sim-to-real reinforcement learning (RL) for contact-rich robot manipulation (Pub. 1).
- Distributed on-robot RL for navigation (Pub. 16 in progress).
- Contributing robot control and accurate physics features to the SPEAR simulation platform.

Intel Labs

July 2020 - April 2022

Postdoctoral Researcher with Matthias Müller and Vladlen Koltun

- Sim-to-real RL for contact-rich robot manipulation (Pub. 1), distributed on-robot RL for navigation (Pub. 16 in progress).
- RGB image-based prediction of hand-object pose (Pub. 4) and contact pressure (Pub. 2), as well as soft robot gripper contact pressure (Pub. 3).

Institute for Robotics and Intelligent Machines, Georgia Tech

Fall 2014 - Spring 2020

Graduate Research Assistant, advisor: James Hays, co-advisor: Charles C. Kemp

- Understanding functional grasps of household objects, focusing on hand-object contact and hand pose (Pubs. 5 to 8)
- Learning to navigate large cities using Convolutional Neural Networks (CNNs) (Pub. 10)
- Panoptic segmentation as a local context signal to improve object detection (Pub. 11)
- Detection and 3D pose estimation of partially occluded objects (Pub. 12)

Facebook Reality Labs, Sausalito, CA

Summer 2019

Research Intern, advisors: Chengcheng Tang and Chris Twigg

Creating a large and diverse dataset of paired 3D hand pose, object pose, hand-object contact and multi-view RGB-D images. Deep learning experiments for the novel task of hand-object contact prediction (Pub 5).

NVIDIA Research, Seattle

Summer 2018

Robotics Research Intern, advisors: Ankur Handa and Dieter Fox

Synthesizing functional human-like grasps for diverse robotic end-effectors, from human demonstrations of hand-object contact (Pub 7).

NVIDIA Research, Santa Clara

Summer 2017

Research Intern, advisors: Jinwei Gu and Kihwan Kim

Deep learning for image-based camera localization: proposed novel algorithms to use geometric constraints between images and to make use of large amounts of unlabelled data through semi-supervised learning (Pub. 9).

Dextro, Inc. New York City Summer 2015

Intern, advisor: Sanchit Arora

Panoptic segmentation as a local context signal to improve object detection (Pub. 11)

GRASP Laboratory, University of Pennsylvania

Spring 2013 - Spring 2014

Research Assistant with Kostas Daniilidis and Daniel Lee

- Detection, 6-DOF pose estimation, and PR2 robot grasping of objects in clutter from a single RGB image (Pub. 13, wiki)
- Particle filter localization and player-goalkeeper communication for direction disambiguation for the Robocup 2013 humanoid robot football competition winning team (Pub. 14, wiki)
- High-performance inference code for "Active Deformable Part Models" Zhu et. al., ECCV 2014
- Detecting partially occluded objects in RGB images (Masters' thesis)

School of Engineering and Applied Sciences, University of Pennsylvania

Fall 2013

Teaching Assistant

- MEAM 510: Design of Mechatronic Systems
- MEAM 520: Introduction to Robotics

INVITED TALKS

- 1. "Robot Learning and Perception for Contact-Rich Manipulation" Allen Institute for AI, 2 March 2023
- 2. "Learning Compliant Object Insertion" Nirma University, 5 August 2022
- 3. "Learning Compliant Object Insertion" CyPhySS 2022, IISc Bangalore Robert Bosch Centre for Cyber Physical Systems, 29 July 2022
- 4. "Contact-Rich Manipulation by Humans and Robots" Department of Computational and Data Sciences, IISc Bangalore, 28 July 2022
- 5. "Contact-Rich Manipulation by Humans and Robots" Department of Computer Science and Engineering, IIT Gandhinagar, 27 July 2022
- "6-part lecture series on Computer Vision, Machine Learning, and Robotics" Nirma University, June-July 2021
- 7. "Sim-to-Real Robot Learning" Symbiosis Institute of Technology, 16 May 2021
- 8. "Contact-Centric Grasping Behavior" Guest lecture at the Robotic Caregivers: From Dreams to Reality Spring 2020 course at Georgia Tech.
- 9. "Hand-Object Contact" University of Toronto People, AI, & Robots Research Group, March 2021
- "Hand-Object Contact During Grasping: Capture, Analysis, and Applications" CVPR 2020 Doctoral Consortium, June 2020
- 11. "A Contact-Centric Understanding of our Functional Grasping Behavior" Guest Lecture in Georgia Tech BMED 8813 course on robotic caregivers, Spring 2020
- 12. "A Contact-Centric Understanding of our Functional Grasping Behavior" Stanford Vision and Learning Lab, Stanford CA USA 23 March 2020
- 13. "A Contact-Centric Understanding of our Functional Grasping Behavior" Facebook AI Research, Pittsburgh PA USA 28 February 2020
- 14. "A Contact-Centric Understanding of our Functional Grasping Behavior" Facebook Reality Labs, Redmond WA USA 26 February 2020
- 15. "A Contact-Centric Understanding of our Functional Grasping Behavior" Amazon Robotics & AI, Seattle WA USA 24 February 2020

SERVICE

- Nirma University Alumni Sponsored Lab: Started a robotics and computer vision lab at my undergraduate university by collaborating with other alumni and department faculty. Involved fundraising, student mentoring, and organization building.
- Delivered a 6-part lecture series on computer vision, machine learning, and robotics at my undergraduate university consisting of lectures and homework notebooks.

- Area Chair for the Indian Conference on Computer Vision, Graphics and Image Processing 2022 and 2023.
- Regularly review for CoRL, CVPR (outstanding reviewer 2019), RSS, ECCV, ICRA, IROS, BMVC, WACV, T-PAMI, and RA-L.
- RoboGrads: VP Academics (2017), VP PhD Robotics Program (2018)
- Asha for Education: Ran the Atlanta half-marathon thrice to raise funds, coached the running group twice

COMPUTER SKILLS

- Programming Languages: C++, Python
- Libraries and Tools: MuJoCo, PyTorch, TF-Agents, Unity ML Agents, ROS, GTSAM, OpenCV