Vikash Kumar
540 Capp Street, Apt 310, San Francisco, 94110

Email: vikash@cs.washington.edu
Phone: +1 206 734 8570
http://homes.cs.washington.edu/~vikash

Education/ Positions

Google Brain, Research Scientist	Feb 2018 - Aug 2019
University of Berkeley, Berkeley Artificial Intelligence Research Lab (BAIR), Postdoctoral scholar	Oct 2017 - Jan 2018
OpenAI , Member of technical staff	Aug 2016 - Oct 2017
University of Washington, Ph.D. in Computer Science and Engineering	Feb 2013 - Feb 2017
University of Washington, M.S. in Computer Science and Engineering	Sep 2010 - Feb 2013
Indian Institute of Technology (IIT) Kharagpur, M.S. in Mathematics and Computing	July 2009 - Apr 2010
Indian Institute of Technology (IIT) Kharagpur, B.S. in Mathematics and Computing	July 2005 - Apr 2009

Interests

Embodied Artificial Intelligence, Deep Reinforcement Learning, Robotics, Optimal Control

Manuscripts

Peer-Reviewed Publications:-

- A Game Theoretic Perspective of Model-Based Reinforcement Learning. *Aravind Rajeswaran, Igor Mordatch, Vikash Kumar. International Conference on Machine Learning (ICML) 2020*
- Emergent Real-World Robotic Skills via Unsupervised Off-Policy Reinforcement Learning. *Archit Sharma, Michael Ahn, Vikash Kumar, Sergey Levine, Karol Housman, Shane Gu. Robotics Science and Systems (RSS) 2020*
- Time Reversal as Self-Supervision. *Suraj Nair, Mohammad B., Chelsea Finn, Sergey Levine, Vikash Kumar. IEEE International Conference on Robotics and Automation (ICRA) 2020*
- Dynamics-Aware Unsupervised Discovery of Skills. *Archit Sharma, Shixiang Gu, Sergey Levine, Vikash Kumar, Karol Hausman. International Conference on Learning Representations (ICLR) 2020*
- Ingredients of Real World Robotics Reinforcement Learning. *Henry Zhu, Justin Yu, Dhruv Shah, Abhishek Gupta, Vikash Kumar, Sergey Levine. International Conference on Learning Representations (ICLR) 2020*
- Benchmarking In-Hand Manipulation. *Silvia Cruciani, Balakumar Sundaralingam, Kaiyu Hang, Vikash Kumar, Tucker Hermans, Danica Kragic. IEEE Robotics and Automation Letters (RAL) 2020*
- Deep Dynamics Models for Learning Dexterous Manipulations. *Anusha Nagabandi, Kurt Konolige, Sergey Levine, Vikash Kumar. Conference on Robot Learning (CoRL) 2019*
- ROBEL: Robotics Benchmarks for Learning. *Michael Ahn, Henry Zhu, Kristian Hartikainen, Hugo Ponte, Abhishek Gupta, Sergey Levine, Vikash Kumar. Conference on Robot Learning (CoRL) 2019*
- Multi-Agent Manipulation via Locomotion using Hierarchical Sim2Real. *Ofir Nachum, Michael Ahn, Hugo Ponte, Shane Gu, Vikash Kumar. Conference on Robot Learning (CoRL) 2019*
- Relay Policy Learning: Solving Long-Horizon Tasks via Imitation and Reinforcement Learning. *Abhishek Gupta, Vikash Kumar, Corey Lynch, Sergey Levine, Karol Hausman. Conference on Robot Learning (CoRL) 2019*
- Learning Latent Plans from Play. *Corey Lynch, Mohi Khansari, Ted Xiao, Vikash Kumar, Jonathan Tompson, Sergey Levine, Pierre Sermanet. Conference on Robot Learning (CoRL) 2019*
- Dexterous Manipulation with Deep Reinforcement Learning: Efficient, General, and Low-Cost. *Henry Zhu*, Abhishek Gupta*, Aravind Rajeswaran, Sergey L., Vikash Kumar. International Conference on Robotics and Automation (ICRA) 2019*
- Learning Deep Visuo-motor Policies for Dexterous Hand Manipulation. *Divye Jain, Andrew Li, Shivam Singhal, Aravind Rajeswaran, Vikash Kumar, Emanuel Todorov. International Conference on Robotics and Automation (ICRA) 2019*
- Learning Complex Dexterous Manipulation with Deep Reinforcement Learning and Demonstrations. *Rajeswaran A, Kumar V, Gupta A, Schulman J, Todorov E and Levine S.* Robotics Science and Systems (RSS) 2019
- Divide-and-Conquer Reinforcement Learning. *Ghosh D, Singh A, Rajeswaran A, Kumar V, Levine S. International Conference on Learning Representations (ICLR) 2018*
- Variance Reduction for Policy Gradient with Action-Dependent Factorized Baselines. *Wu C., Rajeswaran A., Duan Y., Kumar V, Bayen A, Kakade S, Mordatch I, Abbeel . International Conference on Learning Representations (ICLR) 2018*
- Optimal Control with Learned Local Models: Application to Dexterous Manipulation. *Kumar V, Todorov E, Levine S.* **BEST MANIPULATION PAPER AWARD**, *IEEE International Conference on Robotics and Automation (ICRA) 2016*
- MuJoCo Haptix: A virtual reality system for hand manipulation. *Kumar V, Todorov E. IEEE-RAS International Conference on Humanoid Robots (Humanoids) 2015*
- Real-time behavior synthesis for dynamic hand-manipulation. *Kumar V, Tassa Y, Erez T, Todorov E. IEEE International Conference on Robotics and Automation (ICRA) 2014*
- STAC: Simultaneous Tracking And Calibration. *Wu T, Tassa Y, Kumar V, Movellan J, Todorov E. Humanoids 2013*
- An integrated system for real time Model Predictive Control for humanoid robots. *Erez T, Lowrey K, Kumar V, Kolev S, Todorov E. Humanoids 2013*
- A low cost and modular, 20 dof anthropomorphic robotic hand: Design, Actuation and Modelling. *Zhe X, Kumar V, Todorov E. IEEE-RAS International Conference on Humanoid Robots (Humanoids) 2013*
- Synthesis of Complex Behaviors with Optimal Control. *Todorov E, Tassa Y, Erez T, Mordatch I, Kulchenko P, Kumar V Computational and Systems Neuroscience (COSYNE) 2013*
- Fast, strong and compliant pneumatic actuation for dexterous tendon-driven hands. *Kumar V, Todorov E. IEEE International Conference on Robotics and Automation (ICRA) 2013*

- Design of an anthropomorphic robotic finger system with biomimetic artificial joints. *Zhe X, Kumar V, Matsuoka Y, Todorov E. IEEE International Conference on Biomedical Robotics and Bio mechatronics (BioRob) 2012*
- Self and Mutual learning in Robotic Arm, based on Cognitive systems. *Kumar V, Patil C, Sachan S. (best paper award finalist) International Multi-Conference of Engineers and Computer Scientists 2010*

Peer Reviewed Workshop Publications (excluding work that appeared above) :-

- Hand Manipulation Suite: A benchmark for dexterous manipulation. *Kumar V, Rajeswaran R, Gupta A, Todorov E, Levine S, Robotics Science and Systems (RSS) 2017*
- Physically-Consistent Hand Manipulation Dataset. *Kumar V, Todorov E. Workshop on Grasping and Manipulation Datasets. IEEE International Conference on Robotics and Automation (ICRA) 2016*

Selected Press Coverage

- VentureBeat: Google AI researchers want to teach robots tasks through self-supervised reverse engineering
- CNN: Google shows off far-flung A.I. research projects. Jan 29 2020
- VentureBeat: Google's robotic hand AI can learn to rotate Baoding balls with minimal training data. Sept 27th 2019
- The New York Times: Inside Google's Rebooted Robotics Program. Mar 26th 2019
- Columns: Inventing the future: A 'new landmark' for computer science and engineering. Feb 28th 2019
- NeuroHive: A Robot To Use Fingers Like Human Oct 15th 2019
- The New York Times: How robot hands are evolving to do what ours. July 30th 2018
- New Atlas: Bridging the gap between science and fiction. Dec 28, 2016
- Communications of the ACM: Hand Jive: A Robot Hand Learns to Spin. Aug 23, 2016
- Reuters: Robot hand gets a human touch. May 13th 2016
- Wired: This dexterous robot can teach itself to spin a tube of coffee beans. May 10, 2016
- Business Insider: Researchers created a robotic hand that is eerily human-like and can learn on its own. May 29, 2016
- MIT Tech Review: ADROIT featured in TR35. 2016
- UW360: A robotic hand that can move like a human hand, Aug 31 2016
- ScienceDaily: This 5-fingered robot hand learns to get a grip on its own. May 9th 2016
- Engadget: Robot hand learns to twirl objects on its own. May 11th 2016
- GeekWire: UW team creates robotic hand that learns to become more dexterous than yours. May 9th 2016
- Gizmodo: This Robot's Teaching Itself to Twirl a Stick. May 11th 2016
- UWToday: This five-fingered robot hand learns to get a grip on its own. May 9th 2016
- UW CSE News: UW CSE robot hand teaches itself to manipulate objects. May 9th 2016
- CNN: The superhuman robot hand that learns from its mistakes. May 19th 2016
- Tech Insider: Researchers created a robotic hand that is eerily human-like and can learn on its own. May 25th 2016
- Indian Express: Five-fingered robot hand learns to get a grip on its own. May 10th 2016
- UK's Daily Mirror: Incredible five-fingered robotic hand has ability to learn from its own experiences. May 11th 2016
- Economic Times: Five-fingered robot hand learns to get a grip on its own. May 10th 2016
- ZDNet: Five-fingered robot hand has a mind of its own. May 11th 2016
- Kurzweil: This five-fingered robot hand is close to human in functionality. May 10th 2016
- Most significant bit: Adroit: The robot hand for which practice makes perfect. UW-CSE, Summer'16
- Futurism: This five-fingered robot hand is nimbler than your own. May 13th 2016
- Hackaday: Robot cheerleader just needs a hand to learn basic tricks. May 13th 2016
- Design: Five-fingered robot hand that learns tasks on its own. May 10th 2016
- Interesting engineering: Robotic Hands that Teach Themselves to Move. May 12th 2016
- Foxnews: Cool robot hand learns as it goes. May 10th 2016
- IEEE Spectrum: Next-Gen Prosthetic Limbs in Simulation and Reality. Feb 12th 2015
- UW CSE News: People's choice award. Oct 24th 2013
- The New York Times: A robot with a delicate touch. Sep 18th 2012
- The Daily: UW programmers create software for disaster response robot. Nov 12th 2012

Research Experience/ Internships

Deep Dynamics models for Dexterous Manipulation Feb'18-Aug'19

Advisor: Dr. Vincent Vanhoucke, Google Brain

Created and led a research team of 17 members (in 16 months), focusing on deep reinforcement leanring on high-demensional continuous spaces on physical hardware. Our approach learns to simultaneously rotate two baoding ball in the palm of an five finger anthropomorphoric hand within ~4 hours of on-hardware experience.

Towards autonomy in Deep Reinforcement Learning Oct'17-present

Advisor: Dr. Sergey Levine, UC Berkeley

Developing deep reinforcement leanring techniques that can autonomously learn in the real world via direct on-hardware training. Our approach learns from scratch complex manipualation strategies without any human suprvision.

MuJoCo: Advanced Physics Simulation Jan'12-present

Advisor: Dr. Emanuel Todorov, Roboti, llc.

Significantly contributed towards the development of MuJoCo physics simulation engine and MuJoCo Haptix framework.

OpenAI: Embodied Artifical Intelligence Apr'17-Sept'17

Advisor: **Elon Musk**, co-founder, OpenAI

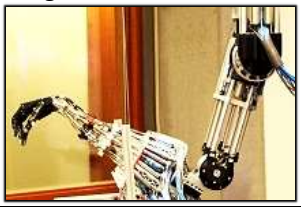
Directly reported to Mr. Elon Musk. Conceptualized and developed the vision for the robotics team at OpenAI. Designed and developed reinforcement learning amenable infrastructure for the robotics lab. Led efforts for accelerating deep reinforcement learning for high dimensional continuous control problems.

Virtual Embodiment for bootstrapping learning based techniques Aug'16-Nov'16

Advisor: Wojciech Zaremba, co-founder, OpenAI

Developed first person virtual embodiment for FETCH robot. The low latency system is capable of hosting dexterous manipulation, both in simulation and on the physical robot. Further involvements include advisory and strategic mentorship for robotics infrastructure, robust physics simulation and motion planning.

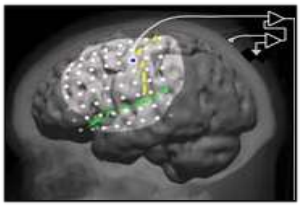
Design, Control, & Behavior Synthesis for ADROIT- A reconfigurable manipulation platform Mar'12-Dec'16



Advisor: Dr. Emanuel Todorov, Applied math & CSE, Univ. of Washington, USA

Design, control, and dexterous manipulation behavior synthesis for a pneumatically-actuated, compliant, anthropomorphic, 28 degree-of-freedom robotic hand capable of performing dexterous object manipulation tasks. Adroit features: joint, touch, tendon length and muscle force sensing capabilities.

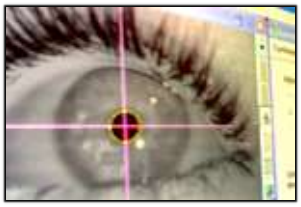
Closed-loop optimal control of prosthetic hands Jan'14-June'15



Advisors: Dr. Raj Rao, Director - CSNE & CSE, Univ. of Washington, USA
Dr. Emanuel Todorov, Applied math & CSE, Univ. of Washington, USA

Closing the loop between the 28-dof-ADROIT-hand and the brain, using ECoG signals, for feedback during hand manipulation. ECoG signals provide high-level feedback in terms of goal selection & corrective maneuvers while an automated controller tries to control the hand.

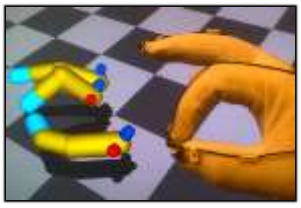
Gesture based control strategies Feb'11-May'14



Advisor: Dr. Emanuel Todorov, Applied math & CSE, Univ. of Washington, USA

Exploiting natural gestures such as eye movements, speech etc. for specifying high-level goals for robots (running low-level controller that realizes the specified high-level goals) thus seamlessly bridging the communication gap between a human and a machine.

Modeling & statistical analysis of virtual environment for understanding human finger interactions April-July'09



Visiting Researcher, CSE, Univ. of Washington, USA
Advisor: Dr. Emanuel Todorov, Applied math & CSE, Univ. of Washington, USA

Studied human finger performing dexterous manipulation experiments analyzing contacts, object interactions and grasping behaviors, addressing issues like contact forces, tactile feedback, 3D depth feedback, obstacle avoidance, optimal trajectories etc.

Optically perfect machining of acrylic surface- Discovery & Automation April-July'08

Summer intern– Intelligent Automation Inc. (IAI), USA
Advisor: Founder & President Emeritus Leonard S. Haynes, IAI, Washington DC, USA

Identification/discovery of a process to polish glued edges of acrylic boxes to optical clarity and realization of an industrial assembly to automate the identified process.

Thesis

Ph.D. : Manipulators and Manipulation in High Dimensional Spaces
Advisor: Dr. Emanuel Todorov, Applied math & CSE, Univ. of Washington, USA
Dr. Sergey Levine, EECS, Univ. of California, Berkeley, USA

M.S. : Fuzzy Genetic Algorithms(FGA) (**BEST M.S. THESIS AWARD**)
Advisor: Prof. Debjani Chakraborty, Dept. of Mathematics, IIT Kharagpur

B.S. : New Genetic Algorithm based multi-objective optimization algorithm(NMGA)
Advisor: Prof. Nirupam Chakraborty, Head of Dept. of Metallurgical & Materials Engineering, IIT-Kharagpur

Students Mentored

- Abhishek Gupta, Ph.D. in EECS under Prof. Sergey Levine and Prof. Pieter Abbeel at UC Berkeley. (Apr'19-present)
- Aravind Rajeshwaran, Ph.D. in CS under Prof. Sham Kakade and Prof. Emo Todorov at U of Washington. (Apr'16-present)
- Anusha Nagabandi, Ph.D. in EECS under Prof. Sergey Levine and Prof. Ron Fearing at UC Berkeley. (Sept'18-Aug'19)
- Suraj Nair, Ph.D. in CS under Prof. Chelsea Finn and Prof. Silvio Savarese at Stanford University. (June'18-Sept'19)
- Kristian Hartikainen, now pursuing Ph.D. under Prof. Shimon Whiteson at University of Oxford
- Dibya Ghosh, Bachelors in EECS at UC Berkeley, (starting Ph.D. at UC Berkeley 2020)
- Arshit Sharma B. Tech in Electrical Engineering, Indian Institute of Technology, Kanpur. (Ph.D applicant 2020)
- Henry Zhu, Bachelors in EECS at UC Berkeley. (Ph.D applicant 2020)
- Visak CV, Master's in ME, University of Washington (Mar'15-Aug'16) (Pursuing Ph.D. at Georgia Tech under Dr. C. Karen Liu)
- Kaiyu Zheng, Bachelors in CS, University of Washington (Pursuing Ph.D. in at Brown University, under Prof. Stefanie Tellex)
- Dylan Holmes, Bachelors in Computer Science, University of Washington (Jul'14-Mar'16)
- Anselm Nicklas, Visiting student, Electrical and Computer Engineering, Technische Universitat Munich, Germany
- Others: Hugo Ponte, Michael Ahn, Justin Yu, Divye Jain, Andrew Li, Shivam Singhal

Invited Talks (excluding conference/workshop talks)

- Facebook AI Research. Learning at your Finger Tips, June'20
- Univ. Of Texas Austin. Learning at your Finger Tips, May'20
- ADSI summer school: Algorithmic Foundations on Learning and control, Aug'19
- Univ. Of Washington: Guest lecture in Deep Reinforcement Learning class, May'18
- IIT-Delhi: Recent realizations in Robotic Learning, Oct'17
- OpenAI: Learning Dexterous Manipulation in the real world, Dec'16
- DeepMind: Learning Dexterous Manipulation via Experience and Imitation, Dec'16
- Google-Brain: Learning Dexterous Manipulation in High Dimensional spaces, Dec'16
- Kindred: Learning Dexterous Manipulation via Experience and Imitation, Dec'16
- Vicarious: Learning Dexterous Manipulation via Experience and Imitation, Dec'16
- Oculus Research, Redmond: Manipulators and Manipulation in High Dimensional Spaces, Mar'16
- MIT, CSAIL: Towards dexterous hand manipulation, Sept'15
- Harward: Towards dexterous hand manipulation, Sept'15
- Microsoft Research, Redmond: Real time synthesis of hand manipulation via Dimensionality Augmentation, Feb'14

Achievements

Awards

- **Best Manipulation Paper Award**, ICRA'16
- 'Viewer's choice award', Affiliates'13, UW, CSE
- **Best Thesis Award**, M.Sc. thesis, Dept. of Mathematics and Computing, IIT Kharagpur '10
- Gold, Open hardware, KSHITIJ'09- Asia's largest techno-management Fest
- 'Most Industrially feasible', Techkriti'09, IIT Kanpur
- Silver, Open hardware, KSHITIJ'08, IIT Kharagpur
- Gold, Geobotics, Great Step'08, IIT Kharagpur
- Gold in Inter-hall Hardware modeling'07, IIT Kharagpur
- Silver in Inter-hall Hardware modeling'08, IIT Kharagpur
- Bronze, Robotic Water-polo, KSHITIJ'06, IIT Kharagpur
- Gold, Inter-hall Product design'06, IIT Kharagpur

	• Bronze, Inter-hall ad-design'09, IIT Kharagpur
Honors	• **BEST ALL ROUNDER**, Indian Institute of Technology IIT-Kharagpur '10 (Ankik Dhar Memorial) • 'Spirit Of Nehru Award', Nehru Hall, IIT Kharagpur '10 • Best All Rounder'09 & Budding Spirit'07, Nehru Hall, IIT Kharagpur
Position of Responsibilities	• **Vice President, Dept. of Mathematics'08-09, IIT** Kharagpur • Chief Editor, AWAAZ – campus monthly newsletter'06-09 • Member of Kharagpur Robotics & Artificial Intelligence Group (KRAIG)
Others	• Several state/district level awards in Hockey, Volleyball, Fine Arts

Scholarships and Grants

- Google cloud research grant, 2019
- NSF Student travel grant, 2014
- Center for Neuroscience Travel Award, Univ. of Washington, 2012, 2014, 2015
- MERIT-CUM-MEANS Scholarship, IIT Kharagpur, 2005, 2006, 2007, 2008, 2009, 2010
- Inter-IIT Sports Scholarship, IIT Kharagpur, 2006-07

Other Professional Involvements

- Organizer
  - Robotics Science and Systems Workshop, What did we learn from the DARPA Robotics Challenge, June 2013
  - University of Washington, Robotics Colloquium, 2014
- Associate Editor
  - IEEE International Conference on Robotics and Automation, 2019
- Conference program Committee / Reviewer
  - Robotics Science and Systems, 2020
  - IEEE Robotics and Automation Letters (RA-L), 2019
  - Science, 2018
  - IEEE International Conference on Robotics and Automation (ICRA), 2014, 2015, 2016, 2017, 2018, 2019
  - Mechatronics, 2018
  - IROS 2014, 2017
- Grant Committee
  - Dutch Research Council, Netherlands Organization for Scientific Research, 2020
- Admissions Committee
  - Computer science graduate admissions committee, University of Washington, 2013, 2004

References

- Dr. Sergey Levine, Assistant Professor, Dept. of Electrical Engineering & Computer Science, Univ. of California, Berkeley
- Dr. Emo Todorov, Associate Professor, Applied Mathematics, Computer Science & Engineering, Univ. of Washington, Seattle
- Dr. Pieter Abbeel, Professor, Department of Electrical Engineering & Computer Sciences, Univ. of California, Berkeley
- Dr. Dieter Fox, Professor, Paul G. Allen School of Computer Science & Engineering, Univ. of Washington, Seattle
- Dr. Abhinav Gupta, Associate Professor, The Robotics Institute, Carnegie Mellon University, Pittsburgh
- Dr. Siddhartha Srinivasa, Professor, Paul G. Allen School of Computer Science & Engineering, Univ. of Washington, Seattle