Vikash Kumar
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Education

University of Washington, Ph.D. in Computer Science and Engineering — 2010- present
Indian Institute of Technology (IIT) Kharagpur, M.S./B.S. in Mathematics and Computing — 2005- 2010

Interests

Robotics, Optimal Control, Artificial Intelligence, Machine Learning

Manuscripts

Conference:-

- 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*

Workshop :-

- Optimal control with learned local models: Scaling dexterous manipulation. Kumar V, Todorov E, Levine S. Exploiting Contact Dynamics in Manipulation. IEEE International Conference on Robotics and Automation (ICRA) 2016
- Physically-Consistent Hand Manipulation Dataset. Kumar V, Todorov E. Workshop on Grasping and Manipulation Datasets. IEEE International Conference on Robotics and Automation (ICRA) 2016

Under preparation/ under review :-

- Learning and Generalizing Skills: Application to Dexterous Manipulation. Kumar V, Gupta A, Todorov E, Levine S.
- High Performance Pneumatics using Model Predictive Control. Kumar V, Todorov E.
- Pneumatic Modelling for Adroit Manipulation Platform. Kumar V.C.V, Kumar V.
- Optimizing fuzzy multi-objective problems using fuzzy genetic algorithms and FZDT test functions. *Kumar V, Chakroborty D*

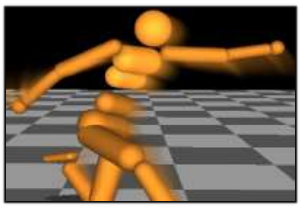
Media

- Hand Jive: A Robot Hand Learns to Spin. Communications of the ACM, Aug 23, 2016
- Robot hand gets a human touch. Reuters. May 13th 2016
- This dexterous robot can teach itself to spin a tube of coffee beans. Wired, May 10, 2016
- Researchers created a robotic hand that is eerily human-like and can learn on its own. Business Insider, May 29, 2016
- ADROIT featured in TR35, MIT Tech Review
- A robotic hand that can move like a human hand, UW360, Aug 31 2016
- This 5-fingered robot hand learns to get a grip on its own. ScienceDaily. May 9th 2016
- Robot hand learns to twirl objects on its own. Engadget. May 11th 2016
- UW team creates robotic hand that learns to become more dexterous than yours. GeekWire. May 9th 2016
- This Robot's Teaching Itself to Twirl a Stick. Gizmodo. May 11th 2016
- This five-fingered robot hand learns to get a grip on its own. UWToday. May 9th 2016
- UW CSE robot hand teaches itself to manipulate objects. UW CSE News. May 9th 2016
- The superhuman robot hand that learns from its mistakes. CNN. May 19th 2016
- Researchers created a robotic hand that is eerily human-like and can learn on its own. Tech Insider. May 25th 2016
- Five-fingered robot hand learns to get a grip on its own. Indian Express. May 10th 2016
- Incredible five-fingered robotic hand has ability to LEARN from its own experiences. UK's Daily Mirror. May 11th 2016
- Five-fingered robot hand learns to get a grip on its own. Econimic Times. May 10th 2016
- Five-fingered robot hand has a mind of its own. ZDNet. May 11th 2016

- This five-fingered robot hand is close to human in functionality. Kurzweil. May 10th 2016
- Adroit: The robot hand for which practice makes perfect. Most significant bit. UW-CSE, Summer'16
- This five-fingered robot hand is nimbler than your own. Futurism, May 13th 2016
- Robot cheerleader just needs a hand to learn basic tricks. Hackaday. May 13th 2016
- This five-fingered robot hand is nimbler than your own. Futurism. May 13th 2016
- Robotic Hands that Teach Themselves to Move. Interesting engineering. May 12th 2016
- Cool robot hand learns as it goes. Foxnews. May 10th 2016
- Next-Gen Prosthetic Limbs in Simulation and Reality. IEEE Spectrum. Feb 12th 2015
- People's choice award. UW CSE News. Oct 24th 2013
- A robot with a delicate touch. The New York Times. Sep 18th 2012
- UW programmers create software for disaster response robot. The Daily. Nov 12th 2012

Research Experiences/ Internships

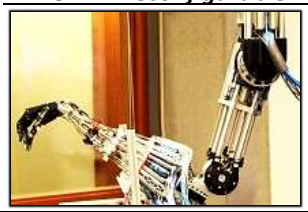
MuJoCo: Advanced Physics Simulation Jan'12-present



Advisors: Dr. Emanuel Todorov, Roboti, llc.

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

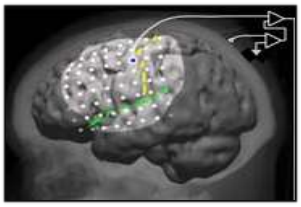
ADROIT- A reconfigurable manipulation platform: Design & Control Mar'12-present



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

Design & control of 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.

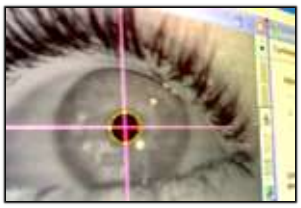
Closed-loop optimal control of prosthetic hands Jan'14-June'15



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 manipultion. ECoG signals provides high level feedback in terms of goal selection & corrective manuvers while an automated controler tries to control the hand.

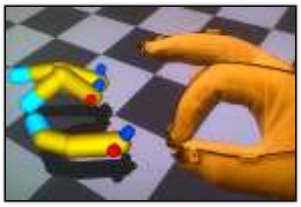
Gesture based control strategies Feb'11-May'14



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 a 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 behaviours, 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.

Dissertation

B.S. Thesis: New Genetic Alogrithm based multi-objective optimization algorithm(NMGA)
Advisor: Prof. Nirupam Chakraborty, Head of Dept. of Metallurgical & Materials Engineering, IIT-Kharagpur
The Algorithm works on a neighborhood concept in the functional space, utilizes the ideas on weak dominance and ranking and uses its own procedures for population sizing. NMGA performs well against standard test functions, and when applied to

a real-life data of integrated steel plant, it outperformed other multi-objective evolutionary algorithm.

M.S. Thesis: Fuzzy genetic Algorithms(FGA)

Advisor: Prof. Debjani Chakraborty, Dept. of Mathematics, IIT Kharagpur

FGA proposes a unique solution strategy for optimizing fuzzy multi objective problems. Extrapolating standard ZDT test functions to fuzzy domains, new benchmark test functions (FZDT) for fuzzy optimization problems have been proposed. Developed FGA has been successfully verified against FZDT test functions. Results were also found coherent with standard ZDT functions under classical assumptions.

Achievements

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
Awards	• 'Viewer's choice award', Affiliates'13, UW, CSE • 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
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

- 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

Students Advised

- Visak CV, Master's in Mechanical Engineering, University of Washington (Mar'15-Aug'16) (Pursuing PhD in Georgia Tech under Dr. C. Karen Liu)
- Dylan Holmes, Bachelors in Computer Science, University of Washington (Jul'14-Mar'16)
- Anselm Nicklas, Visiting student from Department of Electrical and Computer Engineering, Technische Universitat Munich, Germany (Apr'15-Sept'15)
- Kaiyu Zheng, , Bachelors in Computer Science, University of Washington (Mar'14-Apr'14)