Karol Hausman

Contact Information

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Research Interest

My research interests lie in active state estimation, control generation and machine learning for robotics. I investigate interactive perception, where robots use their manipulation capabilities to gain the most useful perceptual information to model the world and inform intelligent decision making. The paradigm of generating motion to improve state estimation (interactive perception) and task execution (reinforcement learning) has been applied throughout my work, where I show that coupling perception and control together can be beneficial for both fields. More recently, I have been investigating deep reinforcement learning and its applications in robotics. I have evaluated my work on many different platforms including quadrotors, humanoid robots and robotic arms.

Education

08.2013 - Present	Ph.D. in Computer Science, **University of Southern California** Robotic Embedded Systems Lab | Adviser: Prof. Gaurav Sukhatme
10.2011 - 10.2013	M.Sc. in Robotics, **Technical University Munich** Thesis: "Object Segmentation and Recognition using Interactive Perception" | Adviser: Prof. Daniel Cremers *summa cum laude*, ranked 2nd in the graduating class
10.2007 - 09.2012	M.Sc. in Mechatronics, **Warsaw University of Technology** Specialization: Robotics *summa cum laude*, ranked 1st in the graduating class Additional one year coursework at the Computer Science Department
10.2009 - 07.2010	Faculty of Philosophy and Sociology, **University of Warsaw** Completed one year coursework towards a B.A. Degree in Philosophy ranked 1st in the class

Work Experience

06.2016 - 09.2016	Research Scientist Intern at **Google DeepMind**, London, UK Adviser: Prof. Martin Riedmiller Leader of a research projected submitted to ICLR 2017.
05.2016 - 08.2016	Robotics Intern at **Qualcomm Research**, San Diego, CA Adviser: Dr. Casimir Wierzynski, Dr. Harris Teague Developed active mapping and planning under uncertainty solutions for an autonomous quadrotor.

06.2015 - 09.2015 Visiting Researcher at **NASA Jet Propulsion Laboratory**, Pasadena, CA

Adviser: Dr. Stephan Weiss, Dr. Larry Matthies

Developed a modular sensor fusion framework with probabilistic sensor switching algorithms for a Mars helicopter. Leader of a research project accepted to ICRA 2016.

05.2014 - 10.2014 Visiting Researcher at **Bosch Research Center**, Palo Alto, CA

Adviser: Dr. Sarah Osentoski, Dr. Scott Niekum

Leader of the Active Articulation Model Estimation research project accepted to ICRA 2015. Developed a number of Learning from Demonstration algorithms on the PR2 robot.

04.2013 - 08.2013 Robotics Intern at **Bosch Research Center**, Palo Alto, CA

Adviser: Dr. Sarah Osentoski

Developed Gazebo simulation for a remote-farming robot. Developed user interfaces and autonomous algorithms for quadrotors.

12.2011 - 03.2013 Research Assistant at **Technical University Munich**, Munich, DE

Intelligent Autonomous Systems Group | Adviser: Dr. D. Pangercic, Prof. Michael Beetz

Developed interactive segmentation package for textured and texture-less objects using the PR2 robot. Developed an open-source framework for interactive perception. Leader of a research project accepted to ICRA 2013.

Journal Articles and Book Chapters

J4. K. Hausman, J. Preiss, G. Sukhatme, S. Weiss, **Occlusion-Aware Trajectory Optimization for Self-Calibration with Application to UAVs**, *In IEEE Robotics and Automation Letters (RA-L)*, 2017.

J3. K. Hausman*, J. Bohg*, B. Sankaran*, O. Brock, D. Kragic, S. Schaal, G. Sukhatme, **Interactive Perception: Leveraging Action in Perception and Perception in Action**, *In The IEEE Transactions on Robotics (T-RO)*, 2017.

J2. K. Hausman, J. Mueller, A. Hariharan, N. Ayanian, G. Sukhatme, **Cooperative Multi-Robot Control for Target Tracking with Onboard Sensing**, *In The International Journal of Robotics Research (IJRR)*, 2015.

J1. K. Hausman, D. Pangercic, Z. Marton, F. Belent-Benczedi, C. Bersch, M. Gupta, G. Sukhatme, M. Beetz, **Interactive Segmentation of Textured and Textureless Objects**, *In Handling Uncertainty and Networked Structure in Robot Control*, L. Busoniu and L. Tamas (eds.), Springer, 2015.

Conference Proceedings

C13. A. Agha-mohammadi, E. Heiden, K. Hausman, G. Sukhatme **Confidence-rich Grid Mapping**, *In International Symposium on Robotics Research (ISRR)*, 2017.

C12. K. Hausman*, Y.Chebotar*, S. Schaal, G. Sukhatme, J. Lim **Multi-Modal Imitation Learning from Unstructured Demonstrations using Generative Adversarial Nets**, *In Neural Information Processing Systems (NIPS)*, 2017.

C11. E. Heiden, K. Hausman, G. Sukhatme, A. Agha-mohammadi **Planning High-speed Safe Trajectories in Confidence-rich Maps**, *In IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2017.

C10. Y.Chebotar*, K. Hausman*, M. Zhang*, G. Sukhatme, S. Schaal, S. Levine **Combining Model-Based and Model-Free Updates for Trajectory-Centric Reinforcement Learning**, *In International Conference on Machine Learning (ICML)*, 2017.

C9. J. Preiss, K. Hausman, G. Sukhatme, S. Weiss, **Trajectory Optimization for Self-Calibration and Navigation**, *In Robotics: Science and Systems (RSS)*, 2017.

C8. K. Hausman*, Y. Chebotar*, O. Kroemer, G. Sukhatme, S. Schaal, **Generalizing Regrasping with Supervised Policy Learning**, *In International Symposium on Experimental Robotics (ISER)*, 2016.

C7. K. Hausman, G. Kahn, S. Patil, J. Mueller, K. Goldberg, P. Abbeel, G. Sukhatme, **Occlusion-Aware Multi-Robot 3D Tracking**, *In IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2016.

C6. Y. Chebotar, K. Hausman, Z. Su, G. Sukhatme, S. Schaal, **Self-Supervised Regrasping using Spatio-Temporal Tactile Features and Reinforcement Learning**, *In IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2016.

C5. K. Hausman, S. Weiss, R. Brockers, L. Matthies, G. Sukhatme, **Self-Calibrating Multi-Sensor Fusion with Probabilistic Measurement Validation for Seamless Sensor Switching on a UAV**, *In IEEE International Conference on Robotics and Automation (ICRA)*, 2016.

C4. Z. Su, K. Hausman, Y. Chebotar, A. Molchanov, G. Loeb, G. Sukhatme, S. Schaal, **Force Estimation and Slip Detection for Grip Control using a Biomimetic Tactile Sensor**, *In Proceedings of the IEEE-RAS International Conference on Humanoid Robotics (Humanoids)*, 2015.

C3. K. Hausman, S. Niekum, S. Osentoski, G. Sukhatme, **Active Articulation Model Estimation through Interactive Perception**, *In IEEE International Conference on Robotics and Automation (ICRA)*, 2015.

C2. K. Hausman, J. Mueller, A. Hariharan, N. Ayanian, G. S. Sukhatme, **Cooperative Control for Target Tracking with Onboard Sensing**, *In Proceedings, International Symposium on Experimental Robotics (ISER)*, Jun 2014.

C1. K. Hausman, F. Balint-Benczedi, D. Pangercic, Z. Marton, R. Ueda, K. Okada, M. Beetz, **Tracking-based Interactive Segmentation of Textureless Objects**, *In IEEE International Conference on Robotics and Automation (ICRA)*, 2013.
Best Service Robotics Paper Finalist.

Reviewed Workshop Papers and Abstracts

W14. K. Hausman*, Y.Chebotar*, S. Schaal, G. Sukhatme, J. Lim **IntentionGAN: Multi-Task Imitation Learningfrom Unstructured Demonstrations**, *Conference on Robot Learning (CoRL)*, 2017.

W13. K. Hausman*, Y.Chebotar*, S. Schaal, G. Sukhatme, J. Lim **IntentionGAN: Multi-Modal Imitation Learningfrom Unstructured Demonstrations**, *RSS Workshop on Learning from Demonstration in High-Dimensional Feature Spaces*, 2017.

W12. Y.Chebotar*, K. Hausman*, M. Zhang*, G. Sukhatme, S. Schaal, S. Levine **Combining Model-Based and Model-Free Updates for Deep Reinforcement Learning**, *In RSS 2017 Workshop on New Frontiers for Deep Learning in Robotics*, 2017.
Best Paper Award

W11. Y. Chebotar*, K. Hausman*, O. Kroemer, G. Sukhatme, S. Schaal, **Regrasping using Tactile Perception and Supervised Policy Learning**, *In AAAI Symposium on Interactive Multi-Sensory Object Perception for Embodied Agents*, 2017.

W10. Y. Chebotar*, K. Hausman*, O. Kroemer, G. Sukhatme, S. Schaal, **Supervised Policy Fusion with Application to Regrasping**, *In IROS 2016 Workshop on Closed-loop Grasping and Manipulation: Challenges and Progress*, 2016.

W9. K. Hausman, James Preiss, G. Sukhatme, S. Weiss, **Observability-Aware Trajectory Optimization for Self-Calibration with Application to UAVs**, *In RSS 2016 Workshop on Robot-Environment Interaction for Perception and Manipulation*, 2016.

W8. Y. Chebotar, K. Hausman, Z. Su, A. Molchanov, O. Kroemer, G. Sukhatme, S. Schaal, **BiGS: BioTac Grasp Stability Dataset**, *In ICRA 2016 Workshop on Grasping and Manipulation Datasets*, 2016.

W7. Z. Su, K. Hausman, Y. Chebotar, A. Molchanov, G. Loeb, G. Sukhatme, S. Schaal, **Slip Classification Using Tangential and Torsional Skin Distortions on a Biomimetic Tactile Sensor**, *In BMVA Workshop on Visual, Tactile and Force Sensing for Robot Manipulation*, 2015.

W6. Z. Su, K. Hausman, Y. Chebotar, A. Molchanov, G. Loeb, G. Sukhatme, S. Schaal, **Slip Detection and Classification for Grip Control using Multiple Sensory Modalities on a Biomimetic Tactile Sensor**, *In IROS 2015 Workshop on Multimodal Sensor-Based Robot Control for HRI and Soft Manipulation*, 2015.

W5. K. Hausman, G. Kahn, S. Patil, J. Mueller, K. Goldberg, P. Abbeel, G. Sukhatme, **Optimization-based Cooperative Multi-Robot Target Tracking with Reasoning about Occlusions**, *In IROS 2015 Workshop on On-line Decision-Making in Multi-Robot Coordination*, 2015.

W4. K. Hausman, C. Corcos, J. Mueller, F. Sha, G. S. Sukhatme, **Towards Interactive Object Recognition**, *In IROS 2014 3rd Workshop on Robots in Clutter: Perception and Interaction in Clutter*, 2014.

W3. K. Hausman, J. Mueller, A. Hariharan, N. Ayanian, G. S. Sukhatme, **Cooperative Multi-Robot Control for Target Tracking with Efficient Switching of Onboard Sensing Topologies**, *In IROS 2014 Workshop on Taxonomies of Interconnected Systems: Topology in Distributed Robotics*, 2014.

W2. K. Hausman, Ch. Bersch, D. Pangercic, S. Osentoski, Z. Marton, M. Beetz, **Segmentation of Cluttered Scenes through Interactive Perception**, *In ICRA 2012 Workshop on Semantic Perception and Mapping for Knowledge-enabled Service Robotics*, 2012.

W1. Ch. Bersch, D. Pangercic, S. Osentoski, K. Hausman, Z. Marton, R. Ueda, K. Okada, M. Beetz, **Segmentation of Textured and Textureless Objects through Interactive Perception**, *In RSS Workshop on Robots in Clutter: Manipulation, Perception and Navigation in Human Environments*, 2012.

Patents

Provisional Patent Holder: Multi-Sensor Fusion with Probabilistic Sensor Switching and System Self-Calibration for a UAV

Scholarships and Awards

2017	Best Paper Award at RSS 2017 New Frontiers for Deep Learning in Robotics Workshop
2013 - 2014	USC Viterbi School of Engineering PhD Fellowship
2011 - 2013	DAAD (German Academic Exchange Service) scholarship for students with outstanding curriculum
2008 - 2011	Warsaw University of Technology annual scholarship for outstanding academic achievements
2013	Best Service Robotics Paper Finalist at ICRA 2013
2010	BEC Best Engineering Competition - 6th place in Poland
2004, 2005	International Championships in Mathematical and Logical Games, finalist x2

Invited Talks

- "Rethinking Perception-Action Loops", University of Washington, 05.2017, MIT, 05.2017, University of Pennsylvania, 05.2017, Google DeepMind, 07.2017
- "Multi-Sensor Fusion with Seamless Sensor Switching and Trajectory Optimization for Self-Calibration", Google Tango, 10.2016, UCLA, 10.2016, Qualcomm, 06.2016
- "Active and Interactive Perception", Stanford, 10.2016
- "Active and Interactive Perception", NASA JPL, 09.2015
- "Robotic Explorers for Environmental Monitoring", Google, 05.2014
- "Active Articulation Model Estimation", Bosch Research Center, 10.2014
- "Interactive Object Segmentation and Recognition", TU Berlin, 12.2012

Professional Activities

Reviewer:

ICRA 2013-2017, IROS 2014-2017, RSS 2017, CoRL 2017, IJCAI 2016, SIMPAR 2016, IEEE Transactions on Robotics, International Journal of Robotics Research, IEEE Robotics and Automation Letters, Autonomous Robots

Organizer:

RSS 2016 Workshop on Robot-Environment Interaction for Perception and Manipulation

Program Committee Member:

RSS 2017 - Revisiting Contact Workshop, IJCAI 2016, SIMPAR 2016, ICRA 2013 - Robots in Clutter Workshop

Student Supervisor:

Eric Heiden - Simultaneous Mapping and Planning
Matthew Buckley - Active Change Detection for Articulation Model Estimation
Joe Mathai - Deep Active Perception

Entrepreneurial Activities

- 2012-2014: Zeebraamusic, Chief Operating Officer
  Responsible for team building, product development, IT management
- 2015-2016: Robotics Consultant for two California-based start-ups