Karol Hausman

Contact Information

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Research Interest

I am interested in enabling robots to autonomously acquire general-purpose skills with minimal supervision in real-world environments. More recently, I have been investigating deep reinforcement and imitation learning and its applications to robotics. I evaluated my work on many different platforms including quadrotors, humanoid robots and robotic arms.

Education

08.2013 - 05.2018	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. and B.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

06.2018 - Present	Research Scientist at **Google Brain**, Mountain View, USA Making robot learning useful.
06.2017 - 09.2017	Research Scientist Intern at **Google DeepMind**, London, UK Adviser: Prof. Martin Riedmiller Leader of a research projected submitted to ICLR 2018.
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

J5. J. Preiss, **K. Hausman**, G. Sukhatme, S. Weiss, **Simultaneous Self-Calibration and Navigation using Trajectory Optimization**, *In The International Journal of Robotics Research (IJRR)*, 2017; under review.

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

C15. R. Julian*, E. Heiden*, Z. He, H. Zhang, S. Schaal, J. Lim, G. Sukhatme, **K. Hausman Scaling Simulation-to-real Transfer by Learning Composable Robot Skills**, *International Symposium on Experimental Robotics (ISER)*, 2018.

C14. **K. Hausman**, J.T. Springenberg, Z. Wang, N. Heess, M. Riedmiller **Learning an Embedding Space for Transferable Robot Skills**, *International Conference on Learning Representations (ICLR)*, 2018.

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

W18. **K.Hausman**, J. T. Springenberg, Z. Wang, N. Heess, and M. Riedmiller, **Learning Skill Embeddings for Transferable Robot Skills**, *NIPS Deep Reinforcement Learning Symposium*, 2017.

W17. **K.Hausman**, J. T. Springenberg, Z. Wang, N. Heess, and M. Riedmiller, **Learning Robot Skill Embeddings**, *NIPS Workshop on Acting and Interacting in the Real World: Challenges in Robot Learning*, 2017.

W16. A. Agha-mohammadi, E. Heiden, **K. Hausman** and G. Sukhatme, **Confidence-aware Occupancy Grids**, *IROS Workshop on Vision-based Agile Autonomous Navigation of UAVs*, 2017.

W15. E. Heiden, **K. Hausman**, G. Sukhatme and A. Agha-mohammadi, **High-speed Safe Trajectory Planning in Confidence-rich Maps**, *IROS Workshop on Vision-based Agile Autonomous Navigation of UAVs*, 2017.

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

W13. **K. Hausman***, Y.Chebotar*, S. Schaal, G. Sukhatme, J. Lim, **IntentionGAN: Multi-Modal Imitation Learning from 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

2018	Best Poster Award at USC Computer Science Annual Research Day
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

- "How to Evaluate a Generalist? Benchmarks in Robot Learning.", Benchmarking in Robotics Workshop, 08.2019

- "Skill Representation and Supervision in Multi-Task RL.", ICML 2019 Workshop on Multi-Task and Lifelong Reinforcement Learning, 06.2019

- "Robot Skill Embeddings and their Applications.", Re-Work 06.2018, 01.2019

- "Learning Representations for Perception-Action Loops", Nvidia, 11.2017, Google Brain, 12.2017, UC Berkeley, 03.2018

- "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

Area Chair:

CoRL 2019

Reviewer:

ICML 2019, NeurIPS 2018-2019, ICRA 2013-2018, IROS 2014-2017, RSS 2017-2018, CoRL 2017-2018, 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:

NeurIPS 2018-2019 Deep RL Workshop, NeurIPS 2019 Workshop on Meta-Learning, Neurips 2019 Workshop on Robot Learning, NeurIPS 2019 Workshop on Learning with Rich Experience, RSS 2017 Revisiting Contact Workshop, IJCAI 2016, SIMPAR 2016, ICRA 2013 Robots in Clutter Workshop

Student Supervisor:

Mark Woodward - Google AI Resident
Archit Sharma - Google AI Resident
Evan Liu - Google AI Resident, now PhD Student at Stanford
Hugo Ponte - Google AI Resident, now start-up founder
Eric Heiden - Simultaneous Mapping and Planning, now PhD student at USC

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