

# Roberto Calandra

## Research Expertise

Robot Learning, Reinforcement Learning, Robotics, Optimization, Gaussian Processes, Deep Learning

## Current Position

Since Sep 2016 **Postdoctoral Scholar**, *University of California: Berkeley*, United States.  
with Sergey Levine

## Education

- 2012–2016 **Ph.D. in Computer Science**, *Technische Universität Darmstadt*, Germany.  
Thesis topic: Bayesian Modeling for Optimization and Control in Robotics  
Advisor: Jan Peters (TU Darmstadt)  
Instructor: Marc P. Deisenroth (Imperial College London)
- 2009–2011 **M.Sc. in Machine Learning and Data Mining**, *Aalto University*, Finland.  
Thesis topic: An Exploration of Deep Belief Networks toward Adaptive Learning  
Advisor: Olli Simula (Aalto University)  
Instructors: Federico Montesino Pouzols (University of Helsinki), Tapani Raiko (Aalto University)
- 2004–2009 **B.Sc. in Computer Science Engineering**, *Università degli Studi di Palermo*, Italy.  
Thesis topic: Design and Building of a Robotics Mobile Platform  
Advisor: Haris Dindo (Università degli Studi di Palermo)

## Professional Experience

- Jul–Oct 2015 **Research Intern**, *Microsoft Research*, Cambridge, UK.  
Worked in the Machine Learning and Perception (MLP) group on the Malmo project.  
[[BBC coverage of the project](#)]  
Advisors: Andrew Blake, Katja Hofmann
- May–Dec 2010 **Research Assistant**, *Bayesian Methodology group*, Aalto University, Finland.  
Worked as data analyst using Gaussian Processes. Developed novel variational inference methods based on EP for LOO. Contributed to the development of the Gaussian Processes toolbox GPStuff.  
Advisor: Aki Vehtari
- Mar–May 2008 **Intern**, *BELTEC s.r.l.*, Italy.  
Designed software and hardware components for industrial automation for *SELEX Galileo*, and for the *INAF – Istituto Nazionale di Astrofisica* (Italian national institute for astrophysics).

## Invited Presentations

- 20 Apr 2017 **DALI 2017 - Data Learning and Inference**, *Tenerife*, Spain, Workshop on Data Efficient Reinforcement Learning.
- 17 Aug 2016 **Max Planck Institute for Intelligent Systems**, *Tuebingen*, Germany, **host**: Autonomous Motion Department.
- 02 May 2016 **Universität Stuttgart**, *Stuttgart*, Germany, **host**: Marc Toussaint, Machine Learning & Robotics Lab.

- 16 Oct 2015 **University College London**, *London*, UK, **host:** Guy Lever.
- 14 Oct 2015 **University of Oxford**, *Oxford*, UK, **host:** Michael Osborne, Machine Learning Research Group.
- 13 Oct 2015 **Imperial College London**, *London*, UK, **host:** Stefan Leutenegger, Dyson Robotics Lab.
- 03 Jun 2015 **University of British Columbia**, *Vancouver*, Canada, **host:** Mark Schmidt.
- 02 Jun 2015 **University of Washington**, *Seattle*, US, **host:** Dieter Fox, Robotics and State Estimation Lab.
- 01 Apr 2015 **TU Freiburg**, *Freiburg*, Germany, **host:** Frank Hutter.
- 31 Mar 2015 **TU Freiburg**, *Freiburg*, Germany, **host:** Wolfram Burgard, Autonome Intelligente Systeme.
- 22 Dec 2014 **Università degli Studi di Palermo**, *Palermo*, Italy, **host:** Haris Dindo, DINFO.
- 24 Apr 2014 **Bosch Research**, *Stuttgart*, Germany.
- 13 Nov 2013 **Imperial College London**, *London*, UK.

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## Teaching & Supervision Experience

### Teaching

- Spring 2015 **Machine Learning I: Statistical Approaches Lecture**, *Teaching Assistant*, TU Darmstadt.
- Fall 2013 & Fall 2014 **Robot Learning Lecture**, *Teaching Assistant*, TU Darmstadt.

### Supervision

- Fall 2015 – Spring 2016 **2-Semesters Project**, *F. Treede, P. Konow and M. Bied*, Design of controllers for the dynamic bipedal walker *FaBi*.  
Supervised jointly with Philipp Beckerle and Alexandra Voloshina
- Fall 2015 **2-Semesters Project**, *L. Fritsche*, Learning to walk on rough terrain.
- Spring 2016 **Bachelor Thesis**, *F. Unverzagt*, Modeling Robustness for Multi-Objective Optimization.
- Fall 2014 – Spring 2015 **2-Semesters Project**, *L. Fritsche and F. Unverzagt*, Human-friendly Telecontrol of the *iCub*.  
Resulted in the publication: Fritsche, L.; Unverzagt, F.; Peters, J.; Calandra, R. (2015). First-Person Tele-Operation of a Humanoid Robot, Proceedings of the International Conference on Humanoid Robots (HUMANOIDS)
- Fall 2014 **1-Semester Project**, *J. Geukes and M. Nakatenus*, Towards Balancing with the *iCub*.
- Spring 2015 **1-Semester Project**, *G. Leser, J. Hatzenbühler, J. Schwaab and N. Eschner*, Implementation and Improvement of the bipedal walking robot *Fox*.  
Supervised jointly with Philipp Beckerle
- 2014 **Bachelor Thesis**, *A. Schaefer*, Prediction of Finger Flexion from ECoG Data with Deep Neural Networks.  
Supervised jointly with Jan Peters
- 2014 **Bachelor Thesis**, *D. Pfau*, Multi-Objective Optimization and Analysis of a Musculoskeletal Robot for Bipedal Locomotion.  
Supervised jointly with Katayon Radkhah
- 2014 **Bachelor Thesis**, *M. Laux*, Online Feature Learning for Reinforcement Learning.
- 2014 **Bachelor Thesis**, *A. Hochlaender*, Reinforcement Learning of PACMAN.  
Supervised jointly with Gerhard Neumann
- 2014 **1-Semester Project**, *S. Luthardt*, Deep Learning for Artificial Skin.
- Fall 2013 **1-Semester Project**, *M. Prediger, F. Schnell and V. Negoescu*, Advanced Bayesian optimization models.
- Spring 2013 **1-Semester Project**, *D. Dittmar and B. Koch*, Robot learning for ball bouncing.
- Fall 2012 **1-Semester Project**, *E. Wolter and T. Baark*, Learning to bounce a ball with a robotic arm.

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## Professional Service

**Organizer**, *NIPS Workshop on Bayesian optimization (BayesOpt)*, 2016.

**Organizer**, *NIPS Workshop on Bayesian optimization (BayesOpt)*, 2015.

**Organizer**, *RSS Workshop on Tactile Sensing for Manipulation: Hardware, Modeling, and Learning*, 2017.

**Organizer**, *RSS Workshop on Learning from Demonstration in High-Dimensional Feature Spaces*, 2017.

**Associate Editor**, *IROS*, 2017.

**Guest Editor**, *JMLR Special Issue on Bayesian Optimization*.

### Reviewer for Journals

- *Journal of Machine Learning Research (JMLR)*
- *International Journal of Robotics Research (IJRR)*
- *Robotics and Autonomous Systems*
- *IEEE Robotics and Automation Letters (RAL)*
- *IEEE Transactions on Robotics (TRO)*
- *Neurocomputing*
- *IEEE Transactions on Cybernetics*
- *IEEE Transactions on Systems, Man, and Cybernetics - Part B: Cybernetics*
- *Autonomous Robots (AuRo): Special Issue on Whole-body control for Humanoid Robots*
- *Autonomous Robots (AuRo): Special Issue on Assistive and Rehabilitation Robotics*

### Reviewer for Conferences & Workshops

- *IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM)*
- *International Conference on Artificial Intelligence and Statistics (AISTATS)*
- *IEEE/RAS International Conference on Humanoid Robots (HUMANOIDS)*
- *International Conference on Artificial Neural Networks (ICANN)*
- *IEEE International Conference on Robotics and Automation (ICRA)*
- *International Joint Conference on Artificial Intelligence (IJCAI)*
- *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*
- *Neural Information Processing Systems (NIPS)*
- *Robotics: Science and Systems (RSS)*
- *International Conference on Machine Learning (ICML)*
- *Conference on Robot Learning (CORL)*
- *NIPS Workshop on Bayesian optimization (BayesOpt)*

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## Publications

### Journals

- [1] **R. Calandra**, S. Ivaldi, M. P. Deisenroth, and J. Peters. Learning from artificial skin: Torque control in presence of contacts using high-dimensional tactile sensors. (submitted).
- [2] **R. Calandra**, M. P. Deisenroth, and J. Peters. Robustness in multi-objective Bayesian optimization. (submitted).
- [3] **R. Calandra**, A. Seyfarth, J. Peters, and M. P. Deisenroth. Bayesian optimization for learning gaits under uncertainty. *Annals of Mathematics and Artificial Intelligence (AMAI)*, 76(1):5–23, 2015.

### Conferences

- [1] S. Olofsson, M. Mehrian, L. Geris, **R. Calandra**, M. Deisenroth, and R. Misener. Bayesian multi-objective optimisation of neotissue growth in a perfusion bioreactor set-up. In *European Symposium on Computer Aided Process Engineering*, To appear.
- [2] Z. Yi, **R. Calandra**, F. F. Veiga, H. van Hoof, T. Hermans, Y. Zhang, and J. Peters. Active tactile object exploration with gaussian processes. In *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pp. 4925–4930, 2016.
- [3] P. Weber, E. Rueckert, **R. Calandra**, J. Peters, and P. Beckerle. A low-cost sensor glove with vibrotactile feedback and multiple finger joint and hand motion sensing for human-robot interaction. In *IEEE International Symposium on Robot and Human Interactive Communication (RO-MAN)*, 2016.
- [4] **R. Calandra**, J. Peters, C. E. Rasmussen, and M. P. Deisenroth. Manifold Gaussian processes for regression. In *International Joint Conference on Neural Networks (IJCNN)*, pp. 3338–3345, 2016.
- [5] L. Fritsche, F. Unverzagt, J. Peters, and **R. Calandra**. First-person tele-operation of a humanoid robot. In *IEEE-RAS International Conference on Humanoid Robots (HUMANOIDS)*, pp. 997–1002, Nov 2015.
- [6] **R. Calandra**, S. Ivaldi, M. P. Deisenroth, E. Rueckert, and J. Peters. Learning inverse dynamics models with contacts. In *IEEE International Conference on Robotics and Automation (ICRA)*, pp. 3186–3191, 2015.
- [7] **R. Calandra**, S. Ivaldi, M. P. Deisenroth, and J. Peters. Learning torque control in presence of contacts using tactile sensing from robot skin. In *IEEE-RAS International Conference on Humanoid Robots (HUMANOIDS)*, pp. 690–695, Nov 2015.
- [8] **R. Calandra**, A. Seyfarth, J. Peters, and M. P. Deisenroth. An experimental comparison of Bayesian optimization for bipedal locomotion. In *IEEE International Conference on Robotics and Automation (ICRA)*, pp. 1951–1958, May 2014.
- [9] **R. Calandra**, N. Gopalan, A. Seyfarth, J. Peters, and M. P. Deisenroth. Bayesian gait optimization for bipedal locomotion. In *Learning and Intelligent Optimization Conference (LION)*, pp. 274–290, 2014.
- [10] M. P. Deisenroth, **R. Calandra**, A. Seyfarth, and J. Peters. Toward fast policy search for learning legged locomotion. In *International Conference on Intelligent Robots and Systems (IROS)*, pp. 1787–1792, Oct 2012.
- [11] **R. Calandra**, T. Raiko, M. P. Deisenroth, and F. Montesino Pouzols. Learning deep belief networks from non-stationary streams. In *International Conference on Artificial Neural Networks (ICANN)*, pp. 379–386, 2012.

#### [Workshops & Technical Reports](#)

- [1] **R. Calandra**, A. Owens, M. Upadhyaya, W. Yuan, J. Lin, E. H. Adelson, and S. Levine. Learning deep grasping models from vision and touch. *submitted to CORL (soon to be arxiv)*, 2017.
- [2] S. Bansal, T. Calandra, S. Levine, and C. J. Tomlin. Mbmf: Model-based priors for model-free reinforcement learning. *submitted to CORL (soon to be arxiv)*, 2017.
- [3] S. Bansal, R. Calandra, T. Xiao, S. Levine, and C. J. Tomlin. Goal-Driven Dynamics Learning via Bayesian Optimization. *ArXiv e-prints*, March 2017.
- [4] D. Buechler, **R. Calandra**, and J. Peters. Variability of musculoskeletal systems with heteroscedastic Gaussian processes. NIPS workshop on Neurorobotics: A Chance for New Ideas, Algorithms and Approaches, 2016.

- [5] E. Rueckert, R. Lioutikov, **R. Calandra**, M. Schmidt, P. Beckerle, and J. Peters. Low-cost sensor glove with force feedback for learning from demonstrations using probabilistic trajectory representations. ICRA Workshop on Tactile & force sensing for autonomous, compliant, intelligent robots, 2015.
- [6] **R. Calandra**, S. Ivaldi, M. P. Deisenroth, E. Rueckert, and J. Peters. Learning inverse dynamics models with contacts using tactile sensors. ICRA Workshop on Tactile & force sensing for autonomous, compliant, intelligent robots, 2015.
- [7] **R. Calandra**, J. Peters, and M. P. Deisenroth. Pareto front modeling for sensitivity analysis in multi-objective Bayesian optimization. NIPS Workshop on Bayesian Optimization (BayesOpt), 2014.
- [8] K. Radkhah, **R. Calandra**, and M. P. Deisenroth. Learning musculoskeletal dynamics with non-parametric models. ICRA Workshop on Novel Methods for Learning and Optimization of Control Policies and Trajectories for Robotics, 2013.
- [9] **R. Calandra**, J. Peters, A. Seyfarth, and M. Deisenroth. An experimental evaluation of bayesian optimization on bipedal locomotion. NIPS Workshop on Bayesian Optimization (BayesOpt), 2013.