

# Filipe F. Veiga

ROBOTICS · ROBOT GRASPING AND MANIPULATION · TACTILE SENSING · BIOMIMETIC CONTROL · REINFORCEMENT LEARNING

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## Research Vision and Interests

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My goal is to **increase robot dexterity** such that robots can easily manipulate objects with multi-fingered robotic hands, allowing them to solve everyday tasks that current robots cannot. To pursue higher levels of robot dexterity, I rely on a crucial aspect of human manipulation, **tactile perception**, developing novel methods for extracting task relevant information from tactile sensors. I also develop **novel control architectures**, that aim at efficiently using the information extracted from the tactile sensors by taking inspiration from neurophysiology and **exploring control modularity and hierarchy**. In addition, I use **machine learning** to learn complex behaviors while focusing on **data efficiency** and on **transferability** of behaviors between simulated and real robot platforms.

## Education

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### PhD in Machine Learning and Robotics

INTELLIGENT AUTONOMOUS SYSTEMS, TECHNICAL UNIVERSITY DARMSTADT

*Darmstadt, Germany*

2013 – 2018

- Thesis: Towards Dexterous In-Hand Manipulation through Tactile Sensing
- Advisor: Jan Peters

### M.Sc. in Electrical and Computer Engineering

INSTITUTO SUPERIOR TÉCNICO, TECHNICAL UNIVERSITY OF LISBON

*Lisbon, Portugal*

2008-2012

- Thesis: Robotic Grasp Optimization from Contact Force Analysis
- Advisor: Alexandre Bernardino
- **Best Master Thesis of 2012 Award by the Portuguese Robotics Society**

### B.Sc. in Engineering Sciences

INSTITUTO SUPERIOR TÉCNICO, TECHNICAL UNIVERSITY OF LISBON

*Lisbon, Portugal*

2004-2008

## Research Experience

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### Postdoctoral Associate - *Current Position*

COMPUTER SCIENCE & ARTIFICIAL INTELLIGENCE LABORATORY, MASSACHUSETTS INSTITUTE OF TECHNOLOGY

*Cambridge, USA*

2019 – Present

- Contributing to the design of high resolution vision based tactile sensors with form factors that are better suited for usage as fingertips to dexterous robot hands.
- Using high resolution tactile information to estimate dynamic properties of object, facilitating the control of highly dynamic manipulation actions.

### Graduate Research Assistant

INTELLIGENT AUTONOMOUS SYSTEMS, TECHNICAL UNIVERSITY DARMSTADT

*Darmstadt, Germany*

2013-2018

- Predicting slip between an object and a fingertip using multi-modal tactile information.
- Exploring control modularity and developing bio-mimetic contact stabilization controllers to efficiently tackling multi-fingered grip stabilization tasks.
- Exploring a hierarchical control framework for learning in-hand dexterous manipulation actions.
- TACMAN Project - Seventh Framework Programme (FP7-ICT-2013-10)

### Undergraduate Research Assistant

VISLAB – COMPUTER VISION LAB, INSTITUTE FOR SYSTEMS AND ROBOTICS, INSTITUTO SUPERIOR TÉCNICO

*Lisbon, Portugal*

2010-2013

- Finding optimal robot grasp poses using model based reinforcement learning.
- HANDLE Project - Seventh Framework Programme (FP7-ICT-2007-3)

# Publications and Patents

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## JOURNAL PUBLICATIONS

**Hierarchical Tactile-Based Control Decomposition of Dexterous In-Hand Manipulation Tasks** 2020

VEIGA, F. F.; AKROUR, R.; PETERS, J., FRONTIERS IN ROBOTICS AND AI (PROVISIONALLY ACCEPTED)

**A Review of Tactile Information: Perception and Action Through Touch** 2020

LI, Q.; KROEMER, O.; SU, Z.; VEIGA, F. F.; KABOLI, M.; RITTER, H. J., IEEE TRANSACTIONS ON ROBOTICS

**Grip Stabilization through Independent Finger Tactile Feedback Control** 2020

VEIGA, F. F.; EDIN B.B.; PETERS, J., SENSORS

**Learning attribute grammars for movement primitive sequencing** 2020

LIOUTIKOV, R.; MAEDA, G.; VEIGA, F. F.; KERSTING, K.; PETERS, J., THE INTERNATIONAL JOURNAL OF ROBOTICS RESEARCH (IJRR)

**Grip Stabilization of Novel Objects using Slip Prediction** 2018

VEIGA, F. F.; PETERS, J.; HERMANS, T., IEEE TRANSACTIONS ON HAPTICS

## PEER REVIEWED CONFERENCE PUBLICATIONS

**SwingBot: Learning Physical Features from In-Hand Tactile Exploration for Dynamic Swing-up Manipulation** 2020

WANG, C.; WANG, S.; ROMERO, B.; VEIGA, F. F.; ADELSON, E., PROCEEDINGS OF THE IEEE/RSJ INTERNATIONAL CONFERENCE ON INTELLIGENT ROBOTS AND SYSTEMS (IROS) **BEST PAPER AWARD**

**Soft, Round, High Resolution Tactile Fingertip Sensors for Dexterous Robotic Manipulation** 2020

ROMERO, B.; VEIGA, F. F.; ADELSON, E., PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON ROBOTICS AND AUTOMATION (ICRA)

**Building a Library of Tactile Skills Based on FingerVision** 2019

BELOUSOV, B.; SADYBAKASOV, A.; WIBRANEK, B.; VEIGA, F. F.; TESSMANN, O.; PETERS, J., PROCEEDINGS OF THE IEEE-RAS INTERNATIONAL CONFERENCE ON HUMANOID ROBOTS (HUMANOIDS) **MIKE STILLMAN AWARD FINALIST**

**Regularizing Reinforcement Learning with State Abstraction** 2018

AKROUR, R.; VEIGA, F. F.; PETERS, J., PROCEEDINGS OF THE IEEE/RSJ CONFERENCE ON INTELLIGENT ROBOTS AND SYSTEMS (IROS)

**Inducing Probabilistic Context-Free Grammars for the Sequencing of Robot Movement Primitives** 2018

LIOUTIKOV, R.; MAEDA, G.; VEIGA, F. F.; KERSTING, K.; PETERS, J., PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON ROBOTICS AND AUTOMATION (ICRA)

**Active Tactile Object Exploration with Gaussian Processes** 2016

YI, Z.; CALANDRA, R.; VEIGA, F. F.; VAN HOOF, H.; HERMANS, T.; ZHANG, Y.; PETERS, PROCEEDINGS OF THE IEEE/RSJ CONFERENCE ON INTELLIGENT ROBOTS AND SYSTEMS (IROS)

**Stabilizing Novel Objects by Learning to Predict Tactile Slip** 2015

VEIGA, F. F.; VAN HOOF, H.; PETERS, J.; HERMANS, T., PROCEEDINGS OF THE IEEE/RSJ CONFERENCE ON INTELLIGENT ROBOTS AND SYSTEMS (IROS)

## WORKSHOP PUBLICATIONS AND DEMOS

### Demonstration: Learning for Tactile Manipulation

2014

HERMANS, T.; **VEIGA, F. F.**; HÖLSCHER, J.; VAN HOOF, H.; PETERS, J., ADVANCES IN NEURAL INFORMATION PROCESSING SYSTEMS (NIPS), DEMONSTRATION TRACK, MIT PRESS

### Active tactile exploration for grasping

2013

**VEIGA, F. F.**; BERNARDINO, A., PROCEEDINGS OF THE ICRA 2013 WORKSHOP ON AUTONOMOUS LEARNING

### Towards Bayesian Grasp Optimization with Wrench Space Analysis

2012

**VEIGA, F. F.**; BERNARDINO, A., PROCEEDINGS OF THE IROS 2012 WORKSHOP BEYOND ROBOT GRASPING

## PATENTS

### Retrographic Sensors with Compact Illumination

ADELSON, E.; ROMERO, B.; **VEIGA, F. F.**

## Awards

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- 2020 **Best Paper Award**, IEEE/RSJ International Conference on Intelligent Robots and Systems *Las Vegas, USA*
- 2019 **Mike Stillman Award Finalist**, IEEE-RAS International Conference on Humanoid Robots *Munich, Germany*
- 2012 **Best Master Thesis of 2012 Award**, Portuguese Robotics Society *Lisbon, Portugal*

## Invited Talks

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- 2018 **Robotic Dexterous Manipulation Workshop**, IEEE-RAS Humanoids 2018 *Beijing, China*
- 2018 **Instituto Superior Técnico** *Lisbon, Portugal*
- 2017 **UC Berkeley** *Berkeley, CA, U.S.A*
- 2015 **Kyushu Institute of Technology** *Kyushu, Japan*
- 2015 **Osaka University** *Osaka, Japan*

## Teaching Experience

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### Touching and grasping with sensitive fingers and hands, Guest Lecturer

*Spring 2020*

TAUGHT ONE SEMINAR SESSION

*Massachusetts Institute of Technology*

### Touching and grasping with soft fingers, Guest Lecturer

*Spring 2019*

TAUGHT ONE SEMINAR SESSION

*Massachusetts Institute of Technology*

### Statistical Machine Learning, Teaching Assistant

*Summer Semester 2016*

DEvised HOMEWORK AND EXAMS, GAVE PROBLEM SOLUTION CLASSES AND PROVIDED OFFICE HOURS.

*Technical University Darmstadt*

### Robot Learning, Teaching Assistant

*Winter Semester 2015/2016*

DEvised HOMEWORK AND EXAMS, GAVE PROBLEM SOLUTION CLASSES AND PROVIDED OFFICE HOURS.

*Technical University Darmstadt*

## Mentoring

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### BACHELOR THESIS

#### Guided Policy Search for In-Hand Manipulation

*Ongoing*

SCHNEIDER, T.; **VEIGA, F. F.**; ABDULSAMAD, H.; PETERS, J.

*Technical University Darmstadt*

#### Can we predict grasp forces from photos?

2017

HEPPERT, N.; **VEIGA, F. F.**; GOESELE, M.; PETERS, J.

*Technical University Darmstadt*

## Tactile Sensing for Manipulation

HUHNSTOCK, N.; **VEIGA, F. F.**; VAN HOOF, H.; PETERS, J.

2014

Technical University Darmstadt

## STUDENT PROJECTS

### Deep Reinforcement Learning for playing Starcraft II

PALENICEK, D.; HUSSING, M.; MEISTER, S; **VEIGA, F. F.**; PETERS, J.

Ongoing

Technical University Darmstadt

### Contact Location Forward Modeling of BioTac Skin-like Data for Contact Location Control

HESSE, T.; NOTZ, D.; **VEIGA, F. F.**; PETERS, J.

2015

Technical University Darmstadt

## Service

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### WORKSHOP ORGANIZATION

#### Visuotactile Sensors for Robust Manipulation: From Perception to Control

KUPPUSWAMY, N.; **VEIGA, F. F.**; YUAN, W.; ALSPACH, A., UTTAMCHANDANI, A., ROBOTICS: SCIENCE AND SYSTEMS

Corvallis, Oregon

2020

#### RoboTac: New Progress in Tactile Perception and Learning in Robotics

KABOLI, M.; BOHG, J.; LI, Q.; **VEIGA, F. F.**, SU, Z.; CHENG, G., IEEE/RSJ INTERNATIONAL CONFERENCE ON INTELLIGENT ROBOTS AND SYSTEMS

Madrid, Spain

2018

#### Multi-Modal Perception and Control

**VEIGA, F. F.**; CALANDRA, R.; BILLARD, A.; PETERS, J., ROBOTICS: SCIENCE AND SYSTEMS

Pittsburgh, USA

2018

#### Tactile Sensing for Manipulation: New Progress and Challenges

LI, Q.; CHERUBINI, A; NATALE, L; HO, V. A.; SU, Z.; **VEIGA, F. F.**, IEE-RAS INTERNATIONAL CONFERENCE ON HUMANOID ROBOTS

Cancun, Mexico

2016

### REVIEWING FOR INTERNATIONAL CONFERENCES

#### Conference on Neural Information Processing Systems (NeurIPS)

2020

#### IEEE International Conference on Automation Science and Engineering (CASE)

2019

#### Eurohaptics

2018

#### Conference on Robot Learning (CORL)

2018, 2019, 2020

#### IEEE International Conference on Robotics and Automation (ICRA)

2015, 2017, 2018, 2019, 2020

#### IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)

2014, 2015, 2016, 2017, 2019, 2020

#### IEEE-RAS International Conference on Humanoid Robots (Humanoids)

2014, 2016, 2017, 2018

### REVIEWING JOURNAL PUBLICATIONS

#### IEEE Robotics and Automation Magazine

#### IEEE Transactions on Robotics

#### IEEE Robotics and Automation Letters

#### Robotics and Autonomous Systems

## References

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### **Prof. Edward Adelson**

MASSACHUSETTS INSTITUTE OF TECHNOLOGY, DEPARTMENT OF BRAIN AND COGNITIVE SCIENCES

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### **Prof. Jan Peters**

TU DARMSTADT, COMPUTER SCIENCE DEPARTMENT, INTELLIGENT AUTONOMOUS SYSTEMS

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Phone: +49-6151-16-25374

Email: [peters@ias.tu-darmstadt.de](mailto:peters@ias.tu-darmstadt.de)

### **Prof. Tucker Hermans**

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### **Prof. Veronica Santos**

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