

Joschka Bödecker

Ph.D., Dipl.-Inf.

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Personal Information

Date/Place of Birth September 29, 1976, Erlenbach am Main, Germany
Nationality German
Marital Status Married

Areas of Interest

Machine Learning, Data-efficient Reinforcement Learning, Recurrent Neural Networks and Reservoir Computing, Gaussian Processes, Deep Learning, Robotics, Complex Systems, Information Dynamics.

Education

- 2006–2011 **Ph.D.**, *Graduate School of Engineering, Osaka University (among the top 3 research institutes in Japan according to Thomson Reuters Essential Science Indicators 2011), Osaka, Japan.*
Advisor: Prof. Minoru Asada, thesis title: "Echo State Network Reservoir Shaping and Information Dynamics at the Edge of Chaos"
- 2002–2003 *Graduate School, University of Georgia (UGA), GA, USA, enrolled in the Artificial Intelligence Master's program*
- 2000–2006 **Diploma (Computer Science)**, *University of Koblenz-Landau, Koblenz, Germany.*
- 1998–2000 *University of Heidelberg, Heidelberg, Germany, undergraduate (Vordiplom) in Medical Informatics*

Academic Positions

- 01/2013–present **Postdoctoral Researcher (Wissenschaftl. Mitarbeiter)**, *Dept. of Computer Science, Faculty of Engineering, Albert-Ludwigs-University Freiburg, Germany.*
- 04/2011–12/2012 **Specially Appointed Researcher**, *Dept. of Adaptive Machine Systems, Graduate School of Engineering, Osaka University, Japan.*

Honors and Awards

- 04/2006–03/2009 **Japan Society for the Promotion of Science (JSPS) Fellowship for Young Researchers**, Japan.
Japan's most prestigious and highly competitive scholarship for Ph.D. students; in addition, I was awarded an independent research budget of yearly 1000000 JPY (about 7500 EUR)
- 01/2005–06/2005 **Heinz-Nixdorf-Foundation Scholarship**, granted for a research visit at Osaka University, Japan.
This also included 6 weeks of intensive Japanese language studies at LSI Bochum, plus another 2 months in Tokyo.
- 08/2002–06/2003 **DAAD Scholarship**, granted for a year abroad at UGA's Artificial Intelligence Center, GA, USA.

Funded Projects

- 2014–2017 **Project “Scalable Autonomous Reinforcement Learning - From scratch to less and less structure”**, DFG Priority Programme Autonomous Learning SPP 1527, helped in the preparation of the proposal.
- 2013–2016 **Principal Investigator of the project “NetControl: Autonomous Control of Network Activity”**, part of the DFG-funded cluster of excellence BrainLinks-BrainTools.
- 2013–2014 **Researcher in the project "Mobile Manipulation in natürlichen Umgebungen – TidyUpRobot"**, funded by the DFG.

2011–2012 **Researcher and group leader in the specially promoted research project "Constructive Developmental Science Based on Understanding the Process From Neuro-Dynamics to Social Interaction"**, Dept. of Adaptive Machine Systems, Osaka University, Japan.

Teaching and Supervision Experience

2013–2014 **Co-Coordinator**, *Introduction to Artificial Intelligence*, University of Freiburg, developing exercise sheets and exam questions for the course.

2011–2012 **Research Group Leader**, Osaka University, developed research plans for and supervised a group of between 4 and 7 students, resulting in three successful master's degrees and three bachelor's degrees for the students.

2011 **Invited Lecturer**, *Introduction to Neural Networks*, Osaka University, developed and taught an introductory course for graduate students as guest lecturer, 2 SWS.

2007 **Invited Lecturer**, *Introduction to Multi-Agent-Programming*, developed and taught a course on programming soccer agents for undergrad students, 2 SWS, Osaka University.

Services for Journals

Associate Editor *Frontiers in Robotics and AI*, Specialty Section Computational Intelligence

Reviewer for
Journals

- IEEE Transactions on Neural Networks and Learning Systems,
- IEEE Robotics and Automation Magazine,
- PLOS Computational Biology,
- Neurocomputing,
- Robotics and Autonomous Systems,
- IEEE Systems, Man, and Cybernetics Part A,
- IEEE Transactions on Autonomous Mental Development,
- Artificial Life

Services for Conferences and Workshops

Publication Chair

IEEE ICDL-EpiRob 2013

Program
Committee
member

- AAAI Conference on Artificial Intelligence (AAAI) 2014,
- Int. Conference on Simulation, Modeling and Programming for Autonomous Robots (SIMPAN) 2012, 2010, 2008,
- Int. Workshop on Guided Self-Organisation (GSO) 2014, 2013, 2012,
- ECML-PKDD Workshop on Collective Learning and Inference on Structured Data (CoLISD) 2012, 2011,
- ECML-PKDD Workshop on Distributed Machine Learning and Sparse Representation with Massive Data Sets (DMMD) 2011

Reviewer for
Conferences

- ICRA 2015, 2013, 2012, 2010, 2006,
- IROS 2013, 2010, 2008,
- ACM/IEEE HRI 2013,
- ICDL-EpiRob 2012,
- ICMC 2011,
- SIMPAR 2010, 2008,
- HUMANOIDS 2009

Workshop Organization

- 2014 Seventh International Workshop on Guided Self-Organisation (GSO-2014, 3-day workshop)
- 2008 *The Universe of RoboCup Simulators* at SIMPAR 2008

Other Professional Services

- Referee Research Foundation Flanders (FWO) grant proposal
- Technical committee RoboCup Soccer Simulation League, 2005-2007
- Organizing committee RoboCup Soccer Simulation League, 2005, 2006 (chair)
- Maintenance committee RoboCup Soccer Simulation League, 2005-2007 (chair), 2008

Membership

- 2013–present IEEE Robotics and Automation Society
- 2013–present IEEE Computational Intelligence Society
- 2011–present IEEE

Publications

Refereed Journal Papers

- Wendelin Böhmer, Jost Tobias Springenberg, Joschka Boedecker, Martin Riedmiller, and Klaus Obermayer. “Autonomous Learning of State Representations for Control: An Emerging Field Aims to Autonomously Learn State Representations for Reinforcement Learning Agents from Their Real-World Sensor Observations”. English. In: *KI - Künstliche Intelligenz* (2015), pp. 1–10. ISSN: 0933-1875.
- Joschka Boedecker, Thomas Lampe, and Martin Riedmiller. “Modeling effects of intrinsic and extrinsic rewards on the competition between striatal learning systems”. In: *Frontiers in Psychology* 4.739 (2013). ISSN: 1664-1078.
- Joschka Boedecker, Oliver Obst, Joseph T Lizier, N Michael Mayer, and Minoru Asada. “Information processing in echo state networks at the edge of chaos.” In: *Theory in Biosciences* 131.3 (2012), pp. 205–213. ISSN: 16117530.
- Joschka Boedecker, Oliver Obst, Norbert Michael Mayer, and Minoru Asada. “Initialization and Self-Organized Optimization of Recurrent Neural Network Connectivity”. In: *HFSP Journal* 3.5 (Oct. 2009), pp. 340–349.
- Norbert Michael Mayer, Joschka Boedecker, and Minoru Asada. “Robot motion description and real-time management with the Harmonic Motion Description Protocol”. In: *Robotics and Autonomous Systems* 57.8 (2009), pp. 870–876.

Book Chapters

- Oliver Obst and Joschka Boedecker. “Guided Self-Organization of Input-Driven Recurrent Neural Networks”. In: *Guided Self-Organization: Inception*. Ed. by Mikhail Prokopenko. Vol. 9. Emergence, Complexity and Computation. Springer Berlin Heidelberg, 2014, pp. 319–340. ISBN: 978-3-642-53733-2.

Refereed International Conference Papers

- Joschka Boedecker, Jost Tobias Springenberg, Jan Wülfing, and Martin Riedmiller. “Approximate Real-Time Optimal Control Based on Sparse Gaussian Process Models”. In: *Adaptive Dynamic Programming and Reinforcement Learning (ADPRL)*. 2014.

- Christoph Hartmann, Joschka Boedecker, Oliver Obst, Shuhei Ikemoto, and Minoru Asada. “Real-Time Inverse Dynamics Learning for Musculoskeletal Robots based on Echo State Gaussian Process Regression”. In: *Proceedings of Robotics: Science and Systems*. Sydney, Australia, July 2012.
- Beata J. Grzyb, Joschka Boedecker, Minoru Asada, Angel P. del Pobil, and Linda B. Smith. “Trying anyways: how ignoring the errors may help in learning new skills”. In: *First Joint IEEE International Conference on Development and Learning and on Epigenetic Robotics*. 2011.
- Oliver Obst, Joschka Boedecker, and Minoru Asada. “Improving Recurrent Neural Network Performance Using Transfer Entropy”. In: *Neural Information Processing Models and Applications*. Ed. by Kok Wai Wong, B Sumudu U Mendis, and Abdesselam Bouzerdoun. Vol. 6444. Lecture Notes in Computer Science. Springer, 2010, pp. 193–200. ISBN: 9783642175336.
- Joschka Boedecker, Oliver Obst, Norbert Michael Mayer, and Minoru Asada. “Studies on Reservoir Initialization and Dynamics Shaping in Echo State Networks”. In: *Proceedings of the 17th European Symposium On Artificial Neural Networks (ESANN’09)*. Ed. by Michel Verleysen. Evere, Belgium: D-Side Publications, Apr. 2009, pp. 227–232.
- Norbert Michael Mayer, Joschka Boedecker, Kazuhiro Masui, Masaki Ogino, and Minoru Asada. “HMDP: A new protocol for motion pattern generation towards behavior abstraction”. In: *RoboCup 2007: Robot Soccer World Cup XI*. Ed. by Ubbo Visser, Fernando Ribeiro, Takeshi Ohashi, and Frank Dellaert. Lecture Notes in Computer Science. Springer, 2008, pp. 184–195.
- Rodrigo da Silva Guerra, Joschka Boedecker, Norbert Michael Mayer, Shinzo Yanagimachi, Yasuji Hirosawa, et al. “Introducing Physical Visualization Sub-League”. In: *RoboCup 2007: Robot Soccer World Cup XI*. Ed. by Ubbo Visser, Fernando Ribeiro, Takeshi Ohashi, and Frank Dellaert. Lecture Notes in Computer Science. Springer, 2008, pp. 496–503.
- Norbert Michael Mayer, Joschka Boedecker, Rodrigo da Silva Guerra, and Minoru Asada. “3D2Real: Simulation League Finals in Real Robots”. In: *RoboCup 2006: Robot Soccer World Cup X*. Ed. by Gerhard Lakemeyer, Elizabeth Sklar, Domenico G. Sorrenti, and Tomoichi Takahashi. Lecture Notes in Computer Science. 2007, pp. 25–34.

- Rodrigo da Silva Guerra, Joschka Boedecker, Norbert Michael Mayer, Shinzo Yanagimachi, Hiroshi Ishiguro, and Minoru Asada. “A new minirobotics system for teaching and researching agent-based programming”. In: *CATE '07: Proceedings of the 10th IASTED International Conference on Computers and Advanced Technology in Education*. Ed. by V. Uskov. Beijing, China: ACTA Press, 2007, pp. 39–44. ISBN: 978-0-88986-700-0.
- Rodrigo da Silva Guerra, Joschka Boedecker, Shinzo Yanagimachi, and Minoru Asada. “Introducing a New Minirobotics Platform for Research and Edutainment”. In: *Proceedings of the 4th International Symposium on Autonomous Minirobots for Research and Edutainment*. Best Student Paper Award. 2007.
- Joschka Boedecker, Norbert Michael Mayer, Masaki Ogino, Rodrigo da Silva Guerra, Masaki Kikuchi, and Minoru Asada. “Getting closer: How Simulation and Humanoid League can benefit from each other”. In: *Proceedings of the 3rd International Symposium on Autonomous Minirobots for Research and Edutainment (AMiRE 2005)*. Ed. by Kazuyuki Murase, Kosuke Sekiyama, Naoyuki Kubota, Tomohide Naniwa, and Joaquin Sitte. Springer, 2006, pp. 93–98.
- Oliver Obst and Joschka Boedecker. “Flexible Coordination of Multiagent Team Behavior using HTN Planning”. In: *RoboCup 2005: Robot Soccer World Cup IX*. Ed. by Itsuki Noda, Adam Jacoff, Ansgar Bredendfeld, and Yasutake Takahashi. Lecture Notes in Computer Science. Springer, 2006, pp. 521–528.

Other Conference and Workshop Papers

- Oliver Obst, Joschka Boedecker, Benedikt Schmidt, and Minoru Asada. *On active information storage in input-driven systems*. arXiv preprint 1303.5526v1. Also published as a poster at the 6th Australian Workshop on Computational Neuroscience, 2013. 2013.
- Joschka Boedecker, Oliver Obst, Yuki Kashima, and Minoru Asada. “Intrinsic computational capabilities of reservoir computing networks in different dynamics regimes and their relation to task performance”. Workshop on Cognitive dynamics in neural systems: mathematical and computational modeling. Lyon, France, Mar. 2012.
- Oliver Obst, Joschka Boedecker, Benedikt Schmidt, and Minoru Asada. “Computing local active information storage in input-driven systems”. Proceedings of Guided Self-Organization (GSO) 2012. Sept. 2012.

- Joschka Boedecker and Minoru Asada. "Towards Self-organized Online Extraction of Invariances Using a Hierarchy of Multiple-timescale Reservoirs". *Front. Comput. Neurosci. Conference Abstract: IEEE ICDL-EPIROB 2011*. 2011.
- Beata J. Grzyb, Joschka Boedecker, Minoru Asada, and Angel P. del Pobil. "Elevated activation of dopaminergic brain areas facilitates behavioral state transition". *IROS 2011 Workshop on Cognitive Neuroscience Robotics*. Sept. 2011.
- Beata J. Grzyb, Joschka Boedecker, Minoru Asada, Angel P. del Pobil, and Linda B. Smith. "Between Frustration and Elation: Sense of Control Regulates the Intrinsic Motivation for Motor Learning". Online. *AAAI Workshop on Lifelong learning*. 2011.
- Joschka Boedecker and Minoru Asada. *SimSpark – Concepts and Application in the 3D Soccer Simulation League*. Online. 2008.
- Michael Mayer, Joschka Boedecker, and Minoru Asada. *On Standardization in the RoboCup Soccer Humanoids Leagues*. Online. 2nd Workshop on Humanoid Soccer Robots at HUMANOIDS 2007. 2007.
- Rodrigo da Silva Guerra, Joschka Boedecker, and Minoru Asada. "Physical Visualization Sub-League: A New Platform for Research and Edutainment". *Proceedings of the 24th SIG-Challenge Workshop*. 2007.
- Minoru Asada, Norbert Michael Mayer, Joschka Boedecker, Masaki Ogino, and Sawa Fuke. *The RoboCup Soccer Humanoid League: Overview and Outlook*. Online. 1st Workshop on Humanoid Soccer Robots at HUMANOIDS 2006. 2006.
- Oliver Obst, Anita Maas, and Joschka Boedecker. "HTN Planning for Flexible Coordination Of Multiagent Team Behavior". *Proceedings of the IJCAI-05 Workshop on Agents in Real-Time and Dynamic Environments*. Edinburgh, Scotland, July 2005.

References

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