Sebastian Trimpe

Max Planck Institute for Intelligent Systems
Autonomous Motion Department
Spemannstr. 38
72076 Tübingen
Germany

phone: +49.7071.601.1716 (office)
e-mail: strimpe@tuebingen.mpg.de
website: trimpe.is.tuebingen.mpg.de

APPOINTMENTS

Research Scientist[1] **and Group Leader** since Sep. 2013
Max Planck Institute for Intelligent Systems (MPI-IS), Tübingen, Germany
Autonomous Motion Department

Postdoctoral Researcher and Lecturer 2013
ETH Zurich, Switzerland
Institute for Dynamic Systems and Control

Research Assistant 2008–2013
ETH Zurich, Switzerland
Institute for Dynamic Systems and Control

EDUCATION

Dr. sc. (Ph.D.), ETH Zurich, Switzerland 2013
Institute for Dynamic Systems and Control, Dept. of Mechanical and Process Engineering
Advisor: Prof. Raffaello D'Andrea. Referees: Prof. Manfred Morari, Prof. Jan Lunze.

Dipl.-Ing. (M.Sc.), Hamburg University of Technology, Germany 2007
Electrical Engineering.

MBA, Hamburg University of Technology/NIT Hamburg, Germany 2007
Technology Management.

Visiting Student Researcher, University of California Berkeley, USA 2007
Dept. of Mechanical Engineering, 8 months, advisor: Prof. Tarek I. Zohdi.

B.Sc., Hamburg University of Technology, Germany 2005
General Engineering Science.

Abitur, Gymnasium Angelaschule Osnabrück, Germany 2001
High school diploma.

AWARDS AND HONORS

Awards

KlarText! Klaus Tschira Award for achievements in public understanding of science 2014
(category: Computer Science). Awarded for PhD thesis and an article making the PhD research accessible to the general public, published in the German popular science magazine "Bild der Wissenschaft." http://www.klaus-tschira-preis.info

IFAC Congress Interactive Paper Prize (best out of 450 interactive papers), awarded at the triennial *World Congress of the International Federation of Automatic Control (IFAC)* for the paper entitled "An Experimental Demonstration of a Distributed and Event-based State Estimation Algorithm." 2011

[1] According to MPI-IS conventions, Research Scientist roughly corresponds to an assistant professor position (see Careers at MPI).

General Engineering Award for the best undergraduate degree, awarded by Hamburg University of Technology and ThyssenKrupp AG. 2005

Fellowships

Max Planck ETH Center for Learning Systems 2015/2016
Fellow (covering 50% of salary at MPI-IS). http://learning-systems.org

German National Academic Foundation (Studienstiftung des deutschen Volkes) 2002–2007
Scholarship throughout undergraduate and graduate studies.

German Academic Exchange Service (DAAD) 2007
Financial support during research stay at University of California Berkeley.

Airbus Germany. Funding of private MBA program in Technology Management at Hamburg University of Technology/NIT Hamburg. 2005–2007

Rheinstahl Foundation (ThyssenKrupp AG). Financial support. 2005–2007

THIRD-PARTY RESEARCH FUNDING (excluding fellowships and industry collaborations)

EcoCPS: Event-based Wireless Control for Cyber-physical Systems (accepted) 2016–2019
Research grant within the German Research Foundation (DFG) Priority Program on "Cyber-physical networking," PI with Marco Zimmerling (TU Dresden).

Bayesian Optimization for Automatic Controller Design 2015
Max Planck Grassroots grant, PI with Philipp Hennig (MPI Tübingen, Empirical Inference).

Co-author: **Distributed Estimation and Control of Mechatronic Systems** 2012
Contributor and co-author of grant proposal at Swiss National Science Foundation (SNSF), Principal Investigator: Raffaello D'Andrea.

INDUSTRY COLLABORATION

Robert Bosch GmbH, Corporate Research, Renningen, Germany 2015–2018
Research collaboration with *Cognitive Systems and Machine Learning* group (Dr. Yasser Jadidi, Dr. Duy Nguyen-Tuong) on *Learning-based Control.*
Joint supervision of PhD project (Andreas Dörr), fully funded by Bosch.

PUBLICATIONS

Journal Articles

[1] M. Wüthrich, S. Trimpe, C. Garcia Cifuentes, D. Kappler, and S. Schaal, "A new perspective and extension of the Gaussian filter," *The International Journal of Robotics Research (invited paper), under review.*

[2] S. Trimpe and R. D'Andrea, "Event-based state estimation with variance-based triggering," *IEEE Transaction on Automatic Control (Special Issue on Control of Cyber-Physical Systems)*, vol. 59, no. 12, pp. 3266–3281, Dec. 2014, [PDF].

[3] S. Trimpe and R. D'Andrea, "A limiting property of the matrix exponential," *IEEE Transactions on Automatic Control*, vol. 59, no. 4, pp. 1105–1110, Apr. 2014, [PDF].

[4] S. Trimpe and R. D'Andrea, "The Balancing Cube: A dynamic sculpture as test bed for distributed estimation and control," *IEEE Control Systems Magazine*, vol. 32, no. 6, pp. 48–75, Dec. 2012, [PDF].

Conference Proceedings (full paper, peer-reviewed)

[1] M. Wüthrich, C. Garcia Cifuentes, S. Trimpe, F. Meier, J. Bohg, J. Issac, and S. Schaal, "Robust Gaussian filtering," in *Proc. of the American Control Conference*, Boston, MA, USA, Jul. 2016, *to appear*, [PDF].

[2] S. Ebner and S. Trimpe, "Communication rate analysis for event-based state estimation," in *Proc. of the 13th International Workshop on Discrete Event Systems*, Xi'an, China, May 2016, *to appear*.

[3] A. Marco, P. Hennig, J. Bohg, S. Schaal, and S. Trimpe, "Automatic LQR tuning based on Gaussian process global optimization," in *Proc. of the IEEE International Conference on Robotics and Automation*, Stockholm, Sweden, May 2016, *to appear*.

[4] J. Issac, M. Wüthrich, C. Garcia Cifuentes, J. Bohg, S. Trimpe, and S. Schaal, "Depth-based object tracking using a robust Gaussian filter," in *Proc. of the IEEE International Conference on Robotics and Automation*, Stockholm, Sweden, May 2016, *to appear*, [PDF].

[5] A. Marco, P. Hennig, J. Bohg, S. Schaal, and S. Trimpe, "Automatic LQR tuning based on Gaussian process optimization: Early experimental results," in *Machine Learning in Planning and Control of Robot Motion Workshop at the IEEE/RSJ International Conference on Intelligent Robots and Systems*, Hamburg, Germany, Sep. 2015, [PDF].

[6] M. Wüthrich, S. Trimpe, D. Kappler, and S. Schaal, "A new perspective and extension of the Gaussian filter," in *Proc. of Robotics: Science and Systems*, Rome, Italy, Jul. 2015, [PDF].

[7] M. Muehlebach and S. Trimpe, "LMI-based synthesis for distributed event-based state estimation," in *Proc. of the American Control Conference*, Chicago, USA, Jul. 2015, pp. 4060–4067, [PDF].

[8] S. Trimpe and M. C. Campi, "On the choice of the event trigger in event-based estimation," in *Proc. of the International Conference on Event-based Control, Communication, and Signal Processing*, Krakow, Poland, Jun. 2015, pp. 1–8, [PDF].

[9] M. Muehlebach and S. Trimpe, "Guaranteed $\mathcal{H}_2$ performance in distributed event-based state estimation," in *Proc. of the International Conference on Event-based Control, Communication, and Signal Processing*, Krakow, Poland, Jun. 2015, pp. 1–8, [PDF].

[10] S. Trimpe and J. Buchli, "Event-based estimation and control for remote robot operation with reduced communication," in *Proc. of the IEEE International Conference on Robotics and Automation*, Seattle, USA, May 2015, pp. 5018–5025, [PDF].

[11] S. Trimpe, "Stability analysis of distributed event-based state estimation," in *Proc. of the 53rd IEEE Conference on Decision and Control*, Los Angeles, CA, USA, Dec. 2014, pp. 2013–2019, [PDF].

[12] S. Trimpe, A. Millane, S. Doessegger, and R. D'Andrea, "A self-tuning LQR approach demonstrated on an inverted pendulum," in *Proc. of the 19th IFAC World Congress*, Cape Town, South Africa, Aug. 2014, pp. 11 281–11 287, [PDF].

[13] S. Trimpe and R. D'Andrea, "Event-based state estimation with variance-based triggering," in *Proc. of the 51st IEEE Conference on Decision and Control*, Maui, HI, USA, Dec. 2012, pp. 6583–6590, [PDF].

[14] S. Trimpe, "Event-based state estimation with switching static-gain observers," in *Proc. of the 3rd IFAC Workshop on Distributed Estimation and Control in Networked Systems*, Santa Barbara, CA, USA, Sep. 2012, pp. 91–96, [PDF].

[15] S. Trimpe and R. D'Andrea, "Reduced communication state estimation for control of an unstable networked control system," in *Proc. of the 50th IEEE Conference on Decision and Control and European Control Conference*, Orlando, FL, USA, Dec. 2011, pp. 2361–2368, [PDF].

[16] S. Trimpe and R. D'Andrea, "An experimental demonstration of a distributed and event-based state estimation algorithm," in *Proc. of the 18th IFAC World Congress*, Milan, Italy, Aug. 2011, pp. 8811–8818, [PDF].

[17] S. Trimpe and R. D'Andrea, "Accelerometer-based tilt estimation of a rigid body with only rotational degrees of freedom," in *Proc. of the IEEE International Conference on Robotics and Automation*, Anchorage, AK, USA, May 2010, pp. 2630–2636, [PDF].

[18] S. Trimpe and R. D'Andrea, "A limiting property of the matrix exponential with application to multiloop control," in *Proc. of the Joint 48th IEEE Conference on Decision and Control and 28th Chinese Control Conference*, Shanghai, China, Dec. 2009, pp. 6419–6425, [PDF].

[19] A. Kwiatkowski, S. Trimpe, and H. Werner, "Less conservative polytopic LPV models for charge control by combining parameter set mapping and set intersection," in *Proc. of the 46th IEEE Conference on Decision and Control*, New Orleans, LA, USA, Dec. 2007, pp. 3363–3368.

Popular Science Articles

[1] S. Trimpe, "Lernende Roboter," *Jahrbuch der Max-Planck-Gesellschaft*, 2015, [online].

[2] S. Trimpe, "Wenn es was zu sagen gibt," *Bild der Wissenschaft (Sonderbeilage)*, pp. 20–23, Nov. 2014, [PDF].

Theses

[1] S. Trimpe, "Distributed and event-based state estimation and control," Doctoral Thesis, ETH Zurich (Swiss Federal Institute of Technology), Switzerland, 2013, [PDF].

[2] S. Trimpe, "On the robustness of swarm behavior to obstacle variations," Master Thesis, University of California Berkeley, CA, USA, and Hamburg University of Technology, Germany, 2007.

[3] S. Trimpe, "Investigation of LPV parameter reduction," Bachelor Thesis, Hamburg University of Technology, Germany, 2005.

Abstracts, Posters

[1] M. Wüthrich, S. Trimpe, D. Kappler, and S. Schaal, "A new perspective and extension of the Gaussian filter," in *Max Planck ETH Workshop on Learning Control*, Tübingen, Germany, Nov. 2015.

[2] A. Marco, P. Hennig, J. Bohg, S. Schaal, and S. Trimpe, "Automatic LQR tuning based on Gaussian process optimization," in *Max Planck ETH Workshop on Learning Control*, Tübingen, Germany, Nov. 2015.

[3] A. Doerr, C. de Crousaz, L. Righetti, and S. Trimpe, "Adaptive and learning concepts in hydraulic force control," in *Max Planck ETH Workshop on Learning Control*, Tübingen, Germany, Nov. 2015.

[4] S. Ebner and S. Trimpe, "Adaptive communication for control," in *Max Planck ETH Workshop on Learning Control*, Tübingen, Germany, Nov. 2015.

[5] A. Marco, P. Hennig, and S. Trimpe, "Automatic controller design based on Bayesian optimization," in *Max Planck Institute for Intelligent Systems, Symposium on Intelligent Systems in Science and Industry*, Tübingen, Germany, Jul. 2015.

[6] M. Wüthrich, S. Trimpe, D. Kappler, and S. Schaal, "The Feature Gaussian Filter," in *IEEE International Conference on Robotics and Automation, Late Breaking Results Session*, Seattle, USA, May 2015.

[7] S. Trimpe, "Distributed and event-based state estimation," in *Tagungsband GMA-Fachausschuss 1.40 "Theoretische Verfahren der Regelungstechnik"*, Salzburg, Austria, Sep. 2014.

[8] S. Trimpe, "Feedback control and learning," in *ETH/MPI Research Network on Learning Systems*, Zurich, Switzerland, Jun. 2014.

INVITED TALKS (excluding conference presentations and tutorials)

Academic Audience

University of Toronto, Inst. for Aerospace Studies (Prof .A. Schoellig), Canada	Jul. 2016
University of Stuttgart, Inst. for System Dynamics (Prof. O. Sawodny), Germany	Jun. 2016
Royal Institute of Technology (KTH), Automatic Control Dept., Stockholm, Sweden	May 2016
Delft University of Technology, Delft Center for Systems and Control, Netherlands	Dec. 2015
Paderborn University, Automatic Control Group (Prof. D. Quevedo), Germany	Nov. 2015
Technische Universität Berlin, Control Systems Group (Prof. J. Raisch), Germany	Jul. 2015
Symposium on Intelligent Systems in Science and Industry, MPI Tübingen, Germany	Jul. 2015
University of Stuttgart, Inst. f. System Theory & Autom. Control (Prof. F. Allgöwer), Germany	May 2015

Karlsruhe Inst. of Technology, Inst. f. Anthropomatics & Robotics (Prof. U. Hanebeck), Germany Nov. 2014
Lund University, Automatic Control Department, Sweden Oct. 2014
Boston University, Center for Information & Systems Engineering, USA Apr. 2014
University of California, Los Angeles, Electrical Eng. Dept. (Profs. Dörfler & Tabuada), USA Apr. 2014
Eindhoven University of Technology, Control Syst. Tech. Sect. (Prof. M. Heemels), Netherlands May 2013
Boston University, Multi-robot Systems Lab (Prof. M. Schwager), USA May 2013
Massachusetts Institute of Technology, Distributed Robotics Group (Prof. D. Rus), USA May 2013
Carnegie Mellon University, Robotics Institute, Pittsburgh, USA Apr. 2013
University of California, Berkeley, EECS (Prof. P. Abbeel), USA Apr. 2013
Max Planck Institute for Intelligent Systems, AMD (Prof. S. Schaal), Tübingen, Germany Apr. 2013
University of Kassel, Distributed Systems Group (Prof. K. Geihs), Germany Feb. 2013
Technische Universität München (TUM), Faculty of Informatics, Germany Feb. 2013
Workshop DFG Priority Program 1305 (Contr. of Netw. Dyn. Syst.), TU München, Germany Oct. 2012
California Institute of Technology, Control and Dynamical Systems Group, USA Sep. 2012
University of Southern California, Center for Robotics and Embedded Syst., Los Angeles, USA Sep. 2012
Royal Institute of Technology (KTH), Automatic Control Dept., Stockholm, Sweden May 2012
Ruhr-Universität Bochum, Inst. for Automation & Computer Control (Prof. J. Lunze), Germany Nov. 2011
Ruhr-Universität Bochum, Inst. for Automation & Computer Control (Prof. J. Lunze), Germany Dec. 2009
Hamburg University of Technology, Inst. of Control Systems (Prof. H. Werner), Germany Nov. 2009
University of Stuttgart, Inst. of Eng. and Comp. Mechanics (Prof. P. Eberhard), Germany Nov. 2007

Industry

IAV, Gifhorn, Germany May 2016
ABB Corporate Research, Baden, Switzerland Apr. 2016

General Audience

Tech Open Air Berlin, Interdisciplinary Technology Festival, Berlin, Germany Jul. 2015
Workshop for high school students and teachers, during IEEE CDC, Los Angeles, USA Dec. 2014
Workshop for high school students and teachers, during IFAC World Congress, South Africa Aug. 2014
Workshop for high school students and teachers, during IEEE CDC, Maui, USA Dec. 2012
Workshop for high school students and teachers, during IEEE CDC, Orlando, USA Dec. 2011
Swiss Science Center Technorama, Winterthur, Switzerland May 2011
Graduation ceremony Hamburg Univ. of Technology, speech on behalf of graduates, Germany Jun. 2008

PUBLIC EXHIBITIONS

Balancing Cube (with Raffaello D'Andrea)
European Control Conference (ECC), Zurich, Switzerland Jul. 2013
International Federation of Automatic Control (IFAC) World Congress, Milan, Italy Aug. 2011
Festival Della Scienza, Genoa, Italy Oct. 2009
Nacht der Forschung, Zurich, Switzerland Sep. 2009

TEACHING

University Lectures

Recursive Estimation, ETH Zurich (151-0566-00) Spring 2013
Graduate level, approx. 160 students, English.
Lecturer. Class overall evaluation: **4.3** (1.0/5.0 lowest/highest, department average: 4.0).

Tutorials

Event-based State Estimation, IEEE MFI 2016, Baden-Baden, Germany — Sep. 2016
IEEE Int. Conf. on Multisensor Fusion and Integration for Intelligent Systems (MFI),
Invited Tutorial.

Teaching Assistant

Recursive Estimation, ETH Zurich (151-0566-00) — Spring 2010/11
Development of new class, main teaching assistant.

Dynamic Programming and Optimal Control, ETH Zurich (151-0563-00) — Fall 2008/09
Development of new class, main teaching assistant.

!And Yet It Moves, ETH Zurich (151-0585-02) — Spring 2008
Main research/teaching assistant in project-based systems engineering class.

Linear Algebra II, Hamburg University of Technology (TUHH) — Spring 2005
Student teaching assistant.

Linear Algebra I, Hamburg University of Technology (TUHH) — Fall 2004
Student teaching assistant.

Electrical Engineering for Information Technology I, TUHH — Fall 2004
Student teaching assistant.

STUDENT ADVISING

PhD

Alonso Marco Valle, MPI Tübingen	since 2016
Andreas Dörr, MPI Tübingen and Bosch Corporate Research Renningen (co-supervision)	since 2015
Manuel Wüthrich, MPI Tübingen (co-supervision with S. Schaal and J. Bohg)	since 2013

PhD internship

Ashish Bussa, MPI Tübingen (co-supervision with L. Righetti)	since 2016

Master

Harsoveet Singh, MPI Tübingen and ETH Zurich	since 2016
Cédric de Crousaz, MPI Tübingen and ETH Zurich (co-supervision with L. Righetti)	2016
Simon Ebner, MPI Tübingen and Univ. Stuttgart	2016
Andreas Dörr, MPI Tübingen and Univ. Stuttgart (co-supervision with L. Righetti)	2015
Alonso Marco Valle, MPI Tübingen and TU Barcelona	2015
Holger Kaden, MPI Tübingen and Univ. Tübingen (co-supervision with J. Bohg)	2014
Simon Dössegger, ETH Zurich	2012
Marc Spirig, ETH Zurich	2010
Dursun Akay, ETH Zurich	2009

Other (Semester Project, Bachelor Thesis, Studies on Mechatronics)

Alexander Millane, ETH Zurich	2013
Kilian Schindler, ETH Zurich	2012
André Widmer, ETH Zurich	2011
Korbinian Nottensteiner, ETH Zurich and TU München	2010
Niklaus Voellmy, ETH Zurich	2010
Andreas Köberl, ETH Zurich	2010
Lukas Wunderli, ETH Zurich	2009
Valentin Baumann, ETH Zurich	2009
Gajamohan Mohanarajah, ETH Zurich and Tokyo Institute of Technology	2008

PROFESSIONAL ACTIVITIES

Conference, Workshop, and Session Organization

Special Session at Int. Workshop on Discrete Event Systems (WODES), Xi'an, China 2016
Organizer of Special Session on "Event-driven Control, Estimation, and Optimization" (with Christos G. Cassandras, Boston University).
http://wodes2016.diee.unica.it

Max Planck ETH Workshop on Learning Control, Tübingen, Germany 2015
Initiator, co-organizer, and program co-chair (with Jonas Buchli, Ludovic Righetti, Melanie Zeilinger).
http://learning-systems.org/events/learningcontrol

International Conference on Event-based Control, Communication, and Signal Processing (EBCCSP), Krakow, Poland 2015
Work-in-Progress Program Chair (with Manuel Mazo Jr., TU Delft).
Organizer and Program Chair of Special Session on "Event-based State Estimation" (with Joris Sijs, TNO Netherlands).
http://ebccsp2015.org

European Control Conference (ECC), Zurich, Switzerland 2013
Member of organizing committee, Academic Tours Chair.
http://www.ecc2013.ethz.ch

International Program Committees

Int. Conf. on Event-based Control, Communication, and Signal Processing (EBCCSP)	2016, 2015
Int. Workshop on Discrete Event Systems (WODES)	2016
IFAC Symposium on Advances in Control Education	2016
Machine Learning in Planning and Control of Robot Motion Workshop at IROS 2015	2015
IFAC Workshop on Internet Based Control	2015
IEEE Int. Conf. on Emerging Technologies and Factory Automation (ETFA)	2015

Reviewing

Journals

Regular: IEEE Transactions on Automatic Control, Automatica, IEEE Transactions on Control Systems Technology.

Occasional: IEEE Transactions on Robotics, IEEE Transactions on Signal Processing, IEEE Signal Processing Letters, IEEE Transactions on Automation Science and Engineering, IEEE Transactions on Vehicular Technology, IEEE Systems Journal, Asian Journal of Control, Sensors, Sensors and Actuators A: Physical.

Conferences

Regular: IEEE Conference on Decision and Control (CDC), IFAC World Congress, American Control Conference (ACC), European Control Conference (ECC), IEEE International Conference on Robotics and Automation (ICRA), International Conference on Event-based Control, Communication, and Signal Processing (EBCCSP).

Occasional: IEEE/RSJ Int. Conf. on Intelligent Robots and Systems (IROS), IEEE Multi-conference on Systems and Control (MSC), IFAC Workshop on Distributed Estimation and Control in Networked Systems (NecSys), International Workshop on Discrete Event Systems (WODES), IFAC Symposium on System Identification (SYSID), IFAC Symposium Advances in Control Education (ACE), IEEE International Conference on Rehabilitation Robotics (ICORR), IEEE International Conference on Emerging Technologies and Factory Automation (ETFA).

Books: Springer.

Research grant proposals: Swiss National Science Foundation (SNSF).

MEMBERSHIPS

Academic

Max Planck ETH Center for Learning Systems, Associated Member	since 2016

Professional Organizations

VDI Verein Deutscher Ingenieure	since 2014
IEEE (Control Systems Society, Robotics and Automation Society)	since 2008
VDE Verband der Elektrotechnik Elektronik Informationstechnik	since 2005

Technical Committees (TCs)

IEEE Control Systems Society, TC on Networks and Communications	since 2015
International Federation of Automatic Control (IFAC), TC on Control Education	since 2014
IEEE Control Systems Society, TC on Control Education	since 2012

INDUSTRY INTERNSHIPS

Airbus Germany, Bremen, Dept. Aeroelastics 2006/2007
Applied system identification: identification of structural aircraft dynamics from flight vibration tests. Advisor: Dr. J. Müller. (6 months)

Basler Vision Technologies, Ahrensburg, Germany 2003
Printed circuit board (PCB) assembly, camera assembly. (1 month)

IBM Germany, Stuttgart, European Technical Center 2002
PC hardware and software test projects. (2 months)

21 April 2016