

Mohamed Abdalmoaty

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Research Interests

Data-driven Modeling and Control; System identification; Filtering and Statistical Signal Processing; and their applications to Modern Power Systems

Academic Appointments

Apr 2023 - present Postdoctoral researcher, Automatic Control Lab (IfA), ETH Zurich.
2019 - 2023 Postdoctoral researcher, KTH Royal institute of Technology & Uppsala University, Sweden.
2013 - 2019 Doctoral student/TA, Decision and Control Systems, KTH Royal institute of Technology.

Academic Degrees

2019 **Ph.D. in Electrical Engineering** (306.5 ECTS), KTH Royal Institute of Technology, Sweden
Thesis: *Identification of Stochastic Nonlinear Dynamical Models Using Estimating Functions*
Supervisor: Prof. Håkan Hjalmarsson (KTH - EECS)

2017 **Licentiate in Electrical Engineering** (*Tekn. Lic.*), KTH Royal Institute of Technology, Sweden
Thesis: *Learning Stochastic Nonlinear Dynamical Systems Using Non-stationary Linear Predictors*

2012 **M.Sc. in Space Technology**, Luleå University of Technology, Sweden
M.Sc. (Ing.) in Systems and Control, Czech technical university, Czech Republic
Thesis: *Measures and LMIs for Optimal Control of Piecewise-Affine Dynamical Systems*
Supervisor: Prof. Didier Henrion (LAAS/CNRS - France)

2008 **B.Sc in Electrical Power and Machines** (5-year program), Helwan university, Egypt
Project: *Design and operation of a 3-phase drive and control unit for driverless train*

Training

2022 Academic Leadership (3 days), UU. Topics: the leadership role, leadership in different group development phases, understanding and managing conflicts, communication, and coaching.

2020 Teaching and learning in higher education (7.5 ECTS), KTH. Topics: student learning in higher education, teaching methods, constructive alignment, teachers' role, design of teaching and learning activities, diversity, and inclusive teaching.

2017 From research to impact (3 ECTS), KTH. Topics: technological readiness level, value proposition, research communication, outreach activity, and press releases.

2015 The sustainable scientist (2 ECTS), KTH. Topics: research ethics, IP in innovation processes, research applications, and funding agencies.

2013 Basic Communication and Teaching (3 ECTS), KTH. Topics: basis for learning and teaching, learning environments, teaching of engineering sciences, feedback and supervision, group work, development as teacher.

Peer-Reviewed Publications

Journal Articles

- [J6] F. E. Tosun, A. M. H. Teixeira, **M. Abdalmoaty**, A. Ahlén, S. Dey. “Quickest Detection of Bias Injection Attacks on the Glucose Sensor in the Artificial Pancreas Under Meal Disturbances”. In *Journal of Process Control*, vol. 153, no. 103162, March 2024.
- [J5] A. Ghosh, **M. Abdalmoaty**, S. Chatterjee, and H. Hjalmarsson. DeepBayes - an estimator for parameter estimation in stochastic nonlinear dynamical models. *Automatica*, Volume 159, January 2024, 111327. (IF 6.15)
- [J4] D. Rodrigues, **M. Abdalmoaty**, E. Jacobsen, V. Chotteau, and H. Hjalmarsson. An integrated approach for modeling and identification of perfusion bioreactors via basis flux modes. *Computers & Chemical Engineering*, 149 (2021): 107238. (IF 4.00).
- [J3] **M. Abdalmoaty**, H. Hjalmarsson, and B. Wahlberg. The Gaussian maximum likelihood estimator versus the optimally weighted least-squares estimator. *IEEE Signal Processing Magazine*, Volume 37, Issue 6, 2020. (IF 11.64)
- [J2] **M. Abdalmoaty** and H. Hjalmarsson. Identification of Stochastic Nonlinear Models Using Optimal Estimating Functions. *Automatica*, 119 (2020): 109055. (IF 5.944)
- [J1] **M. Abdalmoaty** and H. Hjalmarsson. Linear Prediction Error Methods for Stochastic Nonlinear Models. *Automatica*, 105:49-63, July 2019. (IF 5.944)

Conference Papers

- [C21] **M. Abdalmoaty** and R. Smith. Small Noise Analysis of Non-Parametric Closed-Loop Identification. Accepted for CDC 2024.
- [C20] A. Tsiamis, **M. Abdalmoaty**, R. Smith, J. Lygeros. Finite Sample Frequency Domain Identification. Accepted for CDC 2024.
- [C19] R. Smith, **M. Abdalmoaty**, M. Yin. Optimal Data-Driven Prediction and Predictive Control using Signal Matrix Models. Accepted for CDC 2024.
- [C18] R. Smith, **M. Abdalmoaty**, M. Yin. Data-driven formulation of the Kalman filter and its Application to Predictive Control. Accepted for CDC 2024.
- [C17] **M. Abdalmoaty**, E. Balta, J. Lygeros, and Roy Smith. Online Identification of Stochastic Continuous-Time Wiener Models Using Sampled Data. ECC 2024 Stockholm, Sweden.
- [C16] **M. Abdalmoaty**, J. Miller, M. Yin, and Roy Smith. Frequency-Domain Identification of Discrete-Time Systems using Sum-of-Rational Optimization. IFAC Symposium on System Identification, Boston, USA.
- [C15] **M. Abdalmoaty**, Sribalaji C. Anand and André Teixeira. Privacy and Security in Network Controlled Systems via Dynamic Masking. IFAC 2023 Yokohama, Japan.
- [C14] **M. Abdalmoaty** and A. Medvedev. Continuous-Time Pure Delay Estimation From Sampled Measurements. IFAC 2023 Yokohama, Japan.
- [C13] **M. Abdalmoaty** and A. Medvedev. Noise reduction in Laguerre-domain discrete delay estimation. In *the 61th IEEE Conference on Decision and Control (CDC2022)*
- [C12] R. Bereza, O. Eriksson, **M. Abdalmoaty**, D. Broman, and H. Hjalmarsson. Stochastic Approximation for Identification of Non-Linear Differential-Algebraic Equations with Process Disturbances. In *the 61th IEEE Conference on Decision and Control (CDC2022)*
- [C11] A. Ghosh, A. Fontcuberta, **M. Abdalmoaty**, and S. Chatterjee. Time-Varying Normalizing Flows for Dynamical Signals. In *the 30th European Signal Processing Conference (EUSIPCO 2022)*
- [C10] **M. Abdalmoaty**, O. Eriksson, R. Bereza, D. Broman, and H. Hjalmarsson. Identification of Non-Linear Differential-Algebraic Equation Models with Process Disturbances. In *the 60th IEEE Conference on Decision and Control (CDC)*, pp. 2300-2305, 2021.

- [C9] D. Rodrigues, **M. Abdalmoaty**, and H. Hjalmarsson. Toward Tractable Global Solutions to Bayesian Point Estimation Problems via Sparse Sum-of-Squares Relaxations. *American Control Conference (ACC)*, 2020.
- [C8] D. Rodrigues, **M. Abdalmoaty**, and H. Hjalmarsson. Toward Tractable Global Solutions to Maximum-Likelihood Estimation Problems via Sparse Sum-of-Squares Relaxations. In *the 58th IEEE Conference on Decision and Control (CDC)*, 2019.
- [C7] **M. Abdalmoaty** and H. Hjalmarsson. Consistent estimators of stochastic MIMO Wiener models based on suboptimal predictors. In *the 57th IEEE Conference on Decision and Control (CDC)*, pp. 3842-3847, 2018.
- [C6] **M. Abdalmoaty** and H. Hjalmarsson. Application of a linear PEM estimator to a stochastic Wiener-Hammerstein benchmark problem. In *IFAC-PapersOnLine*, Volume 51, Issue 15, pp. 784-789, 2018.
- [C5] **M. Abdalmoaty**, C. R. Rojas, and H. Hjalmarsson. Identification of a class of nonlinear dynamical networks. In *IFAC-PapersOnLine*, Volume 51, Issue 15, pp. 868-873, 2018.
- [C4] **M. Abdalmoaty** and H. Hjalmarsson. Simulated pseudo maximum likelihood identification of nonlinear models. In *IFAC-PapersOnLine*, Volume 50, Issue 1, pp. 14058-14063, 2017.
- [C3] **M. Abdalmoaty** and H. Hjalmarsson. A Simulated Maximum Likelihood Method for Estimation of Stochastic Wiener Systems. In *the 55th IEEE Conference on Decision and Control (CDC)*, pp. 3060-3065, 2016.
- [C2] **M. Abdalmoaty** and H. Hjalmarsson. On Re-weighting, Regularization Selection, and Transient in Nuclear Norm based Identification. In *IFAC-PapersOnLine*, Volume 48, Issue 28, pp. 092-097, 2015.
- [C1] **M. Abdalmoaty**, D. Henrion and L. Rodrigues. Measures and LMIs for optimal control of piecewise-affine systems. *European Control Conference, Zurich 2013*.

Theses

- [T3] M. Abdalmoaty. Identification of Stochastic Nonlinear Dynamical Models Using Estimating Functions. *Doctoral thesis*. KTH Royal Institute of Technology, 2019.
- [T2] M. Abdalmoaty. Learning Stochastic Nonlinear Dynamical Systems Using Non-stationary Linear Predictors. *Licentiate thesis*. KTH Royal Institute of Technology, 2017.
- [T1] M. Abdalmoaty. Measures and LMIs for Optimal Control of PWA Dynamical Systems: Systematic feedback synthesis in continuous-time. *Master thesis*. Luleå University of Technology, 2012.

PhD Courses

Acquired 126.5 ECTS credits in fundamental courses during PhD studies; courses were taught by 5 different divisions (control, signal processing, optimization theory, mathematics, and statistics): Foundation of Analysis; Advanced Real and Functional Analysis (2 courses); Fourier Analysis; Matrix Algebra; Probability Theory; Optimal Filtering; Data-Driven Modelling; Advanced Modelling of Nonlinear Systems; Statistical Inference; Mathematical Methods in Signals, Systems and Control; Convexity and Optimization in Linear Spaces; Convex Optimization with Engineering Applications; Introduction to Model Order Reduction; Adaptation and Learning over Networks; The Theory and Methodology of Science; Basic Communication and Teaching

Honors and Awards

2017/2018	Malme foundation and Knut & Alice Wallenbergs foundation travel grants, in support of my doctoral research.
2015	Malme foundation grant (two-week visit to Kyoto University, Japan).
2012	Dean's Prize for exceptional diploma thesis, Czech technical university.
2011-2012	CTU Scholarship for international graduate students (awarded in competition), Czech technical university.
2008	Honor Degree of bachelor studies, Helwan University (awarded for excellent academic performance).

Teaching Experience

Lecturer/course development

Fall 2023, 2024	System Identification. (4 ECTS; MSc), at ETH Zurich with Prof. Roy Smith.
Spring 2023, 2024	Modelling and Identification (MSc course), at Ashesi University - Ghana with Prof. Roy Smith.
Fall 2022	A Computational Introduction to Stochastic Differential Equations (6 ECTS; PhD) at Uppsala University. Course responsible: Dr. Zheng Zhao. Empirical Modelling (5 ECTS; MSc) and System Identification (10 ECTS; MSc) at Uppsala University. Course responsible: Prof. Per Mattsson.
Spring 2022	Safety and Security in Control Systems (5 ECTS; MSc), at Uppsala University with Prof. André Teixeira and Prof. Alexander Medvedev.

Supervision

2024	Miyang Limnyuy Miki, (MSc; Ashesi University & ETH) Modelling and Control of Precalciner Temperature in the Cement Industry Benno Bösch (MSc; ETH) Robot Assisted Building management.
2021	Anna Wilhelmsson (MSc; KTH), The Implementation and Evaluation of Learning Approaches in State Filtering.
2016	A. Filotheou, M. Guldogus, T. Lin, R. Quiros and X. Xu (Proj. course; KTH), Slip control of F1tenth Autonomous Vehicle System.
2015	A. Fernández, S. Papisideris, and Z. Zafirakis (Proj. course; KTH), Control of Collaborative robotics.
2014	V. Li and Z. Zafirakis (BSc; KTH), Networked Control of Unmanned Air Vehicles.

Teaching Assistant

2024	Robust Control and Convex Optimization. (MSc), at ETH Zurich with Prof. Roy Smith.
2017-2018	Control Theory and Practice, (7.5 ECTS, ~120 international students), KTH Course responsible: Prof. Elling Jacobson
2015-2016	Project Course in Automatic Control, (7.5 ECTS, 8 M.Sc students in 2 groups), KTH Course responsible: Prof. Jonas Mårtensson
2014-2018	Automatic Control Lab assistant Supervising undergraduate and M.Sc. students during practical lab sessions
2014-2016	Automatic Control, (6 ECTS, B.Sc.) KTH Course responsible: Prof. Henrik Sandberg / Assoc. Prof. Jonas Mårtensson
2014	Bachelor thesis project course, (15 ECTS, 2 Bachelor students), KTH Course responsible: Prof. Carlo Fischione

Invited Talks

Nov. 2019	System Identification using Estimating Functions, Global Automation and Control Early Career Workshop, Zhejiang University, China.
May 2018	Linear Prediction Error Methods for Stochastic Nonlinear Models, Division of Automatic Control, Linköping University, Sweden.
Sept. 2012	LMIs and Occupation Measures for Optimal Control of PWA Dynamical Systems, Mathematics, Algorithms and Proofs Workshop, Konstanz University, Germany.

Invited Poster Contributions

I regularly participated in the annual European Research Network on System identification (ERNSI; 2014-present).

2023 (Stockholm, Sweden);, 2022 (KU Leuven, Belgium); 2021 (Virtual, Inria Rennes, France), 2019 (TU/e, The Netherlands); 2018 (Pembroke College, Cambridge, UK); 2017 (Ecole Centrale de Lyon, France); 2016 (University of Padua , Italy); 2015 (Linköping University, Sweden); 2014 (VUB, Belgium).

Scientific Activities and Society Service

- 2013-present I serve regularly as a referee for IEEE and IFAC journals and conferences proceedings.
- 2013-present Regular participation in the European Research Network on System Identification (ERNSI) Workshop (2013-present), IFAC Symposium on System Identification, IFAC World Congress (2015, 2017), IEEE CDC and ECC, and Reglermöte.
- 2018 Participated in the organization of the 18th IFAC Symposium on System Identification (SYSID'18), Stockholm.

Industrial Experience

- July 2012 - April 2013
(research position) Graduate intern at EADS - Astrium GmbH, AOCS/GNC & Flight Dynamics (now Airbus) Friedrichshafen, Germany. Tasks: LMI formulation of occupation measures for analysis and control; Verification simulations for AOCS algorithms of ESA's mission Sentinel- 1/2.
- July 2011 - Sept. 2011
(research position) Intern at EADS - Innovation Works, Aeromechanical Systems (now Airbus) Munich, Germany. Tasks: Integration of flight control systems models of the "Active Control for Flexible 2020 Aircraft" (ACFA2020), an FP7 project, in Simulink and FlightGear.
- Jan. 2009 - Sept. 2010 (Professional) electrical engineer at Petroleum Safety and Environmental Services Company PETROSAFE, Egypt. Tasks: Performed design work, prepared technical scope, specification and drawing among other things.
- Aug. 2007 -Sept. 2007 Intern at New and Renewable Energy Authority (NREA) Labs, Cairo - Egypt. Tasks: On-field training at testing and measurements facilities with emphasis on stand-alone Photovoltaic arrays, and Wind Turbines operation.
- June 2006 -July 2006 Intern at EgyptAir Maintenance and Engineering Company, Cairo International Airport, Cairo - Egypt. Tasks: On-the-Job training at the maintenance hangers; performed several tests/troubleshoots on avionics/electric power systems, rotating machines.
- July 2005 - Aug. 2005 Intern at Izhevsk State Technical University, Izhevsk - Russia. Industrial training on technical design, maintenance and production.