Robert Mattila

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I am a Ph.D. student whose research concerns identification, control and inference in stochastic dynamical systems. My interests are in machine learning, data analytics and their future applications in real-world scenarios – for example, in next-generation health-care.

Research Interests

- Identification, control and inference in stochastic dynamical systems
- Hidden Markov models and (partially observed) Markov decision processes
- Machine learning and optimization

Education

- **KTH Royal Institute of Technology** Stockholm, Sweden
  Ph.D., Department of Automatic Control *2015 - 2020 (Projected)*
  - Supervisors: Prof. Bo Wahlberg and Assoc. Prof Cristian R. Rojas.
  - Topic: Markovian models: Identification, control and application.
- **KTH Royal Institute of Technology** Stockholm, Sweden
  Licentiate Degree. Department of Automatic Control *March, 2018*
  - Title: *Hidden Markov models: Identification, control and inverse filtering.*
  - Opponent: **Prof. Eric Moulines** of Ecole Polytechnique (Paris, France).
- **KTH Royal Institute of Technology** Stockholm, Sweden
  B.Sc. Engineering Physics, M.Sc. Systems, Control and Robotics *2010 - 2015*
  - The Swedish degree of *Civilingenjör i Teknisk Fysik.*
  - The graduation date was one semester earlier than nominal time.
  - B.Sc. GPA of 4.98/5.0 and M.Sc. GPA of 5.0/5.0 .
- **UCM, Universidad Cumplutense de Madrid** Madrid, Spain
  ERASMUS Exchange studies *Spring 2013*
  - All (five) courses taken were taught in Spanish (including reading material).
  - GPA of 8.13/10.0 .
- **THG, Thorildsplans gymnasium** Stockholm, Sweden
  Natural Sciences with specialization on Mathemathics and Computer Science *2007 - 2010*

Skills, Merits and Awards

- **Computer Skills:**

Programming:	Matlab, Python, Julia, Java
Operating Systems:	OSX, Linux, Windows
Other:	LaTeX, git

- **Languages:** Native in Swedish, fluent in English and proficient (B2) in Spanish.

- **Awards:**
  - Awarded the KTH Electrical Engineering Scholarship of Excellence (1 MSEK) in 2015.
  - Awarded a SURF scholarship from Caltech to work with Prof. Richard Murray in 2014.
  - Awarded the Henrik Göransson's Sandviken Scholarship and the KTH Student Scholarship (twice) for outstanding grades.
  - Participated in the final of *Wallenbergs Fysikpris 2010* (Swedish qualifications for the International Physics Olympiad).
  - Awarded scholarship for outstanding grades when graduating from THG.
- **Reviewer** for:
  - IFAC American Control Conference (ACC),
  - IFAC Automatica journal,
  - IEEE Conference on Decision and Control (CDC),
  - ACL Conference on Learning Theory (COLT),
  - IEEE Signal Processing Letters (SPL).
- **KIBok** (`www.kibok.se`): A website for buying and selling used medical textbooks, aimed for students at the Karolinska Institute. The website was developed using Python and Django, and has been running since 2013.
- Hold a Swedish driver's license (B).

Publications

Journals

- Robert Mattila, Cristian R. Rojas, Vikram Krishnamurthy, and Bo Wahlberg. Asymptotically efficient identification of known-sensor hidden Markov models. *IEEE Signal Processing Letters*, 24(12):1813–1817, 2017.

Conferences

- Robert Mattila, Cristian R. Rojas, Vikram Krishnamurthy, and Bo Wahlberg. Inverse filtering for linear Gaussian state-space systems. In *Proceedings of the 57th IEEE Conference on Decision and Control (CDC'18)*, 2018.
- Roberto G. Ramírez-Chavarría, Gustavo Quintana-Carapia, Matias I. Müller, Robert Mattila, Daniel Matatagui, Celia Sánchez-Pérez, Bioimpedance parameter estimation using fast spectral measurements and regularization. In *Proceedings of the 18th IFAC Symposium on System Identification (SYSID'18)*, 2018.
- Robert Mattila, Cristian R. Rojas, Vikram Krishnamurthy, and Bo Wahlberg. Inverse filtering for hidden Markov models. In *Advances in Neural Information Processing Systems (NIPS'17)*, pages 4207–4216, 2017.
- Robert Mattila, Cristian R. Rojas, Vikram Krishnamurthy, and Bo Wahlberg. Identification of hidden Markov models using spectral learning with likelihood maximization. In *Proceedings of the 56th IEEE Conference on Decision and Control (CDC'17)*, pages 5859–5864, 2017.

- Antti Siika, Robert Mattila, Bo Wahlberg, and Joy Roy. An optimal gender- specific treatment policy for abdominal aortic aneurysms constructed using a Markov decision process model. *Journal of Vascular Surgery*, 65(6, Supplement):175S, 2017. Abstracts of the 2017 Vascular Annual Meeting (VAM'17).

- Robert Mattila, Cristian R. Rojas, Vikram Krishnamurthy, and Bo Wahlberg. Computing monotone policies for Markov decision processes: a nearly-isotonic penalty approach. In *Proceedings of the 20th IFAC World Congress*, volume 50, pages 8429 – 8434, 2017.

- Robert Mattila, Antti Siika, Joy Roy, and Bo Wahlberg. A Markov decision process model to guide treatment of abdominal aortic aneurysms. In *Proceedings of the IEEE Conference on Control Applications (CCA'16)*, pages 436–441, 2016.

- Robert Mattila, Vikram Krishnamurthy, and Bo Wahlberg. Recursive identifi- cation of chain dynamics in hidden Markov models using non-negative matrix factorization. In *Proceedings of the 54th IEEE Conference on Decision and Control (CDC'15)*, pages 4011–4016, 2015.

- Robert Mattila, Yilin Mo, and Richard M. Murray. An iterative abstraction algorithm for reactive correct-by-construction controller synthesis. In *Proceedings of the 54th IEEE Conference on Decision and Control (CDC'15)*, pages 6147–6152, 2015.

- Robert Mattila, Cristian R. Rojas, and Bo Wahlberg. Evaluation of spectral learning for the identification of hidden Markov models. *Proceedings of the 17th IFAC Symposium on System Identification (SYSID'15)*, 48(28):897–902, 2015.

Theses

- Robert Mattila, *Hidden Markov models: Identification, control and inverse filtering.* Licentiate thesis, KTH Royal Institute of Technology. Stockholm, Sweden, 2018. Supervisors: Prof. Bo Wahlberg and Assoc. Prof. Cristian R. Rojas.

- Robert Mattila, *On Identification of Hidden Markov Models Using Spectral and Non-Negative Matrix Factorization Methods.* Master's thesis, KTH Royal Institute of Technology. Stockholm, Sweden, 2015. Supervisors: Prof. Bo Wahlberg and Assoc. Prof. Cristian R. Rojas.

- Robert Mattila, *Including Bathymetric Data in Autonomous Surface Vessels' Maneuvering Optimisation Tool.* Bachelor's thesis, KTH Royal Institute of Technology, Stockholm, and Universidad Cumplutense de Madrid (UCM), 2013. Supervisors: Prof. Juan Jiménez and José María Benítez.

Other

- Robert Mattila, Cristian R. Rojas, Vikram Krishnamurthy and Bo Wahlberg, *Inverse Filtering for Linear Gaussian State-Space Models.* Presentation at the 2018 Swedish Control Conference (Reglermötet), June, Stockholm, Sweden.

- Robert Mattila, Cristian R. Rojas, Vikram Krishnamurthy and Bo Wahlberg, *Inverse Filtering for Hidden Markov Models.* Poster at the 2018 WASP AI4X Industry, February, Stockholm, Sweden.

- Robert Mattila, Cristian R. Rojas, Vikram Krishnamurthy and Bo Wahlberg, *Inverse Filtering for Hidden Markov Models.* Poster at the 2017 Workshop of the European Research Network on System Identification (ERNSI), September, Lyon, France.

- Robert Mattila, Cristian R. Rojas, Vikram Krishnamurthy and Bo Wahlberg, *Method of Moments Identification of Hidden Markov Models with Known Sensor Uncertainty Using Convex Optimization*. Poster at the 2016 Workshop of the European Research Network on System Identification (ERNSI), September, Cison di Valmarino, Italy.
- Robert Mattila, Cristian R. Rojas, Vikram Krishnamurthy and Bo Wahlberg, *Method of Moments Identification of Hidden Markov Models with Known Sensor Uncertainty Using Convex Optimization*. Poster at Reglermötet 2016, June, Göteborg, Sweden.
- Robert Mattila, Vikram Krishnamurthy and Bo Wahlberg, *Recursive Method of Moments Identification of Hidden Markov Models using Convex Optimization*. Poster at the 2015 Workshop of the European Research Network on System Identification (ERNSI), September, Varberg, Sweden.

Academic Experience

- **IFAC Symposium on System Identification (SYSID'18)** Stockholm, Sweden
  Volunteer in the organizing crew *Summer 2018*
- **Cornell Tech, Cornell University** Manhattan, USA
  Invited researcher by Prof. Vikram Krishnamurthy *Summer 2017*
  - Worked on inverse problems for Bayesian optimal filters.
- **VUB-ELEC, Workshop on System Identification** Brussels, Belgium
  Included courses on *Summer 2017*
  - Frequency response function measurements (non-parametric tools), dynamic system identification (parametric tools) and control-oriented system identification by, among others, John Lataire, Yves Rolain, Rik Pintelon, Ivan Markovsky, Philippe Dreesen and Simone Formentin.
- **S^{3}CS, Swedish Summer School in Computer Science** Djurö, Sweden
  The courses were taught by *Summer 2016*
  - Michael Mitzenmacher (Hashing Algorithms);
  - Sergei Vassilvitskii (Algorithms for Modern Parallel Systems).
- **UBC, University of British Columbia** Vancouver, Canada
  Invited researcher by Prof. Vikram Krishnamurthy *Summer 2015*
  - Worked on method of moments for hidden Markov models.
- **UBC, University of British Columbia** Vancouver, Canada
  Master thesis with Prof. Vikram Krishnamurthy *Autumn 2014*
- **Caltech, California Institute of Technology** Pasadena, USA
  SURF in the Control and Dynamical Systems (CDS) group *Summer 2014*
  - Supervisors: Prof. Richard M. Murray and Asst. Prof. Yilin Mo
  - Developed an improved abstraction algorithm for the correct-by-construction controller synthesis framework `TuLiP` (implemented in Python).
- **KTH, Royal Institute of Technology** Stockholm, Sweden
  Research intern for Prof. Bo Wahlberg *Summer 2013*
- **ZJU, Zhejiang University** Hangzhou, China
  Participated in the Joint Research Center of Photonics Workshop *Summer, 2012*
  - Implemented optical logic gates exploiting non-linearities in fibers.

Industry Experience

- **Stockholm Vatten AB** — Stockholm, Sweden
  Summer intern — *Summer 2012*
- **Stockholm Vatten AB** — Stockholm, Sweden
  Summer intern — *Summer 2011*
  - Warehouse work including: collecting and delivering items; cleaning and repairing machines; contacting customers; administrative work in the supply system Agresso.

Teaching

- **Bachelor Thesis** — KTH
  Supervisor of two projects on inverse Markowitz portfolio optimization: — *Spring 2018*
  - *Portfolio Optimization with Market State Analysis* by Ossian Krödel and Rasmus Jerndal.
  - *Portfolio Inversion: Finding Market State Probabilities from Optimal Portfolios* by Gustav Ekman and Fredrik Rubin.
- **EL2800 Stochastic Control and Optimization** — KTH
  Teaching assistant — *Autumn 2017*
- **Master Thesis** — KTH
  Supervisor of: — *Spring 2017*
  - *Optimal Input Design by Model Predictive Control for System Identification* by Daniel Merkoulova
- **EL1000 Automatic Control** — KTH
  Teaching assistant — *Autumn 2016*
- **EH1010 Project Course in Electrical Engineering** — KTH
  Supervisor — *Spring 2016*
- **EL1000 Automatic Control** — KTH
  Teaching assistant — *Autumn 2015*

Ph.D. Courses

- Partially observed Markov decision processes
- Game theory
- Mathematical methods in signals, systems and control
- Bayesian networks
- Hybrid systems (stability, stabilization, abstraction and formal verification)
- Probabilistic verification and synthesis
- Matrix algebra
- Probability and random processes
- Convex optimization
- Stochastic control and optimization
- Deep learning in data science (attended lectures)