

Marzia Cescon

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Research interests

System identification; particle filters; modeling and estimation; dynamical systems; complex systems.

Current employment

Research assistant, Lund University

December 2013-Present

Education

Ph.D. in Automatic Control, Lund University, advisor prof. Rolf Johansson. November 2013

Tech. Lic. in Automatic Control, Lund University, advisor prof. Rolf Johansson. June 2011

Master of Science in Automation Engineering (Laurea Magistrale in Ingegneria dell'Automazione),
University of Padova, advisor prof. Giorgio Picci. April 2008

Bachelor Degree in Information Engineering (Laurea Triennale in Ingegneria dell'informazione),
University of Padova. December 2005

Exchange programs

Erasmus student, Lund University.

January 2007 – February 2008

Languages

Italian native

English fluent

Swedish fluent

Projects participation

DIAdvisorTM European IP, FP7 IST-216592, www.diadvisor.eu

2008-2012

Teaching experience

Teaching assistant:

Predictive control, Lund University.

fall 2008, fall 2009, fall 2010, fall 2011, fall 2012

System identification, Lund University.

spring 2009, spring 2010, spring 2011

Process control, Lund University.	fall 2008
Automatic control basic course, Lund University.	fall 2008, fall 2009
Automatic control basic course, Zhejiang University, Hangzhou (China).	fall 2012
Control Theory, Lund University.	spring 2011, spring 2013
Market driven system, Lund University.	spring 2013
<i>Master thesis supervised:</i> Predictive control of insulin in diabetic patients, Julia Herget	2009

Further scientific activities

Reviewer for IEEE Transactions on Automatic Control; IEEE Transactions on Control System Technology; IEEE Transactions on Automation Science and Engineering; International Journal of Adaptive Control and Signal Processing; Journal of Applied Mathematics as well as several international conferences in systems and controls.

Invited talks

Modeling and prediction in diabetes physiology, Caltech, Pasadena, CA, 2 november 2013

Linear modeling and prediction in diabetes physiology, Linkoping University, Linkoping, Sweden, 10 may 2012

Parallel kinematic manipulator dynamics, Wissenschaftskolloquium, Hochschule Heilbronn, Kuenzeslau, Germany, 17 november 2009

Publications

Theses

- Marzia Cescon. Modeling and prediction in diabetes physiology. Doctoral Thesis 1099--SE, Department of Automatic Control, Lund University, Sweden, November 2013.
- Marzia Cescon. Linear modeling and prediction in diabetes physiology. Licentiate Thesis 3250--SE, Department of Automatic Control, Lund University, Sweden, June 2011.
- Marzia Cescon. Subspace-based identification of a parallel kinematic manipulator dynamics. Master's Thesis 5814--SE, Department of Automatic Control, Lund University, Sweden, May 2008.

International Journals

- Marzia Cescon, Rolf Johansson, Eric Renard, and Alberto Maran. Identification of individualized empirical models of carbohydrate and insulin effects on T1DM blood glucose dynamics. *International Journal of Control. Special Issue on Applications of Continuous-Time Model Identification and Estimation.*, 2013.

Book Chapters

- Marzia Cescon and Rolf Johansson. *Linear Modeling and Prediction in Diabetes Physiology*. Springer, 2013.
- Marzia Cescon and Rolf Johansson. *Subspace-based multi-step predictors for predictive control*. The institution of engineering and technology (IET), 2013.

International Conference Proceedings

- Marzia Cescon and Rolf Johansson. Meal and insulin effects on blood glucose dynamic modeling. In *13th Diabetes Technology Meeting (DTM2013)*, San Francisco, CA, USA, November 2013.
- Rolf Johansson, Marzia Cescon, and Fredrik Ståhl. Continuous-time model identification using non-uniformly sampled data. In *11th IEEE AFRICON 2013 Conference*, Mauritius, September 2013.
- Marzia Cescon, Rolf Johansson, and Eric Renard. Individualized empirical models of carbohydrate and insulin effects on T1DM blood glucose dynamics. In *7th IEEE Multi-Conference on Systems and Control (MSC2013)*, pages 258–263, Hyderabad, India, August 2013.
- Marzia Cescon, Rolf Johansson, and Eric Renard. Low-complexity MISO models of T1DM glucose metabolism. In *9th Asian Control Conference (ASCC2013)*, Istanbul, Turkey, June 2013.

- Marzia Cescon, Rolf Johansson, Eric Renard, and Jerome Place. Modeling the impact of a standardized breakfast on T1DM fasting blood glucose. In *12th Diabetes Technology Meeting (DTM2012)*, Bethesda, MD, USA, November 2012.
- Marzia Cescon, Meike Stemmann, and Rolf Johansson. Impulsive predictive control of T1DM glycemia: an in-silico study. In *2012 ASME 5th Annual Dynamic Systems and Control Conference (DSCC2012)*, page 8550, Fort Lauderdale, FL, USA, October 2012.
- Marzia Cescon, Meike Stemmann, and Rolf Johansson. Impulsive predictive control of T1DM glycemia: an in-silico study. In *Reglermöte 2012*, Uppsala, Sweden, June 2012.
- Marzia Cescon, Rolf Johansson, and Eric Renard. Personalized short-term blood glucose prediction in T1DM. In *Proc. 5th International Conference on Advanced Technologies and Treatments for Diabetes (ATTD2012)*, Barcelona, Spain, February 2012.
- Marzia Cescon and Rolf Johansson. Patient-specific glucose metabolism models for model predictive control of T1DM glycemia. In *Proc. 5th International Conference on Advanced Technologies and Treatments for Diabetes (ATTD2012)*, Barcelona, Spain, February 2012.
- Marzia Cescon and Eric Renard. Adaptive subspace-based prediction of T1DM glycemia. In *Proc. 50th IEEE Conference on Decision and Control and European Control Conference (CDC-ECC2011)*, pages 5164–5169, Orlando, FL, December 2011.
- Marzia Cescon and Rolf Johansson. On data-driven multistep subspace-based linear predictors. In *Proc. 18th IFAC World Congress (IFAC2011)*, pages 11447–11452, Milano, Italy, September 2011.
- Marzia Cescon and Rolf Johansson. Multi-step-ahead multivariate predictors: a comparative analysis. In *Proc. 49th IEEE Conference on Decision and Control (CDC2010)*, pages 2837–2842, Atlanta, USA, December 2010.
- Marzia Cescon and Rolf Johansson. Glycemic trend prediction using empirical model identification. In *Proc. 48th IEEE Conference on Decision and Control (CDC2009)*, pages 3501–3506, Shanghai, P.R.China, December 2009.
- Fredrik Ståhl, Marzia Cescon, Rolf Johansson, and Eric Renard. Infinite horizon prediction of postprandial breakfast plasma glucose excursion. In *Proc. 9th Diabetes Technology Meeting (DTM2009)*, page A163, San Francisco, CA, November 2009.
- Marzia Cescon, Isolde Dressler, Rolf Johansson, and Anders Robertsson. Subspace-based identification of compliance dynamics of parallel kinematic manipulator. In *Proc. 2009 IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM2009)*, pages 1028–1033, Singapore, July 2009.
- Marzia Cescon, Fredrik Ståhl, Mona Landin-Olsson, and Rolf Johansson. Subspace-based model identification of diabetic blood glucose dynamics. In *Proc. 15th IFAC Symposium on System Identification (SYSID2009)*, pages 233–238, Saint-Malo, France, July 2009.

Marzia Cescon, Fredrik Ståhl, Rolf Johansson, and Mona Landin-Olsson. Short-term diabetes blood glucose prediction based on blood glucose measurements. In *Proc. 2nd International Conference on Advanced Technologies and Treatments for Diabetes (ATTD2009)*, Athens, Greece, February 2009.

Previous research experience

- Compliance dynamics identification of a Gantry-Tau robot prototype

The Gantry-Tau robot is a parallel kinematic manipulator first presented in [Brogårdh, 2002]. The structure located in our lab at LTH is based on an ABB patent and provides 3-DOF translational motion. The robot, thus, possesses three independent kinematic chains, each of these attached on one side to the ground and on the other side on the mobile tool-center-point (TCP) platform, actuated by three actuators [Cescon et al, 2009]. Constant end-effector orientation is guaranteed by the tau-configuration, as links belonging to the same cluster form parallelograms. To fully exploit the high accelerations achievable by such parallel robot, accurate dynamic models for model-based control are essential. A high-bandwidth robot-workpiece interaction requires a stiff robot without resonances in the concerned frequency interval. It is therefore important not only to identify accurate rigid-body models, but also to study the compliance dynamics for force-controlled applications. Motivated by the above, the compliance dynamics of the Gantry-Tau parallel kinematic robot was identified by means of data-driven black-box identification methods and physical modeling. My tasks consisted in experiment design for data collection where measurements of cart and end-effector positions were obtained by linear encoders, a laser tracker and a camera vision system; data analysis; investigation of the structural stiffness including the behavior of vibrations and resonances of the PKM structure by means of subspace-based system identification methods. Results shown notable compliant behaviour with high resonance frequencies. The overall structure of the Gantry-Tau robot was given a physical interpretation as a network with spring-damper pairs at the edges (the clusters) and masses at the nodes (the carts and the end-effector). Numerical expressions for the inertia and the damping were derived by computing a transformation of the identified models to linear mechanical models.

Torgny Brogårdh. PKM Research-Important Issues, as seen from a Product Development Perspective at ABB Robotics. In *Proc. of the Workshop on Fundamental Issues and Future Research Directions for Parallel Mechanisms and Manipulators*, October 3-4 2002.

Marzia Cescon, Isolde Dressler, Rolf Johansson, and Anders Robertsson. Subspace-based identification of compliance dynamics of parallel kinematic manipulator. In *Proc. 2009 IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM2009)*, pages 1028–1033, Singapore, July 2009.

- Type 1 diabetes mellitus blood glucose modeling, prediction and control

Diabetes is a group of metabolic diseases characterized by the inability of the organism to autonomously regulate the blood glucose levels [Gareth and Picup, 1992]. It requires continuing medical care to prevent acute complications and to reduce the risk of long-term complications. Inadequate glucose control is associated with damage, dysfunction and failure of various organs.

The management of the disease is non trivial and demanding. With today's standards of current diabetes care, good glucose regulation needs constant attention and decision-making by the individuals with diabetes. Against this background, the European FP7-IST research project DIAdvisorTM[www.diadvisor.eu] during the quadrennium 2008-2012 pursued the development of a personalized blood glucose predicting system and an advisory control system, the DIAdvisorTM tool, to be used on the spot by the users in different daily situations, predicting glycemic excursions following meals, insulin intakes and exercise and giving them advices about how to adjust their treatments in order to maintain glycemia as close to normal as possible.

Under the sponsorship of this project, my work focused on glucose metabolism modeling and short-term blood-glucose predictions in Type I Diabetes Mellitus (T1DM). Data were collected in a series of clinical trials and overall included: specific patient parameters (e.g., gender = male, age = 43 years old, BMI = 23.7, weight = 67 kg), characteristics related to diabetes (e.g., disease duration = 10 years, insulin delivery = external pump), associated health conditions and therapies, food intakes and administered insulin doses registered in a logbook, capillary glucose strips, interstitial glucose levels, plasma glucose and plasma insulin concentration from drawn blood samples as well as vital signs. The approaches considered were first principles modeling based on current knowledge in diabetes physiology, and data-driven identification, both black-box and grey-box, of the glucose metabolism system from the collected input-output data. Some of the models and predictors developed were implemented in the advisory tool and underwent clinical trials.

In vivo tests on a population of 43 subjects following at least 70% of the DIAdvisorTMtool recommendations showed an increase by 7.6% in the time spent in normoglycemia and a reduction by 42% in the time spent in hypoglycemia [The DIAdvisor Consortium].

A video showing the tool being tested in clinical trials appeared on Euronews:
<http://www.euronews.com/2012/01/11/over-hygienic-parents-could-be-cause-of-diabetes>
(from minute 6 onwards)

Gareth Williams and John Pickup. *Handbook of Diabetes second edition*. Blackwell Science, Oxford, 1992.

The DIAdvisor Consortium. Final report. 2012. <http://cordis.europa.eu/results/>.

References

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