Marco Forgione

Systems & Control Engineer

Via Talizia 49
21100 Varese, Italy
+39 3453371092
marco.forgione1986@gmail.com
www.marcoforgione.it
Born in Varese (Italy) on 6/7/1986

Areas of Expertise

Systems & Control Modeling, simulation, and control of complex dynamical systems. Estimation, system identification, signal processing, optimization.

Computer Engineering Advanced use of numerical and statistical software. Good programming and server administration skills.

Electronics Modeling of power converters and PLL circuits. Laboratory testing using instrumentation such as oscilloscope, power meter, data logger, etc.

Current position

2015-now **R&D Algorithm Engineer**, *Whirlpool EMEA*, Biandronno (VA), Italy.

Within the Advanced Development group of Whirlpool EMEA, I am involved in several R&D projects with applications for induction cooktops, gas cooktops, and ovens.
In particular, I am engaged in the following activities:

- Development of temperature estimation and control algorithms
- Modeling of half-bridge and quasi-resonant power converters
- Implementation of a hardware-in-the-loop software for real-time algorithm testing connecting a PC to the appliance and to different laboratory instruments.
- Development of control algorithms for electrically-operated gas valves

I make extensive use of the Matlab, Python, and C programming languages for real-time algorithm testing, data visualization and signal processing. Furthermore, I employ statistical methodologies (Six-sigma) and software (Minitab) in order to plan and analyze the validation experiments required to investigate the robustness of my algorithms with respect to different noise sources and process variations.

Previous Position

2014 – 2015 **Postdoctoral researcher**, *Ecole Centrale de Lyon*, France.

I pursued my research in cooperation with the CEA institute of Grenoble aiming to develop novel architectures for phase-locked loop circuits with applications to wireless telecommunications. Furthermore, I was teaching assistant for the courses “Signal processing” and “Analog to digital converters”.

Education

2010 – 2014 **PhD in Systems and Control**, *Delft University of Technology*, The Netherlands.
Thesis title: *Batch-to-batch learning for model-based control of process systems with application to cooling crystallization.*

2007 – 2009 **MSc in Computer Engineering**, *Università degli Studi di Pavia.*
Final grade: **110/110 cum laude**.
Average grade: **29.6/30**.
Thesis title: *Artificial Pancreas: black-box identification of the glucose-insulin metabolisms.*

2004 – 2007 **BSc in Computer Engineering**, *Università degli Studi di Pavia.*
Final grade: **110/110 cum laude**.
Average grade: **29.4/30**.
Thesis title: *Design, realization and control of a laboratory-scale gantry crane.*

Postdoctoral Research Topic

title *Low phase-noise radio-frequency synthesis.*

description I carried out my research project within the Low Phase noise radio-frequency SYnthesis (LOPSY) project at the Ampère Laboratory of Lyon and in collaboration with the CEA institute of Grenoble. In wireless telecommunications, Phase-Locked-Loops (PLL) are widely utilized for the generation of oscillating signals required for the modulation/demodulation operations. In a nutshell, a PLL is a feedback system where a signal generated by a Voltage-Controller Oscillator (VCO) is synchronized with a reference oscillator. A feedback controller generates a voltage command for the VCO which enables synchronization, while honoring constraints on the output phase noise. An intrinsic limitation of the classical PLL structure is that a single degree of freedom - the feedback controller - is available for the rejection of multiple noise sources. Thus, the latter cannot be handled independently from each other. The goal of this project was to overcome this limitation by developing a novel 2 Degrees of Freedom PLL architecture where the reference phase noise is on-line measured and compensated for by a feedforward controller. I was mainly involved in the system behavioral modeling using the Simulink/Simscape environment and the design of control algorithms using an H_∞ approach.

PhD Research Topic

title *Batch-to-batch learning for model-based control with application to batch cooling crystallization.*

supervisors Dr. Paul M.J. Van den Hof and Dr. Xavier Bombois.

description I carried out my PhD within the "Intelligent Observer and Control for Pharmaceutical Batch Crystallization" project supported by the Institute for Sustainable Process Technology (ISPT). Two Dutch universities (TU Delft and TU Eindhoven) and several companies (DSM, Albemarle, FrieslandCampina, MSD, Zeton, IPCOS, DotX, etc.) participated in this project. The goal of my research was to develop and validate algorithms for improving from run to run the performance of model-based controllers for industrial batch processes. My approach consisted in using the measurement collected during one batch run to refine the model used by the controller in the next batch run adopting a bayesian parameter estimation framework. I demonstrated the potential of this method through extensive numerical simulations and real experiments performed both on pilot-scale and industrial-scale batch crystallizers.

Professional Skills

Systems modelling: First-principles and data-driven modelling of engineering systems. System identification, estimators design, time series analysis.

Control design: Design of classical, PID, H_∞, MPC and ILC control algorithms.

Signal Processing: Time/frequency domain signal analysis, analog and digital filter design.

Scientific software: MATLAB, Simulink, Minitab, Modelica

Programming languages: Python, C.

Server administration: Apache, LDAP, MySQL, Vsftpd, SVN.

Instrumentation: Oscilloscope, function generators, spectrum analyzer, etc.

Academic Skills

Scientific output: I am co-author of 5 journal papers and 11 conference proceedings. I presented my scientific results in several international conferences in the Systems and Control Field. I delivered a plenary lecture at the 2013 European Network on System Identification.

Teaching assistant: Signal processing and Analog to Digital Conversion at the Ecole Centrale de Lyon (in French). Process Control, System Identification, and Control Systems Design at the Delft University of Technology (in English).

M.Sc. thesis supervision: I supervised two M.Sc. student theses at the Delft University of Technology.

Languages

Italian	Mother tongue	
English	Fluent	*4-year teaching and working experience*
French	Fluent	*1-year teaching and working experience*
Dutch	Basic	*B1 certificate obtained in 2012*

Publications

M. Forgione., X. Bombois, and P.M.J. Van den Hof. Data-driven model improvement for model-based control. *Automatica*, 52:118–124, February 2015.

A. Mesbah, X Bombois, J.H.A. Ludlage, H. Hjalmarsson, **M. Forgione**, and P.M.J. Van den Hof. Batch-to-batch model improvement for cooling crystallization. *Control Engineering Practice*, 41:72–82, 2015.

A. Mesbah, X Bombois, J.H.A. Ludlage, H. Hjalmarsson, **M. Forgione**, and P.M.J. Van den Hof. Performance diagnosis and plant re-identification. *International Journal of Control*, 88(11):2264–2276, 2015.

S. Kadam, J. Vissers, **M. Forgione**, R. Geertman, P.J. Daudey, A. Stankiewicz, and H.J.M. Kramer. Rapid crystallization process development strategy from lab to industrial scale with PAT tools in skid configuration. *Org. Process Res & Dev.*, 16:769–780, 2012.

L. Magni, **M. Forgione**, C. Toffanin, C. Dalla Man, G. De Nicolao, B. Kovatchev, and C. Cobelli. Run-to-run tuning of model predictive control for type 1 diabetes subjects: *in silico* trial. *Journal of Diabetes Science and Technology*, 3:1091–1098, September 2009.

M. Pellissier, M. Zarudniev, G. Masson, A Korniienko, **M. Forgione**, and G Scorletti. *A 40 dB Spur rejection and 19 dB in band phase-noise cancelling method with 1 kHz frequency accuracy using double control loop PLL for reciprocal-mixing suppression.* Submitted to the 2018 IEEE International Solid- State Circuits Conference., 2018.

M.G. Potters, **M. Forgione**, X. Bombois, and P.M.J. Van den Hof. Least-costly experiment design for uni-parametric linear models: An analytic approach. In *Control Conference (ECC), 2015 European*, pages 848–853. IEEE, 2015.

M. Forgione, X. Bombois, P.M.J. Van den Hof, and H. Hjalmarsson. Experiment design for parameter estimation in nonlinear systems based on multilevel excitation. In *Proceedings of the 2014 European Control Conference*, pages 25–30, Strasbourg Convention and exhibition center, Strasbourg, France, June 2014.

M.G. Potters, X. Bombois, **M. Forgione**, P.E. Modén, M. Lundh, H. Hjalmarsson, and P.M.J. Van den Hof. Experiment design in closed loop with unknown, nonlinear or implicit controllers using stealth identification. In *Proceedings of the 2014 European Control Conference*, pages 726–731, June 2014.

A.C.P.M. Backx, X.J.A. Bombois, P.J. Daudey, **M. Forgione**, R.M. Geertman, P.M.J. Van den Hof, S.S. Kadam, H.J.A. Kramer, J.A.W. Vissers, P. Vonk, and G.M. Westhoff. Towards a more rigorous control of seeded batch crystallization. *Abstract presented at the 19th International Symposium on Industrial Crystallization*, Tolouse, France, September 2014.

M. Forgione, X. Bombois, and P.M.J. Van den Hof. Experiment design for batch-to-batch model-based learning control. In *Proceedings of the 2013 American Control Conference (ACC)*, pages 3918–3923, Reinassance Hotel, Washington, D.C., USA, June 2013.

A. Mesbah, X. Bombois, **Forgione, M.**, J. Ludlage, P. Modén, H. Hjalmarsson, and P.M.J Van den Hof. A unified experiment design framework for detection and identification in closed-loop performance diagnosis. In *Decision and Control (CDC), 2012 IEEE 51st Annual Conference on*, pages 2152–2157. IEEE, 2012.

M. Forgione, A. Mesbah, X. Bombois, and P.M.J. Van den Hof. Batch-to-batch strategies for cooling crystallization. In *Proceedings of the 51st IEEE Conference on Decision and Control*, pages 6364–6369, Grand Wailea, Maui, Hawaii, December 2102.

M. Forgione, A. Mesbah, X. Bombois, and P.M.J. Van den Hof. Iterative learning control of supersaturation in batch cooling crystallization. In *Proceedings of the 2012 American Control Conference*, pages 6455–6460, Fairmont Queen Elizabeth, Montreal, Canada, June 2012.

S. Kadam, J. Vissers, **M. Forgione**, P.J. Geertman, R. Daudey, and H.J.M. Kramer. Rapid determination of a near-optimal seeding procedure at an industrial scale batch crystallizer. In *Proceedings of the 18th International Symposium on Industrial Crystallization*, pages 141–142, ETH Zurich, Zurich, Switzerland, September 2011.

J. Vissers, **M. Forgione**, S. Kadam, P.J. Daudey, T. Backx, A.E.M. Huesman, H.J.M. Kramer, and P.M.J. Van Den Hof. Novel control of supersaturation on an industrial scale pharmaceutical batch crystallizer. In *Proceedings of the 18th*

International Symposium on Industrial Crystallization, pages 141–142, ETH Zurich, Zurich, Switzerland, September 2011.