

Mourad Larbi

Doctor in Applied Statistics

Research interests: Electromagnetic interferences, engineering, high dimensional problems, reliability, sensitivity analysis, surrogate models, statistics, uncertainty quantification

Postdoctoral position (October, 2017 – present)

Supervisor Prof. Madhavan Swaminathan, Professor; Director, Center for Co- Design of Chip, Package, System (C3PS); John Pippin Chair in Microsystems Packaging & Electromagnetics (Georgia Tech, Georgia Institute of Technology, Atlanta, USA)

Description The goal of my research project is to develop new surrogate models for the design of circuits and integrated systems depending on many uncertain parameters (process variations). For instance, we recently developed various surrogate models (e.g. "**sparse polynomial chaos**", "**support vector machine**", "**kriging**" etc.) to estimate the variability of the efficiency in Integrated Voltage Regulator (IVR) and Wireless Power Transfer. In the context of manufacturing process, these techniques should help to accomplish a more robust design of systems.

Postdoctoral position (June, 2016 – August, 2017)

Supervisors Prof. Flavio Canavero, Assoc. Prof. Igor S. Stievano (Department of Electronics, Politecnico di Torino, Torino, Italy), and Dr. Philippe Besnier, Senior Researcher at CNRS (IETR/INSA, Institute of Electronics and Telecommunications of Rennes, National Institute of Applied Sciences, Rennes, France)

Description My research interests aim at pushing forward the state-of-the-art of the design of circuits and integrated systems in high-dimensional uncertainty quantification problems. More particularly, we introduced a surrogate model based on the "**sparse polynomial chaos**" approach, for the analysis of printed circuit board with many uncertain parameters. This metamodel allows to estimate, with a low computational cost compared to Monte Carlo simulation, the response model and provides a sensitivity analysis of the output depending on numerous uncertain variables.

PhD Thesis (Oct., 2012 – Feb., 2016)

Title **Statistical methods for the computation of extreme electromagnetic interferences within complex systems**

Director Dr. Philippe Besnier (IETR/INSA, Institute of Electronics and Telecommunications of Rennes, National Institute of Applied Sciences, Rennes, France)

Co-supervisors Dr. Bernard Pecqueux & Eng. Frédéric Puybaret (CEA, Alternative Energies and Atomic Energy Commission, Gramat, France)

Description This thesis work deals with the estimation of extreme events depending on uncertain input parameters, in the context of electromagnetic applications. Thus, we introduced the so-called “**reliability methods**” and the “**controlled stratification**” technique to estimate a **failure probability** and an **extreme quantile**, respectively, at a low computational cost compared to Monte Carlo simulation. My PhD work can be summarized by:

- ★ State of the art of uncertainty quantification methods: **reliability methods (FORM, SORM, importance sampling and subset simulation)** and of **surrogate models (polynomial chaos, kriging)**. Estimation of extreme electromagnetic events taking into account uncertain input parameters by reliability methods and by the controlled stratification technique. **Validation of these algorithms on canonical and industrial problems**
- ★ Delivery of statistic tools well adapted to the quantification of extreme electromagnetic events to IETR and CEA
- ★ Writing technical reports for IETR and CEA

Publications

- Journal Articles**
- ★ M. Larbi, I.S. Stievano, F.G. Canavero and P. Besnier, “Identification of Main Factors of Uncertainty in a Microstrip Line Network,” *Progress In Electromagnetics Research*, 2018, vol.162, pp. 61-72, June 2018.
 - ★ M. Larbi, I.S. Stievano, F.G. Canavero and P. Besnier, “Variability impact of many design parameters: the case of a realistic electronic link,” *IEEE Transactions on Electromagnetic Compatibility*, vol.60, no.1, pp.34-41, Feb. 2018. DOI: [10.1109/TEMC.2017.2727961](https://doi.org/10.1109/TEMC.2017.2727961)
 - ★ M. Larbi, P. Besnier, B. Pecqueux, “The adaptive controlled stratification method applied to the determination of extreme interference levels in EMC Modelling with uncertain input variables,” *IEEE Transactions on Electromagnetic Compatibility*, vol.58, no.2, pp.543-552, Apr. 2016. DOI: [10.1109/TEMC.2015.2510666](https://doi.org/10.1109/TEMC.2015.2510666)
 - ★ M. Larbi, P. Besnier, B. Pecqueux, “Probability of EMC failure and sensitivity analysis with regard to uncertain variables by reliability methods,” *IEEE Transactions on Electromagnetic Compatibility*, vol.57, no.2, pp.274-282, Apr. 2015. DOI: [10.1109/TEMC.2014.2378912](https://doi.org/10.1109/TEMC.2014.2378912)
- Book Chapter**
- ★ H. M. Torun, M. Larbi, M. Swaminathan, “Machine Learning based Optimization and Uncertainty Quantification for Integrated Systems,” *Machine Learning in VLSI CAD*, Springer, Editors: Ibrahim Elfadel, Duane Boning & Xin Li, 2018.

- International Conferences**
- ★ M. Larbi, H. M. Torun, M. Swaminathan, I.S. Stievano, F. G. Canavero, and P. Besnier, "Uncertainty Quantification of SiP based Integrated Voltage Regulator", 22nd Workshop on Signal and Power Integrity (SPI)", Brest, France, pp. 1-4, May 22-25, 2018.
 - ★ M. Larbi, I.S. Stievano, F.G. Canavero and P. Besnier, "Crosstalk Analysis of Printed Circuits with Many Uncertain Parameters Using Sparse Polynomial Chaos Metamodels", *International Symposium on Electromagnetic Compatibility (EMC Europe)*, Angers, France, Sep. 4-8, 2017.
 - ★ M. Larbi, I.S. Stievano, F.G. Canavero and P. Besnier, "Analysis of a Printed Circuit Board with Many Uncertain Variables by Sparse Polynomial Chaos", *IEEE MTT-S International Conference on Numerical Electromagnetic and Multiphysics Modeling and Optimization for RF, Microwave, and Terahertz Applications*, Seville, Spain, May 17-19, 2017
 - ★ M. Larbi, P. Besnier, B. Pecqueux and F. Puybaret, "Plane Wave Coupling to an Aerial Electrical Cable. Assessment of Extreme Interference Levels with the controlled stratification method", *International Symposium on Electromagnetic Compatibility (EMC Europe)*, Wroclaw, Poland, Sep. 5-9, 2016, pp.112-117. DOI: [10.1109/EMCEurope.2016.7739199](https://doi.org/10.1109/EMCEurope.2016.7739199)
 - ★ M. Larbi, P. Besnier and B. Pecqueux, "The controlled stratification to estimate extreme quantiles in the field of EMC modelling", *International Symposium on Electromagnetic Compatibility (EMC Europe)*, Dresden, Germany, Aug. 16-22, 2015, pp.334-339. DOI: [10.1109/ISEMC.2015.7256182](https://doi.org/10.1109/ISEMC.2015.7256182)
 - ★ M. Larbi, P. Besnier and B. Pecqueux, "Probability of extreme interference levels computed from reliability approaches: application to transmission lines with uncertain parameters", *International Symposium on Electromagnetic Compatibility (EMC Europe)*, Gothenburg, Sweden, Sep. 1-4, 2014, pp.647-652. DOI: [10.1109/EMCEurope.2014.6930985](https://doi.org/10.1109/EMCEurope.2014.6930985)
 - ★ M. Larbi, P. Besnier and B. Pecqueux, "Estimation of failure probability of the end induced current depending on uncertain parameters of a transmission line," General Assembly and Scientific Symposium (URSI GASS), Beijing, China, Aug. 16-23, 2014, pp.1-4. DOI: [10.1109/URSIGASS.2014.6929518](https://doi.org/10.1109/URSIGASS.2014.6929518), <http://www.ursi.org/en/gass.asp>
 - ★ M. Larbi, P. Besnier et B. Pecqueux, "Approche fiabiliste dans un contexte CEM. Exemple d'application" *17ème Colloque International et Exposition sur la Compatibilité Electromagnétique (CEM)*, Clermont-Ferrand, France, 1-3 Juil., 2014

Education

- 2012–2015 **PhD thesis in Applied Mathematics and Statistics**, CEA (*the Alternative Energies and Atomic Energy Commission*), IETR/INSA (*the Institute of Electronics and Telecommunications of Rennes and the National Institute of Applied Sciences, Rennes, France*).
- 2010–2011 **Master's degree in Engineering Mathematics and Applied Economics**, *University of Nice-Sophia Antipolis, Nice, France, obtained with honours.*
- 2009–2010 **First year of Master in Applied Mathematics**, *University of Nice-Sophia Antipolis, Nice, France, obtained with honours.*
- 2006–2009 **Bachelor in Mathematics**, *University of Nice-Sophia Antipolis, Nice, France, obtained with honours.*

Internship

- 2011 6 Months at Queensland Facility for Advanced Bioinformatics, Brisbane, Australia. Data analysis of large biological data sets (genomics, proteomics data sets) to identify relevant variables (genetic markers) with the "sparse Partial Least Squares". Application on a kidney failure.

Computer skills

Platforms Windows, Linux

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Programming knowledge Matlab, R, SAS, VBA, PYTHON, C/C++, Maple, L^AT_EX

Software T_EXMAKER, FEKO, OpenOffice

Languages

English Fluent
Italian Intermediate level
French Mother tongue
Arabic Conversational Tunisian

Participation in international meetings

- March, 2017 Participated in the workshop: "Recent progress for the EMC modelling of electrical cables within complex systems", hosted by ONERA (the French Aerospace Lab), Toulouse, France, March 22-23, 2017. Oral presentation
- June, 2015 Participated in the UMEMA workshop: "Uncertainty Modeling for ElectroMagnetic Applications", organized by University of Clermont-Ferrand, Saint-Nectaire, France, June 29-July 1, 2015. Poster presentation
- Oct., 2014 Participated in the workshop: "Methods for the Quantification of Uncertainties", hosted by the Alternative Energies and Atomic Energy Commission (CEA), Bruyères-le-Châtel, France, Oct. 1-2, 2014. Oral presentation
- June, 2013 Participated in the OpenTURNS users day, hosted by Airbus Group, EDF and Phimeca, University of EDF Group, Chatou, France, June 11, 2013
- May, 2013 Participated in the GdR MASCOT-NUM working meeting on Dimension reduction and Multi-fidelity simulators, Institut Henri Poincaré, Paris, France, May 17, 2013

Scientific community services

- May, 2017 Organization of the UMEMA workshop: "Uncertainty Modeling for ElectroMagnetic Applications", hosted by Politecnico di Torino
Reviewer for IEEE Transactions on Electromagnetic Compatibility

Supervision of PhD students

- 2016–2017 During my postdoctoral position, I began to supervise two PhD students invited at Politecnico di Torino. I have provided theoretical assistance in terms of simulation software (MATLAB), and understanding of uncertainty quantification algorithms

Scientific awards

- September, 2017 Best Paper Award for: M. Larbi, I. S. Stievano, F. G. Canavero and P. Besnier, "Crosstalk analysis of printed circuits with many uncertain parameters using sparse polynomial chaos metamodels," 2017 International Symposium on Electromagnetic Compatibility - EMC EUROPE, Angers, 2017, pp. 1-6. DOI: [10.1109/EMCEurope.2017.8094623](https://doi.org/10.1109/EMCEurope.2017.8094623)
- July, 2016 Richard B. Schulz Transactions Prize Paper Award – Honorable Mention, for the Paper: M. Larbi, P. Besnier, B. Pecqueux, "Probability of EMC failure and sensitivity analysis with regard to uncertain variables by reliability methods," *IEEE Transactions on Electromagnetic Compatibility*, vol.57, no.2, pp.274-282, Apr. 2015. DOI: [10.1109/TEMC.2014.2378912](https://doi.org/10.1109/TEMC.2014.2378912)
- 2014–2016 Two papers published in the International Symposium on Electromagnetic Compatibility (EMC Europe 2014 and 2016), belong to the 8 best papers of the conference

References

- Prof. Madhavan Swaminathan, (School of Electrical and Computer Engineering, Georgia Tech, Atlanta, USA). Contact: madhavan.swaminathan@ece.gatech.edu
- Prof. Flavio G. Canavero, (Department of Electronics, Politecnico di Torino, Torino, Italy). Contact: flavio.canavero@polito.it
- Prof. Igor S. Stievano, (Department of Electronics, Politecnico di Torino, Torino, Italy). Contact: igor.stievano@polito.it
- Dr. Philippe Besnier, (IETR/INSA, Institute of Electronics and Telecommunications of Rennes, National Institute of Applied Sciences, Rennes, France). Contact: philippe.besnier@insa-rennes.fr