PhD Andrés F. López-Lopera

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1 Current position

Postdoctoral researcher, ONERA (Toulouse), France **2020 – Today**
Research project: "Design of experiments and surrogate models for aerodynamic data"
Supervisors at ONERA: Nathalie Bartoli and Thierry Lefebvre

2 Research interests

My research interests include machine learning, data sciences, artificial intelligence, and applied mathematics. More precisely, I focus on stochastic processes, Gaussian processes, Bayesian methods, and signal processing.

3 Education

PhD in Applied Mathematics, Mines Saint-Étienne, France **2016 – 2019**
Title: "Gaussian process modelling under inequality constraints" (manuscript written in English)
Supervisor: Olivier Roustant (Mines Saint-Étienne, France)
Co-supervisors: François Bachoc (IMT, France) and Nicolas Durrande (Prowler.io, UK)
PhD defence: 19 September, 2019.
Jury: Clémentine Prieur (Univ. Grenoble Alpes, France), Sonja Kuhnt (FH Dortmund, Germany), Anthony Nouy (Centrale Nantes, France), Filippone, Maurizio (EURECOM, France), Olivier Roustant, François Bachoc and Nicolas Durrande

M. Eng. in Electrical Engineering, Universidad Tecnológica de Pereira, Colombia **2014 – 2015**
Title: "Switched dynamical latent force models for transcriptional regulation" (manuscript written in English).
Supervisor: Dr Mauricio A. Álvarez.

B. Eng. in Electrical Engineering, Universidad Tecnológica de Pereira, Colombia **2008 – 2013**
Title: *"Selection of the best basis decomposition for the characterization of power-quality disturbance signals using time-frequency transforms"* (manuscript written in Spanish).
Supervisor: Dr Mauricio A. Álvarez.

4 Other academic courses

Bayesian filtering and smoothing, Universidad Tecnológica de Pereira, Colombia **2015**
Speaker: Simo Särkkä (Aalto University, Finland).

Bayesian optimization, Universidad Tecnológica de Pereira, Colombia **2015**
Speaker: Javier González (Amazon Research Cambridge, UK).

Statistical modeling for optimization, Universidad Tecnológica de Pereira, Colombia **2015**
Speaker: Nicolas Durrande(Prowler.io, UK)

Gaussian processes summer school, Universidad Tecnológica de Pereira, Colombia **2014**
Speaker: Neil Lawrence (University of Cambridge, UK).

5 Computer skills

Programming languages: GAMS, Matlab, Python (Jupyter Notebook), R.

Other informatics skills: AutoCAD, Git/Github, Inkscape, LabVIEW, LaTex.

Operating systems: Linux/Ubuntu, Windows.

6 Language skills

Spanish: native.

English: 2nd language – advanced (equivalent to C1).

French: 3rd language – upper intermediate (equivalent to B2).

7 Publications and conferences

Papers published in international journals

[1] F. Bachoc, A. Lagnoux, and A. López-Lopera. "Maximum likelihood estimation for Gaussian processes under inequality constraints". In: *Electronic Journal of Statistics* 13.2 (2019).

[2] A. López-Lopera, N. Durrande, and M. Álvarez. "Physically-inspired Gaussian processes for post-transcriptional regulation in Drosophila". In: *IEEE/ACM Transactions on Computational Biology and Bioinformatics* (2019).

[3] A. López-Lopera and M. Álvarez. "Switched latent force models for reverse-engineering transcriptional regulation in gene expression data". In: *IEEE/ACM Transactions on Computational Biology and Bioinformatics* 16.1 (2019).

[4] A. López-Lopera, F. Bachoc, N. Durrande, and O. Roustant. "Finite-dimensional Gaussian approximation with linear inequality constraints". In: *SIAM/ASA Journal on Uncertainty Quantification* 6.3 (2018).

Preprints and working papers

[5] F. Bachoc, A. López-Lopera, and O. Roustant. "Sequential construction and dimension reduction of Gaussian processes under inequality constraints". arXiv e-prints. URL: https://arxiv.org/abs/2009.04188.

[6] A. López-Lopera, D. Idier, J. Rohmer, and F. Bachoc. "Multi-output Gaussian processes with functional data: A study on coastal flood hazard assessment". arXiv e-prints. URL: https://arxiv.org/abs/2007.14052.

[7] A. López-Lopera, F. Bachoc, N. Durrande, and O. Roustant. "Additive Gaussian processes under linear inequality constraints".

Proceedings in international conferences

[8] A. López-lopera, ST John, and N. Durrande. "Gaussian process modulated Cox processes under linear inequality constraints". In: *International Conference on Artificial Intelligence and Statistics (AISTATS)*. Japan, 2019.

[9] A. López-Lopera, F. Bachoc, N. Durrande, J. Rohmer, D. Idier, and O. Roustant. "Approximating Gaussian process emulators with linear inequality constraints and noisy observations via MC and MCMC". In: *International Conference in Monte Carlo & Quasi-Monte Carlo Methods (MCQMC)*. France, 2018.

[10] A. López-Lopera, M. Álvarez, and A. Orozco. "Sparse linear models applied to power quality disturbance classification". In: *Iberoamerican Congress on Pattern Recognition (CIARP)*. Peru, 2017.

[11] H. Vargas, A. López-Lopera, A. Orozco, M. Álvarez, J. Hernández, and N. Malpica. "Gaussian processes for slice-based super-resolution MR images". In: *International Symposium on Advances in Visual Computing (ISVC)*. USA, 2015.

[12] A. López-Lopera, M. Álvarez, and A. Orozco. "Improving diffusion tensor estimation using adaptive filtering based on local similarity". In: *Iberian Conference on Pattern Recognition and Image Analysis (IbPRIA)*. Spain, 2015.

[13] A. López-Lopera, H. Vargas, G. Daza-Santacoloma, M. Álvarez, and Á. Orozco. "Comparison of preprocessing methods for diffusion tensor estimation in brain imaging". In: *Symposium on Image, Signal Processing and Artificial Vision (STSIVA)*. Colombia, 2014.

Talks in international conferences

[14] A. López-Lopera. "lineqGPR: an R package for Gaussian process regression modelling with linear inequality constraints". In: *UseR!* Toulouse, France, 2019.

[15] A. López-Lopera, F. Bachoc, N. Durrande, and O. Roustant. "Finite-dimensional Gaussian approximation with linear inequality constraints". In: *SIAM Conferene on Uncertainty Quantification (SIAM-UQ)*. Garden Grove, USA, 2018.

[16] A. López-Lopera and Álvarez M. "Switched latent force models for reverse-engineering transcriptional regulation". In: *Machine Learning Summer School (MLSS)*. Arequipa, Peru, 2016.

Talks in symposiums, seminars and workshops in France

[17] F. Bachoc, A. López-Lopera, and O. Roustant. *Gaussian processes under inequality constraints: Sequential construction and dimension reduction*. Mini-Workshop: Uncertainties, Inverse Problems and Machine Learning. Toulouse, France, 2020.

[18] A. López-Lopera, N. Durrande, F. Bachoc, and O. Roustant. *Gaussian Process Regression under Inequality Constraints*. Méthodes d'Analyse Stochastique pour les Codes et Traitements Numériques (Mascot-Num, acronym in French). Rueil-Malmaison, France, 2019.

[19] A. López-Lopera. *Gaussian process regression under inequality constraints*. Workshop on Gaussian Processes. Saint-Étienne, France, 2018.

8 Developments of toolboxes

R packages (CRAN) :

- `lineqGPR`: "Gaussian process regression models with linear inequality constraints"

Matlab toolboxes :

- `PhysicallyGPDrosophila`: "Physically-inspired Gaussian processes for post-transcriptional regulation in Drosophila"
- `SDLFM_ReverseEngineering`: "Switched latent force model for reverse-engineering transcriptional regulation in gene expression data"

9 Research experience

Postdoctoral researcher, ONERA (Toulouse), France **2020 (Nov) – Today**
Research project: "Design of experiments and surrogate models for aerodynamic data"
Supervisors at ONERA: Nathalie Bartoli and Thierry Lefebvre

Postdoctoral researcher, IMT (Toulouse) – BRGM (Orléans), France **2019 – 2020 (Sept)**
Research project: "Risk-Based System for Coastal Flooding Early Warning" – RISCOPE
Supervisors at IMT: Fabrice Gamboa and François Bachoc
Supervisors at BRGM: Déborah Idier and Jérémy Rohmer

PhD student, Laboratory of Informatics, Modelling and Optimization of the Systems (LIMOS), France **2016 – 2019**
Axe: Models and Algorithms for Decision-Making (MAAD, acronym in French).
Thème: Meta-modelling, Continuous Optimisation and Applications (MOCA, acronym in French).
Chair: Chair in Applied Mathematics OQUAIDO.

Assistant researcher, research project COLCIENCIAS – ECOS Nord, Colombia – France **2015 – 2018**
Title: "Spatio-temporal probabilistic models based on partial differential equations for describing the regulation dynamic of the Bicoid protein in Drosophila's early embryo segmentation".

- In collaboration with: Mines Saint-Étienne, France.

Young researcher, Universidad Tecnológica de Pereira, Colombia **2014 – 2016**
Title: "Human-motion synthesis through physically-inspired machine learning models". **2016**

- In collaboration with: University of Sheffield, British Council, UK.

Title: "Sparse latent force models for reverse engineering of multiple transcription factors". **2015**

- In collaboration with: University of Sheffield, British Council, UK.

Title: *"Estimation of electrical propagation in the basal ganglia generated by deep brain stimulation in patients with Parkinson's disease"* (project established in Spanish). **2014**

- In collaboration with: Universidad Rey Juan Carlos, Spain.

10 Teaching

Teaching duties, *Mathematics and Industrial Engineering Department*, Mines Saint-Étienne, France **2016 – 2019**

- **Mathematics**, *Pole – Probability and Statistics*
  · Topics: introduction to programming in R, random variables, uncertainty propagation, Monte-Carlo simulations, principal component analysis (PCA), linear regression.
- **Master in Data Sciences**
  UP2 – Statistical Learning and Machine Learning
  UP4 – Exploitation of Numerical Simulations
  · Topics: computer experiments, Gaussian process regression, maximum likelihood estimation.
- **Master in Production and Logistics Management**, *UP – Supply Chain Management*
  · Topics: R programming, statistical methods for forecasting.
- **Research project**, *Master in Data Sciences*
  · Title: "Meta-modelling under inequality constraints using Gaussian processes"

· Practical sessions were proposed based on R programming and Jupyter notebooks,[1] allowing to reinforce and apply theoretical concepts using a proper coding syntax.

Monitorats, Universidad Tecnológica de Pereira, Colombia 2008 – 2013

- **Basic Sciences:**
  Informatics, Mathematics and Physics (Newtonian Mechanics and Electromagnetism).
- **Génie Électrique:**
  Electric circuits, AC Machines and Signal Processing.

· Practical sessions were proposed based on Matlab and Simulink[2], allowing the conception of systems within an environment of numerical simulations.

· For the courses on signal processing, I contributed in the writing of new teaching materials with pedagogical examples and reinforcement exercises.

11 National and international research visits

- Periodic research visits at IMT, Toulouse, France **2016 – 2019**
- Research visit (1 month) at Prowler.io,[3] Cambridge, UK **2018**
- Research visit (1 week) at University of Sheffield, UK **2018**
- Two internships (equivalent to 3 months) at Mines Saint-Étienne, France – ECOS Nord project **2015 – 2016**

[1] The Jupyter web interface is used for programming in more than 40 programming languages, including Python, R, Julia, Ruby, or Scala.
[2] Simulink is a Matlab's graphical extension for systems modelling and simulations.
[3] The start-up Prowler.io aims at developing a new decision-making platform based on probabilistic modelling, reinforcement learning and game theory.