Omar KASSI
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RESEARCH INTERESTS

My research interests include:

- Functional Data Analysis
- Nonparametric Methods
- Non-Asymptotic Theory

Currently completing a PhD in Mathematics entitled "*Regularity estimation in multivariate functional data analysis with applications*" to be defended on 11th of july.

EDUCATION

- 2022 : PhD candidate in Mathematics at CREST Lab, the National School of Statistics and Information Analysis (ENSAI), Rennes, under the supervision of Prof Valentin Patilea.
  - Doctoral courses in convex analysis for Machine Learning, Gaussian random fields, point process, topological data analysis, AI for decision making, research integrity and ethics.
- 2019-2022 : MSc in Statistic and Machine Learning at the University of Paris Saclay.

RESEARCH

- Kassi, O., Klutchnikoff, N. & Patilea, V. (2023). Learning the regularity of multivariate functional data. arXiv preprint arXiv:2307.14163.
- Kassi, O. & Wang, S. G. (2024). Structural adaptation via directional regularity: rate accelerated estimation in multivariate functional data. arXiv preprint arXiv:2409.00817.
- Kassi, O. & Wang, S. G. (2024). `direg`, R package for directional regularity. `https://github.com/sunnywang93/direg`
- Kassi, O. & Patilea, V.(2025). Optimal inference for the mean of random functions. arXiv preprint arXiv:2504.11025.

TEACHING

During my PhD at ENSAI, I supervised the following tutorials:

- Probability (undergraduate level): random variables, density function, Gaussian vectors, conditional expectation, convergence of sequences of random variables.

- Optimization and Numerical Methods (undergraduate level): optimization under constraints, first and second order methods, Karush-Kuhn-Tucker Conditions, Gradient and Projected Gradient Methods.
- Missing and Corrupted Data (graduate level): censored data, Kaplan-Meier estimator, Inverse Probability (of Censoring) Weighting, propensity score, imputation, MAR, MNAR.

TALKS AND SEMINARS

- Conference presentations
  - May 2025. *Optimal inference for the mean of random functions.* Workshop on uncertainty in multivariate, non-Euclidean, and functional spaces: theory and practice. Isaac Newton Institute of Mathematical Sciences, Cambridge, United Kingdom
  - December 2024. *Directional regularity.* ICSDS 2024, Nice, France
  - August 2024. *Learning the regularity of multivariate functional data.* IMS World Congress, Bochum, Germany
  - June 2024. *Directional regularity.* ISNPS, Braga, Portugal
  - March 2024. *Learning the regularity of multivariate functional data.* FDA-Workshop, Lille, France
  - December 2023. *Learning the regularity of multivariate functional data.* CM-Statistics 2023, Berlin, Germany
  - July 2023. *Learning the regularity of multivariate functional data.* JdS Sfds, Brussels, Begium
  - May 2023. *Learning the regularity of multivariate functional data.* ATMS Workshop, Leuven, Belgium
- Doctoral seminars and discussion groups
  - January 2025. *Short introduction to Stien's method.* ENSAI, Rennes, France
  - March 2024. Directional regularity. Rennes, France
  - December 2023. *Learning the regularity of multivariate functional data.* Dept. of Mathematics, Ruhr University Bochum

RESEARCH MOBILITY

- One week visit at the Dept. of Mathematics, Ruhr University Bochum (supervisor Prof. Holger Dette)
- Two-month visit at the Institute of Finance and Statistics Bonn, funded by the International Outgoing Mobility Grants program of the Collège Doctoral de Bretagne (supervisor Prof Dominik Liebl)

SKILLS

Languages:
Arabic : First language
French : Fluent in written and spoken
English : Fluent in written and spoken
Computer languages: Latex, R, Python.

ABSTRACTS

- Kassi, O., Klutchnikoff, N. & Patilea, V. (2023). Learning the regularity of multivariate functional data.

  Abstract: Combining information both within and between sample realizations, we propose a simple estimator for the local regularity of surfaces in the functional data framework. The independently generated surfaces are measured with errors at possibly random discrete times. Non-asymptotic exponential bounds for the concentration of the regularity estimators are derived. An indicator for anisotropy is proposed and an exponential bound of its risk is derived. Two applications are proposed. We first consider the class of multi-fractional, bi-dimensional, Brownian sheets with domain deformation, and study the nonparametric estimation of the deformation. As a second application, we build minimax optimal, bivariate kernel estimators for the reconstruction of the surfaces.

  Key words: Concentration of estimators; Hölder exponent; Minimax rate; Random fields

- Kassi, O. & Wang, S. G. (2024). Structural adaptation via directional regularity: rate accelerated estimation in multivariate functional data.

  Abstract: We introduce directional regularity, a new definition of anisotropy for multivariate functional data. Instead of taking the conventional view which determines anisotropy as a notion of smoothness along a dimension, directional regularity additionally views anisotropy through the lens of directions. We show that faster rates of convergence can be obtained through a change-of-basis by adapting to the directional regularity of a multivariate process. An algorithm for the estimation and identification of the change-of-basis matrix is constructed, made possible due to the replication structure of functional data. Non-asymptotic bounds are provided for our algorithm, supplemented by numerical evidence from an extensive simulation study. Possible applications of the directional regularity approach are discussed, and we advocate its consideration as a standard preprocessing step in multivariate functional data analysis.

  Key words: Anisotropy; Multivariate functional data; Hölder exponent

- Kassi, O. & Patilea, V. (2025). Optimal inference for the mean of random functions.

  Abstract: We study estimation and inference for the mean of real-valued random functions defined on a hypercube. The independent random functions are observed on a discrete, random subset of design points, possibly with heteroscedastic noise. We propose a novel optimal-rate estimator based on Fourier series expansions and establish a sharp non-asymptotic error bound in L^2-norm. Additionally, we derive a non-asymptotic Gaussian approximation bound for our estimated Fourier coefficients. Pointwise and uniform confidence sets are constructed. Our approach is made adaptive by a plug-in estimator for the Hölder regularity of the mean function, for which we derive non-asymptotic concentration bounds.

  Key words: de La Vallée Poussin operator; Dense and sparse design; Hölder regularity; Monte Carlo linear integration; Optimal plug-in estimators; Stein's method