AI for physical models with geometric tools

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Agenda

Chair members

Context

Objective

Outline
Chair members

- Fabrice Gamboa (PR IMT UPS-Applied Mathematics-)
  - Habilitation 1994
  - Deputy Director UMI CNRS IFCAM (France-India)
Chair members

- Reda Chhaibi (MCF IMT UPS-Pure Mathematics)
  - X 2008-Ph D 2013
  - Research: Probability, Algebra and Geometry
Chair members

- Thomas Pellegrini (MCF IRIT UPS-Computer Science-)
  - ESPCI 2004-Ph D 2008
  - Research: Deep learning and Deep Neural Networks for Signal Applications
Context

The chair is at the crossroad of

- Computer Code Experiments
- Statistical Learning
- Geometry
What are Computer Code Experiments?

- Black Box model modelling a Physical model (meteo, chemistry,...) Involving complicated math model (PDE, integration, Monte Carlo,...)
- $Y = F(X)$. $Y$ is the output $X$ is the input (scenario) both could be image, signal, vector, ...
- Computer Code Experiments = Statistical methods to understand better $F$ (Sensitivity of the inputs, metamodelling, optimization,...)
What is Statistical Learning?

- Observed Sample (supervised) \((Y_i, X_i)\) or only (unsupervised) \((X_i)\) \((i = 1, \ldots, N)\). \(Y\) is the response, \(X\) is the observation, scenario both could be image, signal, vector, ...
- Wish to build \(\hat{F}\) with \(Y \approx \hat{F}(X)\).
- Neural Networks, Regression Trees, Kernel Methods ...
Objective

- Put in action and adapt to statistical learning tools from computer code experiments. Example: sensitivity analysis enlights explainability (link with the chair supported by JM Loubes)
- Put in action hybrid strategies $F, \hat{F}$ to speed up the computations. Example: SAFRAN turbine profiling and neural computing
- Use smart encoding geometries to feed sample $(X, Y)$ for efficient learning. Examples Verblunsky coefficients, Riemannian barycenters, ...
- Use geometry tools to understand and explain $\hat{F}$. Examples Neural Nets, Methods based on Optimal Transport, ...
Outline

▶ Challenging hot topics: Geometry for AI and Statistical learning
▶ Eclectic team, from pure mathematics to computer sciences
▶ Strong interactions with industry: SAFRAN, CONTINENTALAI, RENAULT, ...
▶ Strong interactions with the chairs of JM Loubes (IMT) and S. Gratton (IRIT)
Thanks for your attention

Merci Gracias Obrigado Grazie Спасибо