Paul Saves
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Mathematician and Engineer
Contractual Researcher in Computer Science, Section 27
Institute of Research in Computer Science of Toulouse (IRIT), UMR 5505
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Research Activity

Main Topic: Surrogate Modeling for Explainable Artificial Intelligence and Bayesian Optimization to analyze and optimize complex systems.
7 Q1 Journal Publications (4 in CS and 3 in Applied Maths), 1 A* CS Conference.
Supervision of 1 PhD student ongoing, Participation in 3 research projects, 2 Horizon Europe and 1 ANR, 2 ongoing.

Summary of Research Topics:
Since my PhD, my work has focused on **surrogate modeling and explainable AI for complex systems**, with applications in engineering, environmental, and socio-technical domains. I develop **lightweight surrogate models** (Gaussian processes, random forests, neural networks) to approximate expensive simulations, quantify uncertainty, and enable **derivative-free optimization** in high-dimensional and hierarchical design spaces.
This research includes **multidisciplinary engineering design**, e.g., green aircraft optimization, and **agent-based models** for environmental risks such as wildfires or climate adaptation, integrating active learning, sensitivity analysis, and interpretability methods (XAI) to guide robust decision-making. I have also developed **software tools** (SMT, SEGOMOE, SMT-Explainability) to make these approaches accessible to both researchers and practitioners.
Collaborations have been central, including work with international teams in Europe, North America, and Asia, spanning aeronautics, mobility, and agro-ecological systems. Current projects explore **frugal and interpretable AI pipelines**, linking simulation, surrogate modeling, and decision support for actionable insights in complex systems.
Keywords: Surrogate modeling, explainable AI, complex systems, multi-agent models, frugal optimization, interdisciplinary research, decision support.

Professional experiences

- **Feb. 2025 –** Current **Machine Learning Researcher, Toulouse (France).**

    Agent-based simulations surrogate modeling. This work is part of the ANR MIMICO and targets the evaluation of the impact **of new urban policies on the mobility model** and modeling **the dense crowd simulation**.

- **Sept. 2020 – Jan. 2025 Aircraft Design Optimizer, Toulouse (France).**

    Ecological aircraft Design optimization. This work is part of the "eXtended-Overall Aircraft Design" federation between ENAC, ISAE, and ONERA and targets **ecological aeronautics improvements** for the European projects "AGILE 4.0" and "COLOSSUS" through Systems of Systems modeling and optimization.

- **2022, 4-months International Research Secondment, Polytechnique Montréal, Montréal (Canada).**

    Architectural optimization in aircraft design: Bayesian optimization with hierarchical variables.

- **2020, 6-months Research Internship, ISAE-SUPAERO, ONERA, Toulouse (France).**

    Super-Efficient Global Optimization (SEGO) is a well-established Bayesian solver to optimize expensive-to-evaluate and black box optimization constrained problems. I developed a module for integer and categorical variables handling, for applications in Aircraft Design.

- **2020, 3-months Research Internship, Institute of Informatics Systems, Siberian Branch of the Russian Academy of Sciences, Akademgorodok (Russia).**

    Investigation of algorithms and the creation of a library of programs for signal and image processing based on orthogonal transformations. Restoration of signals and images exposed to impacts, leading to a large loss of information. Steganography algorithms. Participation in scientific seminars, conferences, and preparation of articles.

- **2016, 4 weeks Intern worker, Direction Générale de l'Armement – Tech. Aéronautiques, Balma (France).**

Certifications

- Qualification CNU Section 26: Applications of Mathematics – Maître de Conférences

Education

– **Oct. 2020 – Oct. 2023** <u>Ph.D</u>, **ONERA, ISAE-SUPAERO,** Toulouse (France).

Investigation of Bayesian Optimization, AGILE 4 (SUPAERO, ONERA) - Mixture of Experts, Gaussian process, Hermitian Matrix, Stochastic Algorithms, Covariance Kernels, Aircraft Design. Teaching at ISAE-Supaero: Bayesian Optimization for last year Machine Learning students. Supervision of practical work for last year engineering students in Machine Learning (Data Science and Decision). Numerical Analysis for Master of Aerospace Engineering and 1st year Engineering students.

– **Sept. 19 – Sept. 2020** <u>Master of Science</u> in Operation Research, **ENAC, UPS**, **Toulouse (France).**

Optimization for image processing; Global and deterministic optimization; Graphs and convex programming; Advanced combinatory optimization

– **January. 18 – April. 18** **Mechanical Engineering, Université du Québec à Trois-Rivières (Canada).**

– **Sept. 15 – Sept. 2020** <u>Master of Engineering</u>, **INSA Toulouse, Toulouse (France).**

Advanced Methods in Fluids Mechanics; High Dimension & Deep Learning; Research & Innovation Project; Aerodynamics, pneumatics & hydraulics systems; Paradigms and programming; Management & Communication

Awards

- 2025	French Ministry of Research Best PhD in Open Science 2025 award for my breakthrough works on open-source developments and open science contributions.
- 2024	Foundation ISAE-SUPAERO Best PhD Thesis 2024 award for my breakthrough works on innovative eco-concept aircraft and for many collaborations.
- 2024	American Institute of Aeronautics & Aerospace (AIAA) Best Student Paper 2024 in Multidisciplinary Design Optimization award.
- 2022	American Institute of Aeronautics & Aerospace (AIAA) Best Paper 2022 in Multidisciplinary Design Optimization award given by the Technical Committee (NASA/Boeing) for breakthrough in design optimization for green concept aircraft (hybrid propulsive transonic aircraft).
- 2019	National IA and Deep Learning Contest. Anomaly detection in Big Data. Airbus & INSA. Finalist.

Languages

French **Native**
English **Advanced: TOEIC 955/990**
Spanish **Intermediate**

Extracurrical Activities

Citizenship activities

Spring 2018	EuroScience Open Forum (ESOF), project "STUDENTS EX MACHINA": joint drafting of a manifesto for the symposium: "The human being faced with the challenges of technosciences".
Fall 2017	Study of the life cycle and alternatives for the domestic refrigerator, within the framework of Ecological Engineering.

Associative activities

2017-2018	President, Strategy Games Club, INSA Toulouse
2016-2017	Treasurer, Strategy Games Club, INSA Toulouse
2007-2015	Scout & Charity works.