MICS EA4037

LABORATOIRE MATHÉMATIQUES ET INFORMATIQUE POUR LA COMPLEXITÉ ET LES SYSTÈMES

Mathematics in Interaction with Computer Science (MICS)

Founded in the early 2000's, MICS (formerly MAS) is the research laboratory in Mathematics and Computer Science at CentraleSupélec. Research at MICS is concerned with the analysis and modeling of complex systems and data, whether they come from the industry, life or social sciences, financial markets, information technology or networks.

Research Axes

- **Biomathematics**: Data-driven and Knowledge-based Mathematical Modeling, Statistical Inference and Computational to help solve major challenges in life sciences and health. Methods for Biological Systems and Data. Applications to precision medicine, neurosciences, molecular biology, genetics, plant science, epidemiology, decision-aided diagnosis.

- **Quantitative Finance:** Microstructure, high-frequency massive data: auctions, manipulation, market making, reinforcement learning; Covariance matrix filtering and investment; Agent models: cognitive biases and investor behaviour, money markets; Robust transport, mean-field games.

- **Fundamental Mathematics**: Harmonic analysis and geometric measure theory; Analysis of partial differential equations; Harmonic analysis and geometric measure theory; Numerical analysis; Stochastic analysis (rough paths, Fokker-Planck equation); Probabilistic Modeling and Statistics of Stochastic Processes: Regularity of stochastic processes (fractional processes).

- **Scientific Computing**: Massively parallel computing; GPU computing; Algorithmic interface between parallel computing and the numerical analysis of partial differential equations and algebraic differential equations.

- **Computer Science**: formalisms and methods based on logic, probabilities, graphs, category theory, mathematical morphology for software-based systems.

- **Artificial Intelligence and Decision Modeling**: Deep learning; Representation learning; Few shot and continual learning; Explainable artificial intelligence; AI for computer vision; AI for NLP; Multicriteria decision making, preference learning, knowledge representation and reasoning, explaining decisions, multi-objective optimization, collective decisions.

Application Domains

- Industrial systems (aerospace, construction, energy, transportation);

- Environment (plants, hydrology, landscapes, acoustics);

- Information technology and networks (Internet, multimedia, knowledge management);

- Life sciences (medicine, molecular biology, genetics, epidemiology);

- Markets and companies (finance, capital markets, business intelligence).

HIGHLIGHTS 2023

PRIZES

The jury prize for the national MT180 competition was awarded to **Arthur Ledaguenel**, for his thesis "AI neuro-symbolique : apprendre à partir de données et de règles" (*Neuro-symbolic AI: learning from data and rules*). Arthur is a PhD student at the MICS Laboratory, under the supervision of Céline Hudelot.

Javier Maass, a double-degree student from the University of Chile, has published a paper on the work of his *Research Track* at AAMAS, a rank A* conference. Co-authored with **Anaëlle Wilczynski** and **Vincent Mousseau**, researchers at the MICS laboratory, his paper is entitled "A Hotelling-Downs game for strategic candidatures with binary viewpoints", in the field of "computational social choice"**.**

The 22nd International Conference on Autonomous Agents and Multiagent Systems

London, 29 May-2 June 2023

Gurvan Hermange was awarded the 1st Prize *Impact Science 2023* by the Fondation Centrale-Supélec for his thesis work in MICS laboratory and Gustave Roussy. His subject is the *Mathematical modeling of myeloproliferative neoplasms, from their development to their treatment with Interferon alpha*.
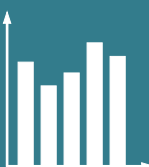
RESEARCH PROJECTS

As part of the government's France 2030 plan, the **Prism National Center for Precision Medicine** in Oncology becomes one of 5 University Hospital Institutes with a €40 million endowment. Led by Gustave Roussy (Pr. Fabrice André), and involving CentraleSupélec, Université Paris-Saclay, INSERM and Unicancer, the Prism program is based on a transformative, long-term vision of cancer treatment and interception.

Created in 2023 with **Transvalor**, a French specialist in the simulation of materials shaping, the **Artificial Intelligence Chair for the Simulation of Materials Shaping Processes** aims to revolutionise the use of simulation tools in the decision-making process of manufacturing companies and to make Industry 4.0 and the digital twin an operational reality in their day-to-day operations. This could lead to reduced use of raw materials, energy savings and more innovative manufacturing processes.

possibilities offered by artificial intelligence applied to digital simulation. Simulation calculations will become faster and easier to perform and understand thanks to Machine and Deep learning, bringing us closer to real-time calculation, a key factor in the digital twin.

Chair holder: Frédéric Magoulès, MICS laboratory

Chair co-holder: Emmanuel Vasquez, L2S laboratory

A Franco-Quebec research team, comprising Jose Dolz and Pablo Piantanida from the ILLS laboratory, and **Maria Vakalopoulou** and **Stergios Christodoulidis** from the MICS laboratory, has won the second call for projects in the France-Quebec bilateral collaborative research program: artificial intelligence in healthcare, run by the *Fonds de recherche du Québec - Santé* (FRQS) and the Health Data Hub (HDH).

Industrial Partners

- AIR LIQUIDE HEALTHCARE
- BNP PARIBAS
- CYBELETECH
- DASSAULT AVIATION
- DASSAULT SYSTEMS
- EDF
- GE HEALTHCARE
- IBM
- ICON CFD
- ILLUIN TECHNOLOGIES
- INCEPTO MEDICAL
- RANDSTAD
- SAINT-GOBAIN
- SCIENTA LABS
- SERVIER
- SICARA
- SNCF
- SUN ZU LAB
- THALES
- THERAPANACEA,
- TRANSVALOR
- VITADX.

Academic Partners

Institut Gustave Roussy, CEA, INRA, INRIA, INSERM, AgroParisTech, Cambridge, Oxford, Georg-August-Universität Göttingen, Sapienza University of Rome, Polytechnic University of Turin, RUDN University, Bar Ilan, TU München, University of Tokyo, Doshisha University (Japan), Beihang University, (China), Providence University (Taiwan), University of Washington, University of Michigan, Temple University, Berkeley Lab (USA).

Key figures

- Professors, Associate Professors & Researchers   33
- Engineers & Administrative staff   6
- PhD Students   52
- PostDocs   7
- Publications of the year (WoS)   41

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