ACADEMY 1
NETWORKS, INFORMATION, AND DIGITAL SOCIETY

2025 highlights



- ADVANCED COMMUNICATION NETWORKS
- ELECTRONICS AND PHOTONICS
- DIGITAL SCIENCES
- DISTRIBUTED BIG DATA
- DIGITALIZATION AND SOCIETY
- DIGITAL LAW

Academy 1 Networks, Information and Digital Society (RISE) unites over 200 researchers and faculty from 19 research units working on digital science and society. Its objectives are to support the emergence of innovative and ambitious research projects, to encourage transdisciplinary initiatives, and to strengthen the outreach of Université Cote d'Azur, both locally and internationally. This is notably achieved by organizing scientific events and international exchanges for students and researchers.

In 2025, the RISE Academy supported:

- **Six Ideas research projects** (€91K)
  - DataDisks - Neural networks to study planet formation
  - EXPLAINER - Revealing the hidden aspects of arguments
  - HUMNI - Human-machine neural interface
  - LaunderCoin - Automatic detection of money laundering on Bitcoin
  - PrefAIdvisor - Eliciting preferences and beliefs from AI-LLMs
  - TransGraph - Transfer learning for graph-structured data

- **Six international doctoral stays under the DocWalker program** (€30K)
  - BROAD Institute, USA
  - EPFL, Switzerland
  - Tokyo Institute of Technology, Japan
  - Adolfo Ibañez University, Chile
  - University of Groningen, Netherlands
  - University of Virginia, USA

- **Nine scientific events** (€18K)
  - Winter School on Antennas and Rectennas for IoT Applications
  - Summer School on Signal and Image Processing
  - Fall School on Data Storage on Synthetic DNA
  - International Brain Week
  - French Conference on AI in Biomedical Imaging
  - Workshop on Better Regulation of Online Tracking
  - Cognition, Information, and Society Study Days
  - Conference on Unconventional and Natural Computing
  - Chair on Legal Perspectives on AI Regulation

- **Two guest researcher stays** (€6K)
  - Pr. Olivier Pfister, University of Virginia, USA
  - Ass. Prof. Luciano Gualà, University of Rome Tor Vergata, Italy

- **Seven Forum Numerica seminars** (€3.5K)

- **Doctoral seminars of the Digital Systems for Humans Graduate School**

Examples of projects

EXPLAINER

The aim of this project is to develop methods and a dataset to make implicit arguments explicit, in order to make the reasoning of AI systems more reliable, transparent, and verifiable.

Victor David, Researcher (Inria, i3S)

Artificial intelligence, argumentation, logic, rhetoric, linguistics

Enthymeme, ambiguity, explainability, neuro-symbolic AI, LLMs

HUMNI

This project aims to develop noninvasive human-machine neural interfaces by decoding motor commands using surface electromyography. It combines numerical EMG simulations with a virtual hand demonstrator for the public.

François HUG, Faculty Member and Researcher (LAMHESS)

Human movement science

Electromyography, motor control, human-machine interface, synergy, motor neuron

Arnaud Legout, Researcher (Inria)

Cybersecurity, graph analysis, blockchain, financial crime

Bitcoin, money laundering, graph, cryptocurrency

LaunderCoin

This project aims to design automated analysis tools to detect money laundering on the Bitcoin blockchain by identifying structural invariants within the real-time graph of global financial flows.

Konstantin Avrachenkov, Researcher (Inria)

Machine learning on graphs, distributed and large-scale computing, smart cities, security

Transfer learning, GNN, scaling, smart grids, cryptocurrency networks

TransGraph

This project focuses on studying transfer learning for graph-related data. This involves using equivalence-preserving and scalable neural networks that are robust to topological changes and exploit patterns and applying them to electrical cascading failures and cryptocurrency fraud.



Credit: ESO/L. Calçada

FOCUS – DataDisks
Neural networks to study planet formation

Objective

Planets form in gaseous, turbulent environments called *protoplanetary disks* that surround very young stars. Within these structures, solids grow from interstellar dust, pebbles, and asteroid-sized objects all the way to planets. To understand how planets form, accurate modeling is required to determine how protoplanetary disks evolve and how gas moves within them. Simulations of computational fluid dynamics are essential to achieve this goal, but they remain very computationally intensive, as simulation grids with very high spatial resolution are needed to model the multiple scales of turbulence and planetary formation.

Despite recently introduced exascale computing, computational resources continue to be a limiting factor when studying the dynamics of these planet-forming regions. This project aims to use artificial intelligence tools to reduce the computational footprint of simulations of turbulent protoplanetary disks.

Method

Various methods have been proposed for more conventional flow conditions. However, developing a method applicable to this astrophysical context is a significant challenge due to the complexity of the physical phenomena involved and the particularly long integration times. These require the use of traditional methods for integrating fluid dynamics equations, which ensure compliance with the laws of physics over the long term, but with reduced spatial resolution. A neural network is then coupled to this solver to correct errors caused by low-resolution discretization.

To successfully achieve this coupling, the project is using state-of-the-art solver-in-the-loop techniques. The goal is to use a neural network to correct, at each time step, the errors in the physical integrator caused by the reduced resolution, and to account for the temporal dimension of the physical problem. This is achieved by optimizing the neural network parameters over multiple time steps during the training phase and by incorporating the physics solver. This implies that the solver is self-differentiable. The training thus aims to reduce the difference between a high-resolution simulation and the low-resolution simulation corrected by the model.

Transdisciplinary approaches are at the heart of this project, which faces both digital and astrophysical challenges. Astrophysical questions lead to innovative developments in machine learning.

Héloïse Méheut,
Researcher, CNRS,
Lagrange Laboratory

Machine learning,
astrophysics, fluid dynamics

Planetary formation,
turbulence, neural networks,
solver-in-the-loop