UNIVERSIDAD POLITÉCNICA DE MADRID

Expression of Interest-UPM Supervisor

Marie Skłodowska Curie Action–Postdoctoral Fellowship 2026 (MSCA-PF-2026)

Supervisor Name	Aurélien Decelle
Email	Aurelien.decelle@upm.es
Department /Institute / Centre Name/Location	Escuela Técnica Superior de Ingenieros Industriales de Madrid Departamento de Matematica Aplicada a la Ingeniería Industrial
Research Area	Mathematics (MAT) Physics (PHY) Information Science and Engineering (ENG)
Research team/group	Our research group studies modern machine learning using concepts from statistical mechanics and disordered systems. We are leaders in energy-based generative models, particularly Boltzmann machines. Our work spans the fundamental understanding of how generative models encode structure during learning, the design of improved training protocols and architectures inspired by computational physics, and the development of new inference tools to extract interpretable information from large datasets, especially in biological applications. We also aim to enhance the transparency and responsible use of neural networks in scientific research.
Keywords	Machine Learning, Restricted Boltzmann Machine, Unsupervised learning, Statistical Physics, Disordered Systems
Research Focus	***Understanding and Applying Generative modelling*** - **Data-driven applications of RBMs in bioinformatics and neuroscience:** RBMs are versatile generative models suited to biologically oriented datasets with limited samples or poor conditioning. Using tools developed in the group, we analyze functional and statistical properties and assess their domain relevance. - **RBMs for efficient simulations of physical systems.** RBMs can approximate complex physical probability distributions. Their bipartite structure enables accelerated simulations and efficient sampling strategies. **- New generative models, training protocols, and interpretative tools: W**e extend RBMs with deeper architectures, improved optimization schemes, and analytical tools to extract higher-order features. **- Theoretical analysis:** We investigate learning dynamics and pattern formation during training. **- Limited or corrupted data.** We investigate robustness, federated settings, and coupled models through analytical and numerical approaches.
Applications: documents to be submitted and deadlines	Please send to the supervisor: CV, letter of motivation, reference letters, one or two pages of research lines for the fellowship. Deadline: 30th April 2025