

PhD scholarship – Call for application  
**EUROMOV Digital Health in Motion**  
IMT Mines Alès - University of Montpellier

## Modeling temporal, rhythmic and social synchronization with spike neural networks

A 3-year fully funded PhD scholarship is proposed by the PhD school (ED I2S) in Alès / Montpellier within the **ANR MODPULS** project.

The successful applicant will become part of a dynamic research environment within the newly multidisciplinary joint research center **EuroMov Digital Health in Motion**.

See this offer on the EuroMov D.H.M website:

[https://dhm.euromov.eu/wp-content/uploads/2022/12/Ph.D\\_Modpuls.pdf](https://dhm.euromov.eu/wp-content/uploads/2022/12/Ph.D_Modpuls.pdf)

Start date: October 1st, 2023 (to September 2027).

Net remuneration around 1630€ monthly (including social security and health benefits).

### Project summary

The temporality of information is crucial to our understanding of the world. Synchronization between different events guides our perception and our actions in many tasks. For example, speech understanding is improved by lip-reading in a context of synchronization between visual and sound perception.

In the field of artificial intelligence, spike neural networks offer a paradigm inspired by the functioning of the human brain, which is based on the synchronization between neuronal impulses. These neural networks are likely to be more efficient than the classical neural networks used in the field of machine learning, and less costly in terms of hardware. They also offer new possibilities for processing temporal data and analyzing synchronizations.

The MODPULS project aims at studying the possibilities and the limits of the use of spike neural networks for the analysis of temporal data related to synchronization, rhythm, and human movement. Through a set of temporal and rhythmic data of different natures and complexities, combining audio, video and human motion data, you will have to implement synchronization tasks with spike neural networks. The fine analysis of synchronization mechanisms opens the field to numerous applications, notably in the human sciences with musical practice, but also in the medical field through the therapeutic analysis of social synchronizations.

## References

- Tavanaei, A., Ghodrati, M., Kheradpisheh, S. R., Masquelier, T., & Maida, A. Deep learning in spiking neural networks. *Neural Networks*. 2018.
- Neftci, Emre O., Hesham Mostafa, and Friedemann Zenke. Surrogate gradient learning in spiking neural networks: Bringing the power of gradient-based optimization to spiking neural networks. *IEEE Signal Processing Magazine* 36.6: 51-63. 2019.
- Damm, L., Varoqui, D., De Cock, V. C., Dalla Bella, S., & Bardy, B. Why do we move to the beat? A multi-scale approach, from physical principles to brain dynamics. *Neuroscience & Biobehavioral Reviews*, 112, 553-584. 2020.

## Applicant profile

As a PhD student, you will be responsible for:

- Independently carrying out research and completing a PhD dissertation within three years,
- Identifying or creating a dataset of temporal and rhythmic,
- Developing algorithms and methods to analyze data with spike neural networks,
- Recruiting participants and organize experiments in our labs,
- Reporting the results in international peer-reviewed scientific journals and conferences.

Applicants should have (or anticipate having) a MSc and research background related to computer science, audio/signal processing, or computational movement science. Knowledge in music (theoretical and practical) will be valued. French is not mandatory, but the candidate must be willing to learn French during their PhD and they must be able to communicate in English.

Applications should include a cover letter discussing your interest in the position, detailed CV, academic results (evaluation, average and ranking of the candidate during the initial course and Msc) and two reference letters.

Send your files to:

- [patrice.guyot@mines-ales.fr](mailto:patrice.guyot@mines-ales.fr),
- [stefan.janaqi@mines-ales.fr](mailto:stefan.janaqi@mines-ales.fr),
- [sebastien.harispe@mines-ales.fr](mailto:sebastien.harispe@mines-ales.fr).

## Presentation of the institution and the host laboratory

The **Institute Mines-Télécom (IMT)** is a French public establishment dedicated to higher education and innovative research and, as it represents the ministries of industry and digital technology, it is the largest group of engineering schools in France. The IMT brings 11 public engineering across France together. Collectively, they train 13,500 engineers and doctoral students as well as employing 4,500 women and men and manage a budget of €400m within 55 research centers connected to the schools. IMT publishes 2000 publications each year and registers 60 patents.

**IMT Mines Alès** is one of the schools of IMT. With its 175 years of history of service to science and industry, the school employs 350 people and trains more than 1100 students, engineers and researchers. Its three teaching and research poles work in the areas of risk environment, materials, civil engineering, industrial engineering and digital technology. The values promoted at the school are boldness, commitment, sharing and excellence. The school spurs on job mobility projects.

**EuroMov Digital Health in Motion** is a new research unit that was officially inaugurated in January 2021. This research collaboration involves the French institutions IMT Mines Alès and the University of Montpellier in partnership with the university hospitals of Montpellier and Nîmes. The research scope promotes cross-fertilization across three main domains of artificial intelligence, movement sciences and health. The research aims to understand the behavioral plasticity of humans in order to consider new therapeutic approaches and improve sensorimotor recovery, whilst providing a platform for innovation of new digital approaches.