PhD position in Simulation and analysis of 3D microstructures by Minkowski functionals and deep learning – 36-month fixed-term contract
SPIN/PMMG

JOB ENVIRONMENT:

Institut Mines-Télécom is the leading public group of engineering and management *Grandes Écoles* in France. Consisting of eight public graduate *Grandes Écoles* and two subsidiary graduate schools, *Institut Mines-Télécom* leads and develops a rich ecosystem of partner schools, economic, academic and institutional partners, key players in education, research and economic development.

Mines Saint-Étienne, a graduate school of the *Institut Mines-Télécom*, is responsible for education, research, innovation, industrial transfer and scientific culture dissemination. With 2,500 students, 500 staff and a budget of €50m, it has 3 campuses dedicated to the industry of the future, health and well-being, and digital sovereignty and microelectronics. It is ranked in the top 15 graduate engineering schools in France and the top 500 universities worldwide.

The 2023-2027 strategy of Mines Saint-Etienne is in line with that of *Institut Mines Telecom*. It aims to:

- Support the ecological, digital and generational transitions and educate the people involved
- Support national and European sovereignty in microelectronics and digital technology

To support this strategy, it is recruiting a **PhD student**.

JOB DESCRIPTION:

The "Sciences des Processus Industriels et Naturels" (SPIN) centre is a research, teaching and technology transfer centre renowned for its expertise in Process Engineering applied to divided solids (grains, pores, particles, powders, soils, ores). As part of the Georges Friedel Laboratory (UMR CNRS 5307), it uses its scientific skills and cutting-edge equipment to support innovation by industrial companies faced with the energy transition and the need to invent new high-performance processes and materials. The SPIN centre is structured into three departments and six research themes: powder technology, geometry and physical chemistry of granular media, complex hydro-systems and geo-processes, industrial crystallisation and application of gas hydrates, reactivity and transformation of solids, electrical properties of solids interacting with gases and instrumentation.

Presentation of the laboratory and research centre: The Georges Friedel Laboratory (LGF) is a CNRS Joint Research Unit (UMR 5307) and belongs to the Institute of Engineering and Systems Sciences (INSIS). Located at the École des Mines de Saint-Étienne and supported by two supervisory bodies (Mines Saint-Étienne and CNRS), the laboratory brings together all the research potential of Mines Saint-Étienne in the fields of materials, mechanics and processes.

The fuel cells are energy conversion systems. Their efficiency is linked to the geometry of the microstructures of which they are composed. Several very different models have been developed in the laboratory, in collaboration with teams of the CEA-Liten in Grenoble. In particular, random fields simulate ensembles whose geometry is close to that of real-life real observations. However, this technique does not allow to adapt to spatial or temporal variations in microstructures, and the manipulation of random fields fields remains relatively simple.
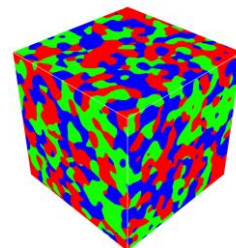
The Minkowski functionals are elementary functionals that describe the geometry of mathematical objects (in 2D of 3D in our case). They give interesting criteria that can be used to compare microstructures together.

The aim of this PhD thesis is to study the evolution of the Minkowski functionals according to the time and the three dimensions (in case of non stationary materials) in order to better simulate the microstructures. Generative

3D models, like diffusion models or GANs, in three dimensions, in conjunction to the Minkowski functions, will be used. The physics principles will be described and compared to real data.The tasks are likely to change according to the needs of the department and Mines Saint-Etienne.

A PhD grant of 3 years is secured.
The position is based on the Saint-Étienne campus.

PROFIL SOUGHT:

Diploma required: Master's degree (or equivalent) in the field of applied mathematics

You have the following skills, knowledge and experience:

- Strong background in applied or theoretical maths
- Good knowledge in computer programming
- Use of scientific language in English and French

You recognise yourself in the following abilities and skills:

- Ability to communicate in English, using scientific language
- Demonstrated research aptitude
- Excellent communication skills

WHY JOIN US:

Institut Mines-Telecom is characterised by:

https://www.youtube.com/watch?v=m39m6hdNC48

- A scientific environment of excellence
- A group with entities throughout France

Mines Saint-Etienne is distinguished by:

- A privileged working environment with a high student supervision rate and a high environment rate (support and back-up functions)
- First-rate experimental and digital resources
- Significant contract research activity (€11m/year in Research and Innovation contracts), mainly with industrial partners
- 25% international students, Member of the T.I.M.E. network and the EULIST European University
- A centre for scientific, technical and industrial culture - *La Rotonde* - which is unique in France, and which has a major impact on society (> 50,000 visitors per year)
- Pleasant workplace, easily accessible by public transport and close to motorways
- Public transport costs reimbursed up to 75% (subject to conditions)
- Sustainable mobility package
- Staff committee that subsidises sports, leisure, cultural and social events and activities
- The possibility of partial remote working

ADDITIONAL INFORMATION:

Recruitment conditions:

- Fixed-term contract for a period of 36 months
- Desired start date: 1st October 2024
- Remuneration will be set according to the candidate's profile, based on the rules defined by the *Institut Mines Télécom's* management framework
- Full time

- Position based in Saint-Étienne

The position is open to all, with accommodation available on request for candidates with disabilities.
The job is open to civil servants and/or the general public.
All applications may be subject to an administrative enquiry.

How to apply:

Applications (CV, covering letter, letter of recommendation if applicable) must be submitted on the RECRUITEE platform **no later than 24/06/2024**:
https://institutminestelecom.recruitee.com/o/phd-position-in-simulation-and-analysis-of-3d-microstructures-by-minkowski-functionals-and-deep-learning-36-month-fixed-term-contract-2

As part of its Equality, Diversity and Inclusion policy, École des Mines de Saint Etienne is an employer that is committed to fair treatment of all applicants.

For further information:

For further information about the position, please contact:
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For all administrative information, please contact:
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Tel/ + 33 (0)4 77 42 01 18

Useful links:

https://www.mines-stetienne.fr/

https://www.imt.fr/

https://www.youtube.com/watch?v=QUeuC5iQiN0

Protecting your data:
https://www.mines-stetienne.fr/wp-content/uploads/2018/12/Informations-des-candidats-sur-les-traitements-de-donn%C3%A9es-personnelles.pdf