

Postdoctoral Position in AI for Nuclear Safety and Radiological Protection

ASNR / Mines Paris PSL

September 30, 2026(First Call)

Context

On nuclear sites, controlling atmospheric contamination is critical to protect workers from radiation. Continuous Air Monitors (CAMs) are deployed to continuously collect airborne aerosols on a filter, assess the accumulated radioactivity in real-time, and trigger alerts if contamination is detected [13]. However, in decommissioning sites, these instruments may exhibit unexpected behavior due to specific atmospheric conditions, such as dust from concrete scraping or steel cutting [7]. The deterministic algorithm currently implemented in these instruments, which decides whether to trigger an alarm based on the recorded spectrum, is not always suitable for such non-standard atmospheric conditions defined by the International Electrotechnical Commission (IEC 60761 series).

To improve the performance of current instruments, the French Authority for Nuclear Safety and Radiation Protection (ASNR) in partnership with Mines Paris-PSL has recently developed a novel Deep Learning-based algorithm [10, 11]. This algorithm is effective in dusty conditions and achieves the same level of accuracy as the current algorithm in normal conditions. With the emergence of AI systems, a new research field focuses on analyzing confidence in their predictions to ensure an operational use of AI in industrial applications. This confidence is particularly important when the algorithm supports expertise and decision-making, as in nuclear safety and radiological protection. The concept of confidence has already been formalized in an industrial context by the European Union Aviation Safety Agency [6] and more recently by ASNR, EDF R&D, Framatome, and CEA for nuclear activities [5], based on five guiding principles: consistency, exactness, robustness, intelligibility, and transparency.

Position Overview

This postdoctoral position, proposed by ASNR and MINES Paris, is included in the EXODD project in partnership with EDF R&D with the objective to apply these guiding principles to the Deep Learning algorithm for spectrum analysis. The goal is to address open research questions related to exactness and robustness to enable its operational implementation in measurement instruments and its application to real spectra. The candidate is invited to present his or her findings at international conferences. The work will focus on the following three development axes:

Axis 1: Improving Model Performance with High-Fidelity Data

This axis focuses on the principle of exactness, ensuring acceptable precision in AI system predictions. So far, the spectrum analysis algorithm has been trained, validated, and tested on a synthetic database. To guarantee acceptable model performance in real-world situations, ASNR is currently developing a high-fidelity simulation code that more precisely describes aerosol deposition mechanisms, albeit at a high computational cost [1]. The objective of this axis is to study how high-fidelity data can improve the algorithm's real-world performance by combining synthetic and high-fidelity data via transfer learning [9, 3] and/or fine-tuning, while using active learning [12] and refinement criteria [4] to strategically enrich the limited dataset.

Axis 2: Operational Exploitation of the Model

This axis focuses on the principle of robustness, evaluating the AI system's performance in the presence of variability. To address this, the work will focus on defining the validity domain of the model, and/or developing a tool to detect whether a new real spectrum significantly differs from the spectra in the training database (in the sense of distance in the latent space). Additionally, building on the work in [11] on uncertainty quantification, conformal prediction will be used to construct OOD detection scores, which is an active research area in the AI community.

Axis 3: Operational Implementation in Measurement Instruments

This axis exploits the contributions of the two previous axes for real-world deployment. The designed model will be embedded on microcontrollers, with optimizations to reduce memory footprint and energy consumption. Tests will be conducted on ICARE [2] to validate the system's behavior under realistic conditions [8]. Finally, an automatic anomaly diagnosis system will be integrated to detect hardware failures or sensor drifts.

Requirements

- Ph.D. in Statistics, Machine Learning, Optimization or Signal/Image Processing.
- Strong background in Machine/Deep Learning and probabilistic modeling.
- Experience with Python and data analysis tools.
- Knowledge of nuclear physics or radiological protection is a plus.
- Knowledge of uncertainty quantification is a plus.
- Fluency in English is required; proficiency in French is a plus.

Duration and Location

- Duration: 18 months.
- Location: ASNR, Saclay, France.
- Deadline for applications: (31 December, 2026) (**Open until filled**)
- Starting day: The start date can be adjusted to accommodate the candidate.

Application

Interested candidates should submit:

- A detailed CV.
- Contact information for at least two references.
- List of publications.

Contact

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References

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