Type d'offre : Laboratory offer

Post date : 24.04.24

IRSN

PhD - Advanced methods for image processing of surface particle contamination (Th RES 24-14 - W/M)

Informations générales

Contact :

To apply

Starting date : Tue 01/10/2024 - 12:00

Trade : PhD

Topic : Analyse et traitement d'images

IRSN :

The dual culture of expertise and research at the Institut de Radioprotection et de Sûreté Nucléaire (IRSN) has always been a heritage handed down from generation to generation of employees. The indispensable combination of these two worlds creates a unique professional framework dedicated to all fields of nuclear safety and radiation protection. This reality, unique in the nuclear industry, has enabled thousands of men and women over the last twenty years to achieve rich and varied careers. In an organization founded on the value and consideration of people, respect for skills nurtures a value chain dedicated to a mission of public interest essential to society as a whole. Recognized the world over for the excellence of its teams, IRSN is committed to making its talent shine.

Détail de l'offre (poste, mission, profil) :

Offer

In the context of facilities using radioactive substances, calculation software has been developed to assess the risk of internal contamination of workers, the positioning of monitoring devices, the fractions of contaminants likely to be transported in ventilation networks to purification devices, or the risk of accumulation of a pollutant. These models and software are refined on the basis of new models and data, such as new metrology tools dedicated to characterizing aerosols on a surface. This thesis aims to deploy advanced computer vision methods to process images of so-called “industrial” surfaces, contaminated by polydisperse aerosols that are difficult to distinguish from the background. The work will have to address both the “numerical” performance of image segmentation, and so-called metrological performance, in other words the ability of the model selected to predict the granulometry of deposited particles, bearing in mind that the hybridization of these two parts is in itself an objective to be evaluated. The experimental bench developed at IRSN provides access to 3D information, and the neural network used to date enables this 3D analysis. Several avenues may be explored to maximize the use of these tools, with the ultimate aim of providing a good representation of the particle size distribution of the particles deposited on the surfaces under consideration.

Missions

The first part of the project aims to set up reference methods and samples covering the desired areas in terms of surfaces and particle types/sizes. The student will carry out a bibliographical review of existing metrological means (*Costa et al., 2021*), investigating other methods based on externalisable sample analysis enabling the detection of low masses (*Malet et al. 2024*). This review will enable the selection of so-called reference techniques for the evaluation metrics selected. The student will also become familiar with the experimental tool developed in advance of this thesis to analyze particle deposition surfaces. The PhD student will be familiar with image segmentation and deep learning techniques for aerosol detection on the surfaces considered, as well as a convolutional neural network (*Stringer et al. 2021*) already used in the team during an internship preliminary to this thesis (Papine-Paktoris et al. 2024). It may be necessary to “mimic” these images or to generate them. **At the end of the first part, the student will have a database of images of these particle-contaminated surfaces, the metrics of which will have been assessed independently by the reference methods chosen.**

In the second part, we will develop this image processing to trace the size and concentration of particles deposited on the surfaces under consideration, using preliminary work on a convolutional neural network and hybridizing it with mathematical morphology methods. A first simple model based on a statistical, empirical approach specific to the given surface and particle size will be proposed. A second, more complex model is already envisaged, based on the 3D information obtained from the images, which is the specificity of the method used here. This method should result in a real, non-empirical model of particle analysis on surfaces. **At the end of this part, the image processing developed will be functional and will be able to easily and rapidly process aerosol images taken by imaging techniques on any noisy surfaces of interest.**

Finally, the last part of the thesis consists of an application on one or more real cases, in which the whole device will be tested on aerosol deposits in experimental situations. This will involve “industrializing” the existing image-acquisition device into an easy-to-use tool.

Costa D., et al.. Measurement Science and Technology 33:9, pages 094001, (2022)
Malet J., Yet al Wiese, European Aerosol Congress, submitted, 2024
Papine-Paktoris S., et al., Congrès Français des Aérosols, March 2024
Stringer, C., et al., Nat Methods 18, 100–106 (2021)

Profile

- Training in general engineering or M2 Research;
- Knowledge in at least one of the following fields: Aerosol physics, fluid mechanics, AI/neural networks. The absence of knowledge in several of these fields can be supplemented during the thesis and is not prohibitive. The candidate must be open to Python programming, although an interest in experimental work is desirable but not a prerequisite;
- Telework: occasional;
- Languages: English (2- Professional level)

The main aim of the thesis is to make advances in the physics and metrology of aerosol deposition, and IRSN is therefore heavily involved in the orientation and direction of the subject and its purpose. Nevertheless, the analysis methods envisaged are ambitious in terms of image analysis and will draw on the CMM's experience.

URL de l'offre :

https://irsn-career.talent-soft.com/offre-de-emploi/emploi-methodes-avancees-de-traitement-d-images-de-contamination-de-surface-en-particules-th-res-24-14-h-f_750.aspx

Lien vers l'offre sur le site dataia.eu :https://da-cor-dev.peppercube.org/node/1052