



Master 2 Internship on Image Processing

Laboratory: Laboratoire des Réactivité et Chimie des Solides (LRCS)

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Supervisors: Dr. Arnaud Demortière (CR CNRS) et Mr. TuanTu Nguyen (PhD Student)

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Required skills: Image processing, Basic skills in Matlab/Python, FIJI, CNN.

Contract date: From March 2020 (4-5 months)

Gratification for internship: 550 euros/month

Topic title: Toward a new metric for tomography image quality assessment (IQA)

Description:

Microstructure plays a crucial role in the performance of the lithium-ion battery electrodes. To improve the performance of the next generation electrodes, the microstructural properties need to be investigated. Various experimental methods have been developed for characterizing microstructure. However, numerical approaches, based on 3D image data, are now gaining interest in the battery community, due to the advances in nanoscale tomographic imaging methods [1]. Nevertheless, tomographic data often suffer from several issues such as low image contrast between different phases with similar absorption coefficients; distortions due to image acquisition or reconstruction step.

As a result, the image quality may be significantly reduced when being presented to a human observer. It can be a source of errors which translates into uncertainties in the calculated parameters, such as volume fractions, tortuosity factor, or the interfacial surface area between phases.

The goal of the internship is to develop a quantitative metric that can automatically predict perceived image (from tomography experiment) quality, which is expected to be in good agreement with subjective opinion from human observers [2] [3]. An image quality metric can play an important role in data processing. First, it can be used to dynamically monitor and adjust image quality, hence it allows to reduce the uncertainties of microstructural parameters extracted from the tomography data. Second, it can be used to benchmark image processing systems and algorithms (acquisition and reconstruction step).

The main missions of the master student will be:

- **Bibliography:** study the state-of-art regarding the IQA field. [2] [3]
- **Application** of already-existed IQA metrics to tomography images; based on these algorithms, a **new metric** can be proposed by the student to be more adapted for tomography applications. Convolutional neural network (CNN) approach will be also used to optimize the different assessment parameters. [4] [5]
- **Analyze** the effect of these image quality metrics on the uncertainties of different microstructural parameters.

The LRCS offers an exciting research environment consisting of internationally recognized researchers as well as young scientists with team spirit. Close international cooperation with top universities and institutes worldwide. Opportunity to get PhD funding could be considered whether the internship is successful.



References: [1] Pietsch, P., & Wood, V. (2017), *Annual Review of Materials Research*, 47, 451-479. [2] A. Mittal *et al.*, *IEEE Transactions on Image Processing*, vol. 21, no. 12, December 2012. [3] A. Mittal, R. Soundararajan and A. C. Bovik, *IEEE Signal processing Letters*, pp. 209-212, vol. 22, no. 3, 2013. [4] Lijuan Tang, Leida Li *et al.*, *Journal of Visual Communication and Image Representation*, 40, 10 2016. [5] Guanghui Yue, Chunping Hou *et al.*, *Digital Signal Processing: A Review Journal*, 91, 8 2019.