

## SEM Image Classification Using CNN Architectures

**Authors :** Güzin Tirkeş, Özge Tekin, Kerem Kurtuluş, Y. Yekta Yurtseven, Murat Baran

**Abstract :** A scanning electron microscope (SEM) is a type of electron microscope mainly used in nanoscience and nanotechnology areas. Automatic image recognition and classification are among the general areas of application concerning SEM. In line with these usages, the present paper proposes a deep learning algorithm that classifies SEM images into nine categories by means of an online application to simplify the process. The NFFA-EUROPE - 100% SEM data set, containing approximately 21,000 images, was used to train and test the algorithm at 80% and 20%, respectively. Validation was carried out using a separate data set obtained from the Middle East Technical University (METU) in Turkey. To increase the accuracy in the results, the Inception ResNet-V2 model was used in view of the Fine-Tuning approach. By using a confusion matrix, it was observed that the coated-surface category has a negative effect on the accuracy of the results since it contains other categories in the data set, thereby confusing the model when detecting category-specific patterns. For this reason, the coated-surface category was removed from the train data set, hence increasing accuracy by up to 96.5%.

**Keywords :** convolutional neural networks, deep learning, image classification, scanning electron microscope

**Conference Title :** ICCBSEA 2023 : International Conference on Computer-Based Systems and Engineering Applications

**Conference Location :** Paris, France

**Conference Dates :** April 13-14, 2023