# Automated methods for soot aggregate segmentation in TEM images using machine learning techniques

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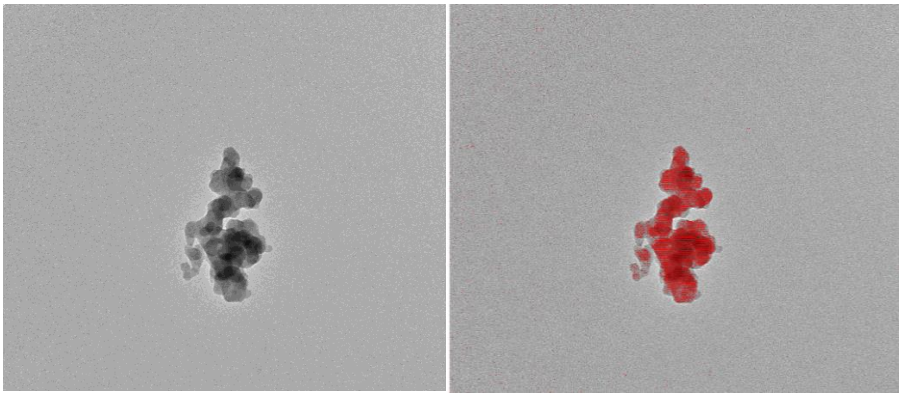

Figure 1: Original TEM image (left) and segmentation results from supervised machine learning (right).

Soot particles negatively affect public health and the environment, and their impact is highly dependent on morphology. As it allows for direct imaging of the particles, transmission electron microscopy (TEM) provides very detailed information about particle morphology. However, reliable analysis of the images often requires manual processing, which is time-intensive and limits the number of images that can be practically analyzed. Automated methods have the promise to speed up soot particle characterization and have previously been applied with varying levels of success. The current work seeks to build on existing TEM image analysis tools by developing machine learning techniques that segment images of soot at the aggregate level. The technique uses a convolutional neural networks (CNN) to distinguish pixels that are part of the particle from those of the background. Nine combinations of network architecture and pre-processing were tested. Using u-net and applying pre-processing to remove the background gradients from TEM images, the optimal network achieved an IoU of 0.79. However, the output was not sufficient to act inputs for automatic methods of primary particle sizing. Future work will focus on extending the technique to fully automate primary particle sizing, through feeding the results into automated primary particle sizing techniques.