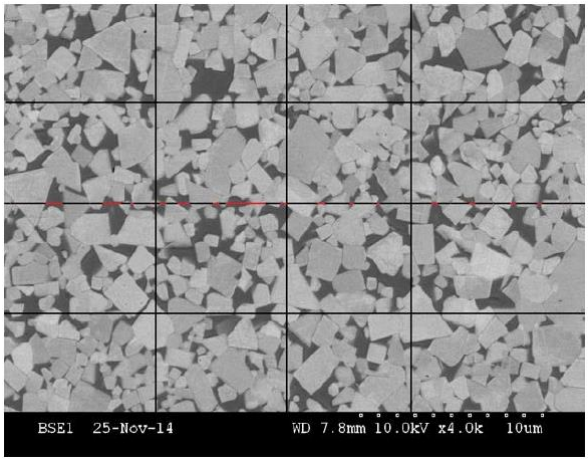
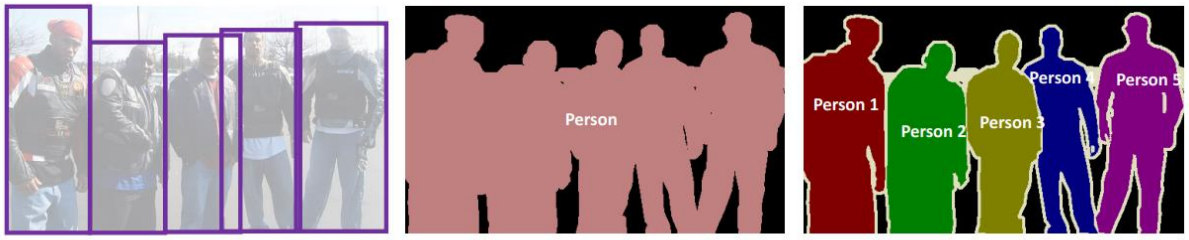
Automatic phase and grain detection for cemented carbides using deep learning

Cemented carbide is a hard material used extensively as cutting tool material. It is one of the most successful composite engineering materials, and consists of tungsten carbide bonded with cobalt. Cobalt acts as a binder phase to hold the hard carbide grains together. Mechanical properties of the material depends strongly on the fraction and grain sizes of the carbide. Electron microscopes are widely used to characterize microstructures of cemented carbide. A typical microstructure is shown in the following, where the light parts are carbide and the dark parts are cobalt. However, measuring the volume fraction and grain sizes of carbide from micrographs usually requires manual work.



Instance segmentation via deep learning has been rapidly develop and has been successfully used in many different fields. It is a challenging computer vision task that requires the prediction of object instances and their per-pixel segmentation mask. This makes it a hybrid of semantic segmentation and object detection.



Object Detection Semantic Segmentation **Instance Segmentation**

In the project, it is suggested to apply instance segmentation for automatic measurement of the volume fraction and grain size of carbide from micrograph. The work includes selection and construction of a suitable deep learning network, training of the network using manually generated ground-truth mask, and determination of volume fraction and grain sizes of carbide after instance segmentation. Successful model will be implemented in the intelligent characterization platform of the department of engineering.