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High Throughput 3D Volumes Data Acquisition Using AI

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FIB/SEM tomography has been established as a key method for 3D analysis of biological samples at isotropic resolution. The technique is based on acquiring thousands of SEM images at high resolution but its applicability is limited by the image acquisition time that may take a few minutes per frame. We developed two different methods using Artificial Inteligence (AI), reducing the acquisition time of 3D samples by different approaches.

The first method is based on scanning areas of interest in high-resolution, while the background is scanned in lower resolution. These areas of interest (AOI) are chosen and labeled by the user on the initial image. Taking into account the scientific question, different AOI can be selected (e.g. mitochondria in a cell or cells within a resin). Based on the initial image's AOI, our solution trains an AI semantic segmentation network that continuously generates scanning masks for subsequent images (Fig. 1). The initial training part takes only 1 minute. Using this method, the required dose and scanning time can be significantly reduced, resulting in an increased throughput in applications such as AutoSlice&View.

The second method aims to accelerate SEM acquisition by image interpolation (data generation). Our new approach interpolates (generates) every second image in the 3D volume, which saves 50 % of image acquisition time.

To achieve the desired resolution in 3D visualization of acquired images, a customer may enlarge (double) slice thickness, and all middle frames between slices will be calculated - generated.
Our developed algorithm uses multiple real acquired images as input, in order to increase the quality of the generated data (Fig. 2). We demonstrate a significant time saving and excellent results on life science datasets from biologically relevant samples.

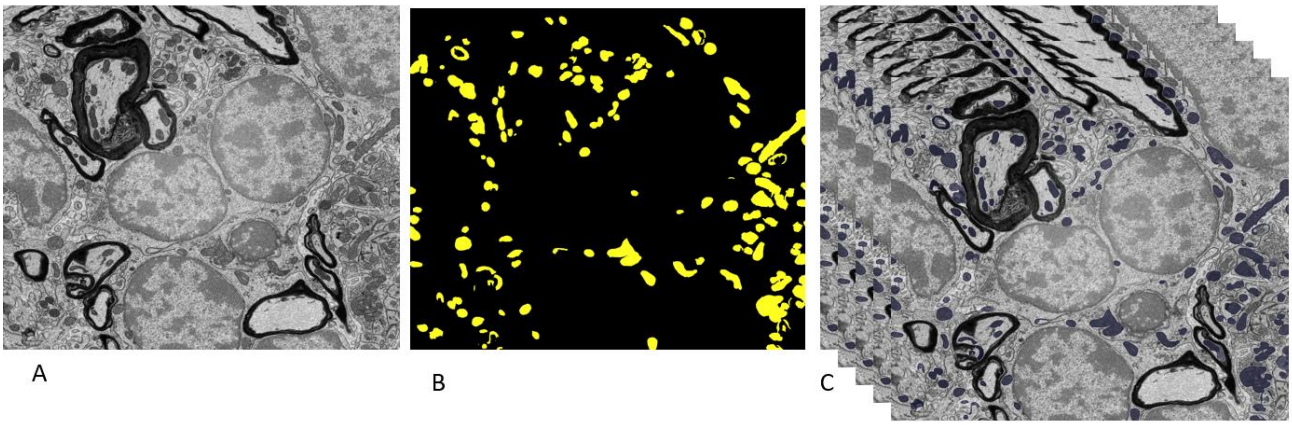

Fig. 1. A) First image from FIB/SEM tomography. B) Mask of the area of interest (mitochondria). C) Subsequent images that are labelled automatically. Mouse brain tissue sample

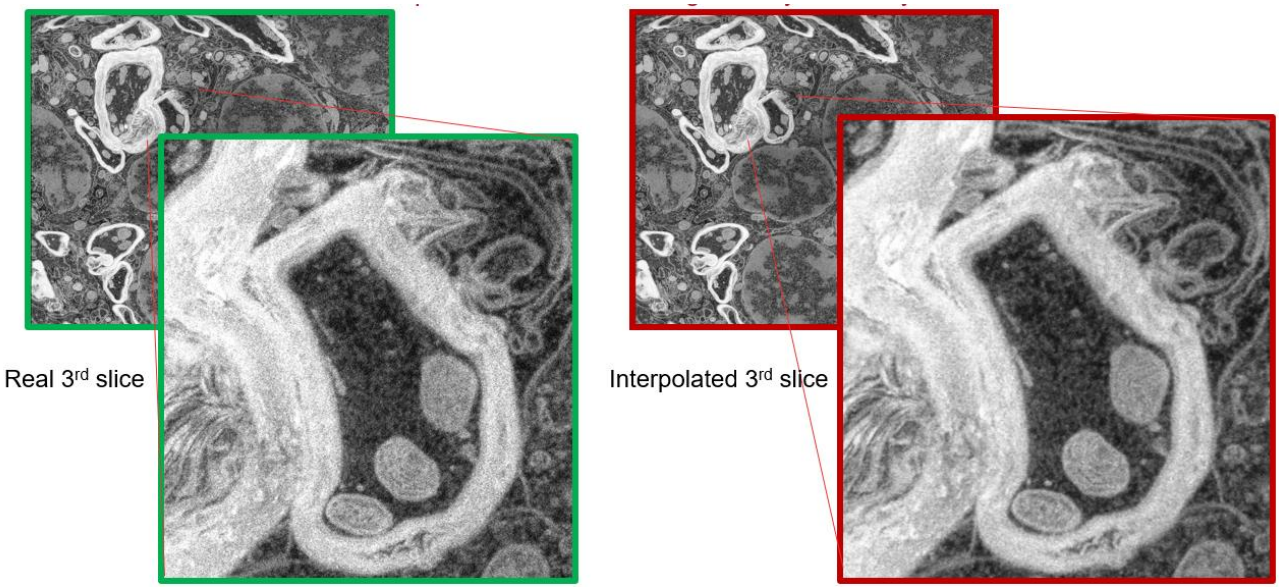

Fig. 2. Original and generated (interpolated) image has the same quality. An example of one slice on which the quality of interpolated dataset is shown.

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