3D shape-based object segmentation of large tomographic datasets

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Recent developments in optical and electron microscopy as well as x-ray technologies have allowed researchers to collect larger and larger tomographic datasets which contain an immense amount of details. In biological and medical sciences, these techniques are of paramount importance to gain a quantitative understanding of the structure and function of biological tissues and materials, but the information have to be 'mined' from these large datasets through segmentation, i.e. the process of assigning each voxel of the volume to an object (label) of interest. Given the intrinsic characteristics of these datasets, the segmentation can be performed, in most cases, only based on the 3D shape of the objects of interest. As there are currently no tools to perform shape based automatic segmentation, the process has to be performed manually. As a result, only regions of interests much smaller than the measured volumes can be analysed. This, in turn, decreases substantially the statistical relevance of the scientific statements that can be drawn from the datasets.

Parallelized machine learning (ML) techniques could represent one option to enable data analysis for larger volume and automatize the processing workflow. However, while these techniques have been well developed for object classification, there are currently only a few examples of their application to 3D segmentation of biological/biomedical datasets.

The aim of this project is to develop software tools with which domain experts can semi-automatically execute parallelized artificial intelligence methods to segment large tomographic biological data volumes based on the 3D shape of the features.

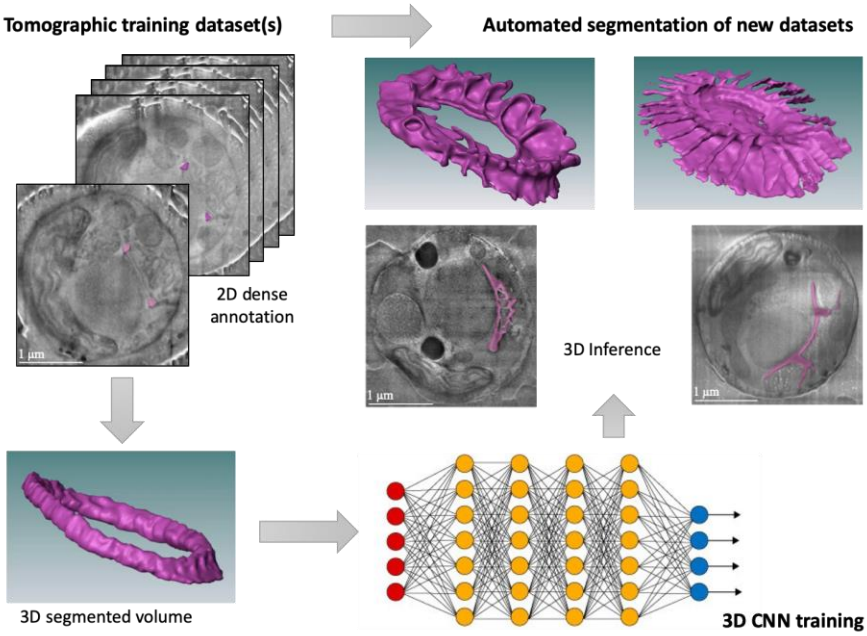

Figure 1: Development of 3D machine learning strategies to semi-automatically segment electron microscopy or x-ray large tomographic datasets