Bachelor Project Idea (draft)

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1 Project Outline

This Bachelor Project will be about extracting a clear model of a tooth from a CT-scan. The aim of this project will be to research whether machine learning can be used to automate the processing of CT-scan imagery to a clean 3D model.

2 Data

In this project, I will work with data from an CT-scanner. This scanner makes cross sections from a part of the body of a patient. These cross sections will be saved in DICOM files (Digital Communication in Medicine, with extension .dcm). When these cross sections are placed on top of each other, a 3D image of a particular section of the body is constructed.

2.1 Problem

Currently, a tooth (or other structure) needs to be extracted from other tissue and image noise by adjusting the border parameters of the values that were obtained from the CT-scan. In such a way, only the tissue with values inside this range will be selected and made into a 3d model. However, adjusting these parameters takes a lot of time to get a clear picture from a particular section. Hence, it would be nice to automate this process, for example with help of machine learning.

2.2 Ideas to tackle the problem

One solution to the problem might be to train a neural network on images that are still messy (as they come from the CT-scan), but which have been made into a clean 3D model by adjusting parameters. So we know the exact border values that were needed to create a clean model for these cases. Next, train a 3D-Convolutional Neural Network (3D-CNN) to recognize the unclear pictures. When the network has been trained, a new instance is presented to the network. The network computes which of the former messy models the new instance resembles the most, and assigns it to that particular model. The parameter values of the model to which the new instance is assigned are copied to the new instance, which, in theory, should make the resulting model free from most noise if the 3D-CNN has been trained correctly. However, since every CT-scan is different, the neural network cannot determine the class to which a new instance belongs with 100 percent certainty. The new instance may be assigned to group A with 93 percent certainty, and to group B with 86 percent accuracy. Hence, the border values may be calculated according to the accuracy rates of 2 (or more groups) to tune them more precisely.

Another idea is to solve the problem using a denoising autoencoder. This network is fed with many solved 3D models, and learns in a certain way what a model should look like. When the network is trained, a new messy CT-scan is presented to the network. Then the network will modify the scan in such a way that it becomes a clean model.