Segmentation of CoViD-19 pathological changes and surrounding organs for longitudinal analyses

Project Management and Software Development for Medical Applications

General Info

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Project Abstract

The CoViD-19 pandemic required great efforts by medical personnel treating infected patients. Many patients were hospitalized for a long period of time, while multiple CT of the thorax were acquired. Yet due to the lack of available infrastructure, changes images were only considered qualitatively. Comparing longitudinal CT quantitatively at voxel-level may be very valuable to understand the progression of the disease. The goal of the project is to segment different pathologies caused by the CoViD-19 infection to then analyze the progression of the disease.

Background and Motivation

In the months during and following the CoViD-19 pandemic, many neural networks (NN) were trained to segment pathologies caused by the infection, such as ground glass opacity, consolidation and pleural effusion [1]. However, it is well known that the generalization of these algorithms depends on the training data. For this reason, there is the necessity to evaluate different NN on the own in-house dataset to select the one performing best.

Moreover, the analysis of CoViD-19 disease progression is still an open research question. It requires the segmentation and the registration of CTs acquired at different time points. The segmentation is essential for two reasons. First, the segmentation of the full lung area, the ribs and the airways is helpful to generate a more robust registration between the two CTs. Second, by assigning at each voxel the corresponding pathology, physicians can analyze the progression at voxel level and not only the change in the volume of the different pathologies ("global progression"). This voxel-wise comparison is only meaningful if the registration is robust.

Student's Task Description

The student will be provided with the code and the pre-trained weights of three different NN for pathologies segmentation in the lungs. For each of the NN, the student is required to run the inference on an in-house dataset of CoViD-19 patients and will select the best performing one.

In addition, the student will use the TotalSegmentator [2] to segment the ribs and the airways in the in-house dataset.

If needed the student will fine-tune the best performing NNs with the goal of obtaining a set of NNs that perform the best in the internal dataset.

Prerequisites

- Knowledge of Medical Image Processing
- Good programming skills in Python
- Experience with PyTorch and image segmentation tools in Python

References

[1] https://www.elsevier.es/en-revista-radiologia-english-edition--419-pdf-S2173510721000033
[2] https://arxiv.org/abs/2208.05868