Reference Values and Proposed Thresholds for the Normal Lung Index Estimated from Quantitative Computed Tomography

Introduction

- Quantitative computed tomography (QCT) techniques might provide objective quantification with some advantages to the visual assessment of abnormal lung parenchyma attenuations.

- We aim to evaluate a fully automatically tool (QUAntitative Lung Imaging Tool, QUALIT) to differentiate and quantify emphysema from airspace cysts using texture-based convolutional neural networks (CNN) on chest computed tomography (CT) images.

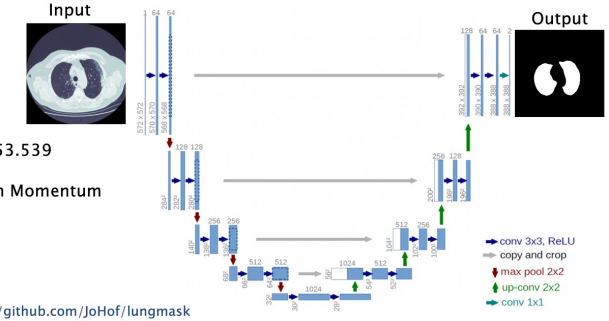
Methods

- QUALIT includes two convolution neural network (CNN) that has been trained for automatic lung segmentation and for the classification of low- (emphysema and cysts, LAA), normal- (normal parenchyma, NAA) and high attenuation areas (ground-glass opacities (GGO), crazy paving/linear opacity (CP/LO) and consolidation, HAA). It also includes a densitometry (Dens) tool that computes LAA (-1000 to -950 Hounsfield units, HU), NAA (-949 to - 700 HU), and HAA (-699 to +50 HU).

Classification

Segmentation

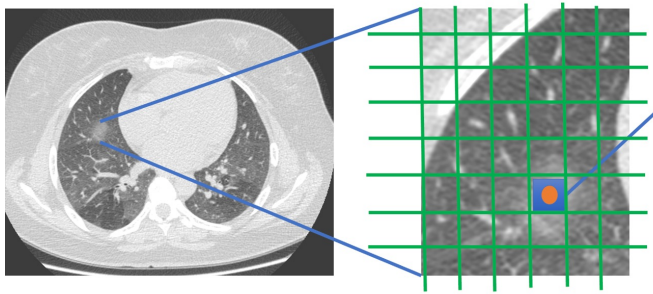
U-Net R231

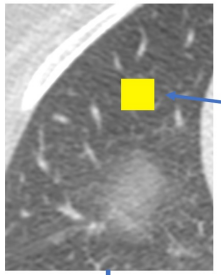


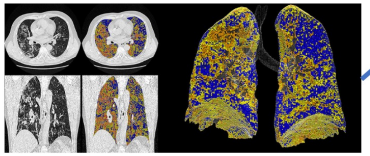
Parameters = 28.953.539

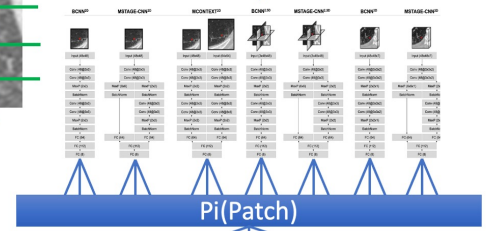
Optimizer = SGD with Momentum

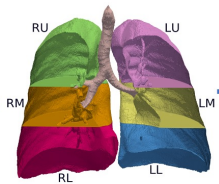
Model available in: https://github.com/JoHof/lungmask

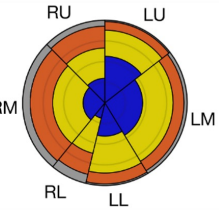


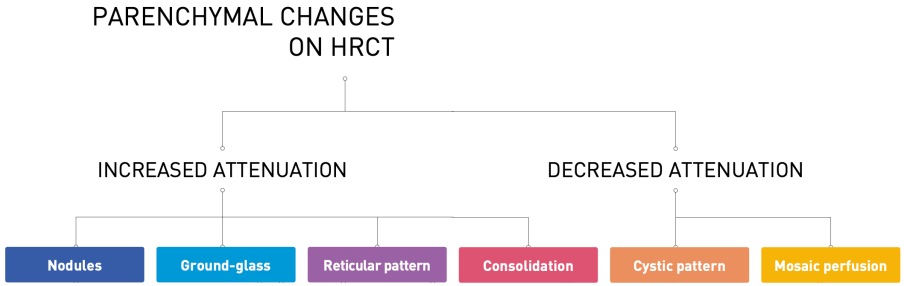




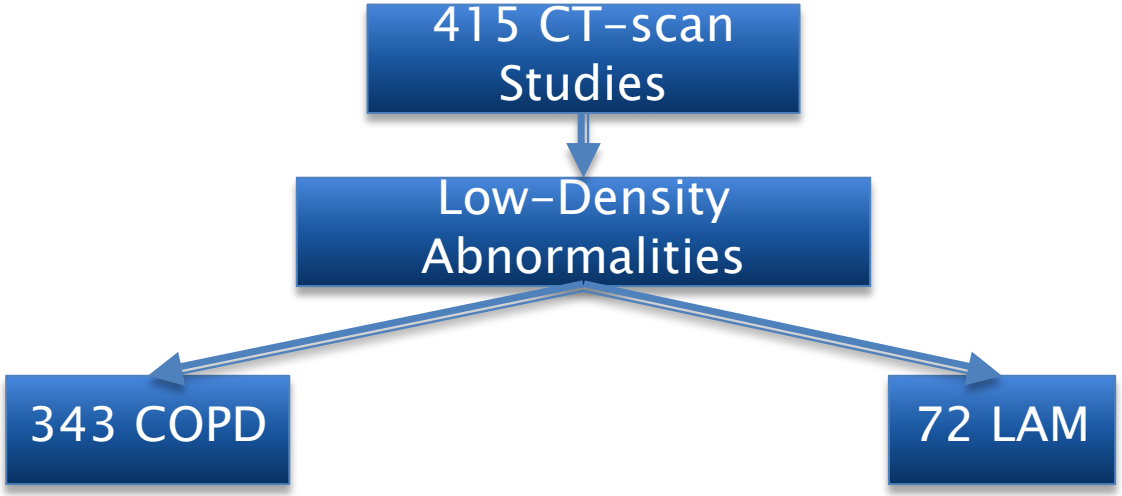


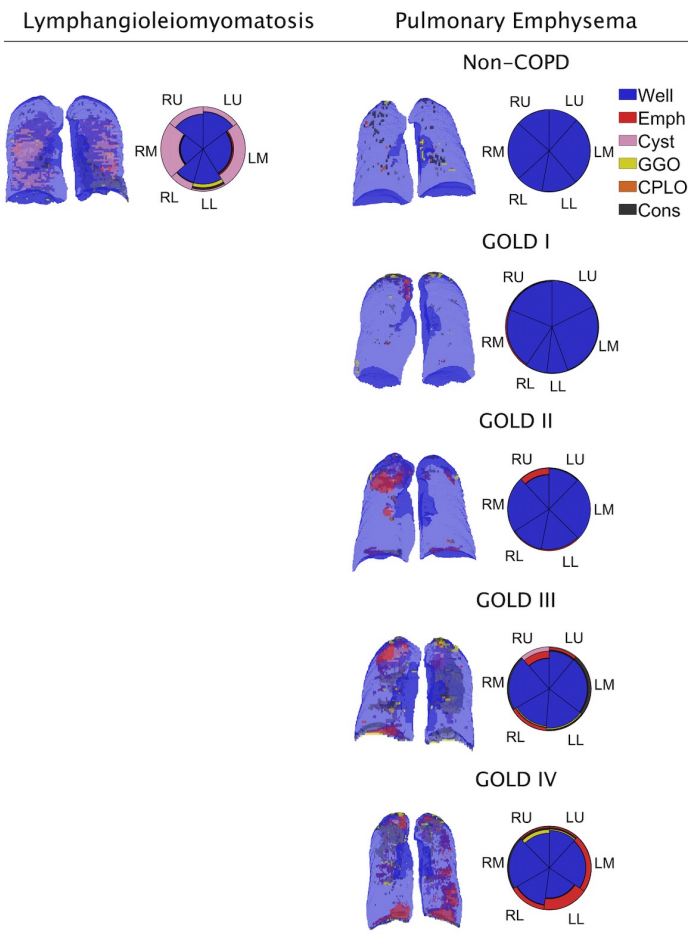






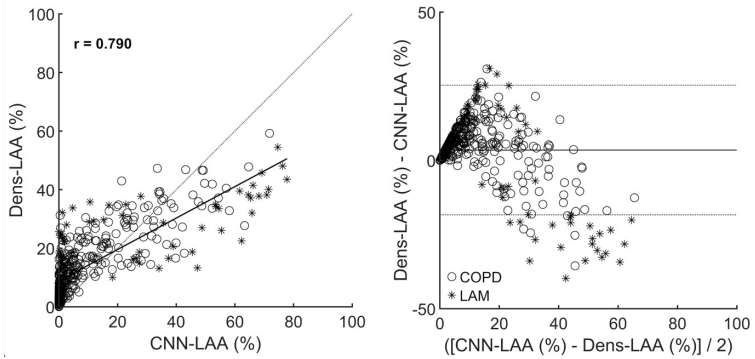
The proposed tool was applied in 415 CT scans, 343 patients with pulmonary emphysema and 72 with lymphangioleiomyomatosis (LAM). Comparison between QUALIT measurements of LAA and pulmonary function tests results were assessed with one-way ANOVA. CNN- and Dens-derived QUALIT measures were also compared and the correlation between them assessed.

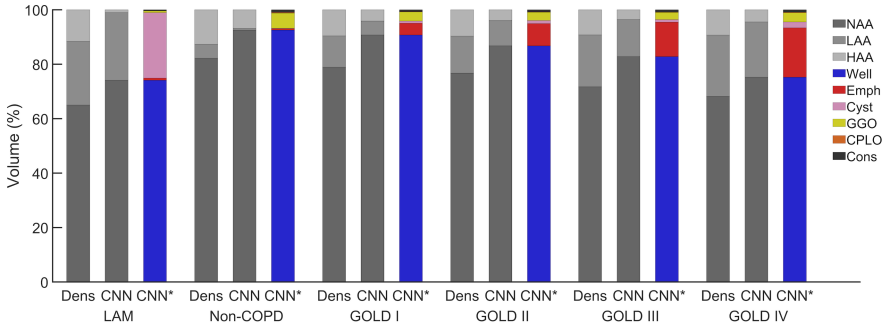


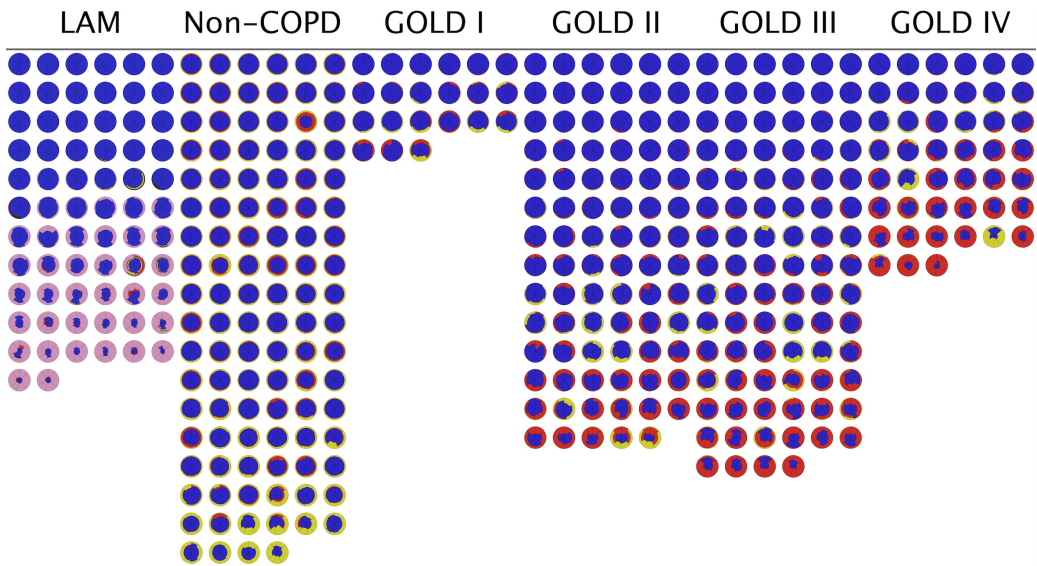


Results

Results: CNN- and Dens-derived parameters were strongly correlated (r = 0.790) and the volume of LAA significantly increased with disease severity (P<0.001).







Conclusions

This study reported both CNN- and Dens-LAA were able to identify LAA and were strongly correlated. However, only CNN texture-based analysis was able to subclassify LAA related to emphysema from LAA related to airspace cysts.