Abstract: Reformulating COPD Classification on Chest CT Scans as Anomaly Detection using Contrastive Representations

cOOpD

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Classification of heterogeneous diseases is challenging due to their complexity, variability of symptoms and imaging findings. Chronic obstructive pulmonary disease (COPD) is a prime example, being underdiagnosed despite being the third leading cause of death. Its sparse, diffuse and heterogeneous appearance on computed tomography challenges supervised binary classification. We reformulate COPD binary classification as an anomaly detection task, proposing cOOpD: heterogeneous pathological regions are detected as out-of-distribution (OOD) from normal homogeneous lung regions. To this end, we learn representations of unlabeled lung regions employing a self-supervised contrastive pretext model, potentially capturing specific characteristics of diseased and healthy unlabeled regions. A generative model then learns the distribution of healthy representations and identifies abnormalities (stemming from COPD) as deviations. Patient-level scores are obtained by aggregating region OOD scores. We show that cOOpD achieves the best performance on two public datasets, with an increase of 8.2% and 7.7% in terms of AUROC compared to the previous supervised state-of-the-art. Additionally, cOOpD yields well-interpretable spatial anomaly maps and patient-level scores which we show to be of additional value in identifying individuals in the early stage of progression. Experiments in artificially designed real-world prevalence settings further support that anomaly detection is a powerful way of tackling COPD classification [1].

References

1. Almeida SD, Lüth CT, et al. cOOpD: reformulating COPD classification on chest CT scans as anomaly detection using contrastive representations. Proc MICCAI. 2023.

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