COVision: A Novel Convolutional Neural Network for the Differentiation of COVID-19 From Common Pulmonary Conditions

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With the growing amount of COVID-19 cases, especially in developing countries with limited medical resources, it's essential to accurately diagnose COVID-19 with high specificity. Due to characteristic ground-glass opacities (GGOs), present in both COVID-19 and other acute lung diseases, misdiagnosis occurs often— 26.6% of the time in manual interpretations of CT scans. Furthermore, current models can identify COVID-19 but cannot distinguish it from other common lung diseases like bacterial pneumonia. COVision is a novel multi-classification convolutional neural network (CNN) that can differentiate COVID-19 from other common lung diseases, with a low false-positivity rate. COVision achieved an accuracy of 95.8%, AUROC of 0.970, and F1-score of 0.954. We found statistical significance that COVision performs better than three independent radiologists, especially on differentiating COVID-19 from pneumonia. In a controlled study comparing COVision to other state-of-the-art architectures, our novel model achieved a higher accuracy on a small training set even with a lower complexity/runtime. After training COVision with 105,000 CT scans, we analyzed our model's activation maps and found evidence that lesions in COVID-19 (specifically GGOs) presented peripherally, closer to the pleura. Finally, using a federated learning model, we ensembled our CNN with a pretrained neural network on clinical factors (age, symptoms, etc.) to create a comprehensive diagnostic tool.

Awards Won:
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