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A Noise-Resilient Framework for Automatic COVID-19 Pneumonia Lesions Segmentation from CT Images

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Abstract: *The coronavirus disease pandemic of 2019 (COVID-19) is sweeping the globe. Medical imaging, such as X-ray and computed tomography (CT), is critical in the global fight against COVID-19, and newly developed artificial intelligence (AI) technologies are enhancing the power of imaging tools and assisting medical specialists. We examine the rapid responses to COVID-19 in the medical imaging community (enabled by AI).Although deep learning algorithms have shown promise in a number of areas, they continue to struggle with noisy-labeled images throughout the training phase. Given that the quality of annotation is inextricably linked to a high level of knowledge, the issue is even more pressing in the medical picture arena. It's still a big difficulty to get rid of the noise from noisy labels for segmentation tasks without adding more annotations. As a noninvasive imaging technique, computed tomography (CT) can detect certain lung symptoms linked with COVID-19. As a result, CT could be a useful tool for early detection and diagnosis of COVID-19. Despite its benefits, CT may have some imaging characteristics in common with COVID-19 and other kinds of pneumonia, making differentiation challenging. Due to its high power of feature extraction, artificial intelligence (AI) leveraging deep learning technology has recently proven remarkable success in the medical imaging arena. Deep learning was used to detect and distinguish between bacterial and viral pneumonia in paediatric chest radiographs.For the segmentation challenge, we present a novel noise-resistant architecture for learning from noisy labels. To better deal with lesions of varied scales and appearances, we present a unique COVID-19 Pneumonia Lesion segmentation network (COPLE-Net), which is a generalisation of Dice loss for segmentation and Mean Absolute Error (MAE) loss for robustness against noise. The noise-resistant Dice loss and COPLENet are combined with an adaptive self-ensembling architecture for training, in which a student model's Exponential Moving Average (EMA) is employed as a teacher model that is adaptively updated by suppressing the contribution. In the context of learning from noisy labels for COVID-19 pneumonia lesion segmentation, our system with adaptive self-ensembling outperforms a regular training method and outperforms existing noise-robust training approaches.*

Keywords: CT, Deep Learning, COVID-19, Noisy Label, Segmentation, Pneumonia, Medical Image Annotation.

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