Diverse COVID-19 CT image-to-image translation with stacked residual dropout

ABSTRACT

Machine learning models are renowned for their high dependency on a large corpus of data in solving real-world problems, including the recent COVID-19 pandemic. In practice, data acquisition is an onerous process, especially in medical applications, due to lack of data availability for newly emerged diseases and privacy concerns. This study introduces a data synthesization framework (sRD-GAN) that generates synthetic COVID-19 CT images using a novel stacked-residual dropout mechanism (sRD). sRD-GAN aims to alleviate the problem of data paucity by generating synthetic lung medical images that contain precise radiographic annotations. The sRD mechanism is designed using a regularization-based strategy to facilitate perceptually significant instance-level di- versity without content-style attribute disentanglement. Extensive experiments show that sRD-GAN can generate exceptional perceptual realism on COVID-19 CT images examined by an experiment radiologist, with an outstanding Fréchet Inception Distance (FID) of 58.68 and Learned Perceptual Image Patch Similarity (LPIPS) of 0.1370 on the test set. In a benchmarking experiment, sRD-GAN shows superior performance compared to GAN, CycleGAN, and one-to-one CycleGAN. The encour- aging results achieved by sRD-GAN in different clinical cases, such as community-acquired pneu- monia CT images and COVID-19 in X-ray images, suggest that the proposed method can be easily extended to other similar image synthetization problems.