Solve Deblurring and Super Resolution in Low-Dose Computer Tomography via One Novel Neural Network

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Computed tomography (CT) is a three-dimensional imaging modality that uses X- ray beams to produce cross-sectional information of an object or a patient. CT suffers from multiple inherent limitations of image quality. The purpose of this study is to propose three deep learning models to address two of the common limitations, namely image blurring and limited spatial resolution. This study will be the first to explore the residual dense network (RDN) and Sharp U-Net's application in medical imaging tasks. Moreover, I creatively incorporate the advantages of these two methods to design a novel neural network architecture named Sharp RDN. The performance of these methods was benchmarked on two data sets through both qualitative and quantitative comparisons. The data sets were American Association of Physicists in Medicine (AAPM) simulated data and The Cancer Imaging Archive (TCIA) clinical data. The metrics for the quantitative measure were peak signal-to-noise ratio(PSNR), structural similarity index measure (SSIM), and root-mean-square deviation (RMSE). Experimental results showed that both RDN and Sharp RDN drastically improved the corrupted image quality by giving a 65% improvement in the deblurring task, and 32% improvement in the SR task. The performance of Sharp U-Net was poorer than RDN and Sharp RDN, indicating that U-Net-type architectures are not suitable for these tasks.

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