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Data Augmentation for Early-Stage Lung Nodules Using Deep Image Prior and Pix2pix

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Abstract : Lung nodules are commonly identified in computed tomography (CT) scans by experienced radiologists at a relatively late stage. Early diagnosis can greatly increase survival. We propose using a pix2pix conditional generative adversarial network to generate realistic images simulating early-stage lung nodule growth. We have applied deep images prior to 2341 slices from 895 computed tomography (CT) scans from the Lung Image Database Consortium (LIDC) dataset to generate pseudo-healthy medical images. From these images, 819 were chosen to train a pix2pix network. We observed that for most of the images, the pix2pix network was able to generate images where the nodule increased in size and intensity across epochs. To evaluate the images, 400 generated images were chosen at random and shown to a medical student beside their corresponding original image. Of these 400 generated images, 384 were defined as satisfactory - meaning they resembled a nodule and were visually similar to the corresponding image. We believe that this generated dataset could be used as training data for neural networks to detect lung nodules at an early stage or to improve the accuracy of such networks. This is particularly significant as datasets containing the growth of early-stage nodules are scarce. This project shows that the combination of deep image prior and generative models could potentially open the door to creating larger datasets than currently possible and has the potential to increase the accuracy of medical classification tasks.

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