USDL: Ultrasound Noise Reduction Using Machine Learning Techniques

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Ultrasound imaging is the most commonly performed cross-sectional diagnostic imaging method in the medical field today due to its adaptability and cost-effectiveness. However, despite these advantages, it has its disadvantages. Speckle noise, inherent in ultrasound, is often the cause of misdiagnosis of conditions such as tumors and arterial blockages. In order to mitigate this issue, doctors currently refer patients to additional testing with expensive diagnostic tools such as MRI, CT-Scans, and Biopsies. Unfortunately, these procedures are often inaccessible to the average person, and consequently, many diseases are left untreated. If the inherent problem of speckle noise in ultrasound is resolved, there would exist a severe reduction in misdiagnosis, which would remove the need for additional testing and greatly reduce the cost of diagnosis and the detection period. In this study, we present USDL, a novel platform that employs deep learning algorithms in order to reconstruct and enhance corrupted ultrasound images. We utilize an unsupervised neural network called an autoencoder which works by compressing its input into a latent-space representation and then reconstructing the output from this representation. We trained our model on a dataset comprising 30,000 in vivo images of soft organs, tissue, and vasculature and compared the quality of the images generated using the structural similarity index (SSIM) and peak to noise ratio (PSNR) measures. In closely simulated conditions, the architecture exhibited an average reconstruction accuracy of 95% as indicated by our SSIM, which outperforms many current state of the art image enhancement and reconstruction techniques.

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