2D to 3D Medical Image Colorization Supplementary

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1. Avoiding unwanted textures in modality conversion using GANs

Stabilizing GANs in 3D is not easy and often GANs can add unwanted textures or artifacts. When working with medical data, these artifacts can affect the perceptual quality of the final colorized volume and this must be avoided. In our modality conversion step, we do not learn a direct mapping from MRI to cryosection (cryo) volume and instead use Poisson reconstruction to generate a Poisson gray volume which helps the GAN learn a mapping to the modality of cryo volume while maintaining the geometry of the structures in MRI.

During the training phase of GANs, the generator tries to maximize the structural similarity (SSIM) to ensure that the geometric structures of the MRI are preserved. To ensure that the network has converged, we plot a graph of the SSIM loss versus the number of epochs. In Figure 1, it can be seen that the SSIM loss is close to -1.95. This implies that the SSIM score is close to 0.95 since the SSIM loss is given by: $\mathcal{L}_{SSIM} = -(1 + SSIM)$.

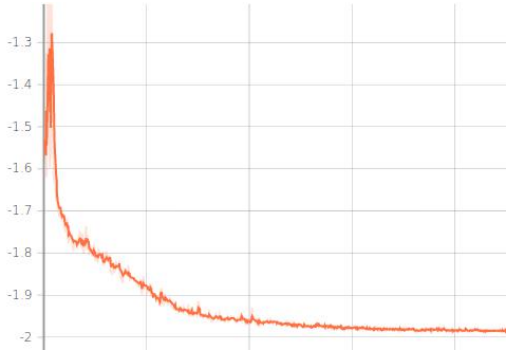

Figure 1: The y-axis is the SSIM Loss and the x-axis is the number of epochs

2. Testing on Unknown Volumes

We test our proposed approach on sample volumes taken from Max Planck Institute–Leipzig(MPI) Mind-Brain-Body dataset [1] and from the MIDAS dataset [2]. The two volumes have the mouth part cropped out to protect the identity of the patient. Testing on these volumes enables us to check how the GAN performs on more recent MRI volumes since it has been trained on a much older MRI dataset. We stylize the two volumes using one of the style images to show a direct comparison in perception. The results are shown in Figure 3. The colors obtained on the volumes are still comparable to those of the style images with some minor gamma adjustment on the output volumes. Further in Figure 2 we show comparison with transfer function based volume rendering. Our method improves perception and helps in making different parts more distinguishable while retaining a photorealistic appearance.

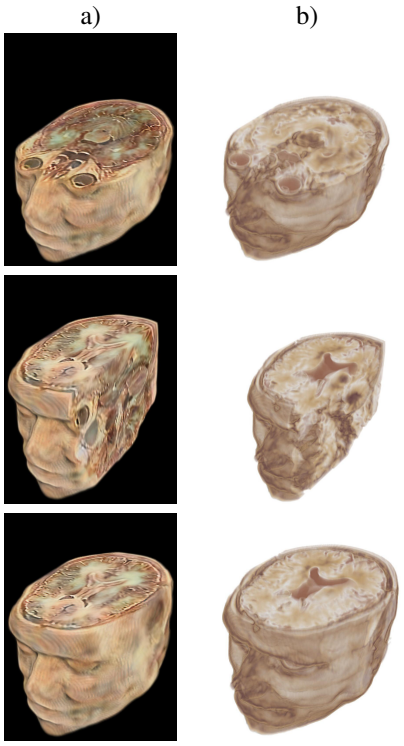

Figure 2: a) images rendered by our method b) images rendered using standard transfer function. The rendering was performed using Inviwo [3].

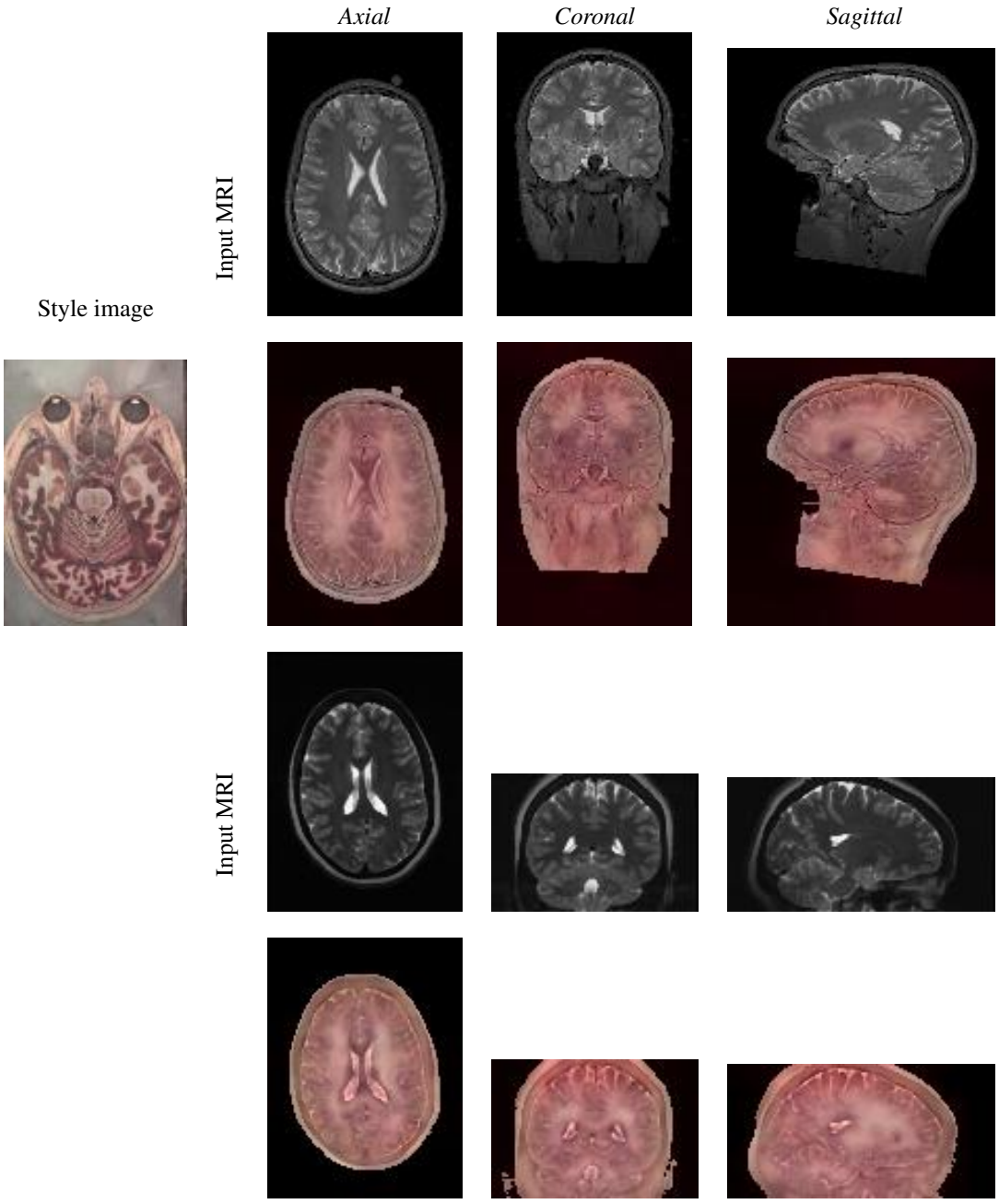

Figure 3: Colorization result with a cryo style image on a MRI volumes taken from MIDAS dataset (row I and II) and MPI dataset (row III and IV).

References

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[3] E. Sunden, P. Steneteg, S. Kottravel, D. Jonsson, R. Englund, M. Falk, and T. Ropinski. Inviwo-an extensible, multi-purpose visualization framework. In *2015 IEEE Scientific Visualization Conference (SciVis)*, pages 163–164. IEEE, 2015.