CBCT-to-sCT generation method in SynthRAD2023

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Abstract. we synthesized CT images from CBCT by using a 3D patch-based conditional generative adversarial network (cGAN).

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1 Methods

Our network was a 3D patch-based cGAN [1] which enabled paired training to synthesize CT images from the CBCT. For our generator G, we used a 3D ResNet12 with 9 residual blocks. In the output layer of G, we applied a Tanh activation which allowed the model to learn more quickly to saturate and multiplied the output by 2000 to bound the range of the sCT intensity to [−2000, 2000] HU. For our discriminator D, we used a 3D convolutional PatchGAN classifier. The network input was a single-channel 3D patch x with the dimension of $160 \times 160 \times 32$ voxels that is randomly cropped from the original CBCT volume X.

We used the Adam optimizer to update the weights of D and G alternatively. We set an initial learning rate as 2×10^{-4} which decayed to zero over 100 epochs. A mini-batch size of 1 was used. The intensities of CBCT volumes were rescaled to [0, 1] before being cropped into patches. Random intensity shifts between −10 and 10 percent and random gamma adjustment with gamma in the range of 0.5 to 1.5 were used for data augmentation. The augmentation strategy encouraged the network to learn to map a dynamic CBCT intensity distribution to a fixed CT HU distribution. During the inference phase, since our network was trained with randomly cropped patches, the whole synthetic CT was generated using a sliding window. The strides for the adjacent patches are 32, 32 and 8 voxels.

References

1. Liu H , Sigona M K , Manuel T J ,et al.Synthetic CT Skull Generation for Transcranial MR Imaging-Guided Focused Ultrasound Interventions with Conditional Adversarial Networks[J]. 2022.DOI:10.48550/arXiv.2202.10136.