SynthRAD 2023: Synthetic CT from MRI

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1 Method

We train two deep learning models for Task 1 of the SynthRAD challenge, one for the pelvic anatomical region and one for the brain anatomical region. We make use of a patch-based approach, with extensive preprocessing and data augmentation.

For preprocessing we use a combination of rigid (for bones) and deformable (for soft tissue) image registration techniques [1]. To do this, we rely on a segmentation algorithm to segment the individual bones. The air background is removed and the voxel intensities of the MRIs and CTs are normalized to the interval $[-1, 1]$.

The models that we train are 3D U-Nets [2] with 50M parameters. The patch size chosen was 96x96x64. Patches are sampled during training from random locations. During inference a sliding window approach is used with overlapping patches and Gaussian weighting applied to the edges. Besides the random crops we use spatial augmentations (random zoom and rotation) and intensity based augmentations (random contrast augmentation). We use a combined mean absolute error and SSIM loss. The models are trained for $100,000$ iterations with a batch size of 12 with the AdamW optimizer. The learning rate starts at 10^{-4} and ends with 10^{-5}.

References

1. Klein et al. elastix: A Toolbox for Intensity-Based Medical Image Registration. IEEE TMI 2010 29 (1):196-205
2. Ronneberger et al., 2015, U-Net: Convolutional Networks for Biomedical Image Segmentation, https://arxiv.org/pdf/1505.04597.pdf