

CT Reconstruction from Dual-View Depth Images and Topograms for Prospective Risk Minimization

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Introduction

- Tube current modulation (TCM) [1, 2] is a technique used to reduce patient dose.
- RiskTCM [3] needs a coarse CT volume before the full CT scan.
- Current methods take two X-Ray projections (lateral and anterior-posterior) as input.

Aim: CT coarse reconstruction from lateral X-ray projection and an anterior-posterior depth image.

Dataset

LIDC-IDRI [4], 1010 anonymized thoracic CT scans.

- Preprocessing: volumes resampled to 2.5 mm isotropic resolution and cropped to 128³.
- Synthetic data generation (Figure 1): X-ray projections and aligned depth maps generated with fan-beam geometry matching a Siemens SOMATOM Force scanner.
- Split: 70% training, 20% validation, 10% testing.

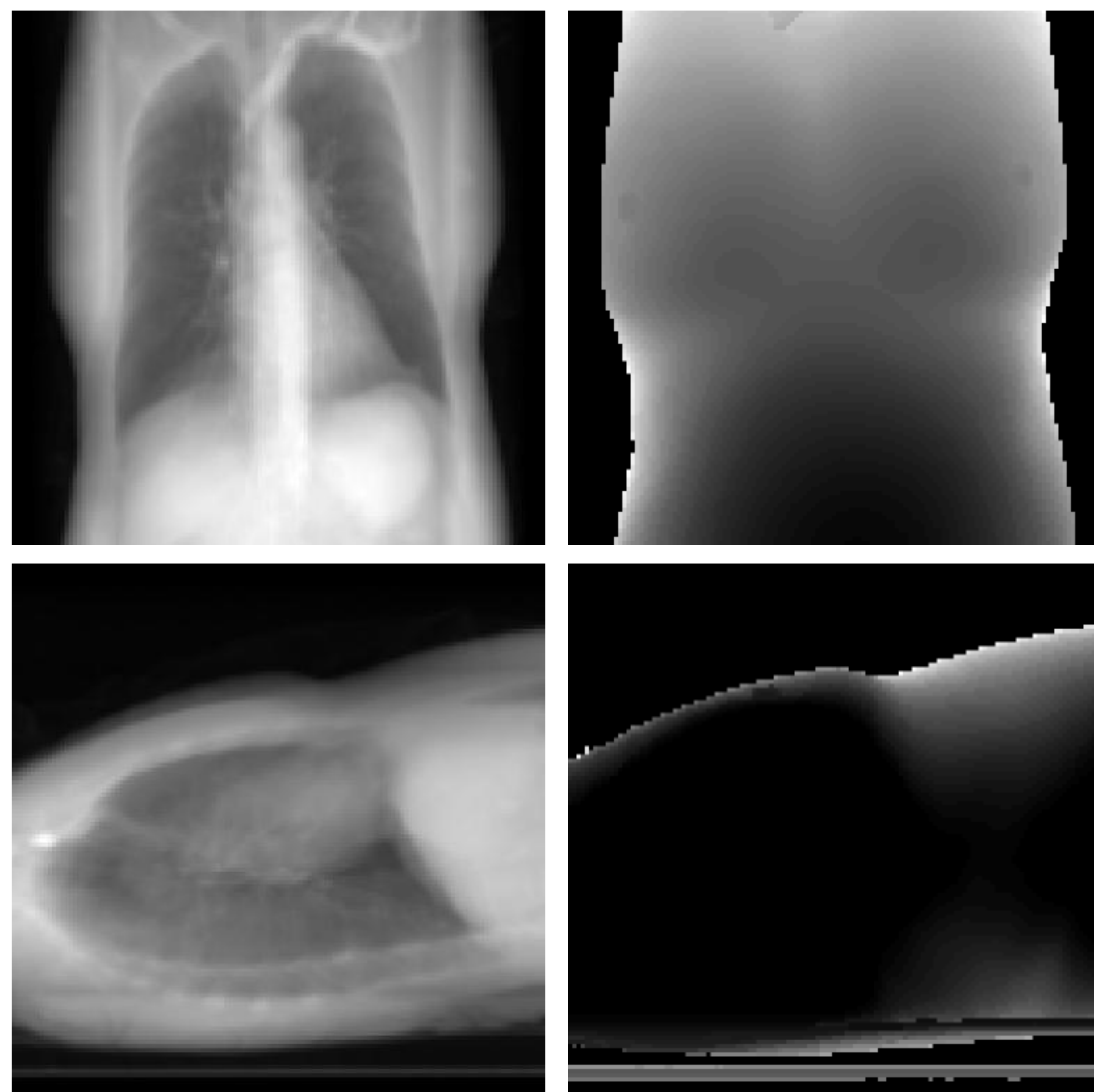


Figure 1: the input data used in our experiments is generated synthetically using the corresponding CT volumes of the LIDC-IDRI dataset [4]. Depth images, AP and lateral X-Ray projections are simulated.

Method

Built on the work of Liu [5], the discriminator adopts the architecture of Isola [6] and the generator is derived from X2CT-GAN [7] (Fig. 2). The proposed GAN reconstructs a 3D CT volume from two complementary 2D inputs: a lateral X-ray projection and an AP depth image.

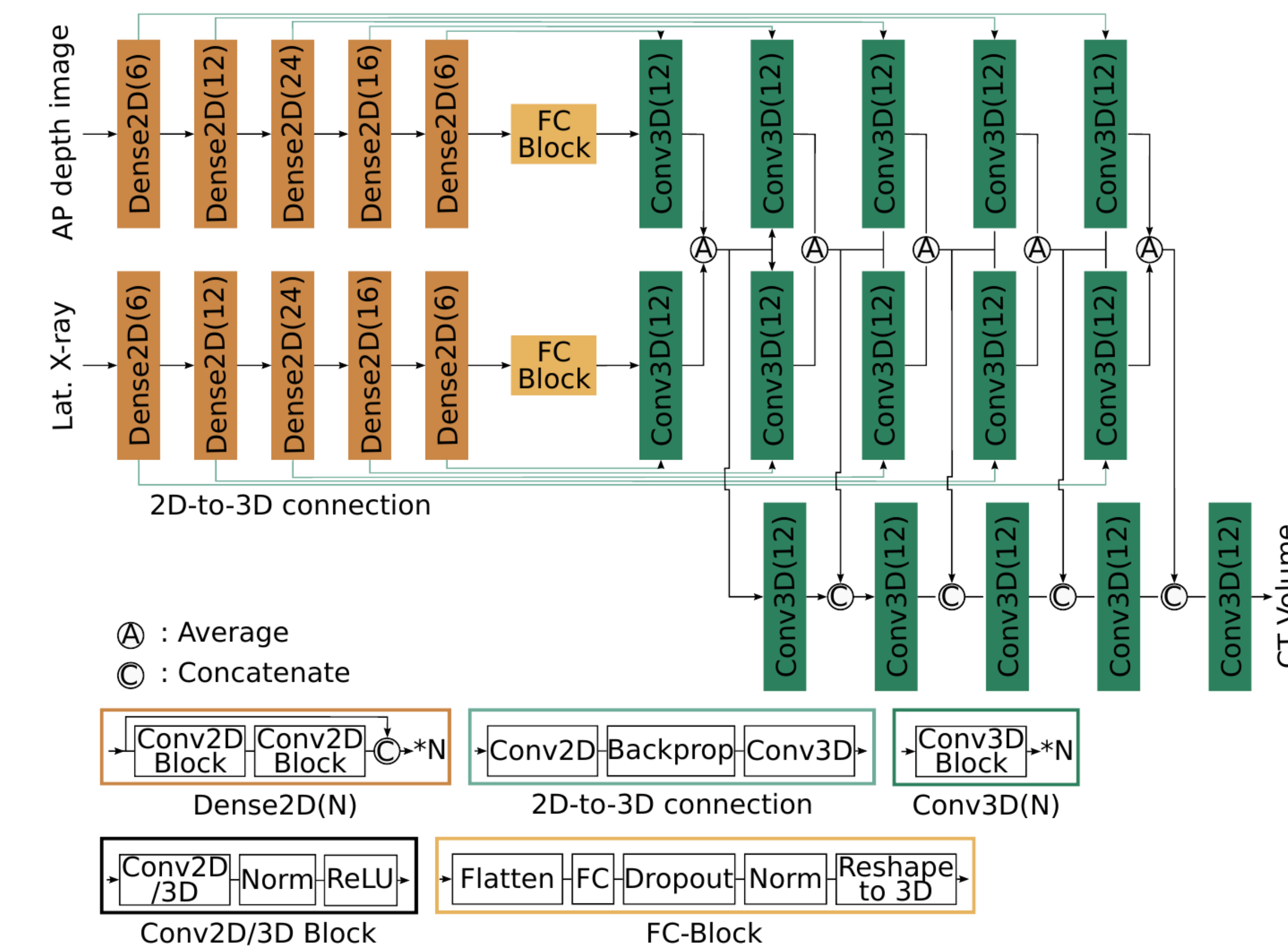


Figure 2: the generator used in our experiments as proposed in [7]. Two 2D input images, a lateral X-ray and an AP depth image, are reconstructed to a 3D CT volume. Figure adapted from Liu et al. [5], CC BY 4.0.

Quantitative results

Inputs		Metrics		
Input 1	Input 2	RMSE ↓	PSNR ↑	SSIM ↑
Lat. X-ray	AP X-ray	237.17 ± 34.66	24.83 ± 1.18	0.55 ± 0.08
Lat. X-ray	AP Depth	247.32 ± 32.90	24.45 ± 1.10	0.54 ± 0.07
Lat. X-ray	Lat. X-ray	246.92 ± 37.19	24.49 ± 1.26	0.55 ± 0.07
Lat. Depth	AP Depth	279.86 ± 34.45	23.37 ± 1.03	0.48 ± 0.08

Table 1: comparison of different input combinations and resulting evaluation metrics.

Qualitative results

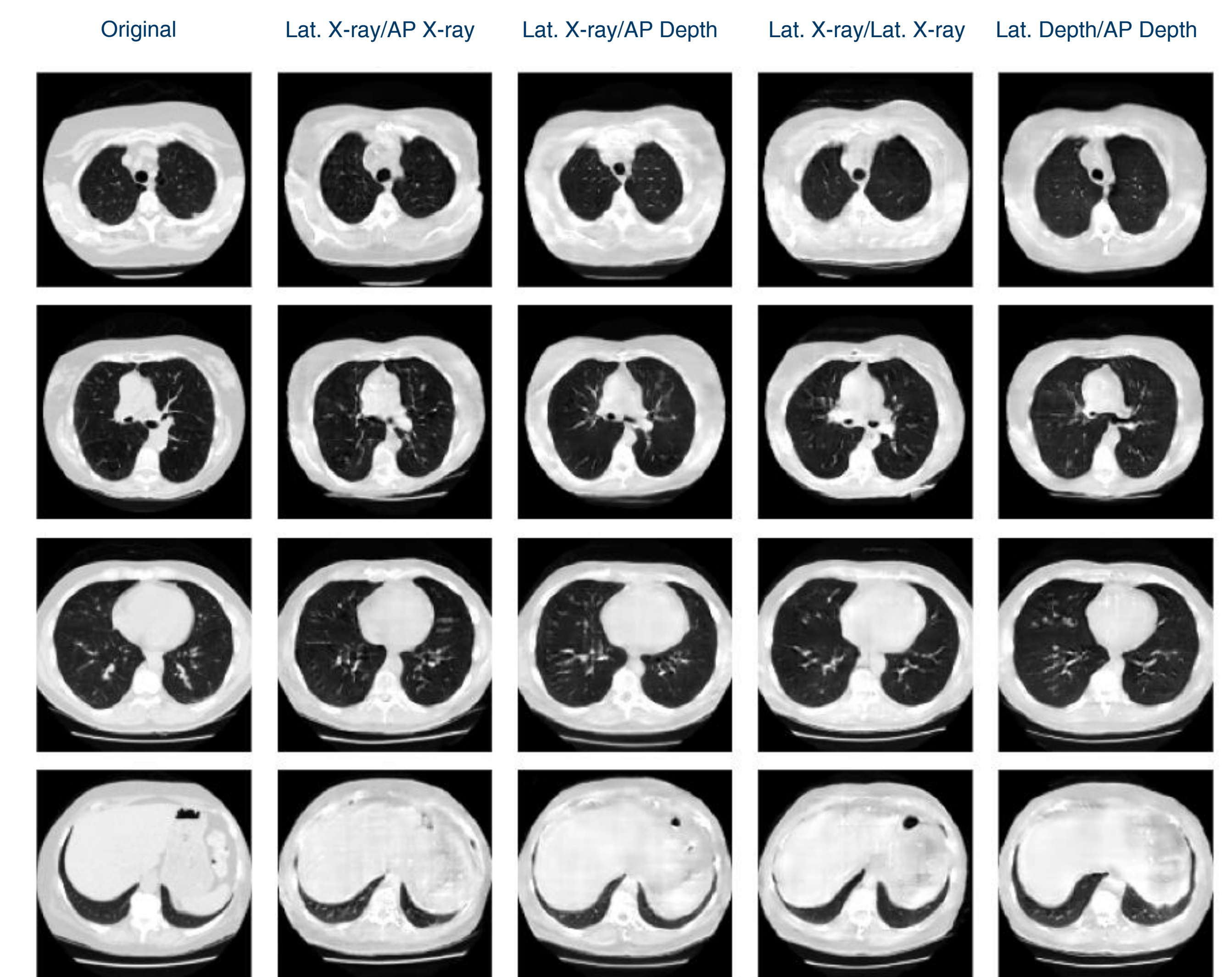


Figure 3: representative slices from reconstructed CT volumes using different inputs. Each row shows a slice from a different test sample, windowed to C = -600 HU, W = 1500 HU.

Conclusion and future work

Paired biplanar X-ray projections provided the highest accuracy, while a combination of a lateral X-ray and a depth image produced promising results.

Future work

- Explore improved integration of depth data.
- Investigate impact of noise and low-resolution depth images.
- Integrate organ segmentation loss.
- Contemplate the use of diffusion models instead of GANs.

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