## Anatomically constrained CT image translation for heterogeneous blood vessel segmentation - Supplementary Material

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## Table 1: Some of the parameters for 3D affine registration using SimpleITK-SimpleElastix

Parameter Name	Parameter Value		
Final BSpline Interpolation Order	2		
Interpolator	Linear Interpolator		
Maximum Number Of Iterations	32		
Maximum Number Of Sampling Attempts	8		
Metric	Advanced Mattes Mutual Information		
Number Of Samples For Exact Gradient	4096		
Number Of Spatial Samples	4096		
Optimizer	Adaptive Stochastic Gradient Descent		
Registration	Multi Resolution Registration		
Resample Interpolator	Final BSpline Interpolator		

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Figure 1: Top: example of renal ROI selection using the number of black pixel in relation to the total pixels of each individual slice to automatically select the first slice of the lungs and the last slice of the visceral area as the upper and lower reference points respectively. Bottom: comparison of CycleGAN and UNIT trained without and with renal ROI selection (no PBS strategy used). For both methods, we used U-Net as generator network and Patch-GAN as discriminator mechanism. First row: from ceCT to CT. Second row: from CT to ceCT. An idea of how the expected output should look like is provided in the last column.



Figure 2: Comparison of some other state-of-the-art methods on slices of the unpaired test set. 1st row: ceCT to CT. 2nd row: CT to ceCT. The slices in all tests are selected with PBS in the renal section. The input in the other direction gives an idea of what the expected result should look like. "Att." indicates the use of an attention layer as the last layer, while "Wass. Loss" the use of Wasserstein distance as Discriminator Loss.



Figure 3: Two examples of 3D affine registration using SimpleElastix.



Figure 4: Top: example to show differences in SSBR scores using the original training and our proposed one. Bottom: some examples of input selection methods. Image B is chosen starting from image A with a Position-Based Selection (*PBS*), 3D *affine* registration+*PBS* or our proposed SSBR selection.



Figure 5: Segmentation results of the most heterogeneous patient (top) and the least heterogeneous one (bottom). Arteries are displayed in green, and veins in blue. Arrows: strong (red), light (orange) and no (green) error.

Table 2: Segmentation performance on **real ceCT** of 15 patients of an **extended ceCT private dataset**, composed of 65 patients (we used 43 for training and 7 for validation). Dice score (DS), precision (PR), recall (RC) and 95th percentile of the Hausdorff distance (HD95) are given (mean and standard deviation). All tests were done using 3D nnU-Net framework with intensity and geometric data augmentation.

INPUT Database	Structure	DS [100%] (†)	PR [100%] (†)	RC [100%] (†)	HD95 [mm] (↓)		
on 15 patients							
real ceCT	Arteries	63.45 (5.67)	71.73 (9.99)	57.87 (7.31)	17.46 (9.65)		
	Veins	42.64 (20.12)	76.67 (13.17)	31.84 (17.12)	23.55 (17.00)		
real ceCT and fake <sub>PBS</sub> CT	Arteries	65.60 (4.45)	73.04 (10.83)	60.91 (7.12)	15.59 (8.47)		
	Veins	45.77 (18.67)	73.14 (14.88)	35.37 (17.87)	21.25 (20.05)		
real ceCT and fake <sub>Ours</sub> CT	Arteries	70.01 (3.99)	76.29 (8.23)	65.77 (7.73)	13.47 (10.09)		
	Veins	56.55 (20.20)	81.53 (8.91)	46.98 (22.38)	20.93 (22.96)		
on 5 more heterogeneous							
real ceCT	Arteries	63.23 (4.24)	74.86 (7.53)	54.99 (4.55)	15.54 (6.08)		
	Veins	27.43 (20.62)	66.64 (15.59)	19.90 (17.58)	24.90 (8.42)		
real ceCT and fake <sub>PBS</sub> CT	Arteries	64.97 (1.12)	76.68 (11.92)	57.61 (5.97)	15.49 (5.26)		
	Veins	33.16 (18.83)	62.77 (18.28)	24.18 (16.09)	20.91 (7.55)		
real ceCT and fake <sub>Ours</sub> CT	Arteries	70.15 (3.52)	80.40 (9.97)	62.89 (4.71)	12.15 (6.65)		
	Veins	37.00 (16.11)	77.58 (11.78)	26.01 (14.02)	21.71 (6.33)		