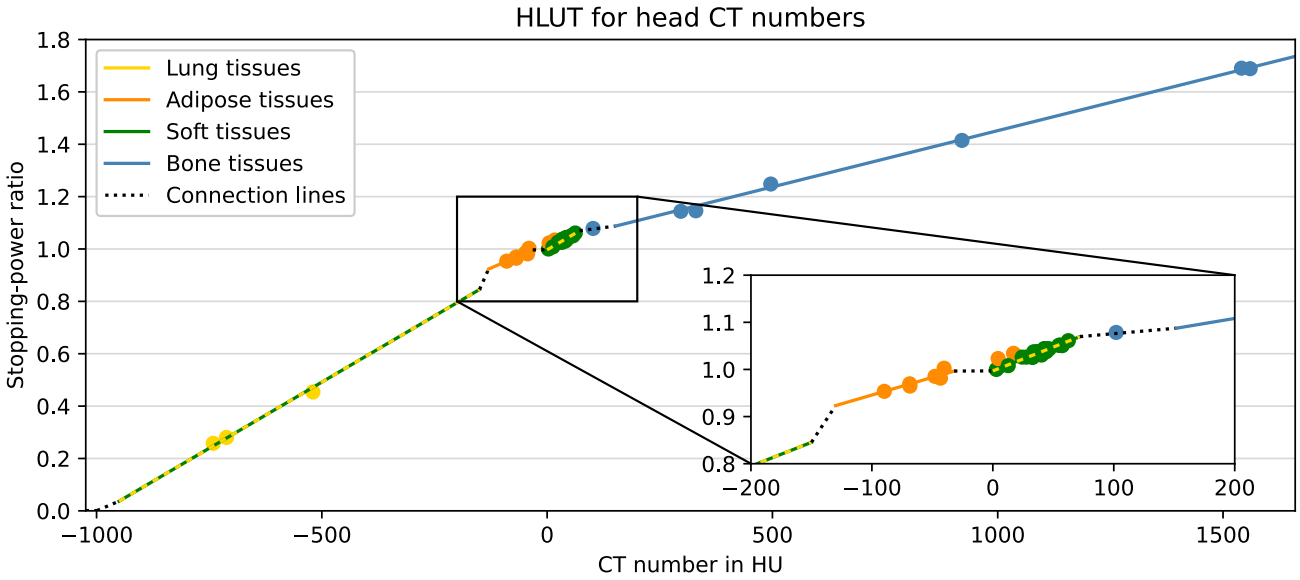
Hounsfield Look-Up Table (HLUT) generation and evaluation

Intended for research use only



HLUT generation and evaluation tool following the HLUT generation guide
DOI: 10.1016/j.radonc.2023.109675
Report based on data stored in Excel sheet
ut/DataForCTCalibration_Siemens_goOpenPro_120kVp.

Date of creation:
2023-07-09

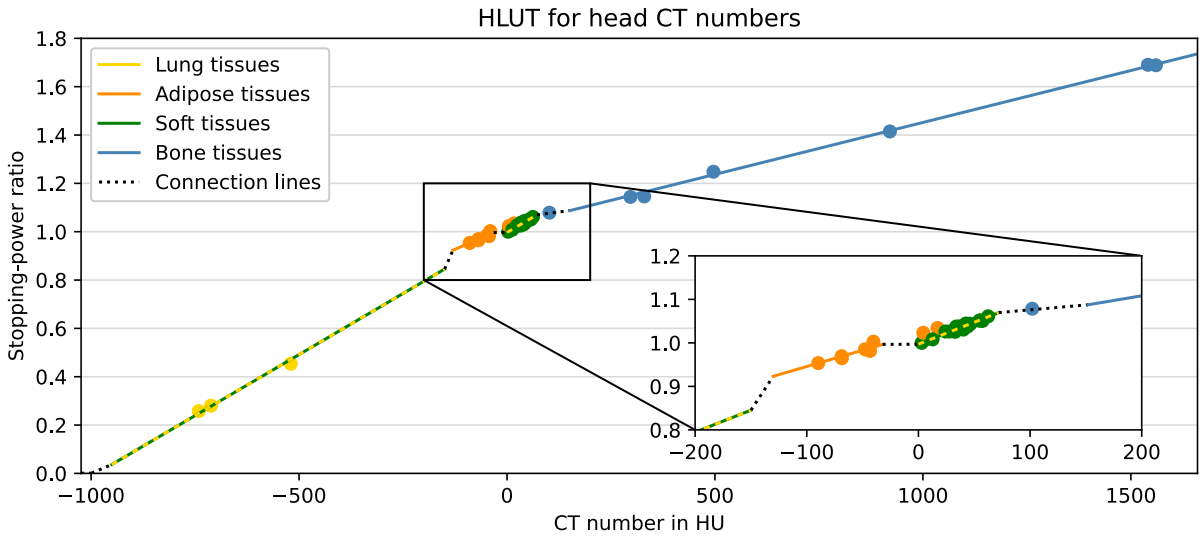
Generated HLUTs

To be visually evaluated regarding the proximity of the datapoints to the curve and the need for a body size-specific HLUT, see Supplementary Material Evaluation Box 5.

HLUT for head phantom

CT number	SPR
-1024	0.0011
-999	0.0011
-950	0.0369
-150	0.8453
-130	0.9233
-32	0.9966
0	0.9969
72	1.0697
152	1.0876
2000	1.8816

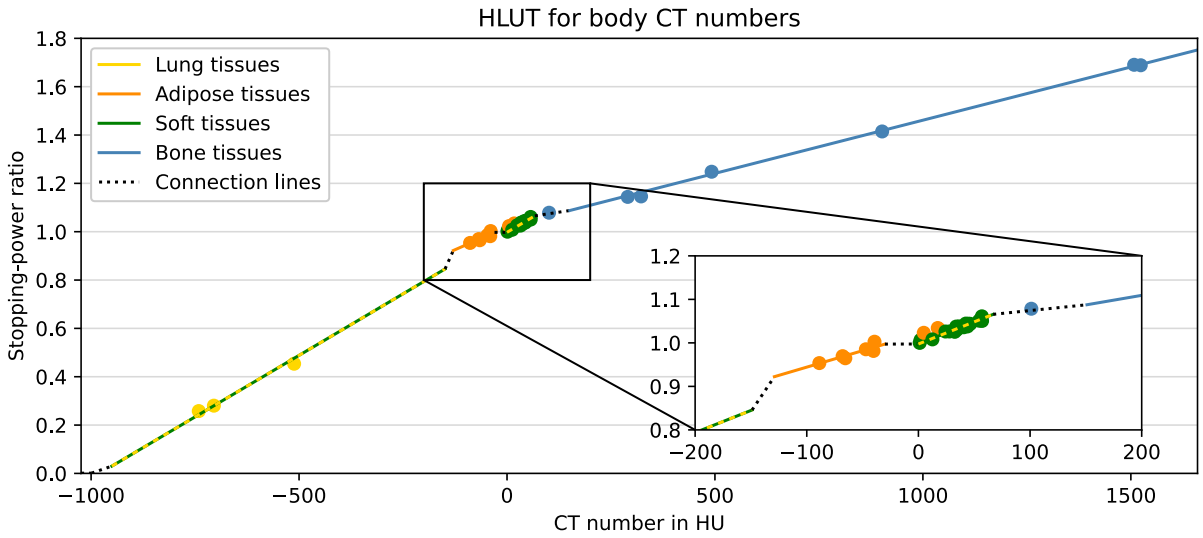
Please note: The highest point is set arbitrarily to 2000 HU. Please check the guide for the different options to extend the HLUT beyond this point.



HLUT for body phantom

CT number	SPR
-1024	0.0011
-999	0.0011
-950	0.0302
-149	0.8457
-129	0.9223
-30	0.9972
0	0.9974
67	1.0656
151	1.0877
2000	1.9014

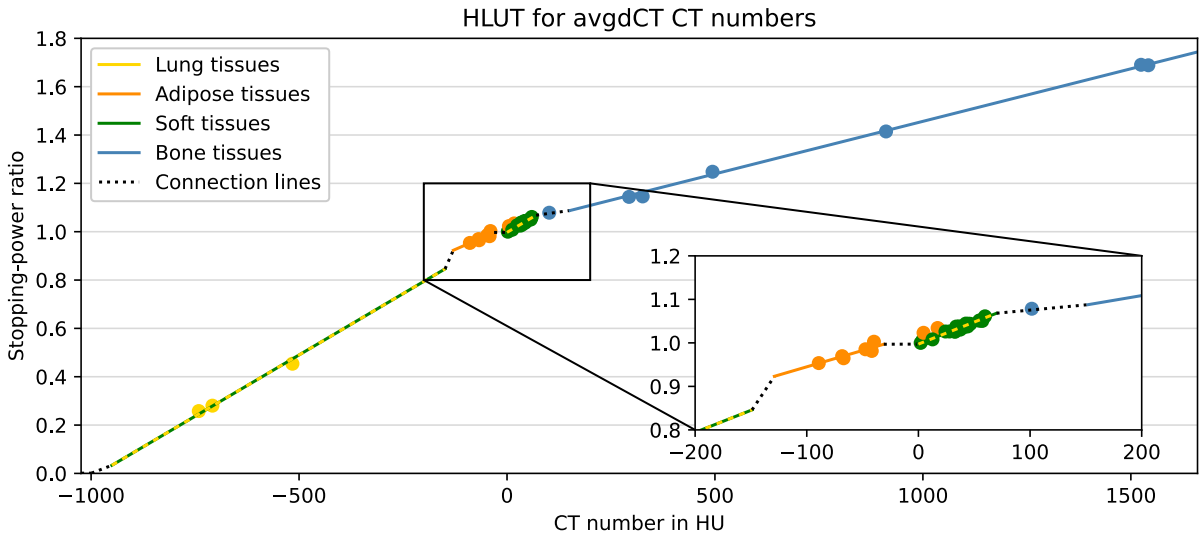
Please note: The highest point is set arbitrarily to 2000 HU. Please check the guide for the different options to extend the HLUT beyond this point.



HLUT for averaged CT numbers

CT number	SPR
-1024	0.0011
-999	0.0011
-950	0.0335
-149	0.846
-129	0.9232
-31	0.9969
0	0.9972
70	1.0682
152	1.0879
2000	1.8914

Please note: The highest point is set arbitrarily to 2000 HU. Please check the guide for the different options to extend the HLUT beyond this point.

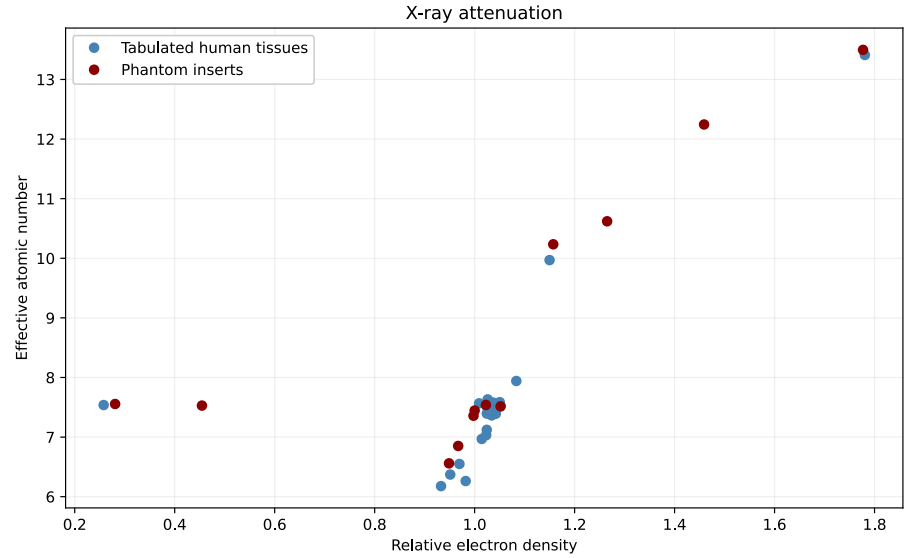


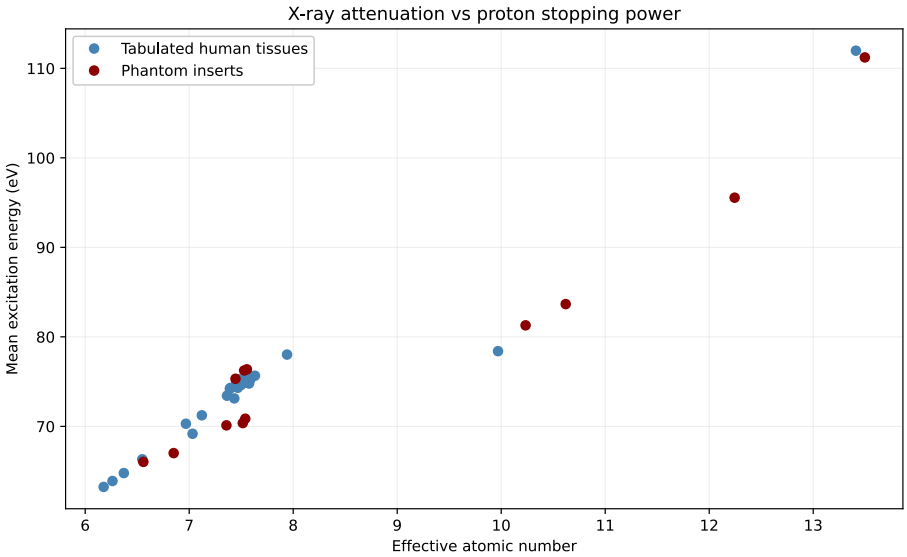
HLUT evaluation results

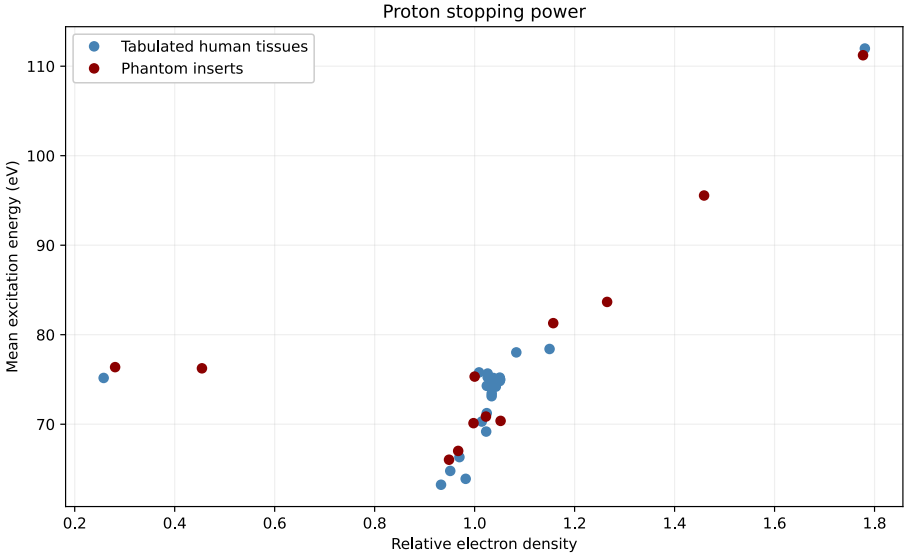
Evaluation box 1: Size-dependent impact of beam hardening on CT numbers

Insert name	CT number head	CT number body	Difference
Lung LN300	-712	-705	-7
Lung LN450	-520	-512	-8
HE General Adipose	-69	-65	-3
HE Breast 50:50	-43	-40	-3
Liquid Water	3	1	2
HE CT Solid water	6	2	4
HE Brain	40	35	6
HE Liver	62	57	6
HE Inner Bone	330	322	8
CaCO3 30%	496	492	4
CaCO3 50%	921	902	19
HE Cortical Bone	1560	1524	36

Evaluation box 2: Tissue-equivalency of phantom inserts







Evaluation box 3: Check of estimated CT numbers

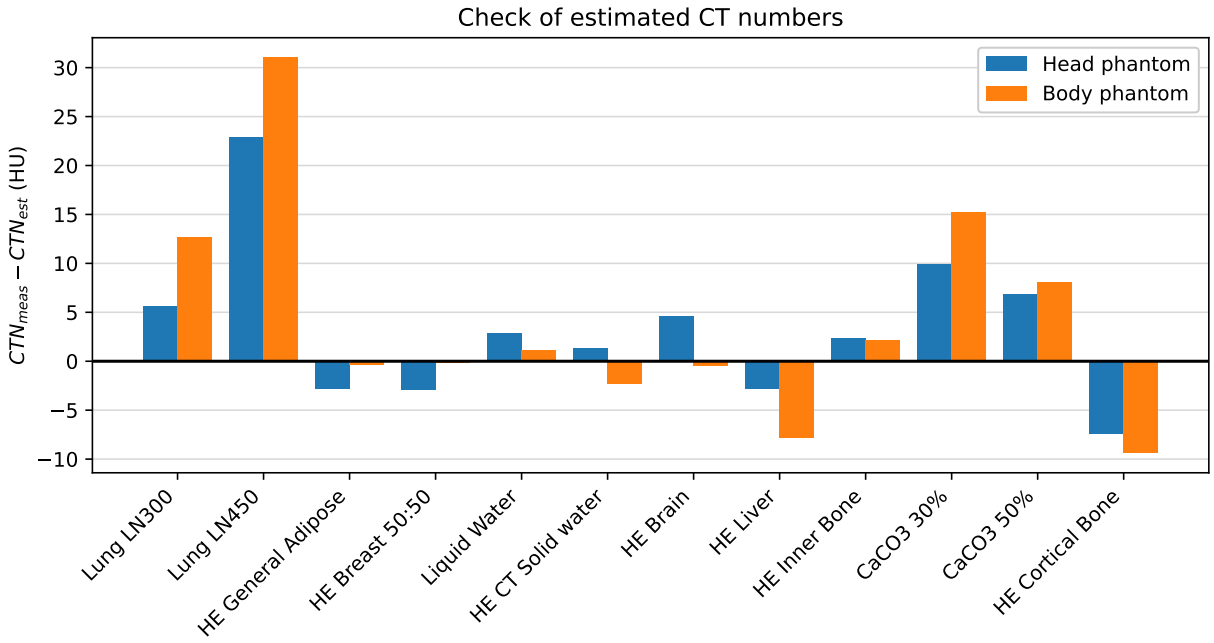
Comparison of measured and estimated CT numbers for the phantom inserts

Head phantom:

Insert name	CT number measured	CT number calculated	Difference
Lung LN300	-712	-717	6
Lung LN450	-520	-543	23
HE General Adipose	-69	-66	-3
HE Breast 50:50	-43	-40	-3
Liquid Water	3	0	3
HE CT Solid water	6	5	1
HE Brain	40	36	5
HE Liver	62	65	-3
HE Inner Bone	330	328	2
CaCO3 30%	496	486	10
CaCO3 50%	921	914	7
HE Cortical Bone	1560	1568	-7

Body phantom:

Insert name	CT number measured	CT number calculated	Difference
Lung LN300	-705	-717	13
Lung LN450	-512	-543	31
HE General Adipose	-65	-65	0
HE Breast 50:50	-40	-40	0
Liquid Water	1	0	1
HE CT Solid water	2	4	-2
HE Brain	35	35	0
HE Liver	57	65	-8
HE Inner Bone	322	320	2
CaCO3 30%	492	477	15
CaCO3 50%	902	894	8
HE Cortical Bone	1524	1533	-9

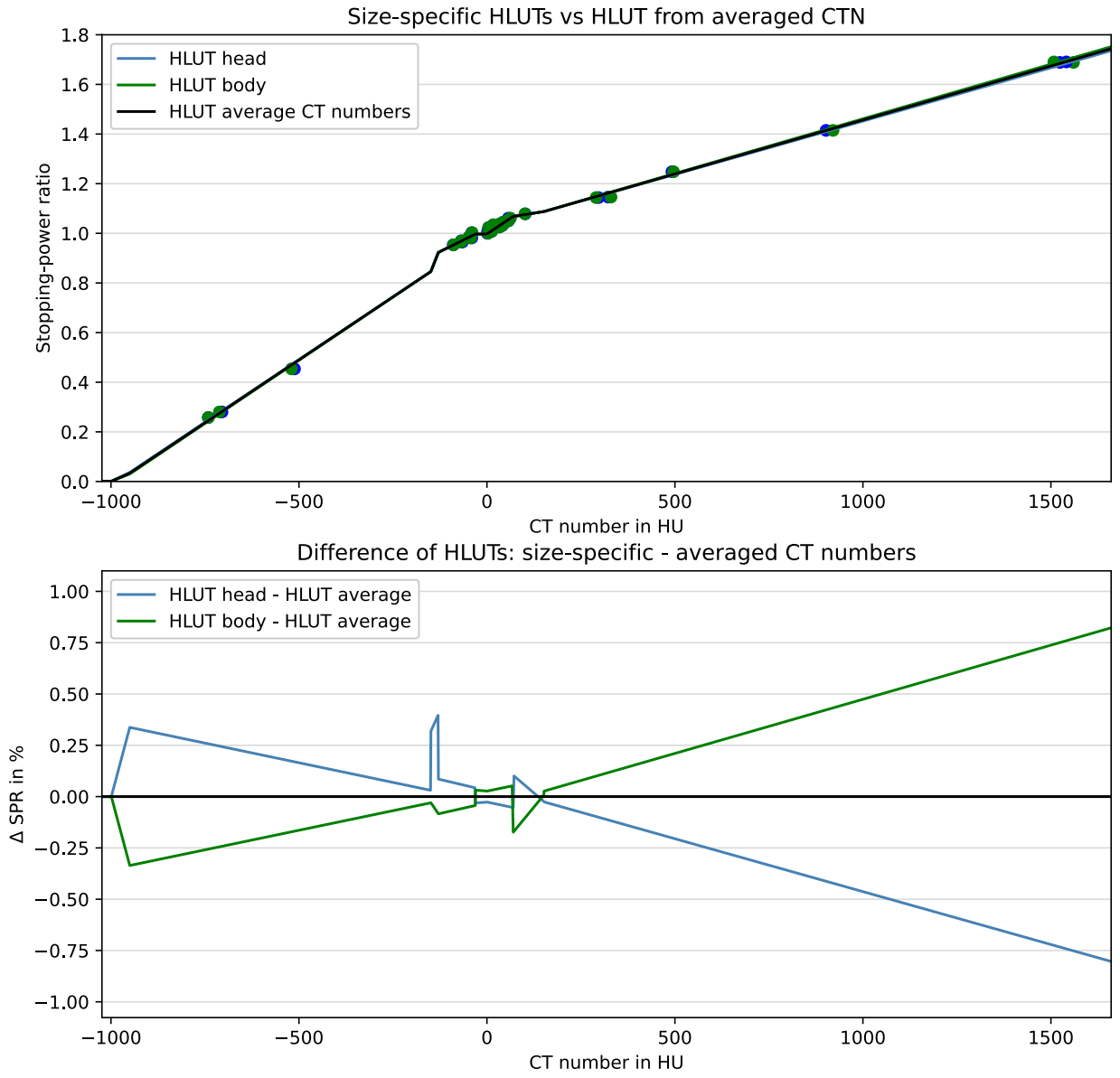


Evaluation box 4: Consistency check of measured and calculated SPR values

No measured SPR values provided. The evaluation is therefore skipped.

Evaluation box 5: Assessment of body-region specific HLUTs

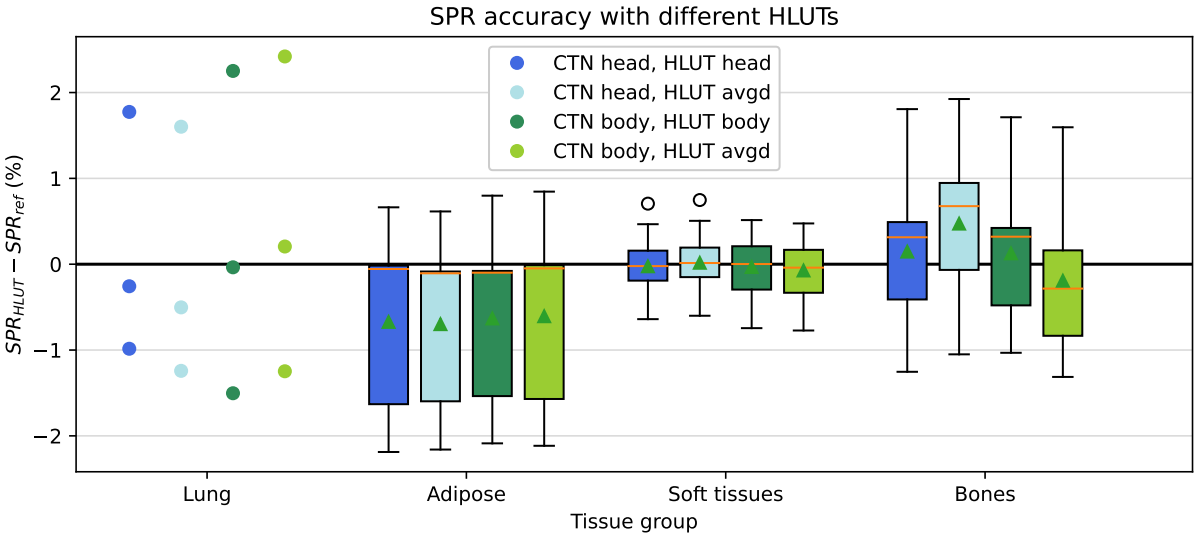
Comparison of head & body HLUTs with HLUT generated from averaged CT numbers.



End-to-end testing: Evaluation of the generated HLUT

Evaluation of the HLUT fitting accuracy (fit vs individual datapoints)

Difference of reference values to those predicted using the HLUTs generated with the he



HLUT accuracy for head and body with respective HLUT:

Head phantom:

Metric	All tissues	Lung	Adipose	Soft tissue	Bone
Mean error (%)	-0.12	0.18	-0.67	-0.02	0.15
Mean absolute error (%)	0.54	1.01	0.92	0.26	0.74
RMSE (%)	0.8	1.18	1.23	0.33	0.91

Body phantom:

Metric	All tissues	Lung	Adipose	Soft tissue	Bone
Mean error (%)	-0.12	0.24	-0.63	-0.03	0.13
Mean absolute error (%)	0.57	1.26	0.94	0.28	0.7
RMSE (%)	0.82	1.56	1.2	0.35	0.84

Influence of insert location on CT number for bone phantom inserts:

CT numbers measured in the middle (CTN middle) vs CT numbers measured in the outer
the phantom (CTN outer):

Insert name	CTN middle (HU)	CTN outer (HU)	Difference (HU)
HE Inner Bone	322	304	18
CaCO3 30%	492	466	26
CaCO3 50%	902	857	45
HE Cortical Bone	1524	1459	65