

Characterization of MR coils: LIL7

October 9, 2019

1 Coil

Coil name : LIL7
Geometry : surface
Active element number : 1
Manufacturer : Siemens
Operating mode : Tx/Rx
SN : xxxx

2 Phantom

Phantom name : Bouteille
T1 = 260 ms
T2 = 160 ms
Description : 1.25g NiSO4 x 6H2O, 5g NaCl /litre d eau.

3 Study

Institution : CERMEP
Station : MRC51044
MRI manufacturer : SIEMENS
Static field $B_0 = 3$ T
Date of experiment : 2017-03-07
Nucleus : 1H
Protocol name : fl3d_cor_1.36iso_TR15TE6_BW200_FA5_noPreScan_FS
Sequence name : *fl3d1_ns 3D

4 Acquisition parameters

BF1 = 123.2506 MHz
BW = 51 kHz
Echo Time : 6 ms
Repetition Time : 15 ms
Number of Average : 1
Flip Angle = 5°
Acquisition Time : 4 min 10 s
FOV (H-F*L-R*A-P) = $347 \times 173.5 \times 174.08 \text{ mm}^3$
Voxel Size (H-F*L-R*A-P) = $1355 \times 1355 \times 1360 \text{ }\mu\text{m}^3$
Matrix = $256 \times 128 \times 128 \text{ pixels}$

5 Measurement of the SNRc

• Confidence evaluation of the noise measurement (STD_{air}) :

- C_0 , a data mining class, selects the VOIs where $R_{exp} = R_{th} \pm 1\%$ with $R_{exp} = \frac{MEAN_{air}}{STD_{air}}$ the signal-to-noise ratio in the air and R_{th} is the theoretical ratio for the Rayleigh distribution. The χ^2 test is applied only on these VOIs.
- H_0 , the null hypothesis of the χ^2 goodness of fit test, is defined as: the noise in C_0 follows the Rayleigh distribution. H_0 is accepted (Acc) if $\chi^2 \leq \chi_c^2$ otherwise rejected (Rej) where χ_c^2 is the critical χ^2 for a $p_value = 0.05$.

• SNR measurement :

- $MEAN_{obj}$ is the average of the VOI in the object at 50% of the reference signal.
- \overline{STD}_{air} is the average on 200 values of STD_{air} validated by the χ^2 test.
- $SNR = 0.655 \frac{MEAN_{obj}}{\overline{STD}_{air}}$.

• SNR corrected (SNRc) :

- Sequence parameter correction: $SP_{fac} = \frac{1}{V_{voxel}} \sqrt{\frac{BW}{N_x N_y N_z NA}}$
- Relaxation time correction: $RT_{fac} = \frac{(1 - \cos(\alpha) E_1)}{(1 - E_1) \sin(\alpha) E_2}$ where $E_1 = e^{-\frac{TR}{T_1}}$, $E_2 = e^{-\frac{TE}{T_2}}$
- $SNRc = SNR * SP_{fac} * RT_{fac}$ is the SNR corrected by SP_{fac} and RT_{fac} .

Confidence					SNR measured			SNR corrected		
R_{exp}	R_{th}	C_0	$\chi^2 < \chi_c^2$	H_0	$MEAN_{obj}$	\overline{STD}_{air}	SNR	SP_{fac}	RT_{fac}	SNRc
1.91	1.91	14061	200	Acc	359.89	0.49	481 ± 24	0.04	12.68	269 ± 13

Combination of two sets of data detected. ImageScaleFactor found = 103.5

6 Characteristic lengths of uniformity vs capture zone

- Uniform length or volume is a dimension where the signal is inferior or equal to 10% or 50% variation in the reference signal (S_{ref}). In the case of volume coil, S_{ref} is the signal at the center of the phantom. In the case of surface coil, S_{ref} is the maximum value found in the image.
- Capture length or volume is the entire volume captured by the coil. This value is independent of S_{ref} .
- Ratio of lengths or volumes is the uniform-to-capture ratio.

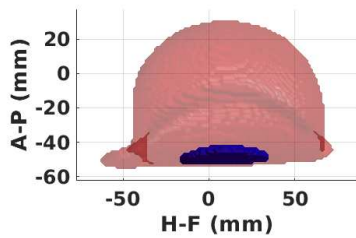
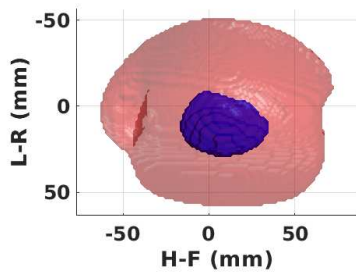
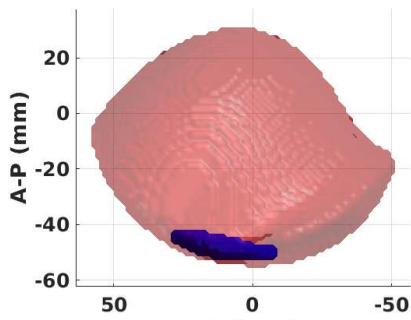
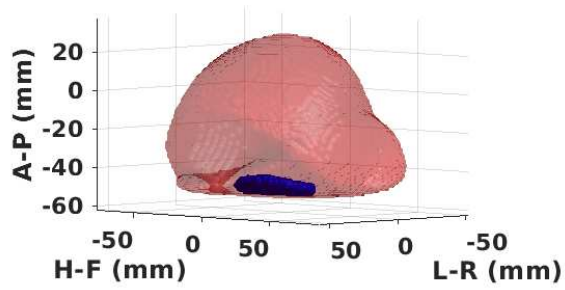
		10% variation in S_{ref}	50% variation in S_{ref}
H-F	Uniform length (mm)	0.00 ± 2.71	0.00 ± 2.71
	Capture length (mm)	91 ± 3	91 ± 3
	Ratio of lengths (%)	0.00 ± 2.99	0.00 ± 2.99
L-R	Uniform length (mm)	0.00 ± 2.71	0.00 ± 2.71
	Capture length (mm)	80 ± 3	80 ± 3
	Ratio of lengths (%)	0.00 ± 3.39	0.00 ± 3.39
A-P	Uniform length (mm)	5.4 ± 2.7	26 ± 3
	Capture length (mm)	83 ± 3	83 ± 3
	Ratio of lengths (%)	6.6 ± 3.5	31 ± 4
Vol	Uniform volume (cm^3)	7.1 ± 4.1	64 ± 14
	Capture volume (cm^3)	519 ± 13	519 ± 13
	Ratio of volumes (%)	1.4 ± 0.8	12 ± 3

7 Uniform versus capture volumes

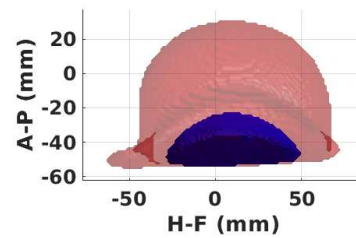
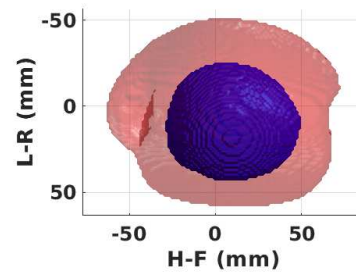
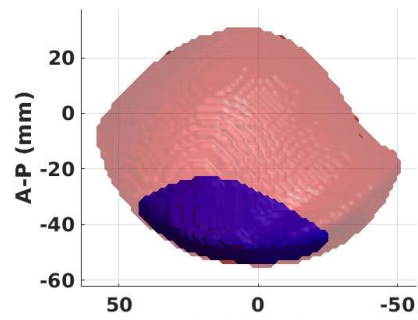
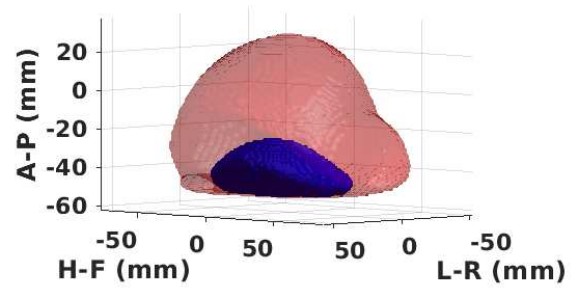
Uniform volume : blue color

Capture volume : red color

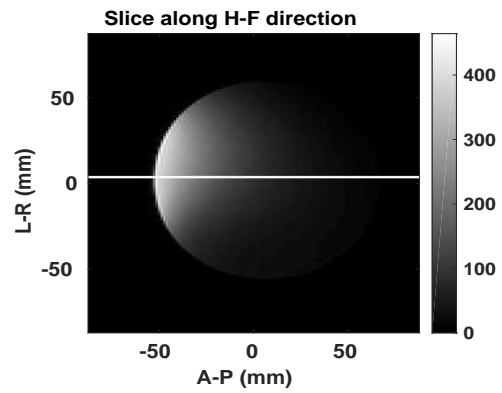
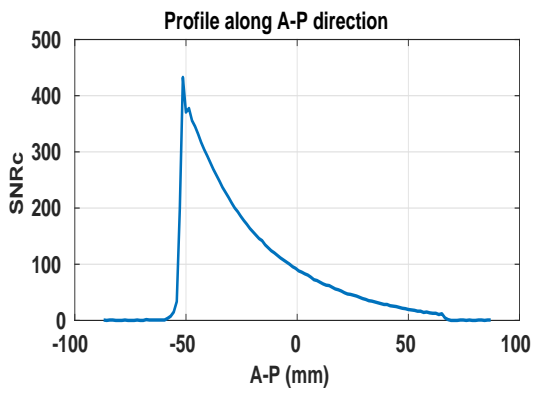
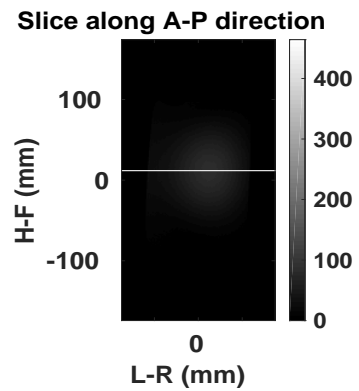
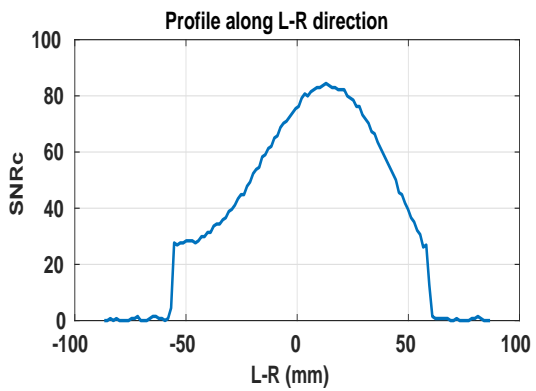
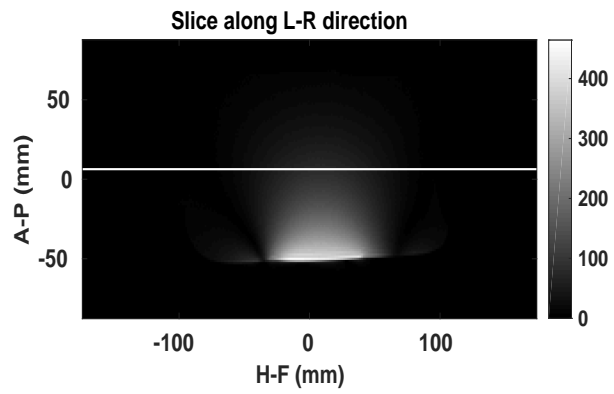
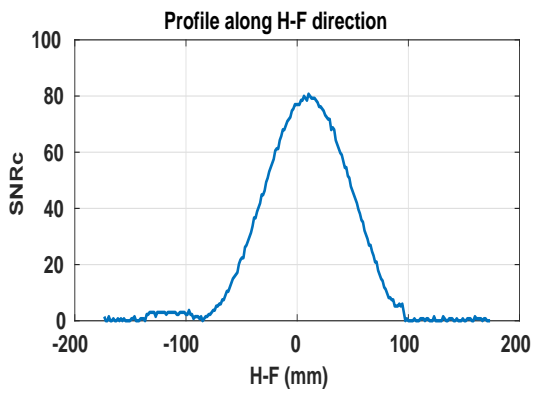
10% variation in S_{ref}



50% variation in S_{ref}



8 Profiles and Slices



9 Comparison with anterior results

Abbreviations:

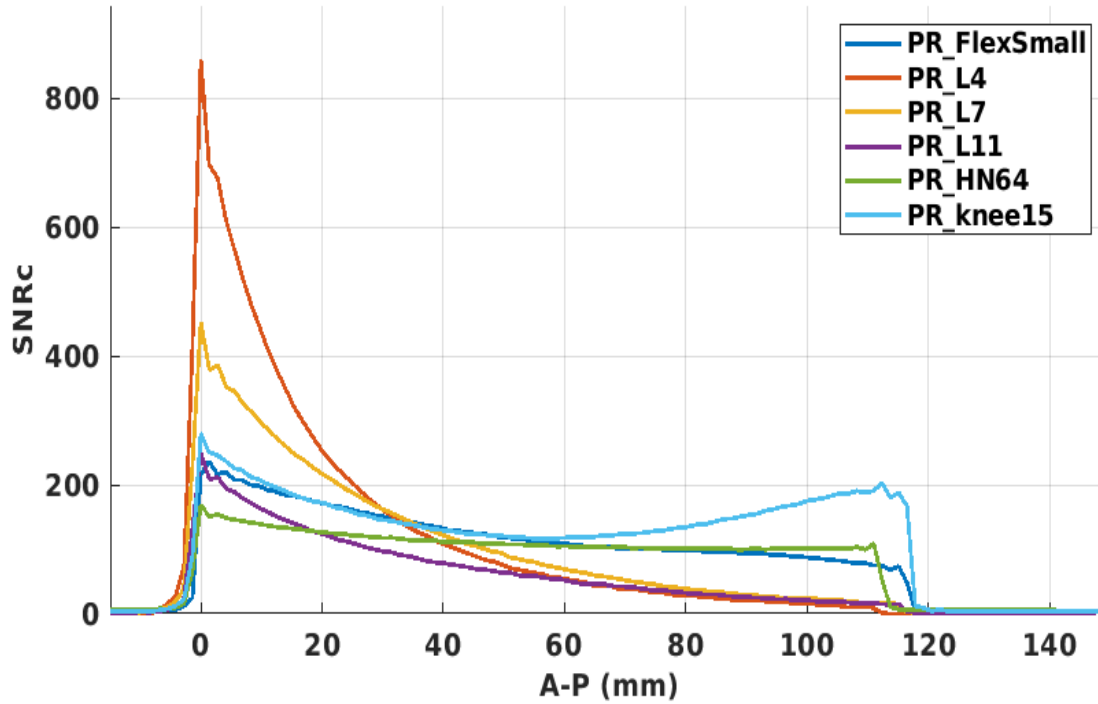
Acc: Rows appear in white when H_0 is accepted which mean that the measurement of SNR is validated.

Rej: Rows appear in gray when H_0 is rejected which mean that the measurement of SNR is biased.

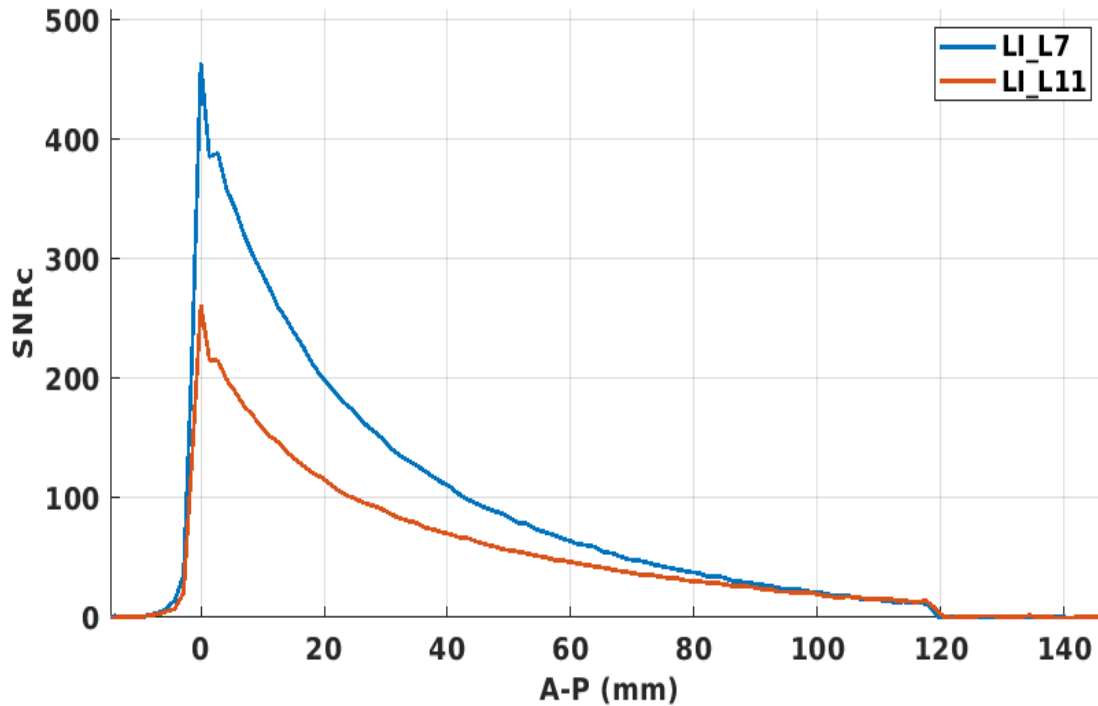
Coil	Mode & Nuc	Date & time	Location & station	B_0 (T)	Phantom	H_0	SNR	SNR corrected	Uniform volume @50%(cm^3)
HEH_-HeadNeck20CH	Tx/Rx 1H	2019-08-30 17h16	Hopital Edouard Herriot Pav B HEHMR2	1.5	Bouteille15T	Acc	166 ± 4	52 ± 1	1355 ± 100
HEH_Knee8CH	Tx/Rx 1H	2019-08-30 16h12	Hopital Edouard Herriot Pav B HEHMR2	1.5	Bouteille	Acc	197 ± 5	62 ± 2	657 ± 75
NC_FS	Tx/Rx 1H	2019-03-29 19h33	CHU NANCY BRABOIS ADULTES AWP166008	3	Bouteille	Acc	195 ± 5	109 ± 3	521 ± 54
NC_HN64	Tx/Rx 1H	2019-03-29 18h09	CHU NANCY BRABOIS ADULTES AWP166008	3	Bouteille	Acc	200 ± 5	112 ± 3	1019 ± 83
NC_HN20	Tx/Rx 1H	2019-03-29 17h12	CHU NANCY BRABOIS ADULTES AWP166008	3	Bouteille	Acc	194 ± 5	109 ± 3	1447 ± 98
NS_HN20CH	Tx/Rx 1H	2018-11-26 09h52	NeuroSpin MRCTRIO	3	Bouteille	Acc	190 ± 5	107 ± 3	1366 ± 95
NS_HN64CH	Tx/Rx 1H	2018-11-26 09h27	NeuroSpin MRCTRIO	3	Bouteille	Acc	197 ± 5	110 ± 3	888 ± 77
Re_FlexSmall	Tx/Rx 1H	2018-11-21 11h05	CTRE AWP166066	3	Bouteille	Acc	177 ± 4	99 ± 2	485 ± 48
Re_20cnx	Tx/Rx 1H	2018-11-21 10h55	CTRE AWP166066	3	Bouteille	Acc	202 ± 5	113 ± 3	1346 ± 94
Re_64cnx	Tx/Rx 1H	2018-11-21 10h46	CTRE AWP166066	3	Bouteille	Acc	210 ± 5	118 ± 3	938 ± 79
IR_HN20	1H 123MH 1H	2018-11-12 20h41	IRMAS NORD AWP66062	3	Bouteille	Acc	189 ± 5	106 ± 3	1326 ± 91
IR_HN64	Tx/Rx 1H	2018-11-12 20h20	IRMAS NORD AWP66062	3	Bouteille	Acc	176 ± 4	114 ± 3	721 ± 61
QC_20CH	Tx/Rx 1H	2018-11-07 14h24	Universite d aix Marseille AWP66072	3	Bouteille	Acc	180 ± 5	101 ± 3	1318 ± 93
PR_knee15	Tx/Rx 1H	2018-09-21 18h55	Cermep AWP66012	3	Bouteille	Acc	223 ± 6	125 ± 3	889 ± 94
QC_FlexSmall	Tx/Rx 1H	2017-09-19 10h29	Universite d aix Marseille AWP66072	3	Bouteille	Acc	184 ± 5	103 ± 3	459 ± 52
QC_64CH	Tx/Rx 1H	2017-05-31 10h23	Universite d aix Marseille AWP66072	3	Bouteille	Acc	185 ± 5	103 ± 3	822 ± 74
LLL11	Tx/Rx 1H	2017-03-07 15h26	CERMEP MRC51044	3	Bouteille	Acc	258 ± 13	144 ± 7	174 ± 28
LLL7	Tx/Rx 1H	2017-03-07 15h13	CERMEP MRC51044	3	Bouteille	Acc	481 ± 24	269 ± 13	64 ± 14
IR_FlexSmall	Tx/Rx 1H	2016-12-19 17h21	IRMAS NORD3TR AWP66062	3	Bouteille	Acc	167 ± 4	109 ± 3	393 ± 42
IR_FlexSmall	Tx/Rx 1H	2016-12-19 17h13	IRMAS NORD3TR AWP66062	3	Bouteille	Rej	170 ± Inf	110 ± Inf	392 ± 43
PR_HN64	Tx/Rx 1H	2016-12-14 17h30	Cermep Prisma	3	Bouteille	Acc	194 ± 5	109 ± 3	757 ± 72
PR.L11	Tx/Rx 1H	2016-12-14 16h59	Cermep Prisma	3	Bouteille	Acc	253 ± 13	142 ± 7	173 ± 28
PR.L7	Tx/Rx 1H	2016-12-14 16h29	Cermep Prisma	3	Bouteille	Acc	459 ± 23	257 ± 13	59 ± 13

Coil	Mode & Nuc	Date & time	Location & station	B ₀ (T)	Phantom	H ₀	SNR	SNR corrected	Uniform volume @50% (cm ³)
PR_L4	Tx/Rx 1H	2016-12-14 14h29	Cermep Prisma	3	Bouteille	Acc	816 ± 41	458 ± 23	16 ± 5
PR_FlexSmall	Tx/Rx 1H	2016-11-29 18h24	Cermep AWP66012	3	Bouteille	Acc	189 ± 5	106 ± 3	435 ± 49

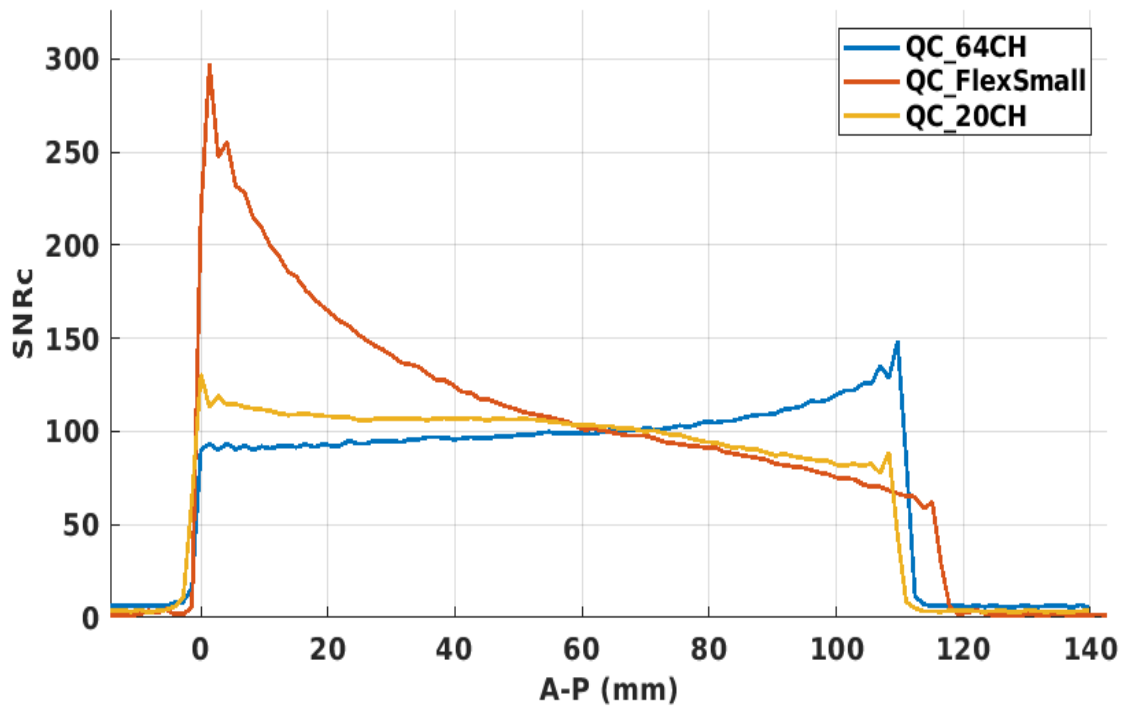
MRI: AWP66012 --- Phantom: Bouteille



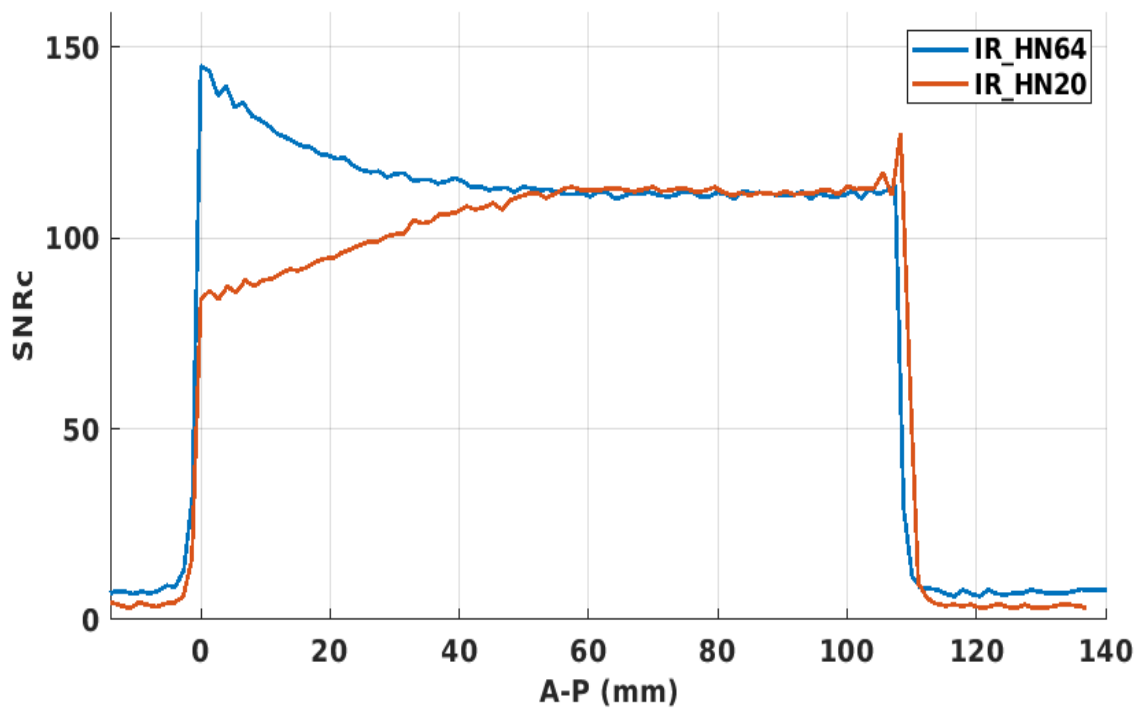
MRI: MRC51044 --- Phantom: Bouteille



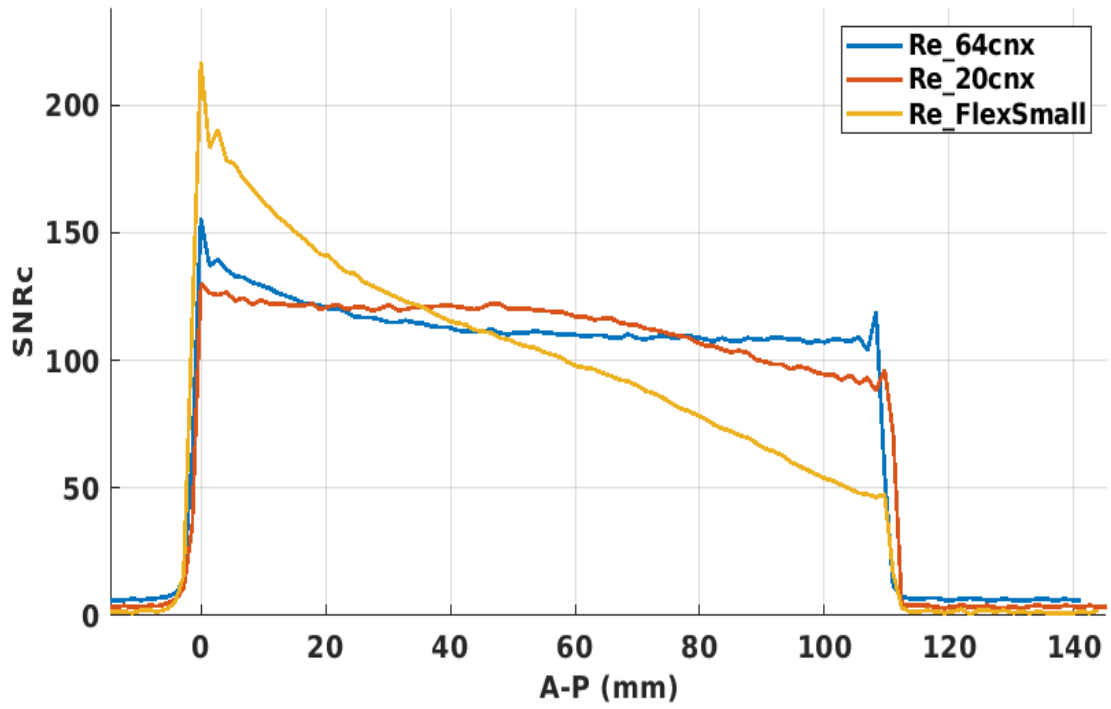
MRI: AWP66072 --- Phantom: Bouteille



MRI: AWP66062 --- Phantom: Bouteille



MRI: AWP166066 --- Phantom: Bouteille



MRI: MRCTRIO --- Phantom: Bouteille

