

Parameters and trade-offs

Signal to noise ratio factors (SNR depends on):

- 1- Main magnetic field: $\uparrow B_0 \rightarrow$ SNR increase (because less spins will be able to be in the high energy level and more spin in the net magnetization)
- 2- Proton density (number of the protons in the area under the examination)e.g lung and pelvic
- 3- voxel volume

- ▶ 4- TR (long TR allows full recovery) and more spins available for next excitation
- ▶ 5- TE (short TE is less dephasing and more signal)
- ▶ 6- flip angle (90 produce more signal) + 180 refocusing pulse increase the signal
- ▶ 7- NEX (increase the NEX increase the SNR) double the NEX increase the SNR $\sqrt{2} = 1.4$ so to double the SNR we need to increase the NEX by 4
- ▶ 8- receive bandwidth (range of frequencies sampled during the application of the readout frequency)
- ▶ ↓ receive bandwidth → ↓ noise → ↑ SNR

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- ▶ 9- coil type (control the amount of the signal received and therefore the SNR)

Quadrature coil(two coil together) increase the SNR

Phase array coil (several coil set together) increase the SNR more

Surface coil increase the SNR because it near from the wanted area

To optimize image	Adjusted parameter	Consequence
Maximize SNR	↑ NEX	↑ scan time
	↓ matrix -	↓ scan time (p/matrix) ↓ resolution
	↑ slice thickness	↓ resolution
	↓ receive bandwidth	↑ minimum TE
	-	↑ chemical shift
	↑ FOV	↓ resolution
	↑ TR	↓ T1 weighting ↑ number of slices
	↓ TE	↓ T2 weighting
Maximize resolution (assuming a square FOV)	↓ slice thickness	↓ SNR
	↑ matrix -	↓ SNR ↑ scan time (p/matrix)
	↓ FOV	↓ SNR

To optimize image	Adjusted parameter	Consequence
Minimize scan time	↓ TR	↑ T1 weighting ↓ SNR ↓ number of slices
	↓ Phase matrix -	↓ resolution ↑ SNR
	↓ NEX	↓ SNR ↑ movement artefact
	↓ slice number in volume imaging (3D)	↓ SNR

Parameter	Benefit	Limitation
TR ↑	↑ SNR (full recovery) ↑ number of slices	↑ scan time ↓ T1 weighting
TR ↓	Scan time ↑ T1 weighting	↓ SNR ↓ number of slices
TE ↑	↑ T2 weighting	↓ SNR
TE ↓	↑ SNR	↓ T2 weighting
NEX ↑	↑ SNR ↑ signal averaging	↑ scan time
NEX ↓	↓ scan time	↓ SNR ↓ signal averaging

Parameter	Benefit	Limitation
Slice thickness ↑	↑ SNR	↓ resolution
	↑ coverage	↑ partial voluming
Slice thickness ↓	↑ resolution	↓ SNR
	↓ partial voluming	↓ coverage
FOV ↑	↑ SNR	↓ resolution
	↑ coverage	
	↓ aliasing (pFOV)	
FOV ↓	↑ resolution	↓ SNR
		↓ coverage
		↑ aliasing (pFOV)
(p)Matrix ↑	↑ resolution	↑ scan time
		↓ SNR if pixel small
(p)Matrix ↓	↓ scan time	↓ resolution
	↑ SNR if pixel large	
Receive bandwidth ↑	↓ chemical shift	↓ SNR
	↓ minimum TE	

Parameter	benefit	Limitation
Receive bandwidth ↓	↑ SNR	↑ chemical shift
		↑ minimum TE
Large coil	↑ area of received signal	↓ SNR
		Sensitive to artefacts
		Aliasing with small FOV
Small coil	↑ SNR	↓ area of received signal
	Less sensitive to artefacts	
	Less prone to aliasing with small FOV	