

Workshop 7 - questions

1. A ^1H MRI image has a resolution of 128×128 pixels; its field of view measures $5 \text{ cm} \times 5 \text{ cm}$.
 - (i) How many points in k -space were acquired for this image?
 - (ii) What was the total duration of acquisition, if a scan (*i.e.* acquisition of a single line of points in k -space) was taken every 75 ms?
 - (iii) A maximum phase encoding gradient of $g_{\text{max}} = 20 \text{ mT/m}$ was used to acquire the image. What was the duration of the phase encoding gradient pulse?
2. A ^1H MRI image was acquired with 256×256 points in the k -space with a k -space resolution of $\delta k = 0.42 \text{ rad/cm}$.
 - (i) How large is the field of view?
 - (ii) Is the resolution sufficient to see small blood vessels of 0.2 mm diameter?
3. At the slice selection stage of an MRI experiment, a magnetic field gradient of 2.5 mT/cm was used. What is the thickness of the excited slice that results from a radiofrequency pulse with a 200 Hz excitation bandwidth?
4. Suppose the RF transmitter frequency is set $\Delta\omega$ above the on-resonance value for the magnet centre and a slice selection pulse is issued. For a given gradient amplitude g_z , determine the resulting shift Δz in the slice position.
5. In practice, the main field B_0 may not be homogeneous. Explain qualitatively why a spatially varying B_0 would distort the slice profile, even with a perfectly shaped RF pulse and gradient.
6. Explain why, in the data shown in Figure 4 of the lecture notes, it is important that the centre of the echo in time corresponds to the centre of the k -space window. Using the properties of Fourier transform discussed in the preceding lectures, explain what would happen if the centre of the k -space window is shifted.
7. Because of transverse relaxation, the nuclear induction signal decays exponentially with time. Explain qualitatively why a finite T_2 time limits the extent Δk that can be reached in k -space during a readout, even if arbitrarily strong gradients were available.