Medical Instrumentation II MRI Exam – Model Answer

May 22, 2012

Solve as Much as You Can – Maximum Grade: 100 Points

Part I. Answer the following questions by marking the best answer among the choices given [5 points each]:

1. Changing the amplitude of the RF pulse results in changing the … of the selected slice.
    a. Flip angle (*)
    b. Thickness
    c. Position
2. If the inversion time used with inversion recovery pulse sequence was 400 ms, then the sequence will suppress the signal from the tissue characterized by …
    a. T1 value of 280 ms
    b. T1 value of 580 ms (*)
    c. T2 value of 300 ms
3. To collect data for one 128x256 MRI image, at least … excitations are needed.
    a. 128 (*)
    b. 256
    c. 32768
4. To maintain the spatial resolution in the phase encoding direction with a larger field of view, ... are used.
    a. Larger phase encoding steps for same coverage
    b. Same phase encoding steps for larger coverage
    c. Smaller phase encoding steps for same coverage(*)
5. Closed magnets are preferred to open MRI systems because of …
    a. Higher SNR (*)
    b. Lower cost
    c. Flexible patient access
6. Consider a 1.5T magnet with applied gradient G_z=20 mT/m, the difference in Larmor frequency between two locations inside the magnet with x=0 and x=1 cm is equal to …
    a. -8.52 kHz
    b. 0 (*)
    c. 8.52 kHz
7. MRI systems use … to improve the uniformity of the B0 magnetic field.
    a. Gradient coils
    b. Superconducting coils
    c. Shim coils (*)
8. A proton density weighted pulse sequence can be …
    a. A spin echo sequence with long TR and long TE
    b. A partial saturation sequence with long TR and short TE (*)
    c. A partial saturation sequence with short TR and short TE

Part II. Mark the following statements as either True (T) or False (F) (3 points each):

9. Tissues with higher T2 appear darker in T2-weighted imaging. (F)
10. We cannot measure net magnetization aligned in the same direction as B0. (T)

11. T2* relaxation time of a tissue is longer than its T2 relaxation times. (F)
12. Long TR reduces T2 contrast. (F)
13. Proton density weighting is present in all types of MRI contrasts. (T)
14. The larger the RF pulse flip angle, the larger the received FID magnitude. (F)
15. Changing the slice selection gradient changes both slice thickness and position. (T)
16. Increasing TE reduces the SNR for the same pulse sequence. (T)
17. Magnetic field ramp down must be fast to ensure quenching. (F)
18. A 10m×10m room can be enough to host a 2.0T magnet with active shielding. (F)
19. Permanent magnets up to 1T can be used in open MRI systems. (F)
20. The signal at time TE=0 in a spin echo pulse sequence depends on T2. (F)

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21. [15 points] For a multi-slice spin echo imaging sequence with parameters given as: slice thickness: 5mm, flip angle: 60 degrees, matrix size: 128x192, FOV: 20cmx25cm, NEX: 2, and TR/TE: 2500/60, and number of slices: 60, calculate the total acquisition time required for this sequence to perform this scan.

Number of slices in each TR= 2500/60= 41 slice
Number of TRs required for all slices = 60/41= 2
Scan time= 2 x 2 x 128 x 2500 ms

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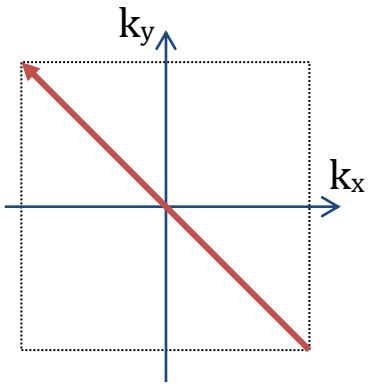
22. [15 points] Draw a properly labeled T2-weighted pulse sequence that acquires the shown k-space trajectory:



1. A spin echo sequence
2. Initial point: Gx having one positive pulse and Gy has one negative pulse
3. Acquiring the line shown: negative small Gx gradient and positive Gy gradient for an area that is double the area of the pulse.