

Lesson 11 (B): Fast pulse sequences 2

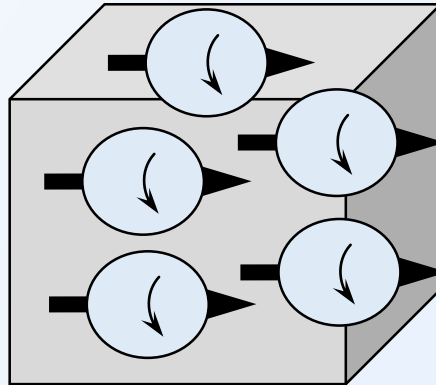
Aims

- Learning the following topics about fast pulse sequences:
- Gradient echo pulse sequence
- Spoiled gradient echo

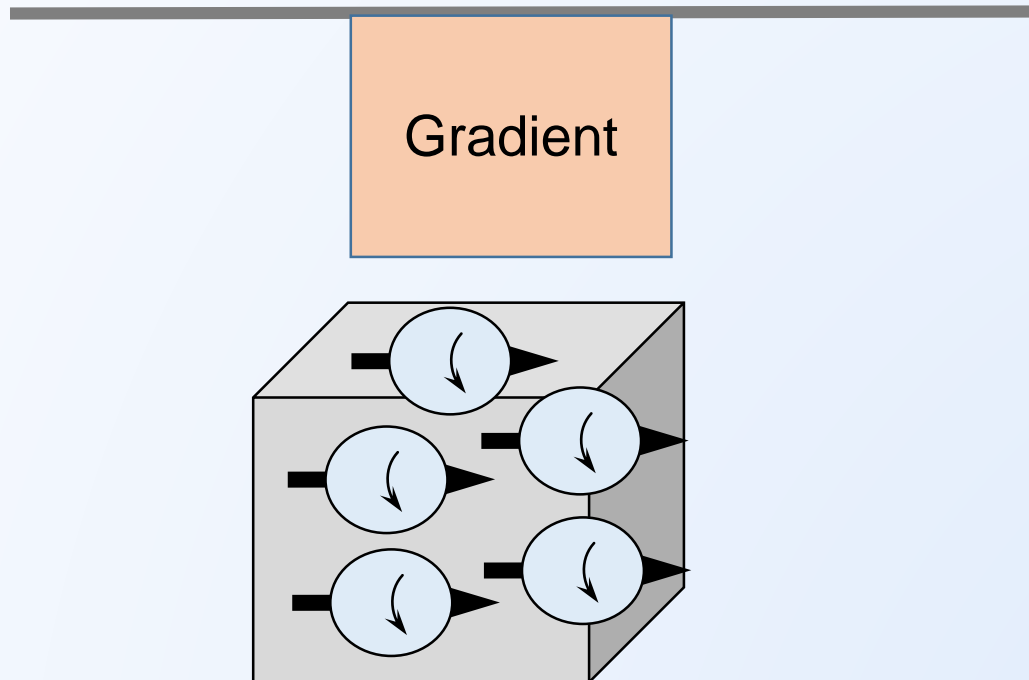
Gradient echo

- Role of gradients: to dephase and rephase protons in order to generate an echo.
- Flip angle less than 90°
- Short TR
- Short TE

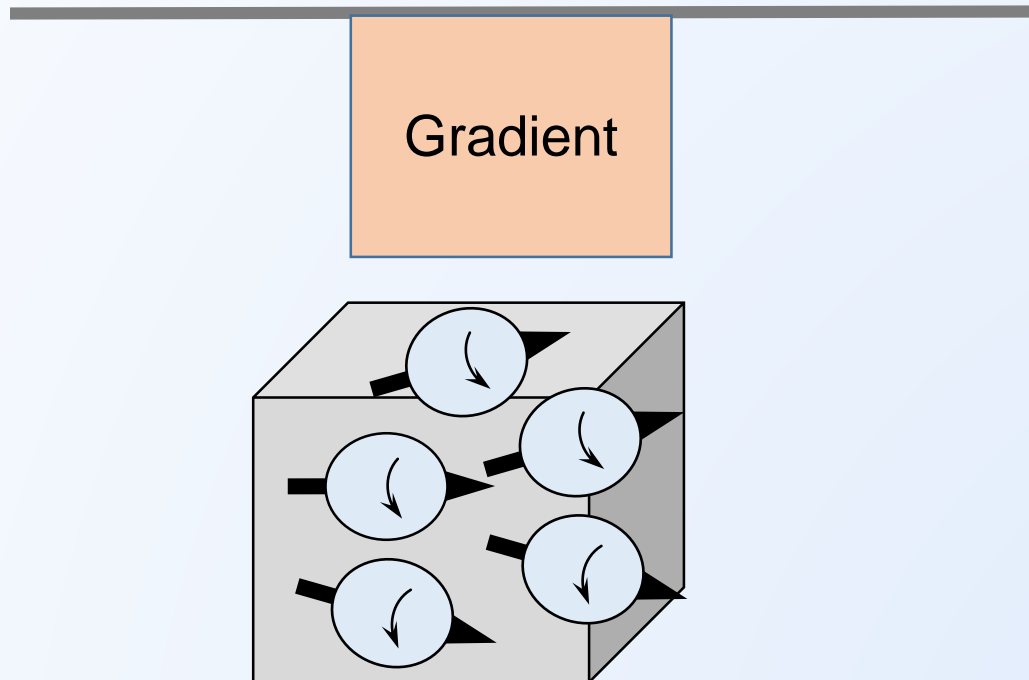
Gradient echo



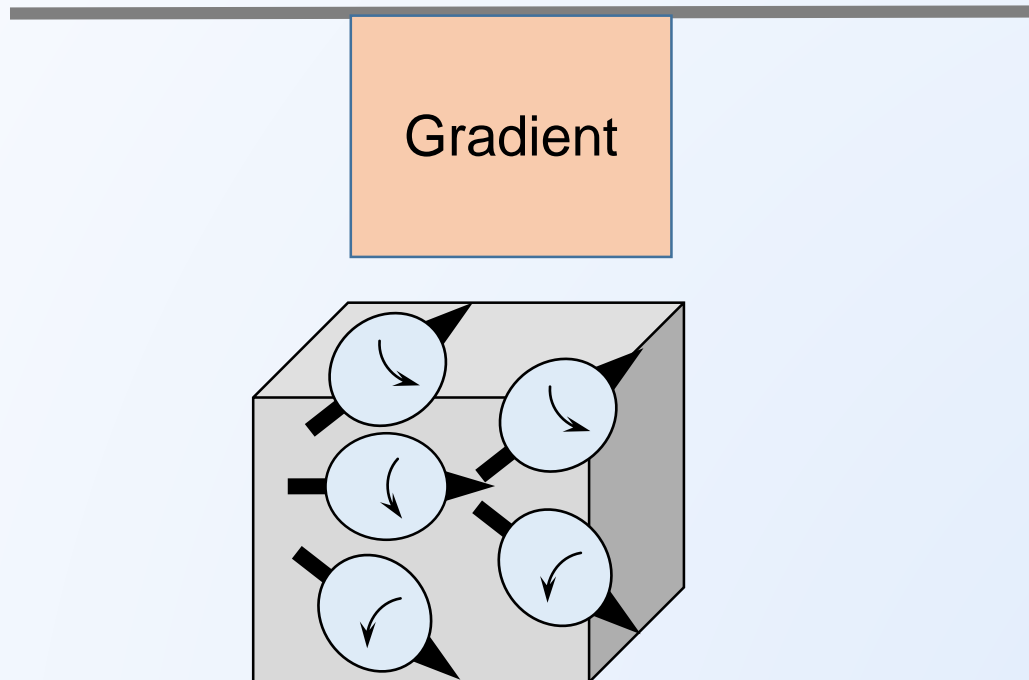
Gradient echo



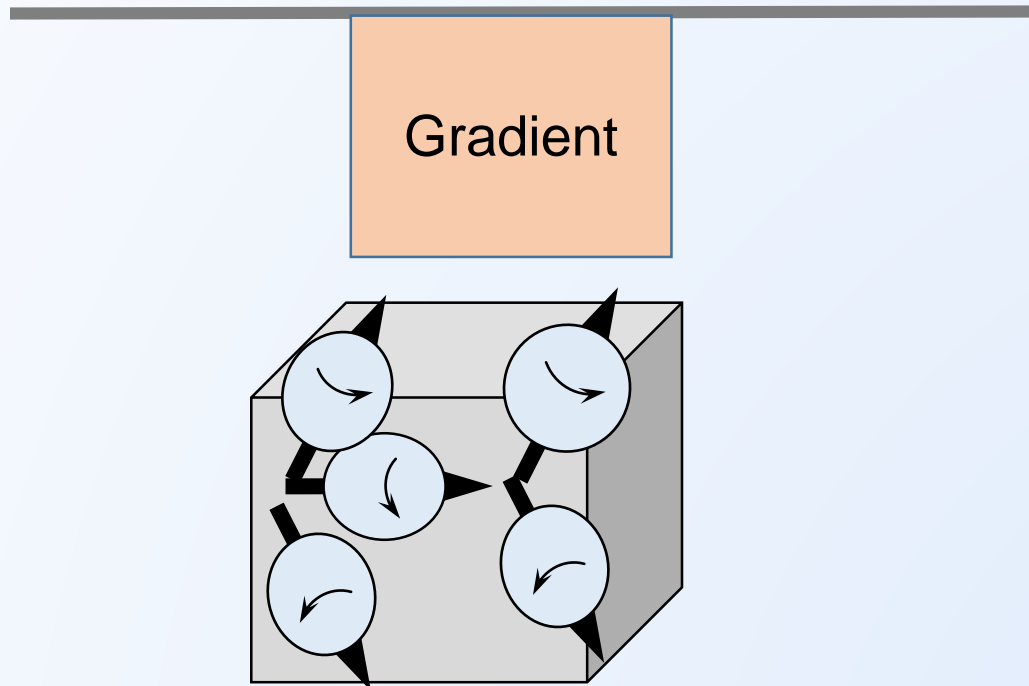
Gradient echo



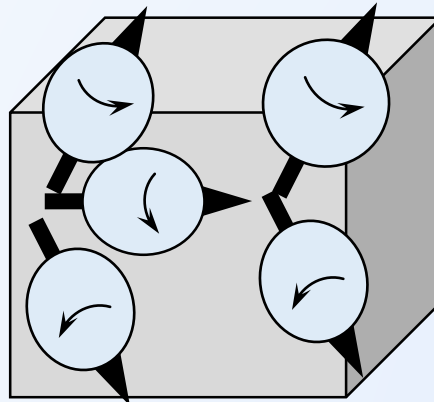
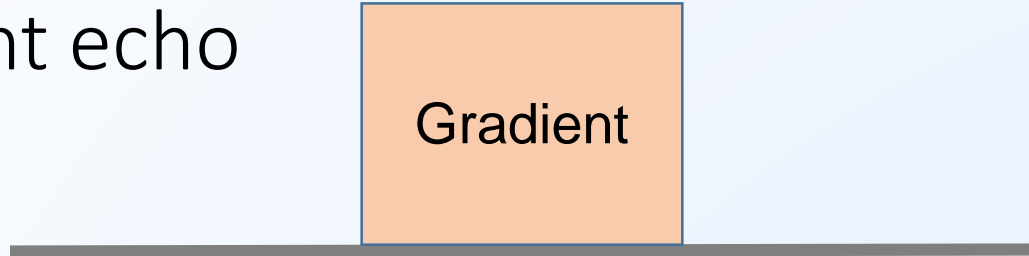
Gradient echo



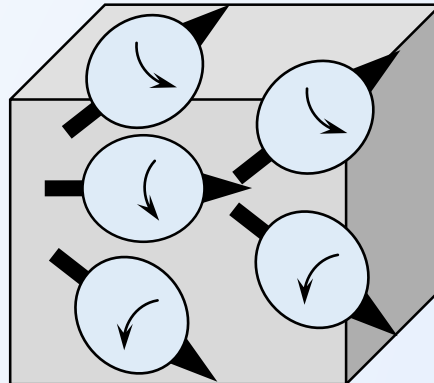
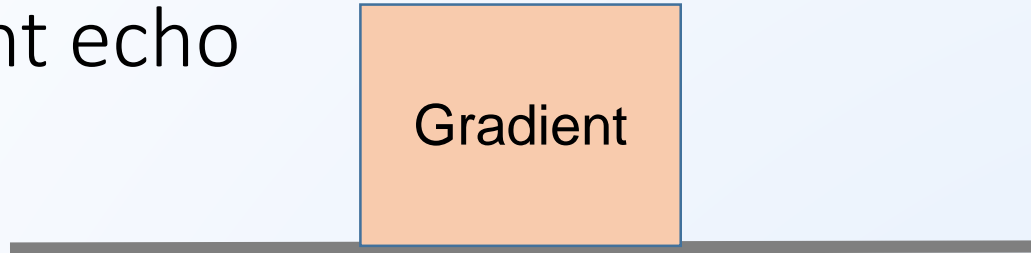
Gradient echo



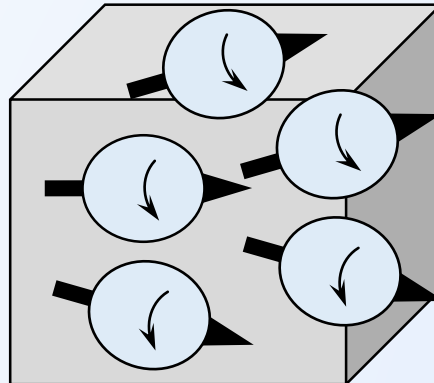
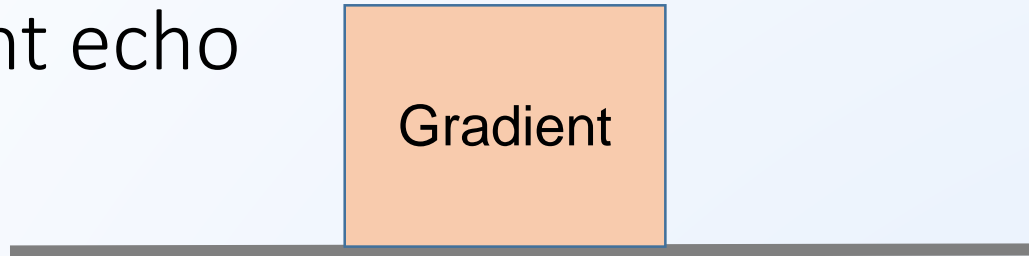
Gradient echo



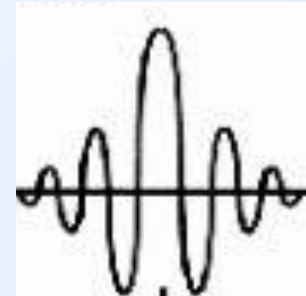
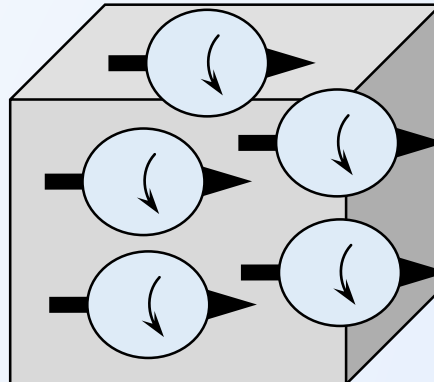
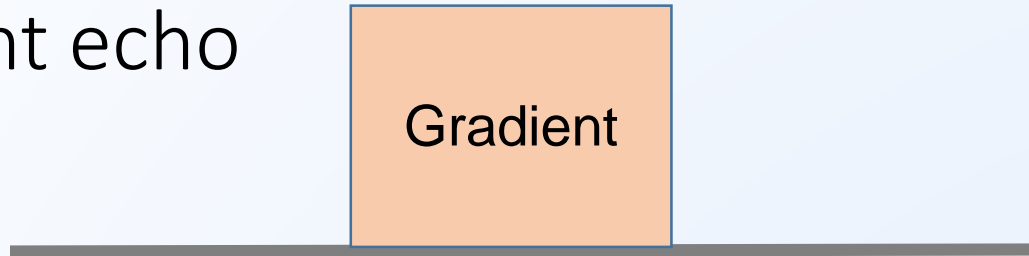
Gradient echo



Gradient echo



Gradient echo



Echo

Gradient echo

- It gives $T2^*$ images instead of $T2$ image.
- ?
- Applying gradients that leads to dephase of protons.

Gradient echo

- Gradient Echo (GE)
- Gradient Recalled Echo (GRE)

Spoiled gradient echo

Spoiled gradient echo

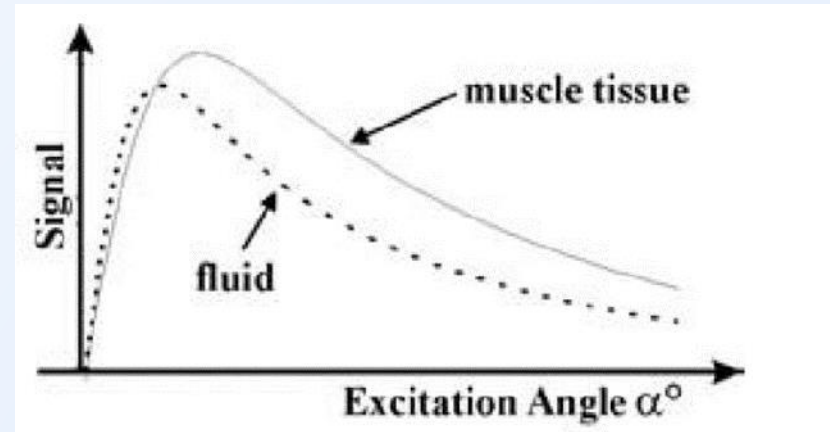
- “Spoiling” refers to the destruction of any $T2^*$ contrast in the image →
- Getting a T1 weighted image (T1WI) using a gradient technique

Spoiled gradient echo

- Siemens: Fast low-angle shot (FLASH)
- General Electric: Spoiled gradient-recalled acquisition in the steady state (SPGR)
- Philips: T1 fast field echo (T1-FFE).

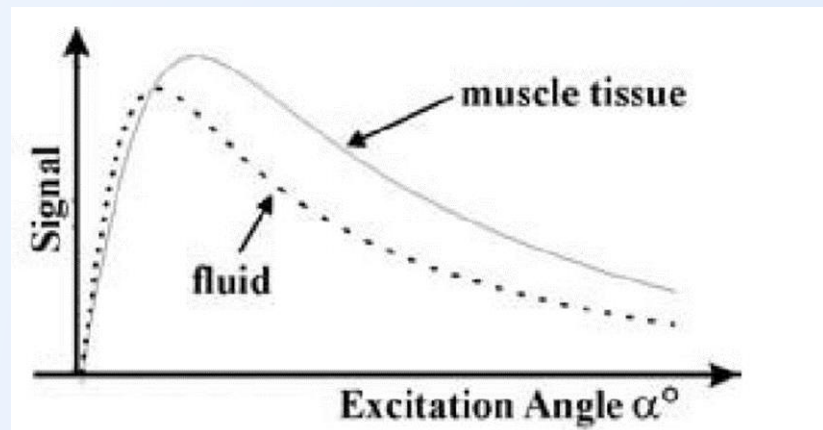
Ernst angle

- Signal intensity changes as a function of excitation angle.
- The maximum signal occurs for an angle called the Ernst angle.
- $\alpha_E = \arccos(e^{-TR/T1})$
- However, Ernst angle is not necessarily the best choice for flip angle.
- ?

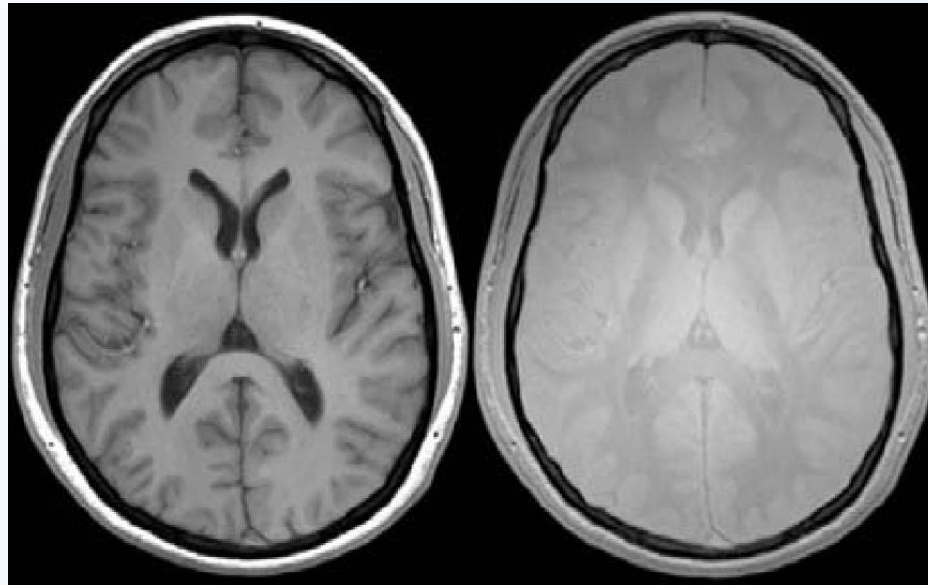


Flip angle, SNR and CNR

- Larger flip angles than the Ernst angle and short TR produce T1-weighted images with better tissue contrast but lower total signal.
- However, for lesion detection, CNR is typically more important than SNR.



Effect of FA on T1-weighted image contrast



FA= 70°

FA= 20°

Summary

- Gradient echo pulse sequence
- Spoiled gradient echo