

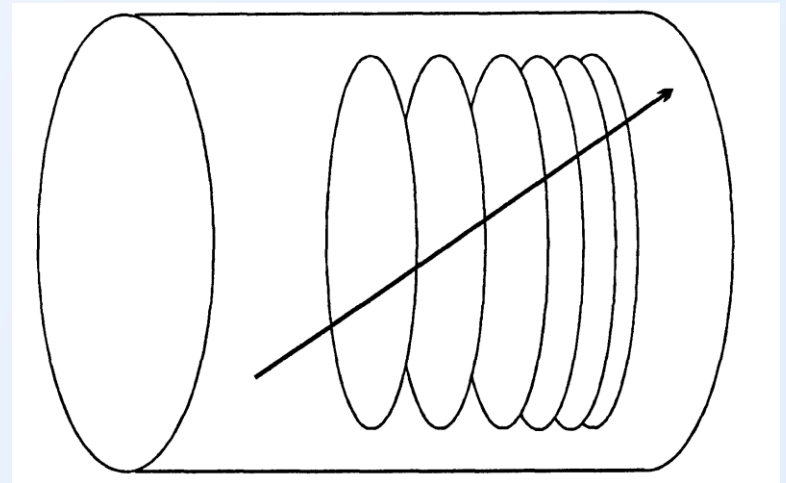
Lesson 9 (A): Gradient coils

Aims

- Learning the following topics:
- Magnetic field gradient
- Amplitude of gradient slope
- Gradient strength units
- Gradient coils

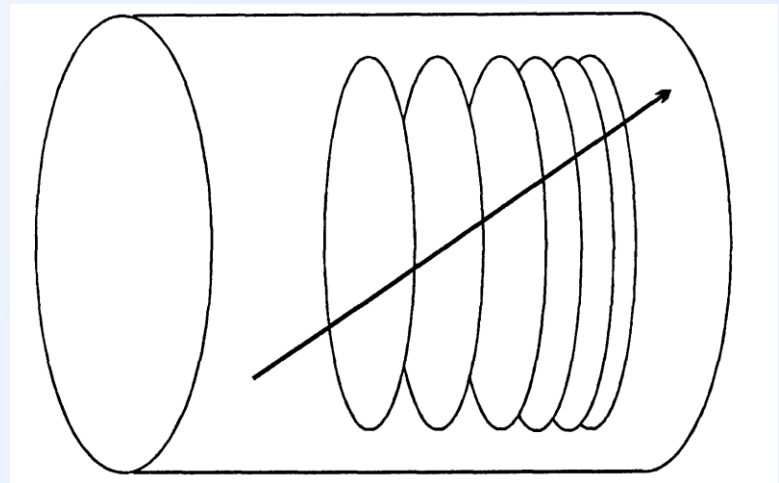
Magnetic field gradient

- If the loops are spaced closely of one end of the solenoid and gradually become farther apart at the other end, the resultant magnetic field becomes stronger at one end than the other. This is called magnetic field gradient.



Gradient coils

- Gradient coils provide a linear gradation or slope of the magnetic field strength from one end of the solenoid to the other.



Amplitude of gradient slope

- The amplitude of the gradient slope is determined by
- the magnitude of the current passing through the coil.

Gradient coils

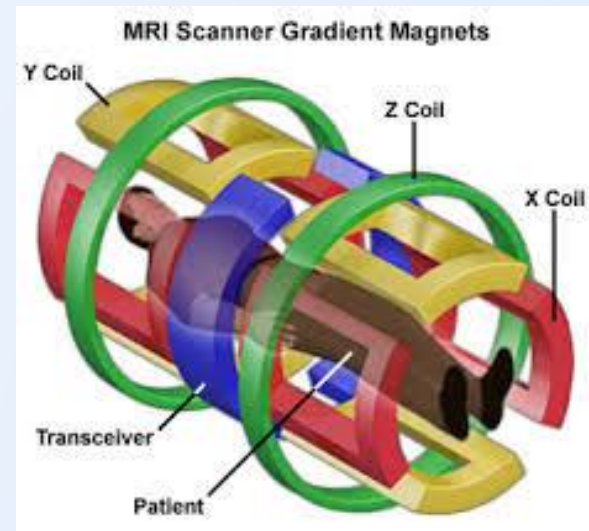
- Gradient coils are powered by gradient amplifiers.
- Faults in the gradient coils or gradient amplifiers →
- Geometric distortion in the MR image.

Gradient strength units

- G/cm or mT/m
- $1 \text{ G/cm} = 10 \text{ mT/m}$
- Stronger gradients permit:
- High speed imaging
- High resolution imaging

Gradient coils

- Three orthogonal gradient coils are used corresponding to the axes x , y , and z in a three-dimensional coordinate system.
- This then allows encoding of data in three coordinates.
- Depending on their orientation axis the gradient coils are called G_x , G_y , and G_z .



Gradient and gradient coils

- The gradients are referred to as:
- The slice-select gradient
- The phase-encoding gradient
- The frequency-encoding or readout gradient

Summary

- Magnetic field gradient
- Amplitude of gradient slope
- Gradient strength units
- Gradient coils
- Application of gradient coils in spatial encoding

References

- Hashemi RH and Brandy WG. MRI the Basics, Second Edition.