

Solutions to Quiz #4

7 November 2006

- For four (4) of the following, specify the words in the acronym; you don't need to explain anything.
 - MRI *Magnetic Resonance Imaging*
 - PET *Positron Emission Tomography*
 - SAR *Synthetic Aperture Radar*
 - CT *Computed Tomography*
 - RIT *(I don't think I have to tell you).*

- Which of the following medical imaging systems DEPEND on digital computers for their existence? In other words, which systems could not exist without digital computers (circle all that apply)
 - X-ray imaging *no*
 - CT scans *yes*
 - MRI scans *yes*
 - ultrasound *not really, but I will accept yes*
 - PET scans *yes*

- What distinguishes an "active" imaging system from a "passive" imaging system?

The source of the "illumination" or "energy." If the source is controllable by the imaging system (as in Radar and Sonar), the the system is "active." If the source is not controllable by the system or user, then the system is "passive."

- Both sound and light propagates in the form of waves. Describe the differences in the physical nature of these waves. I am most interested in qualitative differences, but feel free to discuss quantitative differences if you can.

Light is a "transverse" wave, which means that the oscillation is perpendicular to the direction of propagation. Sound waves are "longitudinal," which means that the oscillation is "to-and-fro" along the direction of travel. Could also add that sound requires a medium and light does not.

- Specify the meanings of the variables in the following equation AND describe the significance:

$$\Delta\theta \sim \frac{\lambda}{D}$$

This is the "resolution equation." The quantity $\Delta\theta$ is the angle between two point objects (such as stars when viewed from earth) that can just be distinguished, λ is the wavelength of the illumination, and D is the diameter of the collector (often a lens). This equation indicates that the ability of the system to "resolve" details in the image. If the diameter of the system is increased (use a larger lens or mirror), then the resolution angle gets smaller and the system is better able to resolve fine detail.