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ED6001 - Medical Image Analysis

Anatomical Planes:

→ Superior (head) — Inferior (feet)
→ Anterior (front) — Posterior (back)
→ Proximal (central) — Distal (peripheral)

• Transverse plane • Coronal plane • Sagittal plane

Image Representation

→ Modality (X-ray, CT, & MRI etc.)
→ Analog / Digital → 2D / 3D (RGB...) → Scalar / Vector

→ Brightness of image can represent temperature, tissue attenuation etc.

→ Image 2D signal; $f(x,y)$ ⇒ 3D space
→ Image 3D signal, $f(x,y,z)$ ⇒ 4D space

Medical Image Eg:

→ $\mu(x,y)$, Linear attenuation coefficient, for X-ray
→ $h(x,y,z)$, CT number, Computed Tomography
→ $T_2(x,y,z)$, transvere relaxation time in MRI

Image Quality

→ Physics oriented ⇒ Noise, accuracy ~~etc~~, Resolution, Contrast etc.
→ Task oriented ⇒ sensitivity, specificity etc.

Contrast:

→ Local change in brightness ⇒ Ratio b/w avg brightness of object and background.

Resolution:

→ Ability differenciate small structures

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Noise and Distortion

$g = D(f) + n$ → Random noise

- g → we get
- $D(f)$ → we want
- n → Distortion

$SNR_a = \frac{\text{amplitude (f) (Signal)}}{\text{amplitude (N) (Noise)}}$ $\quad SNR\,(dB) = 20 \log_{10} SNR_a$

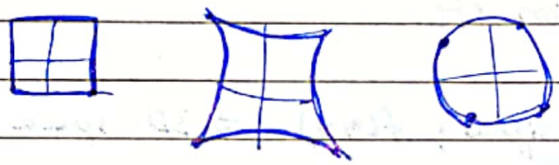
~~Err~~ $SNR_a = \frac{A}{\sigma_N}$ → A → RMS/Avg ~~Noise~~

σ_N → Noise distribution characteristics

Distortion:

→ ~~Gro~~ → Geometry or Intensity compared to ~~the~~ real object

→ Magnification, saturation etc.



Common Artifacts

→ Motion → Star → Hardening → Ring.

~~Dig~~ Diagnostic Accuracy and Disease

Test	Disease +	Disease −
+	a	b
−	c	d

Sensitivity = $a/a+c$

Specificity = $d/b+d$

Accuracy = $a+d/a+b+c+d$

+ve predictive value = $a/a+b$

-ve " " = $d/c+d$

prevalence = $a+c/a+b+c+d$

Digital Image formation

→ Sampling analog signal ⇒ Sampling using $\delta(x,y)$ ≈ zero every where except (x,y)

→ Resolution

→ Dynamic Range