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Nuclear medicine

Week 3; Block 6; Section 3: Data aquisition in PET

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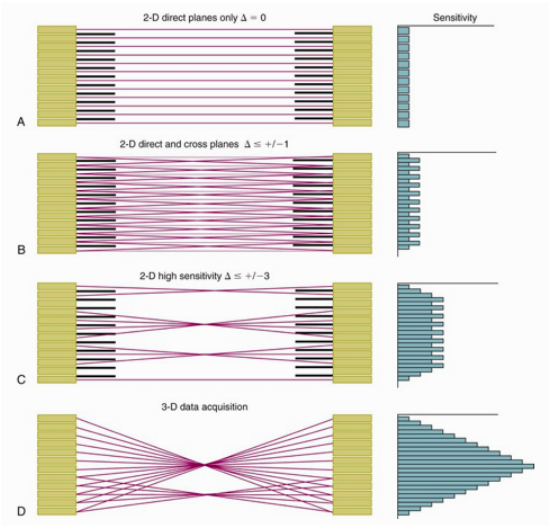
Section 3

Data aquisition in PET

Event recording topologies



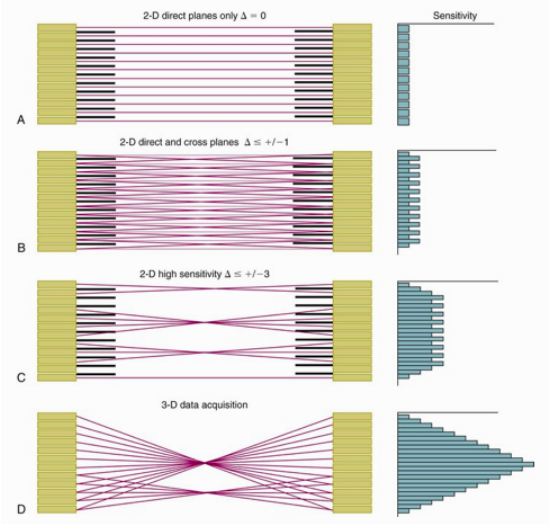
A) 2D data acquisition: septa such that:

- Accept only 'in line' γ pairs
- Reduced rate of scatters & randoms
- Recons: e.g. filtered back projection
- Least efficient

B) Cross planes: septa such that $\Delta = \pm 1$:

- Accept coincidences in neighbouring cells
- Increased rate of scatters & randoms
- Scanner centre, effective separation $= \frac{d}{2}$
- Recons: as in A using effective separation
- For n rings $\Rightarrow 2n - 1$ image planes
- Efficiency enhanced

Event recording topologies



C) Cross planes: septa such that $\Delta = \pm 2; \pm 3$:

- Accept coincs for cells with $|\Delta| = 1, 2, 3$
- Increased rate of scatters & randoms
- Recons: for large $|\Delta|$ resolution decreases
- Efficiency enhanced

D) 3D acquisition mode: no septa

- Accept all coincidences
- Sensitivity increases $\times 4 - \times 8$
- Recons: require 3D algorithm
- Increased rate of scatters & randoms
- Most efficient

Numerical comparison of sensitivities

Histograms in figures A–D indicate spacial dependence of relative efficiency;
$\rightarrow$ indicates, for example, object of interest should be in the centre of a 3D scanner

For some 'typical' systems:

- PET scanner in 2D mode (1 slice per detector ring): 0.002–0.005 counts/s/Bq
- PET scanner in 3D mode (coincidences between all rings): 0.02–0.1 counts/s/Bq
- SPECT (for comparison): 0.0001–0.0003 counts/s/Bq

Summary of section 3

Resolution and sensitivity can be improved by expanding range of allowed coincidences

Sensitivity in PET can exceed that of SPECT by more than a factor of 10