PET/CT Technology Updates, Quality Assurance and Applications

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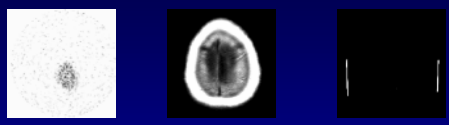
Outline

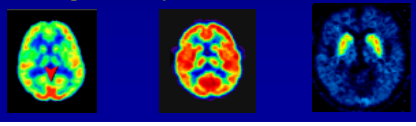
- Evolution of PET instrumentation
  - 2D → 3D
  - Dedicated → PET/CT
- Advantages and short comes of PET/CT
  - Possible solutions to the short comes
- QA for quantitative PET imaging
- New features in PET/CT scanners
- Future developments in PET/CT imaging

WHAT IS PET?

- **Functional imaging modality as compared to structural**



- **Functional images show:**
  - **Blood flow**
  - **Glucose metabolism**
  - **Receptor density**



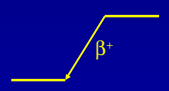
Principles of PET Imaging

- **Injection of a radioactive tracer to image chemical/biological processes.**
- **Radioactive tracer decays by Positron Emission.**
- **When the tracer is introduced into the body, its site-specific uptake can be traced by means of the labeled atom.**

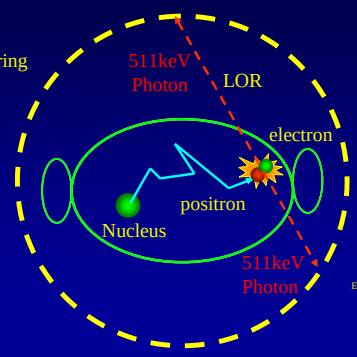
Positron Decay

$$p = n + \beta^{+} + \upsilon$$

- A nucleus with too low a neutron-to-proton ratio converts a proton to a neutron, emitting a positron (β^{+}) and a neutrino (υ) to carry off the excess energy.

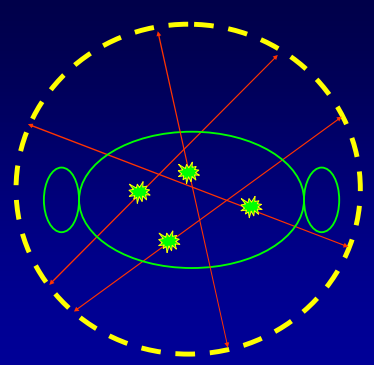


Annihilation

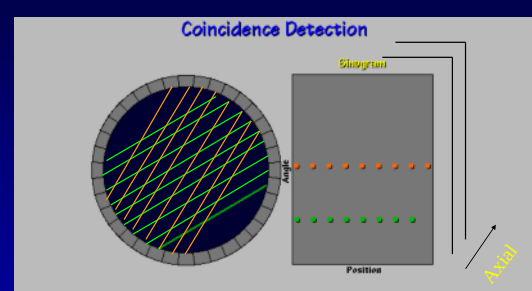


$E=mC^2$

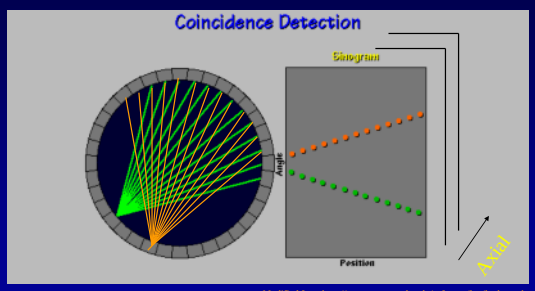
Electron rest mass = 9.11×10^{-31} kg
$C=3.0 \times 10^{8}$ m/s
1 joule =1 kg m^2/s^2
1 e = 1.602x10-19 coulomb
1 eV = 1.602×10^{-19} J
Thus: E =1.02 MeV



LOR Data Storage

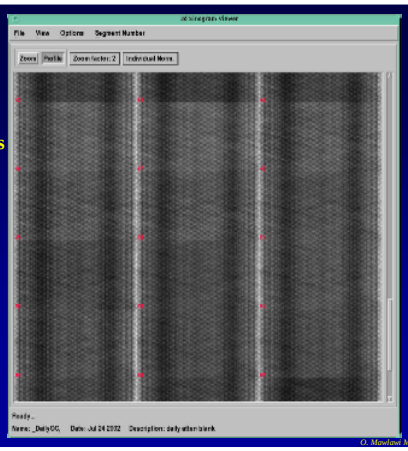


Modified from http://www.crump.ucla.edu/software/lpp/lpphome.html



Modified from http://www.crump.ucla.edu/software/lpp/lpphome.html

Sample Sinograms



Quantification: Power of PET

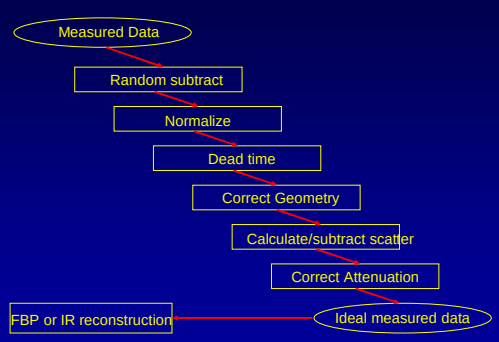
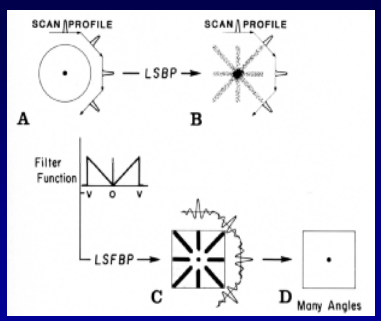
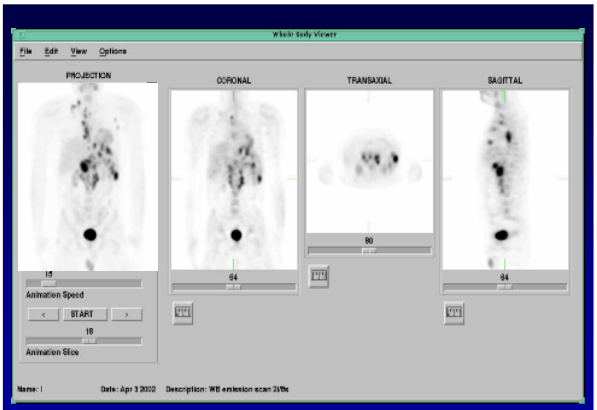


Image reconstruction

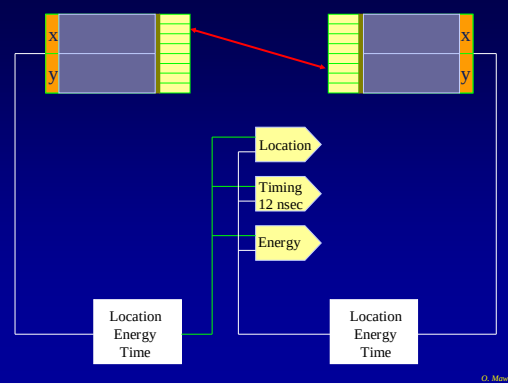


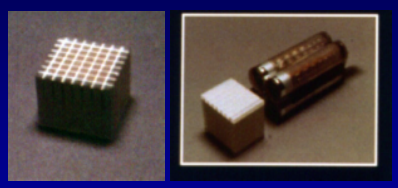
after the application of several corrections

From physics in Nuclear medicine Sorenson and phelps



Overall LOR Determination process





8*8 Scintillation block Block / PMT setup

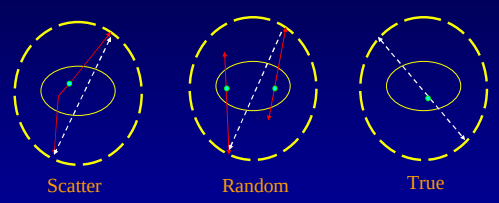
Physical Properties of PET Scintillators

Material	BGO	GSO	LSO	NaI(Tl)	LYSO*
Density	7.1	6.7	7.4	3.7	-
Atomic number, Z	75	59	66	51	-
μ, cm^{-1} @ 511 keV	0.95	0.70	0.88	0.34	0.80
Mean free path, mm	10.5	14.1	11.4	29.1	12.5
Photofraction, %	40	25	32	17	35
Light Output, photons/MeV	9000	8000	30000	41000	31500
Decay time, ns	300	60	40	230	40
λ, nm	480	440	420	410	-
Energy resolution, %FWHM	12	9	10	8	15
Hygroscopic	No	No	No	Yes	No
Index of Ref.	2.15	1.85	1.82	1.85	-

Adapted from: Zanzonico et al. Sem. Nuc. Med. vol 34 No 2 2004

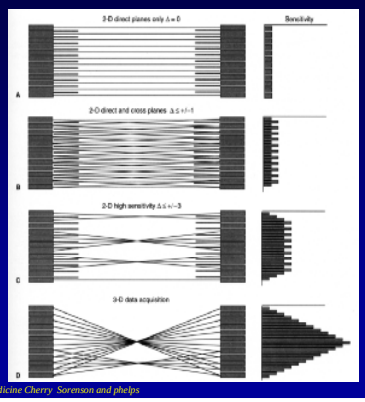
*Properties supplied by GE Healthcare.

Type of recorded events



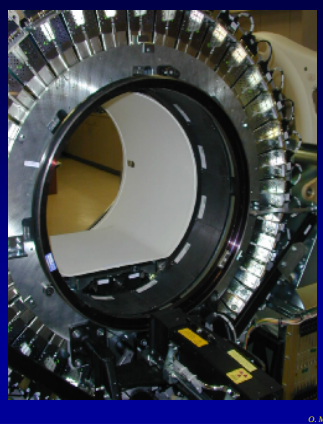
Total events = Trues + Randoms + Scatter

2D vs 3D PET imaging



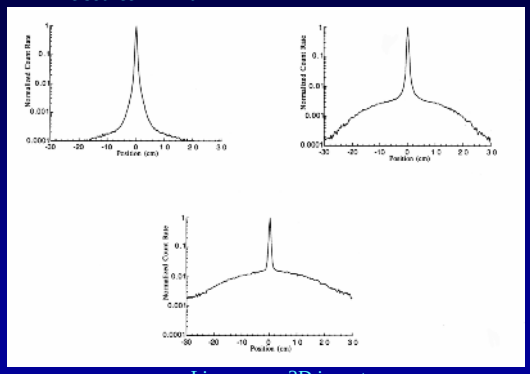
From physics in Nuclear medicine Cherry Sorenson and phelps

Inter-plane Septa



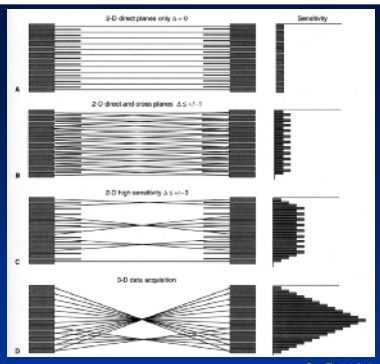
Line source 2D in air

Line source 2D in water



Line source 3D in water

The theory and practice of 3D PET by Bendriem and Townsend



From: Physics in Nuclear Medicine Cherry S et al.

Increase in sensitivity in 3D over 2D

* less injected activity → less cost
* less patient exposure
* shorter scanning time

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Quantification: Power of PET

Measured Data
↓
Random subtract
↓
Normalize
↓
Dead time
↓
Correct Geometry
↓
Calculate/subtract scatter
↓
Correct Attenuation
↓
Ideal measured data
→
FBP or IR reconstruction

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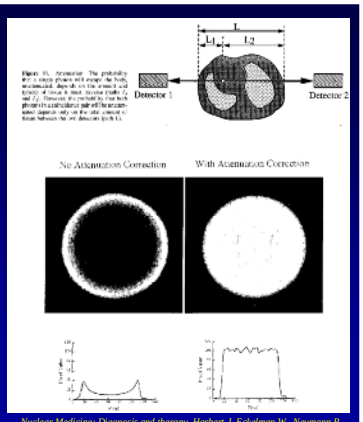
$$P_1 = e^{-\mu L_1} \qquad P_2 = e^{-\mu L_2}$$

$$P_1 * P_2 = e^{-\mu L}$$

Attenuation is dependant on the path length and not the depth of the source of activity

Four ways to get an attenuation map
1) Measured (MAC)
2) Calculated (CAC)
3) Segmented (SAC)
4) CT based (CTAC)



Nuclear Medicine: Diagnosis and therapy. Harbert J, Eckelman W., Neumann R.

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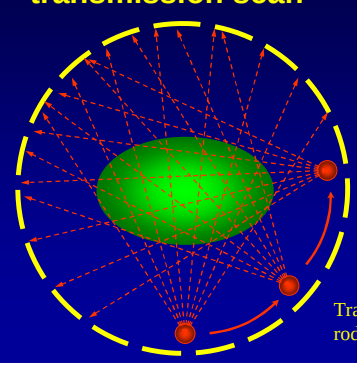
Attenuation correction using transmission scan



Transmission rod source (^{68}Ge)

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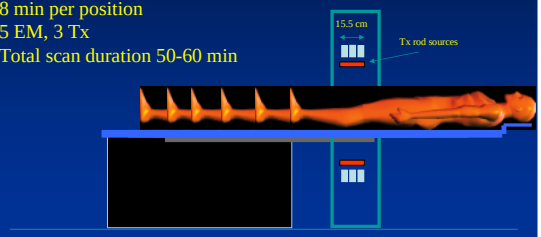
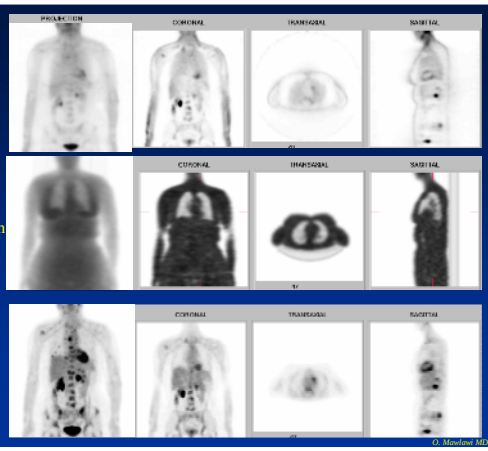
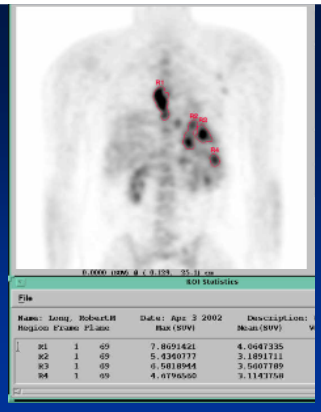
Dedicated PET Imaging

- Emission (2D mode)
- Transmission (scans are interleaved)
- 5 to 6 bed positions
- 8 min per position
- 5 EM, 3 Tx
- Total scan duration 50-60 min





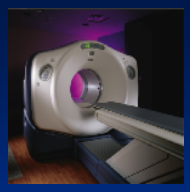


SUV = (Measured activity * Patient weight)/Injected dose

Disadvantages of dedicated PET imaging techniques

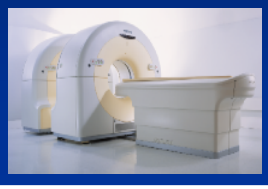
- Transmission
  - Noise due to low gamma ray flux from rod source
  - Transmission is contaminated by emission data
- Scan duration
  - Time consuming (emission & transmission)
  - Increased patient movement (image blurring)
- Efficiency
  - Decreased patient throughput
  - Difficulty in correlating images to other diagnostic modalities accurately

Hybrid Imaging



GE Discovery ST

Siemens/CTI Biograph

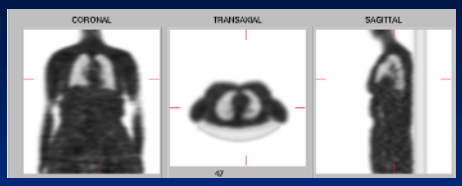


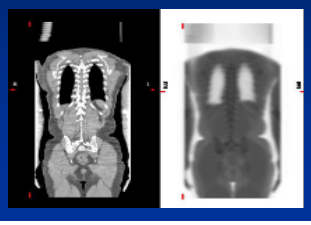
Phillips Gemini

PET/CT: rationale

- Short duration, low noise CT-based attenuation correction
- Improved patient throughput (< 30 min total scan duration)
- Combines functional (PET) and anatomical (CT) imaging
- PET and CT components can be operated independently
- Fully quantitative, whole-body images for SUV calculation
- Improved patient comfort and convenience (single scan)
- Improved imaging accuracy for therapy planning & monitoring

Short duration, low noise CT-based attenuation correction

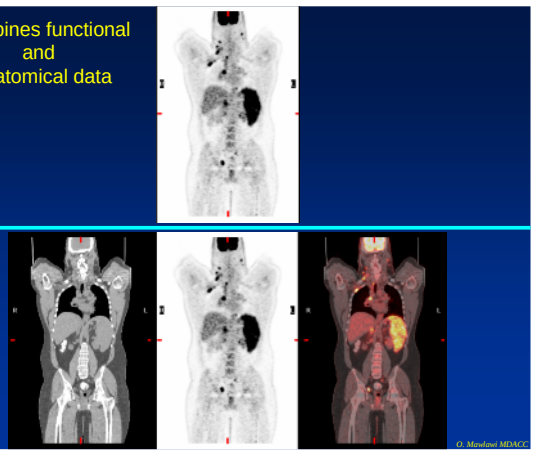




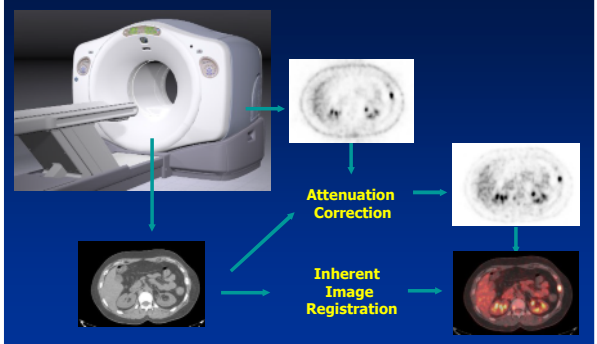
Improved patient throughput

- Replace Tx scan by CT scan
- 3-5 min Tx scan duration
- 5-7 FOVs ➔ 15-35 min of Tx scanning
- CT scan for whole body is about 1min
- About 30 min of time saving per patient
- Dedicated PET scan duration of 50 min
- PET/CT scan duration of 20 min

Combines functional
and
Anatomical data

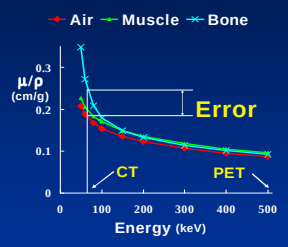


CT based attenuation correction



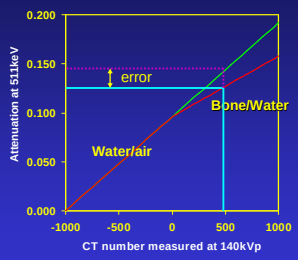
Attenuation Scaling with Energy

- Attenuation Values are Energy Dependent
- Water (Soft Tissue) and Bone are Different
- Solution is to Segment Image into Tissue and Bone and Scale Separately



Converting CT Numbers to Attenuation Values

- For CT values < 0 , materials are assumed to have an energy dependence similar to water
- For CT values > 0, material is assumed to have an energy dependence similar to a mixture of bone and water
- The green line shows the effect of using water scaling for all materials



Types of Artifacts

PET/CT imaging artifacts are due to :

- Contrast media
- Truncation
- Respiratory motion
- Metal implants

Converting CT Numbers to Attenuation Values

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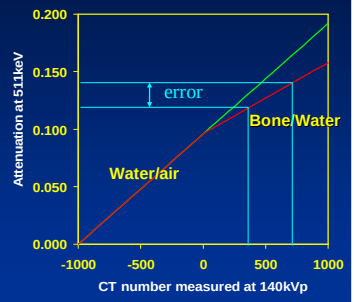
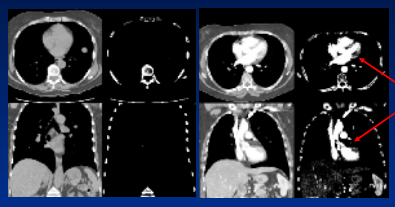
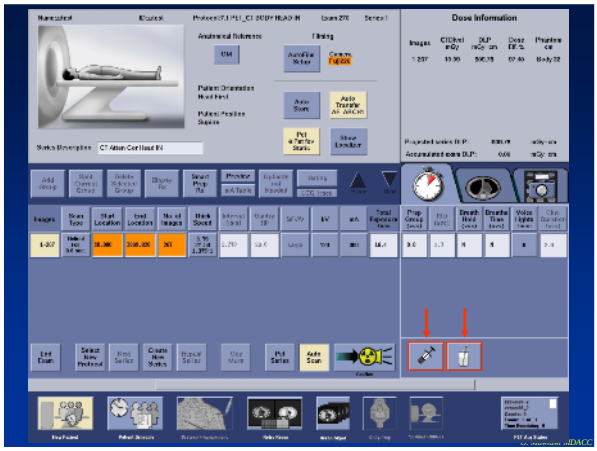
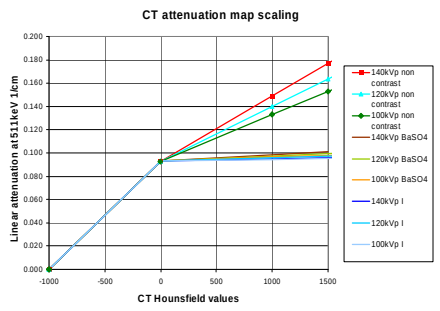


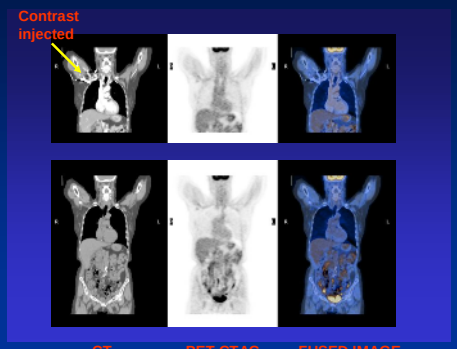


Contrast: Optiray 320, 100cc, 3cc/sec





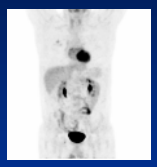
Contrast Artifact- Intravenous



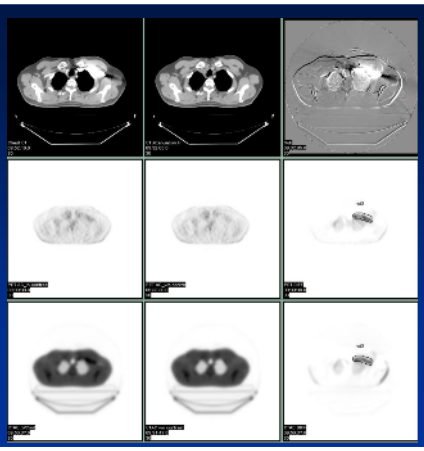
CT PET CTAC FUSED IMAGE

With contrast

Without contrast



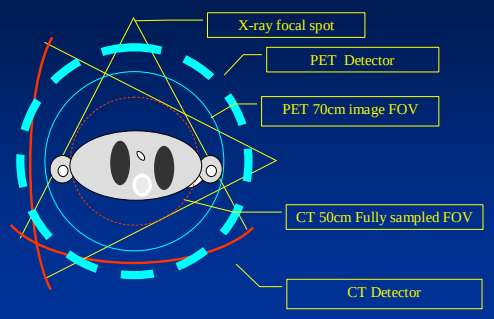
61 year male with history of esophageal cancer



SUV change
1.23 to 1.90
54% inc

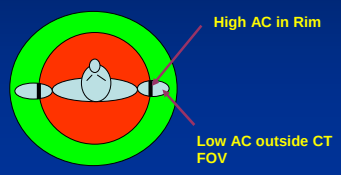
Truncation

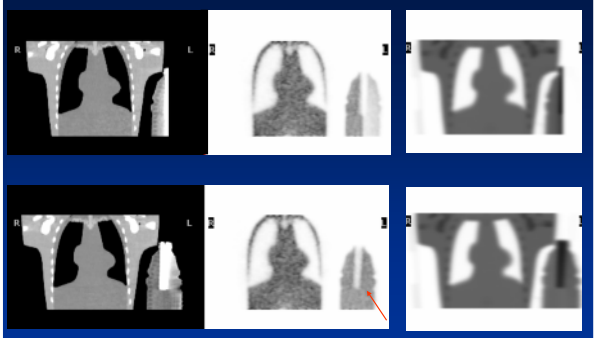
CT and PET Fields of View



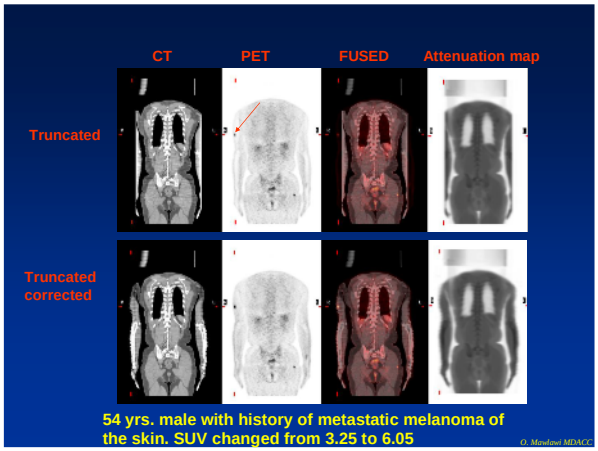
Truncation artifact appears as:

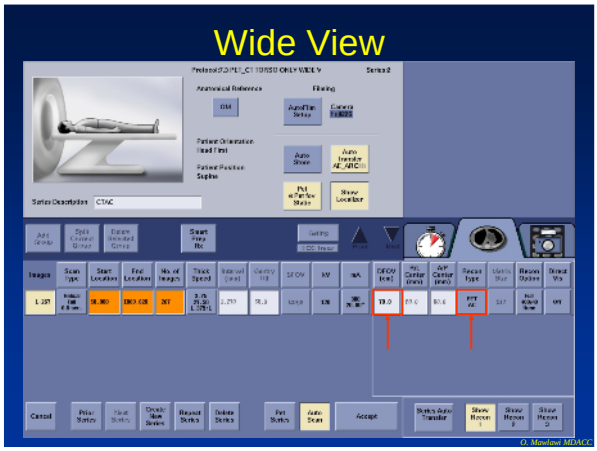
1. Rim of high activity concentration (AC) at the truncation edge in the PET image
2. Area of low activity concentration in the region extending beyond the CT FOV on the PET image due to the absence of attenuation coefficients.





Activity concentration recovered to within 5% of original value





Metal Artifacts

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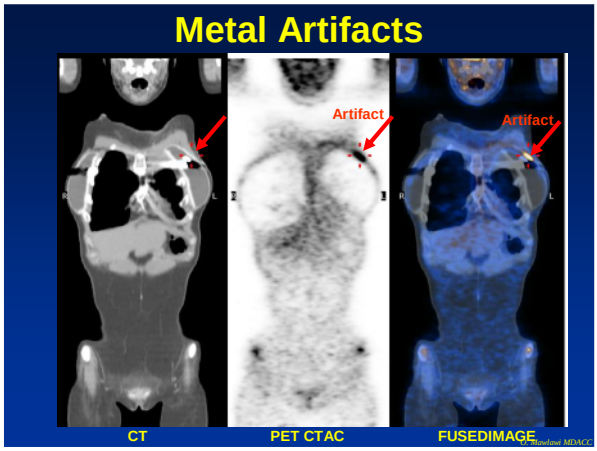
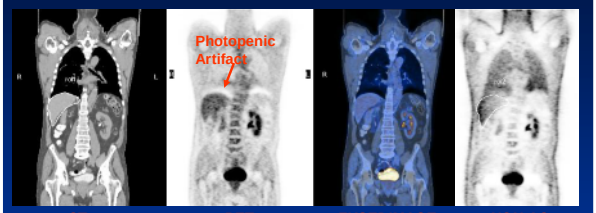


Breathing Artifacts

Breathing Artifact- Curvilinear Cold Areas

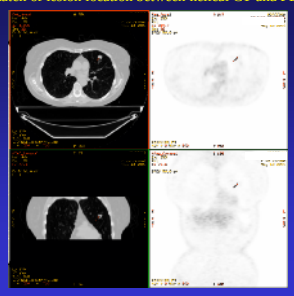


CT PET FUSEDIMAGE NON AC

- CT scans acquired at full inspiration result in a downward displacement of the diaphragm due to the expansion of the lungs.
- Attenuation coefficients in this region will be underestimated since they represent air rather than soft tissue.
- The attenuation corrected PET images will result in a curvilinear cold area corresponding to this region.

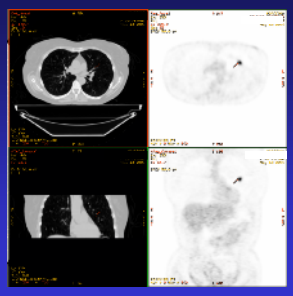
Breathing Artifact

Mismatch of lesion location between helical CT and PET

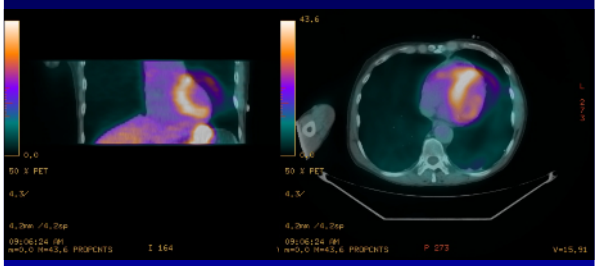


Breathing Artifact

Mismatch of lesion location between helical CT and PET



Mismatch between PET and CT – Cardiac Application

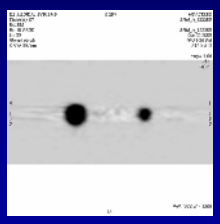


Courtesy of J. Brunetti, Holly name

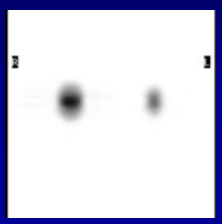
Blurring due to object motion during data acquisition

⬇

Underestimation of Activity concentration



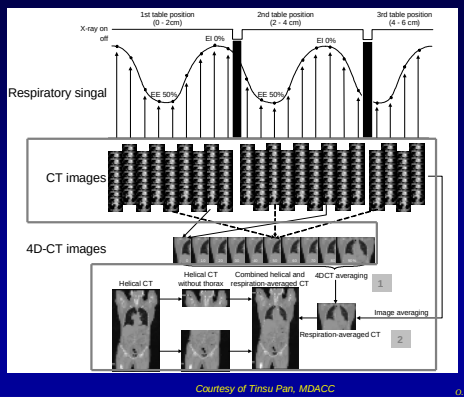
Stationary



Moving

Possible solutions

Average CT – 4D CT

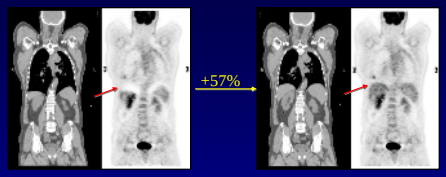


Courtesy of Tinsu Pan, MDACC

Clinical Studies

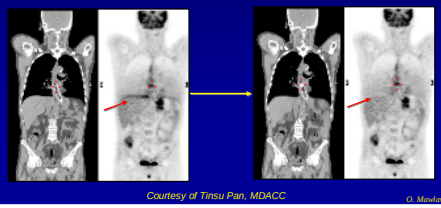
Mismatch 1:

CT diaphragm position lower than PET



Mismatch 2:

CT diaphragm position higher than PET



Courtesy of Tinsu Pan, MDACC

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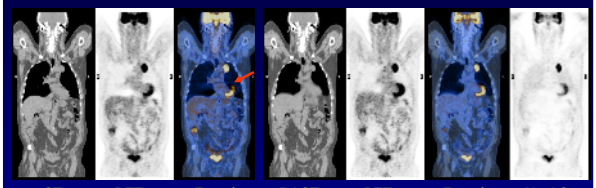
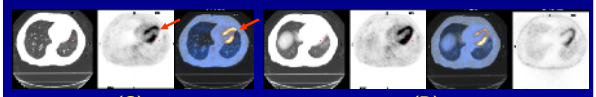


CT PET Fused RACT PET Fused No AC

(A) (B)



(C) (D)

Courtesy of Tinsu Pan, MDACC

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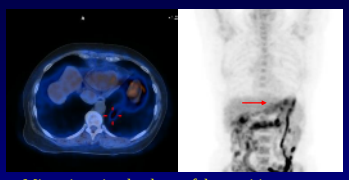
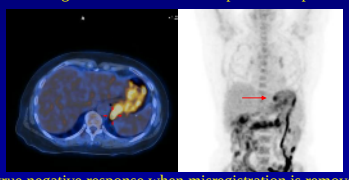
Improve the restaging after chemo



Misregistration lead to a false positive response to chemo.



A true negative response when misregistration is removed with ACT

Courtesy of Tinsu Pan, MDACC

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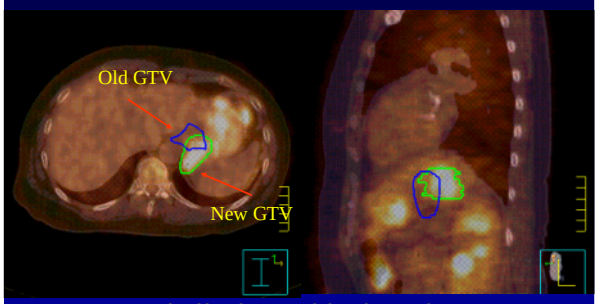
Impact on treatment planning



Previous GTV was outlined based on CT and clinical PET without motion correction.
New GTV was redefined based on the correct information from PET with ACT.

Courtesy of Tinsu Pan, MDACC

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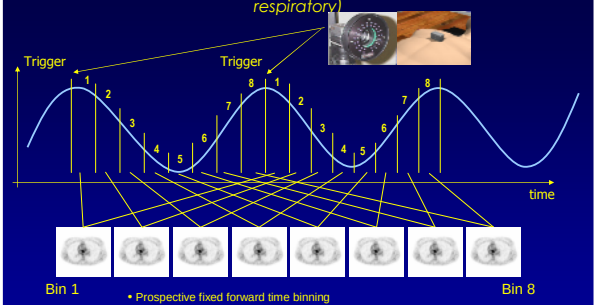
Gated PET *(Used to image repetitively moving objects: cardiac, respiratory)*



- Prospective fixed forward time binning
- Ability to reject cycles (cardiac) that don't match
- Single 15 cm FOV Gated PET
- User defined number of bins and bin duration
- As number of bins increase, the duration and motion per bin decreases. However images will be noisy unless acquired for longer durations.

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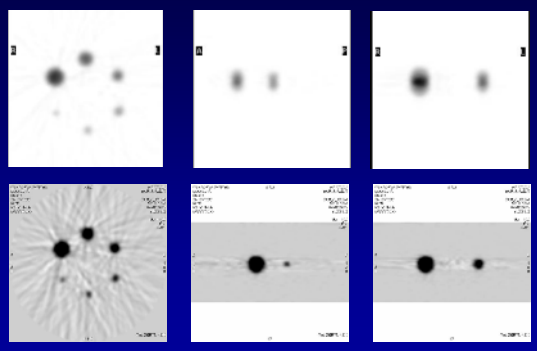
4D-Gated PET



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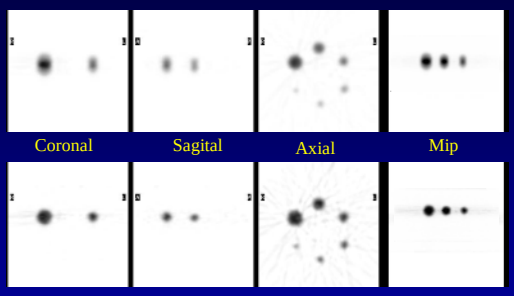
Phantom Study



Sphere (volume)	Gated	Static	Error (%)
1 (16.5 cc)	31624	33546	-6.1
2 (8.4 cc)	31316	21872	30.2
3 (4 cc)	29919	20607	31.1
4 (2 cc)	22857	13643	40.3
5 (1 cc)	19087	8264	56.7
6 (0.5 cc)	11897	5143	56.8

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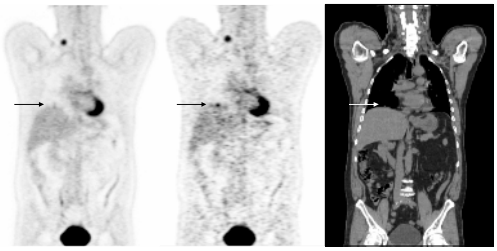
Impact of Whole-body Respiratory Gated PET/CT

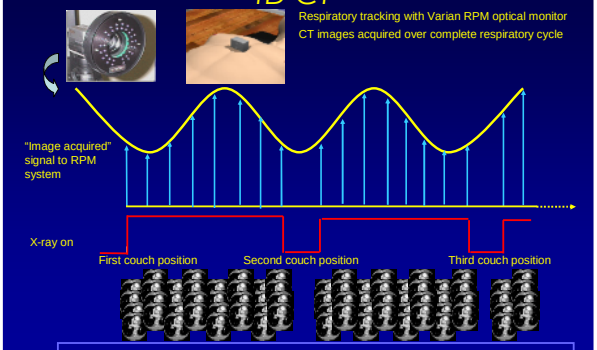


Static wholebody | Single respiratory phase (1 of 7, so noisier) | 1 cc lesion on CT

- The max SUV of the lesion goes from 2 in the static image to 6 in the respiratory-gated image sequence

Courtesy of P Kinahan, UW

New CT Application… Advantage 4D CT



Respiratory motion defined retrospective gating

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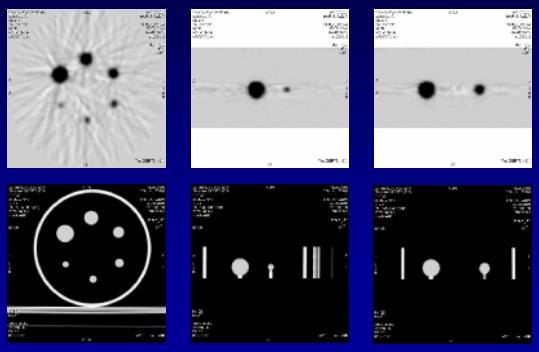
4D-PET/CT



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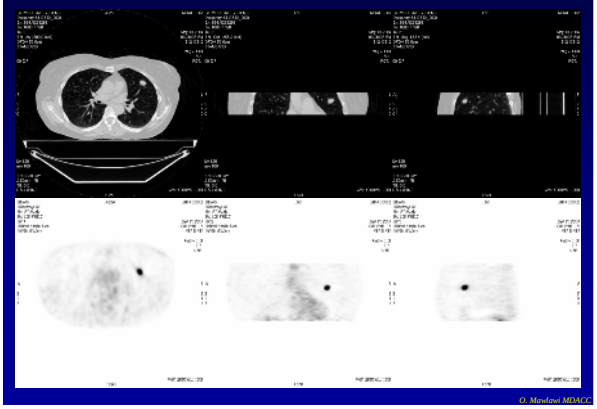
4D PET/CT



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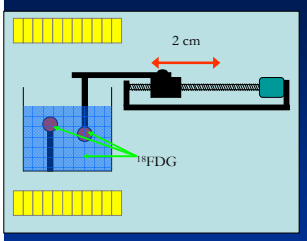
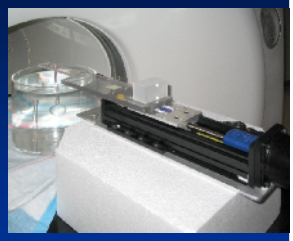
Phantom Study





Sphere-to-Background Ratio: 5.18
Total Activity: 2.49mCi
Scan Duration: 3 min
Number of Time Bins: 10

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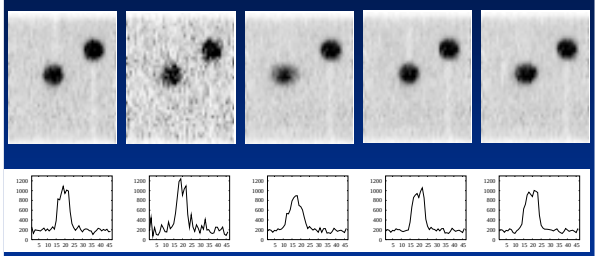
Phantom Study Results



Quality Assurance in Quantitative PET/CT

Definitions

- Quality Assurance
  - "….. systematic monitoring and evaluation of the various aspects of a project, service, or facility to ensure that standards of quality are being met"

http://www.webster.com/dictionary/quality%20assurance

- Quality Control
  - "an aggregate of activities (as design analysis and inspection for defects) designed to ensure adequate quality especially in manufactured products"

http://www.webster.com/dictionary/quality%20control

Quantitative PET Performance

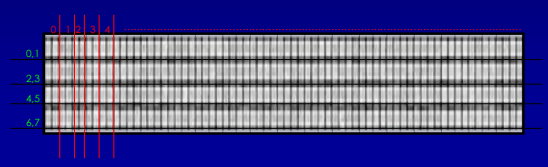
3 Factors that may affect SUV measurements

- Patient Compliance
  - Fasting
  - Blood Glucose levels
- Scan Conditions
  - Scan time post injection
  - Patient anxiety/comfort during uptake (room temperature, etc.)
  - Patient motion during acquisition
  - PET/CT artifacts
- Intrinsic System Operating Parameters
  - Calibration
  - QA – Maintenance of operating parameters
  - System performance characterization
  - Image processing algorithms

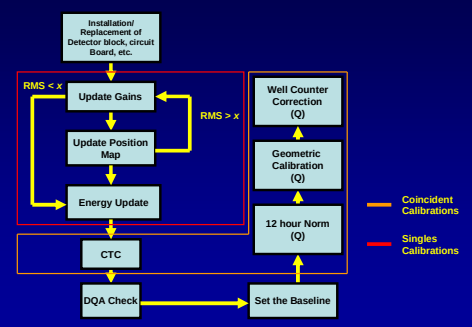
PET Detector Array Format and Design

Discovery STe example…

- Detector Array consists of 35 modules (0-34)
- Each module consists of 8 blocks (0-7)
- Each block consists of 8 x 6 BGO crystal array
- 1 Timing circuit per crystal pair
- 35*8*(8x6)= 13440 total detectors



PET Detector Calibration Overview



Daily Quality Assurance Baseline

- A baseline QA acquisition is taken after Singles and Coincidence calibration are performed following installation of the system
- A baseline QA acquisition is also performed whenever a detector block or circuit board has been replaced
- Used to construct ratio image comparing current DQA results with this baseline acquisition

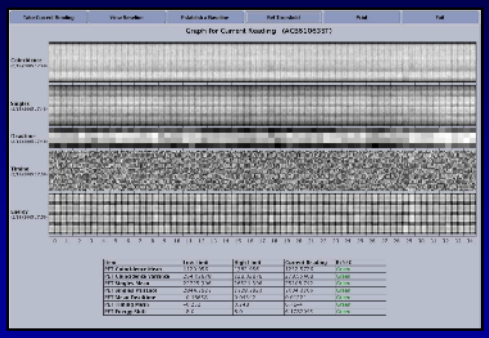
PET Daily QA Scan

- Uses Ge-68 source pin that rotates across face of detector array
- Includes a ~2 min normalization component in which counts from the source flood are acquired
- Also includes a daily CTC after flood acquisition is complete
- Generates a visual map of detector array used to validate detector functionality
- Generates statistics used to indicate scanner performance

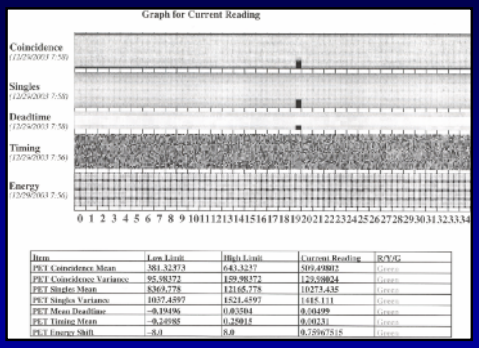
Daily Quality Assurance Scans

- Purpose
  - To ensure that optimal clinical images will be obtained from the scanner on a daily basis
  - To quantitatively compare scan results with manufacturer and institutional specifications and standards
  - To enforce appropriate device usage by the technologist
  - To allow baseline data to be available in order to derive functional trends in image quality

PET Daily QA Scan



PET Daily QA Scan

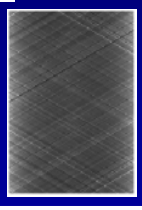


Item	Low Limit	High Limit	Current Reading	R/Y/G
PET Coincidence Mean	381.32373	643.3237	519.49802	Green
PET Coincidence Variance	95.98372	159.98372	129.98024	Green
PET Singles Mean	8369.778	12165.778	10273.435	Green
PET Singles Variance	1037.4597	1521.4597	1485.111	Green
PET Mean Deadtime	−0.19496	0.83504	0.04199	Green
PET Timing Mean	−0.24985	0.25015	0.00231	Green
PET Energy Shift	−8.0	8.0	0.75967515	Green

Pre-Normalization

Post-Normalization

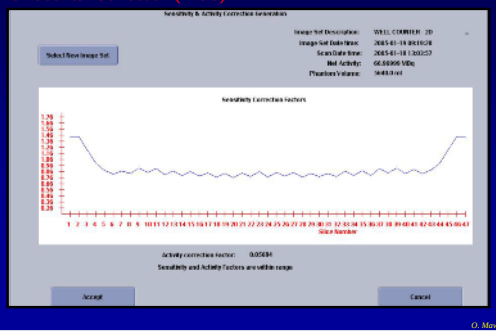
Normalization sinogram



Courtesy of magnus Dahlbom

Coincidence Calibrations

- Well Counter Correction (WCC)



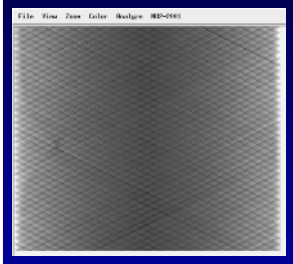
Coincidence Calibrations

- Pre-calibrated Phantom

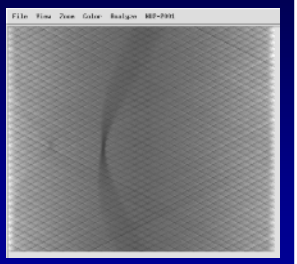
Coincidence Calibrations

- Pre-calibrated Phantom
  - Pros
    - Eliminates need to prepare a source, fill and calibrate a phantom
  - Cons
    - Based on phantom manufacturer's dose calibrator readings
    - Patient studies based on site dose calibrator readings
    - Therefore, there exists a potential discrepancy between the dose calibrators used to calibrate the scanner, and the dose calibrators used to assay the doses of patient studies performed on the scanner (un-correlated)

Normalization effects

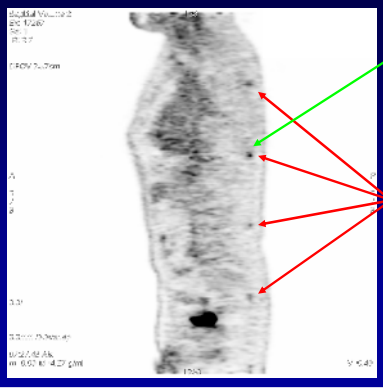


Good Norm



Bad Norm

Effect of bad Normalization



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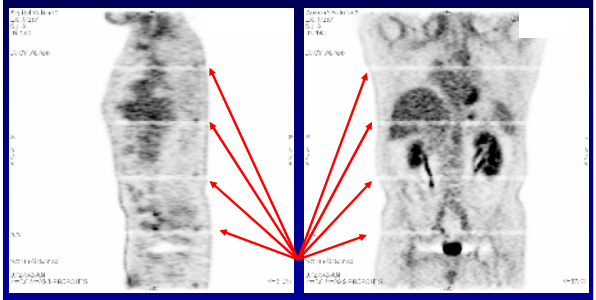
Effect of wrong WCC



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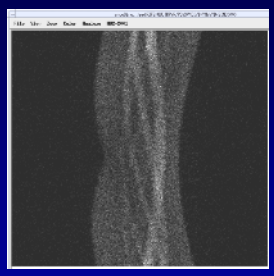
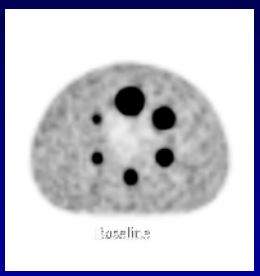
Effects of Bad Blocks





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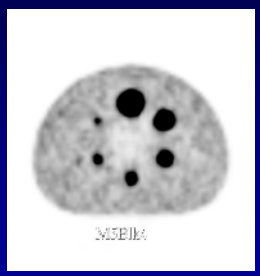
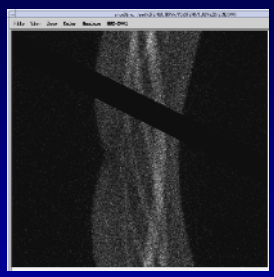
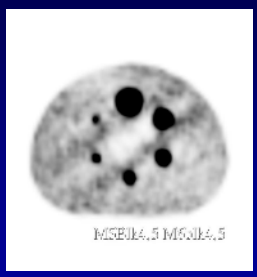
Effects of Bad Blocks

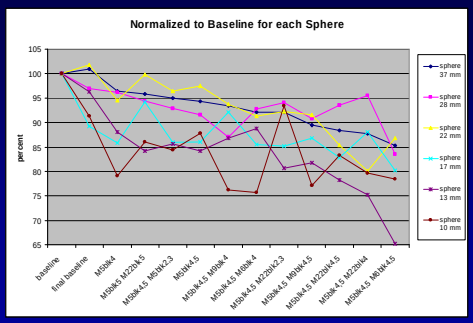


O. Mawlawi MDACC

Effects of Bad Blocks







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  - QA – Maintenance of operating parameters
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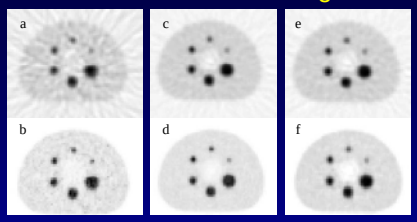
  - Image processing algorithms

Effect of Reconstruction Algorithm



(a) 2D-FBP; (b) 2D-OSEM; (c) 3D-RP; (d) 3D-IR; (e) 3D-FORE+FBP; (f) 3D-FORE+OSEM.

AC max under different reconstruction algorithms (Bq/cc)

($x10^4$)	Sphere 1	Sphere 2	Sphere 3	Sphere 4	Sphere 5	Sphere 6
Algorithm a	3.03	2.74	2.52	2.30	1.75	1.12
Algorithm b	3.14	3.14	2.82	2.90	2.14	1.74
Algorithm c	2.83	2.76	2.62	2.41	1.60	1.07
Algorithm d	2.93	2.92	2.98	3.21	2.19	1.33
Algorithm e	2.78	2.75	2.64	2.40	1.59	1.10
Algorithm f	2.85	2.74	2.71	2.52	1.65	1.09

A

3D IR
2it 20sub

B

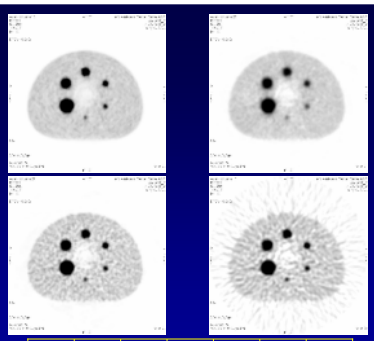
3D FORE
2it 5sub

C

3D FORE
5it 28sub

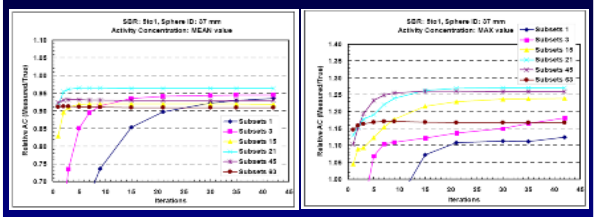
D

3D FORE
FBP

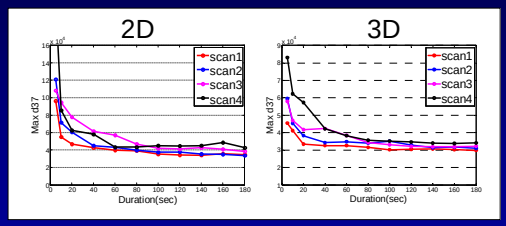


Max SUVbw in different spheres

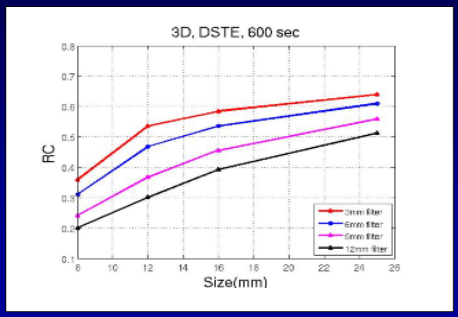
	1	2	3	4	5	6
A	10.8	10.3	9.9	8.9	6.5	3.8
B	8.6	7.6	6.6	5.5	3.9	2.8
C	10.3	9.7	9.1	8.3	6.3	4.7
D	10.4	9.3	9.3	7.7	5.9	4.8



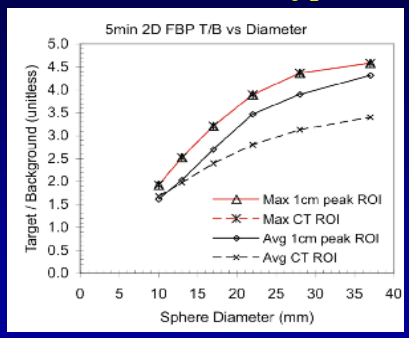
Effect of scan duration and count density on maximum AC



Effect of smoothing on measured AC



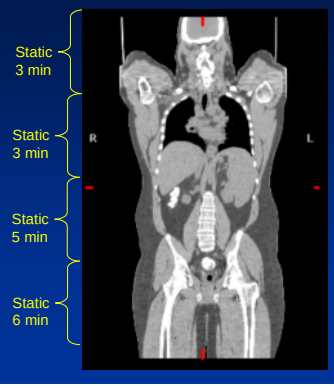
Effect of ROI type



Courtesy of Kinahan UW

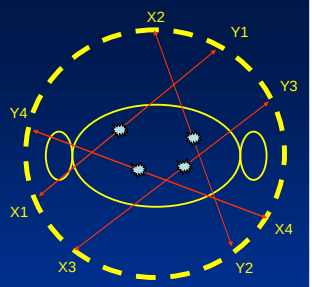
New PET Scanner Features

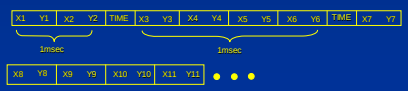
PET data acquisition of different duration per FOV



LIST Mode

- Time ticks are fixed at 1msec intervals
- The number of events between time ticks depends on the amount of activity in the field of view
- The more activity, the more the events between time ticks.
- Very flexible, data can be rebinned as static, dynamic, or gated.
- Requires large amount of memory





LIST data format

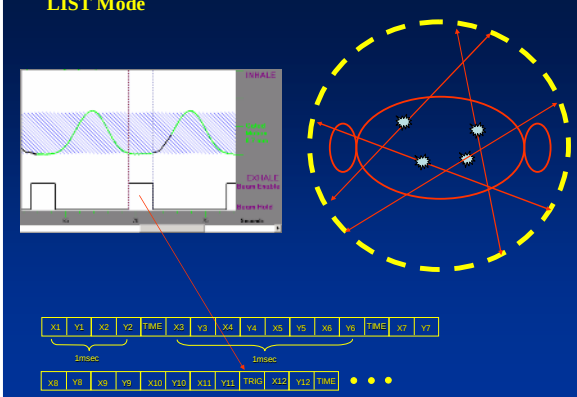
Section of a list file (141MB) using a 25MBq (0.7mCi) Ge-68 rod source acquired for a duration of 15 seconds.

Advantages of List mode acquisition:

- Ability to post process the data using different prescriptions.
- Mode of acquisition can be varied (static, dynamic, gated….)
- Duration of the scan can be changed (compare different scan durations)
- Chop off data segments based on user definition.

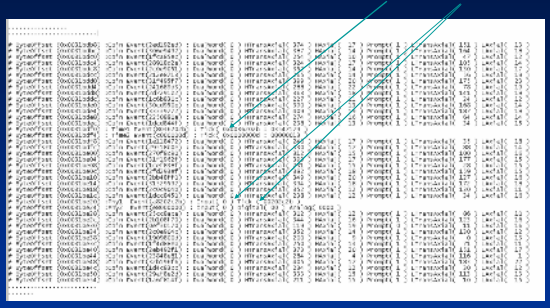
List mode allows rebinning of acquired data into different durations

LIST Mode



LIST data format

Triggers allows for double gating – resp and cardiac



Section of a list file (141MB) using a 25MBq (0.7mCi) Ge-68 rod source acquired for a duration of 15 seconds.

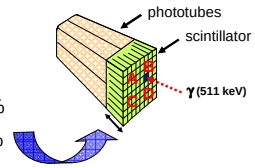
New PET Scanner Designs

Improved sensitivity with TrueV SIEMENS

- *thicker LSO crystals*

  20 mm ➔ 30 mm
- LSO volume increase: 50%
- sensitivity increase: 40%

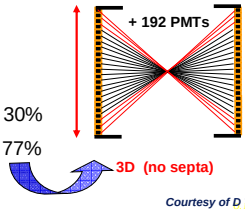
  ★ **planar sensitivity**



- *extended axial FOV*

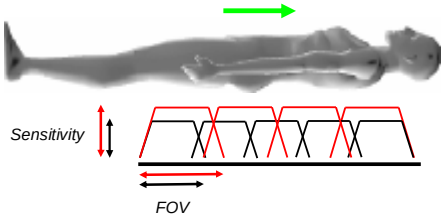
  16.2 cm ➔ 21.6 cm
- LSO volume increase: 30%
- sensitivity increase: 77%

  ★ **volume sensitivity**



Courtesy of D Townsend

Advantages of the extended Axial Field-of-View

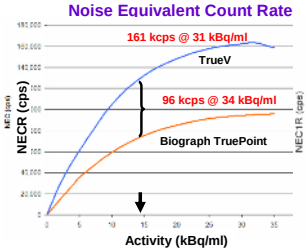


- increased sensitivity = shorter imaging per bed (or more counts)
- larger axial FOV = fewer bed positions for same axial coverage
- reduction in imaging time (or dose) of ~2 for comparable quality

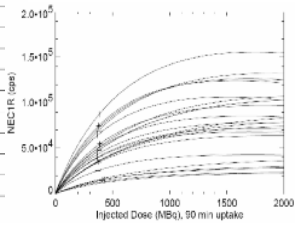
Courtesy of D Townsend

Biograph TruePoint performance

Noise Equivalent Count Rate



Patient NECRs



Sensitivity (cps/kBq)

Biograph TP	4.49
TrueV	8.10

Spatial resolution (mm)

	transverse	*axial*
Biograph TP	4.1	4.5
True V	4.2	4.7

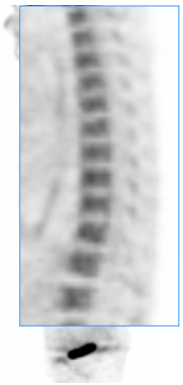
Scatter (%) (425 keV)

Biograph TP	34 %
TrueV	34 %

Courtesy of D Townsend

Staging head and neck cancer **Biograph 6 TrueV**

Molecular Imaging Program



Scan duration: 10 min

5/06
10.4 mCi, 90 min pi
108 lbs; 2 min/bed, 5 beds
4i / 8s; 5f

Courtesy of D Townsend

SIEMENS

BrainPET* **for MAGNETOM Trio, A Tim System**

* Works in Progress. The information about this product is preliminary. The product is under development and is not commercially available in the U.S., and its future availability cannot be ensured.

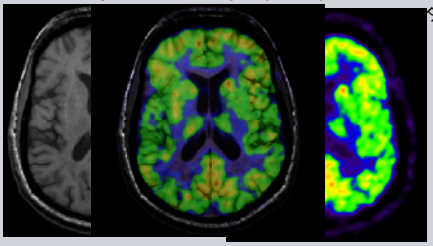
Innovation is in our genes.

SIEMENS

BrainPET for MAGNETOM Trio,
The first results

Works in Progress. The information about this product is preliminary. The product is under development and is not commercially available in the U.S., and its future availability cannot be ensured.

First ever *in-vivo* images simultaneously acquired by MR and PET (17.11.06)



MR MR-PET PET

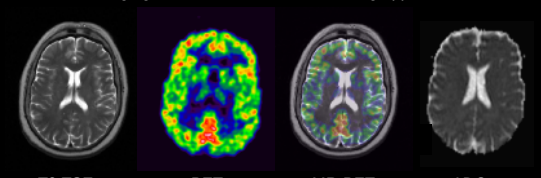
Courtesy of Townsend and Nahmias University of Tennessee, USA and Schlemmer, Pichler, Claussen University of Tuebingen, Germany

Innovation is in our genes.

BrainPET for MAGNETOM Trio, A Tim System
The first results

SIEMENS

Artifact free imaging even with the most demanding applications



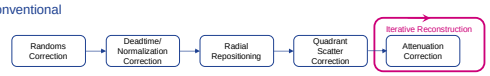
T2 TSE | PET | MR-PET | ADC

Diffusion EPI sequence applied during PET acquisition.

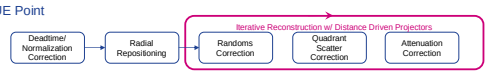
Courtesy of University of Tennessee, USA and University of Tuebingen, Germany

VUE Point – Iterative Reconstruction

Conventional

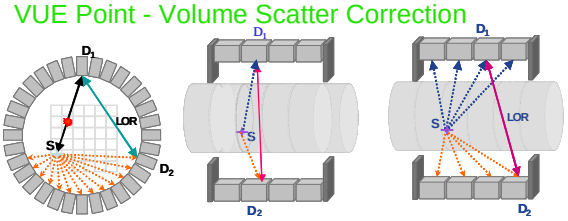


VUE Point



VUE Point HD (mid-2007 update)

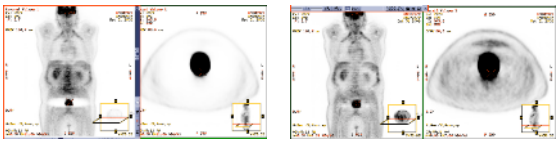
VUE Point - Volume Scatter Correction



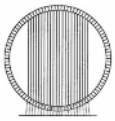
Quadrant Scatter Correction
- Direct block scatter LOR
- Single-quadrant processing
- High activity ratio artifact

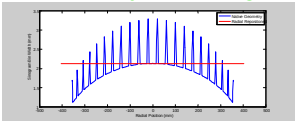
Volume Scatter Correction
Cross block scatter LOR
Multi-quadrant processing
Reduced artifact potential

Discovery ST



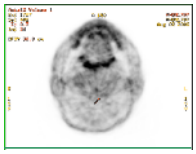
VUE Point – Detector Geometry Modeling

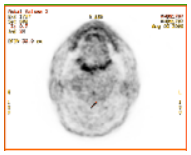




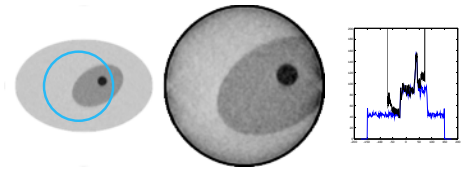
Radial Repositioning (former)
- Data into evenly spaced grid for Fourier filtering
- Crystal position model includes effects of block gaps and "average" penetration
- Output data determined by linear interpolation between data points

Detector Geometry Modeling
- Allows all corrections to be included in loop (normalization/deadtime)
- Improvement in resolution
- Eliminates noise correlation introduced by radial repositioning
- Reduction in spoke artifact





VUE Point – Targeted Iterative Reconstruction



• Targeted Iterative Reconstruction may lead to artifacts and quantitative inaccuracy if the data outside the FOV is not considered

• A full FOV (left) and targeted FOV (center) reconstruction of a simulated phantom (blue circle indicates the bounds of the targeted region)

• Horizontal profiles through the full FOV (blue) and targeted FOV (black) are shown in the graph on the right.

VUE Point – Targeted Iterative Reconstruction

An Improved Solution: Keyhole Reconstruction

A more efficient method to accomplish the targeted reconstruction can be described in the following steps:

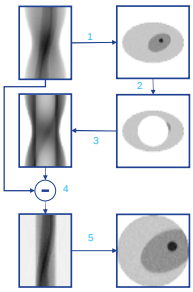
1.) Reconstruct the full SFOV at a pixel pitch greater than the desired final pixel pitch in the DFOV

2.) Zero out the pixels in this image corresponding to the DFOV

3.) Forward-project the resulting image to create a sinogram representing the activity outside the DFOV

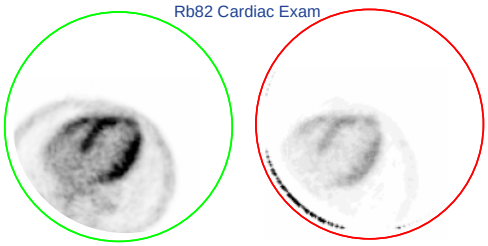
4.) Subtract sinogram from the original data set, to leave a data set representing only activity from inside the DFOV

5.) Reconstruct this sinogram at the desired pixel pitch to create the final, targeted image



VUE Point – Targeted Iterative Reconstruction

Rb82 Cardiac Exam



Targeted Iterative Reconstruction "Keyhole Technique"

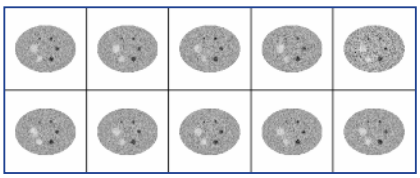
Targeted Iterative Reconstruction "Conventional Technique"

VUE Point – Detector Normalization

- Detector Geometry Reconstruction enables normalization & deadtime to be included in the iterative reconstruction loop
- Normalization & deadtime corrections in the loop increase detector variation stability
- Phantom simulation, 300k counts, 2D image
  - edge crystals with 100%, 80%, 60%, 40%, 20% efficiency of the center crystals

Pre-correction Normalization

"In-the-loop" Normalization

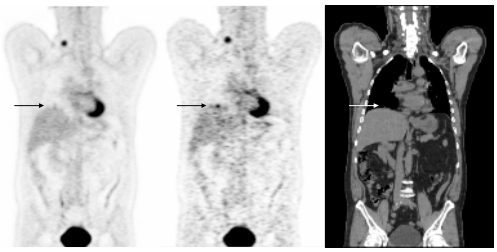


0 20 40 60 80

% degradation in efficiency of edge crystals w.r.t central crystals

Motion Freeze

Impact of Whole-body Respiratory Gated PET/CT

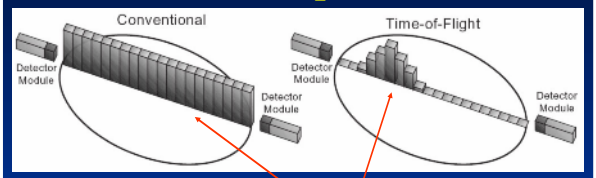


Static wholebody | Single respiratory phase (1 of 7, so noisier) | 1 cc lesion on CT

- The max SUV of the lesion goes from 2 in the static image to 6 in the respiratory-gated image sequence

Courtesy of P Kinahan, UW

Time-of-Flight Acquisition: Principles



$$\Delta x = \frac{\Delta t}{2} c$$

*C = 3*10⁸ m/s*

Back projection along the LOR

O. Mawlawi MDACC

Time of Flight and SNR, examples...

$$\Delta x = \frac{\Delta t}{2} c \qquad SNR_{TOF} \cong \sqrt{\frac{D}{\Delta x}} \cdot SNR_{conv}$$

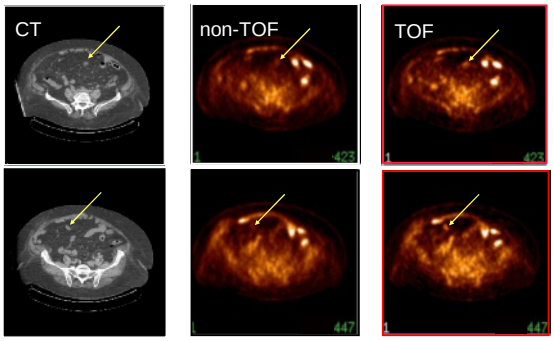
Time Resolution (ns)	Δx (cm)	SNR improvement (20 cm object)	SNR improvement (40 cm object)
0.1	1.5	3.7	5.2
0.3	4.5	2.1	3.0
0.5	7.5	1.6	2.3
1.2	18.0	1.1	1.5

Best measurement on LSO small crystal pair [W. Moses]

Overall present time resolution on HiRez scanner

O. Mawlawi MDACC

Colon cancer 119 kg (BMI = 46.5) 30 min scan

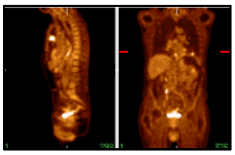


Improvement in lesion detectability with TOF

Average-weight patient study

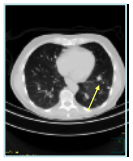
Tongue CA,
lung mets

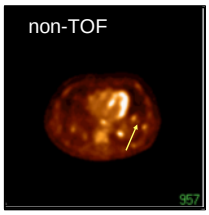
67 kg
BMI = 29.0

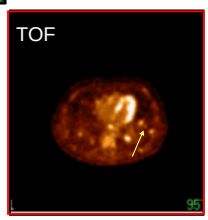


20 min scan

CT



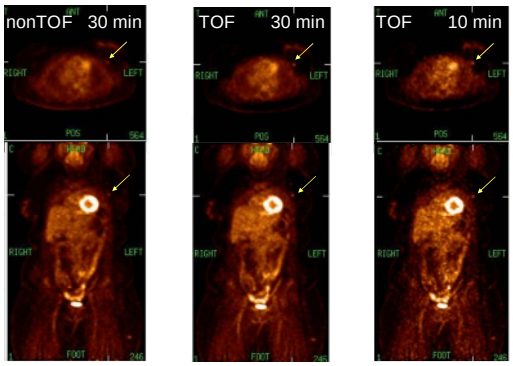




Improvement in lesion contrast with TOF

Courtesy of J. karp

non-Hodgkin's lymphoma 136 kg (45 BMI)



TOF tumor contrast (SUV) higher than non-TOF by 1.5

Courtesy of J. karp

TOF tumor contrast superior to non-TOF for 10 min as well as 30 min scan

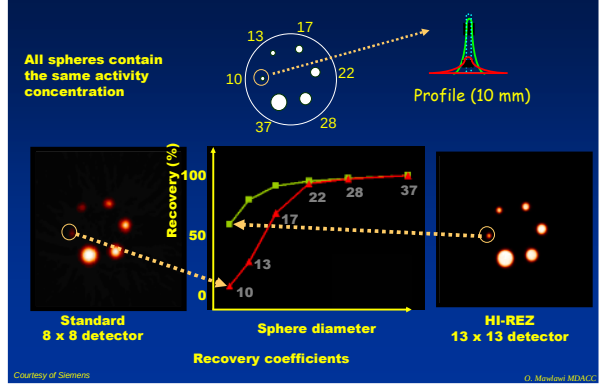
FUTURE

O. Mawlawi MDACC

Mixed acquisition protocol

O. Mawlawi MDACC

Effect on Partial voluming



Courtesy of Siemens

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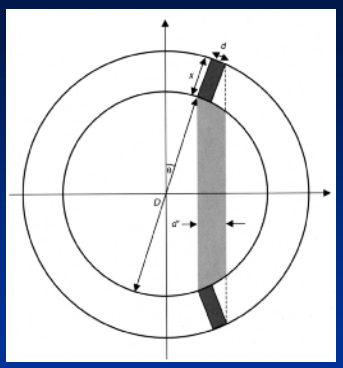
Depth of interaction



From physics in Nuclear medicine Cherry, Sorenson and phelps

O. Mawlawi MDACC

Quantitative PET Performance

3 Factors that may affect SUV measurements

- Patient Compliance
  - Fasting
  - Blood Glucose levels
- Scan Conditions
  - Scan time post injection
  - Patient anxiety/comfort during uptake (room temperature, etc.)
  - Patient motion during acquisition
  - PET/CT artifacts
- Intrinsic System Operating Parameters
  - Calibration
  - QA – Maintenance of operating parameters
  - System performance characterization
  - Image processing algorithms

O. Mawlawi MDACC

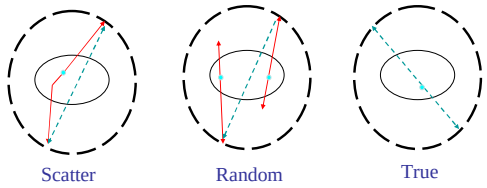
Thank You

O. Mawlawi MDACC

All of the following are types of events that a PET scanner detects ***except***:

25% 1. True Events
25% 2. Scatter Events
25% 3. False Events
25% 4. Random Events

Type of recorded events



Total events = Trues + Randoms + Scatter

10

Attenuation in PET imaging is dependent on:

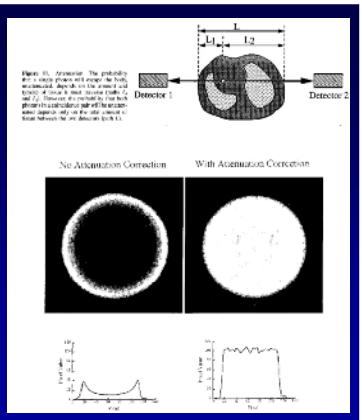
25% 1. Annihilation photons path length
25% 2. Depth of annihilation event in the radioactive source
25% 3. Amount of radioactivity present in the source
25% 4. Number of detectors in the scanner

$$P_1 = e^{-\mu L_1} \qquad P_2 = e^{-\mu L_2}$$

$$P_1 * P_2 = e^{-\mu L}$$

Attenuation is dependant on the path length and not the depth of the source of activity

Four ways to get an attenuation map
1) Measured (MAC)
2) Calculated (CAC)
3) Segmented (SAC)
4) CT based (CTAC)



Nuclear Medicine: Diagnosis and therapy. Harbert J. Eckelman, W. Neumann, P.C.

10

All of the following are advantages of PET/CT imaging over dedicated PET imaging ***except:***

25% 1. Shorter total scan duration
25% 2. Better image resolution
25% 3. Low noise attenuation correction
25% 4. Automatic fusion of functional and anatomical images

10

Disadvantages of dedicated PET imaging techniques

- Transmission
  - Noise due to low gamma ray flux from rod source
  - Transmission is contaminated by emission data
- Scan duration
  - Time consuming (emission & transmission)
  - Increased patient movement (image blurring)
- Efficiency
  - Decreased patient throughput
  - Difficulty in correlating images to other diagnostic modalities accurately

O. Mawlawi MDACC

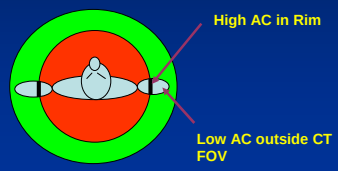
Truncation artifact in PET/CT imaging:

25% 1. Reduces activity concentration in the affected area
25% 2. Increases the activity concentration in the affected area
25% 3. Has no effect on activity concentration in the area of interest
25% 4. Affects mainly small size patients

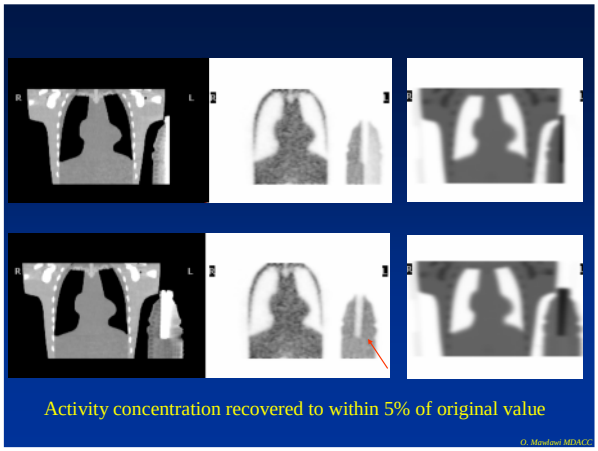
10

Truncation artifact appears as:

1. Rim of high activity concentration (AC) at the truncation edge in the PET image
2. Area of low activity concentration in the region extending beyond the CT FOV on the PET image due to the absence of attenuation coefficients.



O. Mawlawi MDACC



All of the following are PET/CT artifacts due to the use of CT for attenuation correction of PET data ***except***:

25% 1. Contrast media artifact
25% 2. Tube current artifact
25% 3. Metallic artifact
25% 4. Breathing motion artifact

10

Types of Artifacts

PET/CT imaging artifacts are due to :

- Contrast media
- Truncation
- Respiratory motion
- Metal implants

O. Mawlawi MDACC

A well counter calibration in PET imaging is used to:

25% 1. Correct for variations in image uniformity
25% 2. Correct for variations in detector gains
25% 3. Correct for differences in detector coincidence timing
25% 4. Transform detected count rate to activity concentration

10

Coincidence Calibrations

- Well Counter Correction (WCC)