

Optimisation of Computed Tomography (CT) based attenuation correction for Positron Emission Tomography (PET) on a Siemens Biograph mCT Flow PET/CT scanner

G Woolley, E Papadopoulos, TJ Wood, CS Moore and GA Wright
Hull & East Yorkshire Hospitals NHS Trust

Introduction

- CT in PET can be used for a wide range of clinical purposes, including fully diagnostic, anatomical localisation and/or attenuation correction (AC). The purpose of each CT scan will determine the acquisition protocol used, and hence patient dose.

Aim

- To optimise CT protocols for scans needed for the sole purpose of attenuation correction.

Methods

Acquisition Protocol

- Siemens mCT Flow Edge PET/CT with TrueV.
- PET reconstruction:
 - Siemens UltraHD (2 iterations, 21 subsets, 5mm Gaussian filter, resolution recovery, time of flight)
- CT parameters/reconstruction:
 - 120kV, CARE Dose 4D, 780mm FoV.
 - SAFIRE off, Kernel- B30f medium smooth.
- Reference tube currents for CARE Dose 4D:
 - 100, 30, 20, 10 and 6 mAs.

Standardised uptake value (SUV)

- PET uniformity phantom
 - 20-110MBq
 - 4 minute single bed acquisition.

Contrast and background variability

- NEMA 2001 image quality phantom.
 - 4:1 and 8:1 sphere to background ratios.
 - Procedure and calculation as described by NEMA NU 2-2012¹.

Statistical analysis

- ANOVA used to compare the values calculated using each AC map.

Results

- No significant differences between AC maps for contrast and background variability.
- Small but statistically significant differences between SUVs.

Mean value	6mAs	10mAs	20mAs	30mAs	100mAs	P-value
PET uniformity (SUV)	1.032 ± 0.01	1.035 ± 0.01	1.034 ± 0.01	1.033 ± 0.01	1.033 ± 0.01	<0.001
NEMA 8:1 contrast (%)	68.46 ± 9.59	68.46 ± 9.59	68.49 ± 9.6	68.5 ± 9.62	68.51 ± 9.62	>0.9
NEMA 8:1 background variability (%)	2.99 ± 0.47	3.01 ± 0.47	2.99 ± 0.47	2.97 ± 0.48	2.97 ± 0.48	>0.5
NEMA 4:1 contrast (%)	64.41 ± 13.13	64.46 ± 13.12	64.48 ± 13.12	64.5 ± 13.13	64.5 ± 13.13	>0.9
NEMA 4:1 background variability (%)	2.44 ± 0.31	2.45 ± 0.32	2.43 ± 0.31	2.41 ± 0.31	2.42 ± 0.32	>0.4

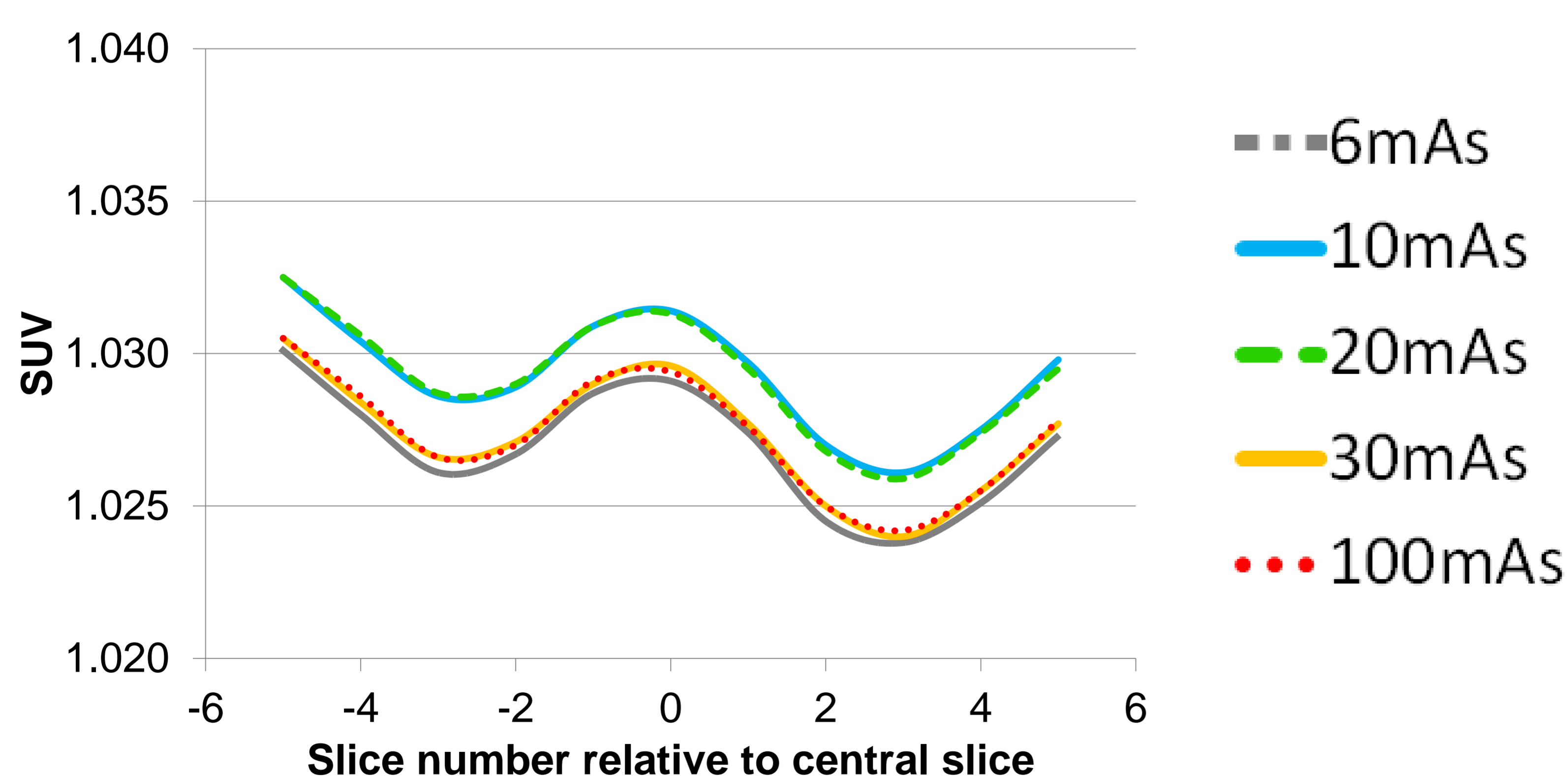


Fig 1: Mean variation in SUV for central slices of PET uniformity phantom using different reference mAs AC maps

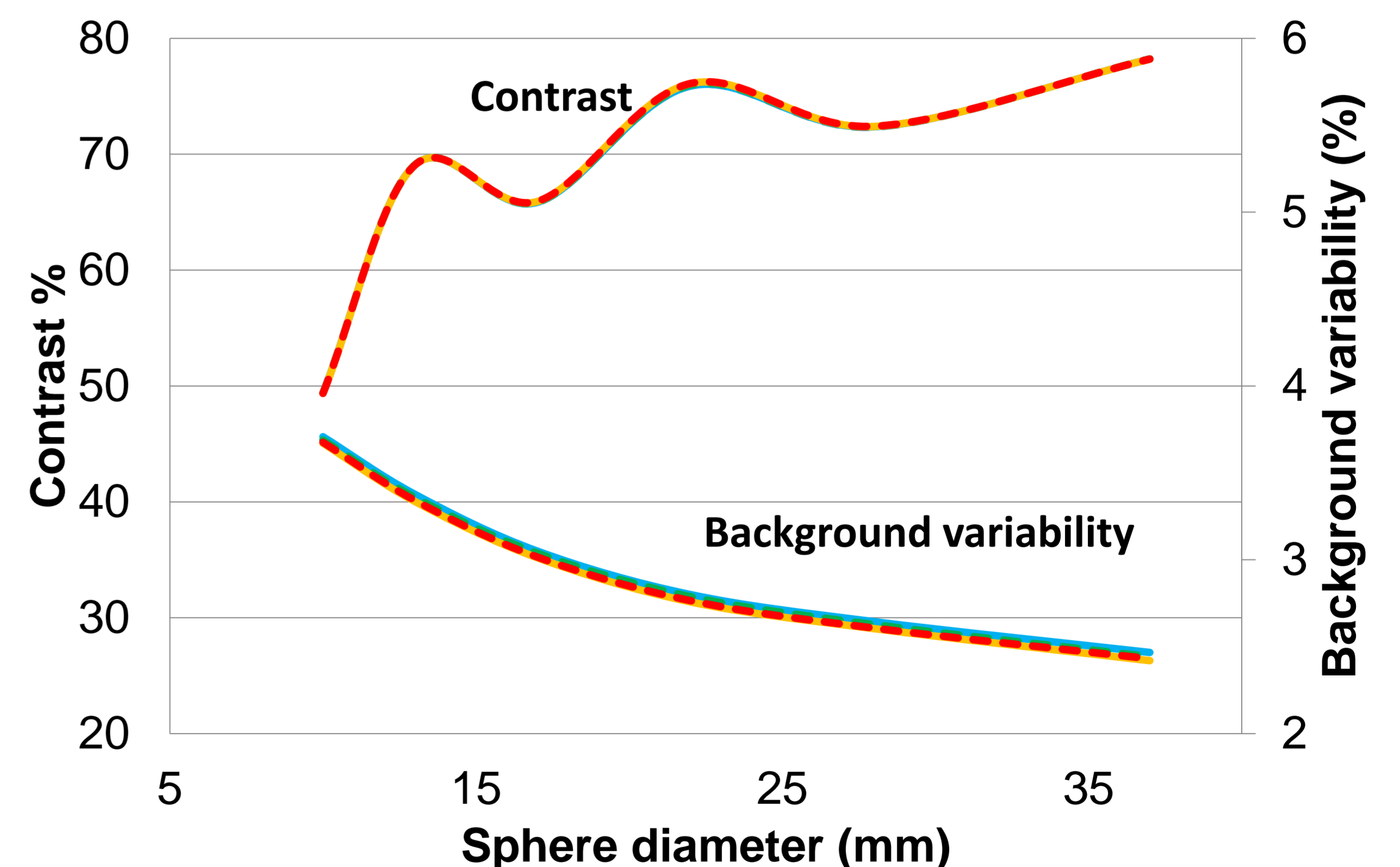


Fig 2: Mean NEMA 8:1 results using different reference mAs AC maps. NEMA 4:1 showed similar results.

Future Work

- Different phantom sizes
- High attenuation materials
- Fixed tube currents

Conclusion

- Reducing tube current for attenuation correction purposes is unlikely to significantly degrade PET image quality.**

References

1) NEMA NU 2-2012 Performance Measurements of Positron Emission Tomographs (PETs), National Electrical Manufacturers Association 2012.