Event-by-Event Attenuation Measurement for ACS2-Based PET Systems

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Motivation

- Patient motion reduces the image quality and affects accurate analysis of tracer kinetics in PET
- Also misalignment between transmission and emission has an influence on the image quality and quantification
- PET systems (e.g. ECAT Exact HR+) usually allow “motion gating” and list-mode acquisition during emission only
- Potential motion correction approaches therefore compensate for motion during emission phase only
- Recent developments on PET/MR (long MR acquisition times) suggest an increasing importance on that matter

Methods

- Development of new acquisition protocols for automatic extraction of the transmission sources [18F]F during a list-mode-based emission (simulated transmission)
- Enhancement of list-mode sorter software (lmSorter) to incorporate differences of list-mode transmission scans (i.e. scattered bit usage)
- Evaluation of feasibility and accuracy:
  (1) Quantitative comparison of a histogram-mode transmission vs. a list-mode transmission scan via intensity correlation histograms (of images at rest)
  (2) Phantom measurement with simulated respiratory motion and amplitude-based gating (Figure 1)

Results

- Difference between histogram-mode transmission and list-mode-based transmission (without motion) < 3.5% (deviation of intensities from identity line)

Conclusions

- List-mode-based transmission scans are feasible with ECAT Exact HR+ PET scanners and require only minimal modifications of the standard protocols
- Only low differences due to the hardware-based insertion of time stamps during a “simulated transmission”
- Gated transmissions (in addition to a gated emission) facilitate the accurate correction for motion considerably

Figure 1: Respiratory phantom with motion tracked steel ball (red) attached