Performance Evaluation of a PET Demonstrator for PET-MR Imaging Based on Monolithic LYSO:Ce Scintillators

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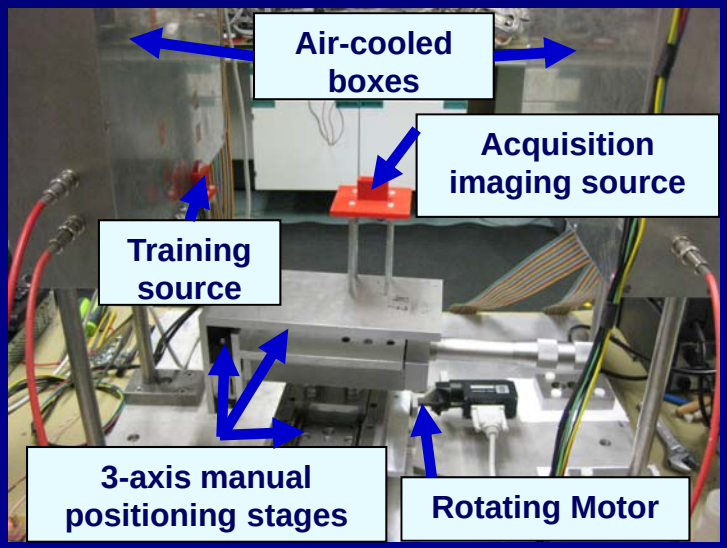
- The BrainPET Scanner
  - PET/MRI scanner with APDs which allow operation inside strong magnetic fields.
  - Artificial neural network (NN) position determining algorithms provides spatial resolutions in the order of 2 mm FWHM for the LYSO:Ce monolithic blocks
- The Experimental Demonstrator Setup
  - PET demonstrator based on four crystals face-to-face at nominal BrainPET distance (40 cm).
  - Air-cooled boxes for stabilizing the temperature of the APDs.
  - 8 rows and 8 columns from the VATA241 ASIC are digitized by 12-bit ADCs.
  - Trigger signals provided by the ASIC are processed by a Virtex5 FPGA.
  - Three-axis manual positioning stages for moving the source along the PET FoV.
  - A precision rotating motor allows acquisition of tomographic data at different angles.



Results

- Energy resolution (Photopeak widths):
  - **^{22}Na (511 keV) = 22.0%**
  - **^{137}Cs (662 keV) = 18.0%**
  - **^{22}Na (1274 keV) = 11.1%**
  - Very good linearity (R = 0.99999)
- Spatial resolution from NN algorithms:
  - Measured spatial resolutions: between 2.20 mm and 2.32 mm FWHM.
  - Similar spatial resolutions obtained using a collimated beam width of 1 mm for NN training

Spatial resolution in coincidence with	FWHM (mm)	Center at (mm)
Block 1	2.20	0.13
Block 3	2.21	-0.01
Block 5	2.26	-0.12
Block 7	2.32	-0.17

- Coincidence operation:
  - Detector block profile by measuring the coincidence count rate over the detector block.
  - The readout board works as expected. sending the digitalization of the 8 rows and 8 columns provided by the ASIC to a PC, together with the detector block identifier and its time stamp.