A sampling ADC data acquisition system for positron emission tomography

Abstract:
A data acquisition system for a positron emission tomograph (PET) based on avalanche photodiode (APD) readout of lutetium oxyorthosilicate (LSO) scintillator crystals is presented. The analog data of each APD are read out by fast analog to digital converters (ADCs) and processed within field programmable gate arrays (FPGAs). The ADCs are continuously sampling with a 80 MHz, low jitter clock, which is synchronous for the whole detector. The main tasks of the FPGAs are pulse detection and extraction of signal timing information from the digitized data stream. The detected signal pulse data are therefore compared to a predefined set of pulse shapes with known phase shifts with respect to the sample clock. By searching for the best match within this calibration set, a precise start time information for the signal pulse can be determined. The calculated time values are then transmitted from the ADC cards via fiber optic links to multiplexer modules which combine the different data streams and can also perform further processing like search for coincident events. Finally, the preprocessed detector data are transmitted from the multiplexers to PCI cards in the image reconstruction computers by gigabit optical links.