

技术及应用

### 正电子发射断层成像系统中数字化多通道时间数字转换研究

王培林<sup>1, 2, 3</sup>; 李道武<sup>1, 2</sup>; 丰宝桐<sup>1, 2</sup>; 帅磊<sup>1, 2</sup>; 孙芸华<sup>1, 2</sup>; 胡婷婷<sup>1, 2</sup>; 魏书军<sup>1, 2</sup>; 黄先超<sup>1, 2</sup>; 廖燕飞<sup>1, 2</sup>; 柴培<sup>1, 2</sup>; 贡明凯<sup>1, 2</sup>; 章志明<sup>1, 2</sup>; 魏龙<sup>1, 2</sup>

1.中国科学院 高能物理研究所 核分析技术重点实验室, 北京100049 2.北京市射线成像技术与装备工程技术研究中心, 北京100049 3.中国科学院 研究生院, 北京100049

收稿日期 修回日期 网络版发布日期:

**摘要** 利用现场可编程门阵列 (FPGA) 内部延迟链, 对正电子发射断层成像 (PET) 系统中高精度时间数字转换 (TDC) 进行研究。采用粗时间和精细时间相结合的方式测量时间, 粗时间利用时钟计数器实现, 精细时间利用FPGA延迟链实现。测试时间测量的微分非线性性和积分非线性, 并在双探头PET实验平台上通过时间符合, 对系统总体时间分辨进行测试。实验结果表明, TDC时间分辨达79.3 ps, 微分非线性为-0.2 LSB/0.2 LSB, 积分非线性为-0.2 LSB/0.3 LSB, 双探头PET实验系统总体时间分辨达2.1 ns, 可满足PET系统对时间测量的要求。

**关键词** [正电子发射断层成像](#) [时间数字转换](#) [FPGA](#)

分类号

### Multi-channel Digitized Time-to-Digital Converter of Positron Emission Tomography System

WANG Pei-lin<sup>1, 2, 3</sup>; LI Dao-wu<sup>1, 2</sup>; FENG Bao-tong<sup>1, 2</sup>; SHUAI Lei<sup>1, 2</sup>; SUN Yun-hua<sup>1, 2</sup>; HU Ting-ting<sup>1, 2</sup>; WEI Shu-jun<sup>1, 2</sup>; HUANG Xi-an-chao<sup>1, 2</sup>; LIAO Yan-fei<sup>1, 2</sup>; CHAI Pei<sup>1, 2</sup>; YUN Ming-kai<sup>1, 2</sup>; ZHANG Zhi-ming<sup>1, 2</sup>; WEI Long<sup>1, 2</sup>

1.Key Laboratory of Nuclear Analysis Techniques, Institute of High Energy Physics, Chinese Academy of Sciences, Beijing 100049, China; 2.Beijing Engineering Research Center of Radiographic Techniques and Equipment, Beijing 100049, China; 3.Graduate University of Chinese Academy of Sciences, Beijing 100049, China

**Abstract** High precision time-to-digital converter (TDC) in positron emission tomography (PET) system was studied with the delay chains in field-programmable-gate-array (FPGA). Time measurement includes two parts, coarse time measurement implemented by a clock-driven counter, fine time measurement by delay chains in FPGA. Differential nonlinearity (DNL) and integral nonlinearity (INL) were tested, and also, total time resolution of the double-detector PET experimental platform was measured by time coincidence. The results demonstrate that the time resolution of TDC reaches 79.3 ps, and the DNL is between -0.2 LSB and 0.2 LSB, the INL is between -0.2 LSB and 0.3 LSB, the total time resolution of the double-detector PET experimental platform reaches 2.1 ns. Performance of the TDC, implemented in FPGA, can meet the demand of time measurement in PET system.

**Key words** [positron](#) [emission](#) [tomography](#) [time-to-digital](#) [converter](#) [field-programmable-gate-array](#)

DOI

扩展功能	
<b>本文信息</b>	
▶ <a href="#">Supporting info</a>	
▶ <a href="#">[PDF全文](1196KB)</a>	
▶ <a href="#">[HTML全文](0KB)</a>	
▶ <a href="#">参考文献</a>	
<b>服务与反馈</b>	
▶ <a href="#">把本文推荐给朋友</a>	
<b>相关信息</b>	
▶ <a href="#">本刊中 包含“正电子发射断层成像”的 相关文章</a>	
▶ <a href="#">本文作者相关文章</a>	
·	<a href="#">王培林</a>
·	
·	
·	<a href="#">李道武</a>
·	
·	<a href="#">丰宝桐</a>
·	
·	<a href="#">帅磊</a>
·	
·	<a href="#">孙芸华</a>