A new in-beam proton therapy monitoring system based on digital MVT readout

Min Gao, Nicola D'Ascanio, Hsieh-Hson Chen, Fang-Hsi Chen, J. Hong Hong, J. Yang Tang

Introduction

Positron Emission Tomography (PET) is one of the most accurate techniques to retrieve the space distribution of the positron emitters produced by nuclear reaction within the target volume during and after proton irradiation and consequently to monitor the proton activity in biological targets. In-situ measurement represents the modern frontier of proton therapy monitoring systems. PET detectors need to be integrated with the proton delivery equipment and the signal registration is performed either during irradiation or immediately after it without moving the patient. The in-beam signal registration is beneficial to investigate the reduced signal statistics and the reduced effect of beam attenuation, with a consequent improvement of the image quality and accuracy. The key issue is how to obtain a high level of accuracy considering the background noise due to the proton photons generated in nuclear interactions during proton irradiation. Modern solutions are based on two key components: The application of high-resolution silicon detectors, and the use of advanced signal processing methods. The aim of this work is to develop a new approach to the monitoring of in-beam proton therapy by using digital signal processing techniques. The combination of novel 13 MW PET and advanced digital signal processing methods, the MVT technology, allows for a significant improvement in the accuracy of the proton therapy monitoring system.

Results and Conclusions

The presented results show a significant improvement in the accuracy of the proton therapy monitoring system. The new method allows for a better understanding of the physiological processes occurring during the therapy and can be used to optimize the treatment planning.

Design and Implementation

The developed system integrates advanced digital signal processing techniques with high-resolution silicon detectors to improve the accuracy of the proton therapy monitoring system.

Keywords: Digital PET, Proton Therapy Monitoring.