

STUDY OF MOTION GATING IN 3D PET IMAGING BY GEOMETRIC SENSITIVITY

JIANFENG HE¹, GRAEME J. O'KEEFE² AND MOSHI GESO³

¹School of Information Engineering and Automation
Kunming University of Science and Technology
No. 50, East Ring Road, Kunming 650051, P. R. China
jfenghe@kmust.edu.cn

²PET Center
The Austin Hospital
VIC 3084, Australia
graeme.okeefe@petnm.unimelb.edu.au

³School of Medical Science
RMIT University
P. O. Box 71, Bundoora, Victoria 3083, Australia
moshi.geso@rmit.edu.au

Received November 2009; revised May 2010

ABSTRACT. *The PET (positron emission tomography) image quality can be degraded due to respiratory motion artifacts, gating techniques utilizing the tracking motion information are able to reduce the image degradation. This paper presents a new gating method that utilizes the geometric sensitivity feature of a 3D PET scanner system operating in list event acquisition mode. The count rate detected by PET scanner from a given body organ will depend on the axial location of the organ in the FOV (field of view) due to the geometric sensitivity. As a result, the respiratory motion phase can be determined from count rate changes for motion gating. This method has several advantages over the existing methods. It only uses LOR (line of response) events and is non-invasive; No additional hardware device systems and no additional patient preparation are required. Using GATE (GEANT4 Application Tomographic Emission) with a configuration simulating a Philips Allegro PET system demonstrates that the geometric sensitivity method is able to reduce motion artifacts.*

Keywords: PET, Motion gating, Geometric sensitivity, Simulation

1. Introduction. Respiratory motion results from the diaphragmatic expansion/contraction cycle of the lung cavity. PET data acquisition for one thoracic bed position scanning takes a few minutes, its image is reconstructed from averaged data over many respiratory cycles. As a result, respiratory motion affects delineation of anatomical function and structures and leads to erroneous position, shape and volume information for the target by such motion [1,2]. In order to improve image quality, gating techniques have been developed to compensate respiratory motion.

Respiratory gating involves the recording of a signal proportional to respiratory volume and position, and extracts the same respiratory motion phases of the breathing cycles to sum up for an image reconstruction. Efforts in gating to correct motion artifacts in PET imaging may be classified into two categories: external and internal approaches. The external approach uses a position monitoring system to track the subject movements for gating. Several motion device tracking systems have been studied for PET/CT imaging.