行政院原子能委員會

委託研究計畫研究報告

動物實驗用螺旋式 CT 影像重建方法研究

Study on Iterative Reconstruction Methods for Animal CT

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中文摘要

關鍵字：X 光斷層掃瞄，疊代式影像重建方法，影像重建系統模型

傳統 X 光斷層掃瞄(CT)能提供解剖結構影像，如果與核子醫學影像系統(正子斷層掃瞄或單光子斷層掃瞄)結合，可同時提供功能性與解剖性影像，增進診斷的準確，提供更多的診療資訊。CT 影像更可被利用來計算核子醫學影像中的衰減補償係數，增加核醫影像的定量分析。新近發展的螺旋式（Helical or Spiral）CT，在造影儀旋轉同時，病床也同時移動，如此形成螺旋掃瞄軌跡。螺旋式 CT 的優點是可以快速掃瞄以及可掃瞄厚度變細，增加時間與空間的解析度，並且可以提供最佳的動態資料。但是在低能量，低劑量，以及快速掃瞄的考慮下，傳統的影像重建方法，如 FBP，並不能相對提供滿意的影像品質，而疊代式影像重建方法，正可以針對以上的挑戰，增進影像品質與解析度。本計畫是針對 CT 疊代式影像重建定量分析研究，期望透過 CT 疊代式影像重建方法，針對核研所現有的小動物錐形 CT 影像系統，先建立一套錐形 CT 影像重建系統模型(System Model)以及 CT 疊代式影像重建軟體，以作為未來進一步的螺旋式 CT 疊代式影像重建研究平台。另外，針對低劑量的 CT 資料，採用主要成份分析法減少雜訊對影像品質的影響。未來將解決因為物理現象引起的影像雜訊，例如散射 金屬假影 beam-hardening 等，增進 CT 影像品質。我們先用數位假體來測試雜訊處理與疊代重建，接著應用在核研所的 CT 所得真實假體資料。

Abstract

Keywords: X-Ray computed tomography, Iterative Reconstruction, System Model

X-ray computed tomography (CT) offers anatomical images of attenuation characteristic within living bodies, and if combined with nuclear medicine imaging, provides both functional and anatomical images for accurate diagnosis. CT images can be also used to correct the attenuation in the nuclear medicine images with better quality of attenuation coefficients. The new developed multi-slice CT system with helical scanning has the advantage of fast scanning and low dose, thus improving spatial and temporal resolutions, and also offers better dynamic information. An image reconstruction method is needed to convert the scanned projection data into a tomographic image in CT. Conventional analytical reconstruction method, FBP (Filtered Backprojection), is used widely due to its fast reconstruction speed. However, under the conditions of low energy, low dosage, and fast scanning, the image quality from FBP reconstruction in modern CT is sub-optimal due to many reasons. Iterative reconstruction method can overcome the above problems with correct noise and physical modeling, and can be readily adapted to different geometrical systems. It has been proved that iterative reconstruction outperforms FBP with better image qualities. We plan to build up an iterative reconstruction platform for more qualitative CT reconstruction for the animal CT system developed in INER. We will study different noise treatment and then build up a system model for cone-beam CT and an iterative CT reconstruction using an OS-type convergent algorithm. This system will facilitate the physical effect corrections including scatter, metal artifact and beam-hardening, in the future. To reduce the noise effects from

low-count data acquisition, we also applied the PCA noise reduction technique on the low-count CT data from simulation, as well as the real data acquisition from INER microCT.