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Improving Small Tumor Volume Estimation Accuracy in Positron Emission Tomography Using Resampling and Regional Blind Deconvolution Restoration

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Accurate estimation of tumor volume on Positron Emission Tomography (PET) images is an important requirement in radiotherapy planning and other similar applications in Oncology. Tumors with less than 2 cm diameters are particularly difficult to quantify mainly due to the limited spatial resolution of PET cameras and the large pixel sizes. The purpose of the present work is to present a new method for the accurate volume estimation of small tumors and demonstrate its efficacy on real oncological PET images that contain simulated tumors. First, images in three dimensional form were reduced to small volumes incorporating the individual tumors in order to increase the efficiency of the image restoration process and reduce the effects of the varying point spread function (PSF) across the FOV. A blind deconvolution algorithm based on the Lucy-Richardson method was used to restore the cropped volumes by reducing the effect of the resolution loss. Parameters were optimized by the use of a relative difference index. The resultant image was then resampled using interpolation methods in order to reduce the pixel size. The tumor in the final image was delineated with the 50% thresholding method. The entire procedure was applied to the [18F] FDG PET images in the ONCOPET database. The ONCOPET image database consists of image sets of 128x128x375 voxels. Real patient scans were used and tumors of different sizes were simulated with spheres of varying activities. Finally, projection data were reconstructed using the fully AW-OSEM 3-D algorithm using six iterations and 16 subsets with a Gaussian isotropic postfiltering of 8 mm. The MIPAV image processing platform was used for visualization, cropping and segmentation. The volume estimation error was reduced from 583 % to less than 9 % for small tumour of 14 mm diameter and a signal to background ratio of four. First results indicate that a substantial improvement in accuracy of small tumor volume estimation can be achieved by the use of this method. This may contribute to higher precision in radiotherapy planning and other oncological applications using PET.

Biography

Alpaslan KOÇ is a PhD student in the Institute of Biomedical Engineering in Boğaziçi University. He is also a lecturer in the Vocational College of Health Services in the Kırklareli University. His research areas are related with the Nuclear Medicine Imaging Instrumentation, Optimization, and Radiotherapy Planning.

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