AUTHOR	HERATH, KB
ORIGINAL TITLE	Techniques for computerized quantitation of spatial resolution ,linearity and contrast of a scintillation camera from bar pattern images
DEGREE	PhD
YEAR	1993
INSTITUTE	University of Peradeniya
LOCATION	UP(MED)
MAIN HEADING	GAMMA CAMERAS
ABSTRACT	A computer based quantitative method was formulated (in FORTRAN 77) for the purpose of monitoring intrinsic spatial resolution, linearity and contrast of a gamma camera. Digital images of ordinary bar pattern phantoms were used for the analysis. Square shaped ROIs of 3x3 ern dimensions in' real space were placed on the digital images of each quadrant with one dimension parallel to the' bars. One dimensional Fourier analysis was performed on profiles derived from each of these using an algorithm formulated specifically for this purpose. After carefully analysing the amplitudes of the first 20 frequencies of images acquired On a 512 matrix size, it was found that only the dominant amplitude was associated with a sUfficiently low ICV which could be used as a useful index to monitor the performance of the camera. This was tested for its integrity and specificity as an index to monitor the spatial resolution and was termed the Fourier Index of Spatial, Resolution (FISR). For the assessment of non-linearity, the bar size [BS (FT)] Has estimated from the frequency of the dominant amplitude. A Contrast index was estimated in count density space using the data in the count profile of each ROI. By estimating the distance betHeen the peaks of this count profile average bar Slze [BS(Cl] was calculated which was used as an alternative method of assessing non-linearity. There was extremely good correlation between the FISR, value and the FWHM and between the FISR and the FWTM values (correlation coefficient >0.96). There was also very good correlation between the FISR and the contrast index values (correlation coefficient >0.96). The FISR increased in value with increasing matrix size up to 512 fora Siemens Gammasonics Digitrac 75 camera which had a effective field of view diameter of 38 cm. However, for a 1024 matrix size it did not show any further increase. The percent CV values associated with it were in the range of 0.74 to 2.86, for count densities corresponding to 4 minutes of data acquisition. On the other hand the contrast index value continued to increase with increasing in matrix Slze. The sensitivities associated with the FISR values obtained with 4, 3.5, 3 and 2.5 mm bar sizes were higher than those of the FWHM or FWTM values in showing variations of spatial resolution. The bar size that yielded the maximum sensitivity for a comparatively low percent CV was found to be 3.5 mm. The best bar size to use for the estimation of contrast index values was found to be either 4 or 3.5 mm. The

FISR values and -contrast index values, both differentiated extremely well the qualities of images obtained wi th a new Siemens Gammasonics Digi trac 75 camera and a "11 year old mobile Technicare S420 camera. The percentage nonlinearity computed from both BS(FT) and BS(C) values showed the non-linearity that existed in the images of the mobile camera. These were not shown in images from the Siemens camera because it was equipped with linearity correction circuits. The computer quantitation method of estimating the spatial resolution, the linearity and the contrast index studied can be successfully implemented to monitor these qualities of a gamma camera and possess the following advantages: 1. As the value FISR measures more than the spatial resolution, it is a more powerful index than FWHM which can be used to monitor the performance of a gamma camera, 2. Incorporating the software for the above technique would be trivial, as present day computer systems use Fourier techniques for reconstruction, smoothing, etc., 3. Although according to the optimum conditions, the 512 matrix size yielded the maximum value of FISR for the Siemens camera, a 256 matrix could be used successfully, 4. Implementation of this method could well be carried out by having only one PLES phantom of bar spacing 3.5 for all cameras within a department, 5. The measurements can cover the entire field of the detecting system in both directions, 6. The estimations of spatial resolution, linearity and contrast can be completed in about 15 minutes, 7. The measurements involve both the camera and the computer and hence it is a method of monitoring both systems, 8. The FISR values obtained with the 3.5 mm bar size 50 percent more sensitive than the FWHM value in analysing variations of spatial resolution, 9. Action levels could be set at meaningful values so that cameral computer performance could be monitored by inexperienced personnel using a simple graphic display.