Reconstruction of Factor Images of Dynamic SPECT by Discrete Tomography

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In nuclear medicine the metabolism of the human body can be followed by the mapping different γ-ray emitted radioisotopes. The studies are acquired by equipments (e.g. γ-camera) which can detect the distribution of radioisotopes in different organs, tissues. The dynamic SPECT (Single photon emission computer tomography) is a kind of imaging method which gives 4D images from projections acquired by γ-camera. In this case each 4D image represents a time series of 3D images. The series of the projection images from a direction describes the biological process according to that direction. If these projection images are analysed by factor analysis, the factor images can be considered as the projections of the 3D factors. Since the factors are objects with homogenous distribution of radioactivity, they can be reconstructed by a special method of discrete tomography. Discrete tomography reconstructs functions from a few projections. The range of these functions must be a predefined discrete set. During the reconstruction we must take the absorption of the γ-ray into account.

Mathematically the problem is the following. 3D homogenous objects are to be reconstructed from 4 projections. To solve it we applied an iterative method based on simulated annealing. Simulation experiments were applied: projection data of software phantom were generated. The projections contain noise and the effect of absorption and the camera errors. The reconstruction was calculated on each 3D factor slice by slice. The results of our method will be presented on a simulated kidney phantom.