

## Image Reconstruction in Emission Tomography using Point Clouds

### Abstract

Historically, nuclear medicine imaging has been done using 2D views. With the advent of computers and tomography, 3D images were acquired and stored in regular arrays of voxels. Although a logical extension from 2D, representation of a 3D object as a stack of 2D images may not be optimal for image reconstruction. This is because voxels with rectangular geometry do not accurately approximate the geometry of the imaged objects. This mismatch is especially significant for nuclear medicine studies where degrading physical factors force the images to be reconstructed on grids that consist of large cubic voxels. In the presented approach, the image is represented as a set of points in space (point cloud) with unrestricted locations and intensities assigned to each point (node) with volume represented by a set of non-overlapping tetrahedrons defined by the nodes. The selection of this representation was dictated by two factors. First, each image will have its own grid that will be designed to accurately and efficiently represent each image. By using unrestricted node positions, a geometry with arbitrary local sampling that varies across the image volume can be modeled. Second, the tetrahedral geometry of the image will take advantage of recent revolutionary progress in computer graphics hardware in order to use advanced visualization techniques for stereoscopic interactive 3D visualization of the imaging data. The representation creates framework for voxel-less multi-resolution representation of the image in nuclear medicine. Reconstruction of an image defined by a point cloud creates an inverse problem that will be discussed and numerical solution will be presented.