MLEM & Ray Tracing Image Reconstruction Techniques for UCT PET Detector.

At UCT, positron imaging techniques are used to investigate systems of flow for science and engineering applications. As an example, positron emission tomography (PET) measurements are performed of the distribution of liquid in 2D flowing foams to investigate bubble coalescence in mineral froth flotation. The impact of the results and the feasibility of more complex measurements, such as extending the results to 3D and multiphase media, are limited by the simplicity of the image reconstruction techniques and uncertainties around the longer range of the positron in the gas phase. The goal of this preliminary study is to develop an advanced image reconstruction technique, namely maximum-likelihood expectation-maximisation (MLEM), for the PET camera configuration at UCT. PET measurements were performed on a point sorce on the surface of a cylinder and of a helix structure wound around a cylinder. The images were reconstructed with both MLEM and a simple back projection algorithm to ascertain the ability of the technique to reconstruct three-dimensional images. This is a promising first step towards the investigation of bubble coalescence in 3D; the next stage of which will be achieved with Géant 4 simulation of the PET camera and a spherical shell radiolabeled with a positron emitting radionuclide.

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