

Evaluation of a median solution in Emission tomography using a collimator with large and long holes.

The project of emission tomography using a collimator with large and long holes (CACAO-TROLL) has been created to improve the quality of radionuclide imaging. Radionuclide imaging is actually very useful in the medical field for diagnosis purpose, with about 20 millions annual examinations. In contrast with this high number of examinations which witnesses the usefulness of molecular imaging, the sensitivity of the gamma camera is incredibly bad. Only 1 photon over 10,000 is detected with this instrument. The CACAO-TROLL project aims to dramatically increase this sensitivity, by a factor of 100 or 1000. The spatial resolution of the gamma camera is also low, 10 to 15 mm. In the CACAO-TROLL project we propose to use of longer hole to increase the spatial resolution. A linear motion is added in the acquisition process to provide a sufficient amount of data. Mathematically one faces a new inverse problem where the collimation is finalized during the tomographic reconstruction. Examples of such reconstructions have already been published. However there is room for further improvements.

The subject of the thesis will be to develop a new algorithm of tomographic reconstruction, looking for a median solution. We recently published that the linear optimization is of great value for solving this sort of problem. We have recently obtained good results, better than those obtained by MLEM or OSEM algorithm. (Maximum Likelihood- Expectation maximisation; ordered subsets Expectation maximisation). To date, however, these results were obtained on small images sizes. The purpose of this thesis will be to adapt this algorithm to large size images. Some ways will have to be explored: dualization, division into subsets, or multi-scale algorithms. Once the algorithm will be functioning, it will be applied to a practical experiment.