Development of iterative reconstruction software to investigate influence of μCT on μSPECT

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I. Introduction

μSPECT technology allows the evaluation of the biological process of drugs and therapies in the pre-clinical phase. The next step is absolute μSPECT quantification. This requires accurately reconstructed μSPECT images and precisely determined coordinates of the regions of interest (ROI). There are still some challenges coupled to determining these ROIs in μCT images. The soft tissue shows little contrast due to image degrading effects and the low attenuation difference between different tissues.

In this research, we want to increase the soft tissue contrast in μCT and use it more efficiently in μSPECT reconstruction. To achieve these goals, we first developed CT and SPECT reconstruction software. Simulated and measured data were used as validation.

II. Methods

Iterative CT reconstruction was based on a 3D distance driven (back)projector in a positivity-constrained ordered-subset simultaneous algebraic reconstruction technique (C-OS-SART). We increased the efficiency of the implementation by using geometrical symmetry and an internal reconstruction format optimized for CPU caching.

A 7-ray resolution recovery approach was chosen for iterative SPECT reconstruction. Attenuation correction was incorporated based on the μCT image and pinhole penetration was accurately modeled. Scatter was corrected for by using triple energy window correction on list mode data.

Normalized root mean squared error (NRMSE) was calculated to compare iterative CT reconstruction, analytical CT reconstruction and a ground-truth image of the Shepp-Logan phantom. Iterative and analytical CT and SPECT reconstruction were qualitatively compared on measured pre-clinical data.

III. Results and conclusion

NRMSE drops by 50% when using C-OS-SART and the CT images show higher noise but also higher resolution. The μSPECT reconstructed images show much higher resolution and better uniformity.

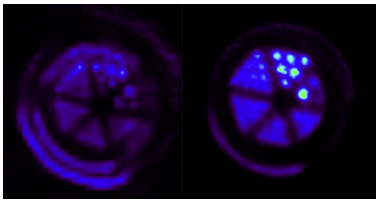

Figure 1. Conventional reconstruction on the left, our approach on the right.

This provides us with the tools to investigate the influence of CT soft tissue contrast on SPECT quantification further.

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References

[1] Bruno De Man et al., *Distance-driven projection and backprojection in three dimensions*, Phys. Med. Biol., 49:2463-2475 (2004).