Contribution ID: **11** Type: **Oral**

Fast and memory-efficient reconstruction of sparse Poisson data in listmode with non-smooth priors with application to time-of-flight PET

Wednesday, 22 May 2024 17:40 (15 minutes)

TOF sinograms of TOF PET scanners have a large memory footprint. Currently, they contain ~4e9 data bins which amount to ~17GB in single precision. Using iterative algorithms to reconstruct such enormous TOF sinograms becomes challenging due to the memory requirements and the time needed to evaluate the forward model. This is especially true for more advanced optimization algorithms such as the SPDHG algorithm which allows for the use of non-smooth priors using subsets with guaranteed convergence. SPDHG requires the storage of additional sinograms in memory, which severely limits its application to data sets from TOF PET systems.

Motivated by the sparse nature of the TOF sinograms, we propose a new listmode (LM) extension of the SPDHG algorithm for reconstruction of sparse data following a Poisson distribution. LM-SPDHG is evaluated in 2D and 3D simulations and a real dataset acquired on a TOF PET/CT system. The performance of the proposed LM SPDHG algorithm is compared against the conventional sinogram SPDHG and listmode EM-TV.

We show that the speed of convergence of LM-SPDHG is equivalent to the original SPDHG. However, we find that for a TOF PET system with 400ps TOF resolution, LM-SPDHG reduces the required memory from ~56GB to 0.7GB for a short dynamic frame and to 12.4GB for a long static frame.

In contrast to SPDHG, the reduced memory requirements of LM-SPDHG enable a pure GPU implementation on state-of-the-art GPUs which drastically accelerates reconstruction times.

Field

Software and quantification

Primary author: SCHRAMM, Georg (KU Leuven)

Co-author: HOLLER, Martin (University of Graz)

Presenter: SCHRAMM, Georg (KU Leuven)

Session Classification: Special Track on Image reconstruction

Track Classification: [Special track] Advanced reconstruction algorithms