Implementation of weighted filtered backprojection in DIRA (Dual-Energy Iterative Algorithm)

Our group develops a model-based iterative reconstruction (MBIR) algorithm DIRA, which determines elemental composition of patient tissues from dual-energy computed tomography (DECT) scans. There are many potential uses for this. In our group, we focus on applications for radiation treatment planning. Knowledge about the tissue composition allows for more accurate computation of spatial distribution of absorbed dose.

Today DIRA is implemented for 2D parallel geometry and partially for 3D helical geometry (where it uses the PI-method), see Figure. This master thesis work concerns implementing the weighted filtered backprojection in DIRA (3D helical geometry).

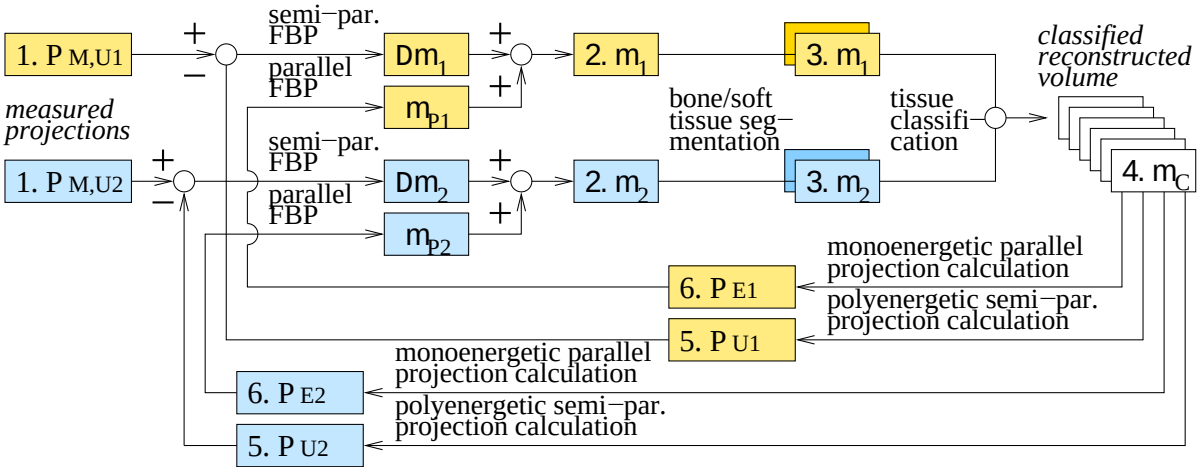

Figure 1: The DIRA iterative reconstruction algorithm based on the PI-method.

The basic task:

Implementation and evaluation of DIRA for 3D helical geometry, based on the Weighted FBP [4] and 3D projections. Indata: projection-data of mathematical phantoms. Programming language: Matlab and C.

Possible extensions:

1. Investigate the long object problem, i.e. “the projected volume is larger than the reconstructed volume”, [2].
2. Use real data from SIEMENS SOMATOM DECT scanner as indata.

Available code:

1. Matlab/C code for 2D and 3D (PI-Method) DIRA.
2. C code for 3D projection generation.

Requirements:

The student should have programming skills in Matlab and C. Knowledge of the general principles of computed tomography and the interactions of x- rays (10 – 150 keV) with matter is desirable. The project is suitable for biomedical engineering, electrical engineering and computer engineering students.

Organization:

The work will be continuously discussed in our research group Åsa Carlsson Tedgren, Michael Sandborg, Gudrun Alm Carlsson, Alexandr Malusek, Maria Magnusson). Student's location will be either the Division of Radiological Sciences, Campus US, Linköping University or the Division of Computer Vision, Campus Valla, Linköping University

References:

[1] Henrik Turbell, “Cone-Beam Reconstruction using Filtered Backprojection”, PhD thesis, Linköping University, 2001.

[2] Magnusson et.al., “Handling of Long Objects in Iterative Improvement of Non-Exact Reconstruction in Helical Cone-Beam CT.” IEEE Trans. Med. Imag., Vol.25, No.7, 2006.

[3] Stierstorfer et. al.: “Weighted FBP - a simple approximate 3D FBP algorithm for multislice spiral CT with good dose usage for arbitrary pitch”, Phys. Med. Biol., 49, 2004.

[4] Sunnegårdh, Danielsson, “Regularized iterative weighted filtered backprojection for helical cone-beam CT,” Medical Physics 35, 2008.

For more information, contact:

- Maria Magnusson, PhD, (Maria.Magnusson@liu.se) or
- Alexandr Malusek, PhD, (Alexandr.Malusek@liu.se) or