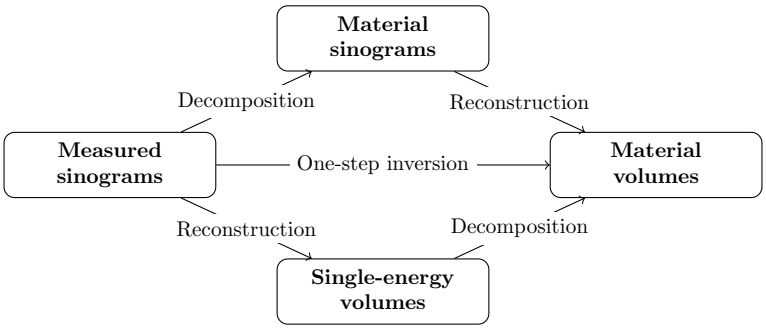
Master fellowship: K-edge one-step spectral CT reconstruction for imaging myocardium ischemia

Scientific context

Spectral photon counting computed tomography (SPCCT) is a new technology for acquiring energy-resolved x-ray projections [2] which is clinical since 2021. These projections can be used to obtain mono-energetic CT images of the patient via material decomposition. When a contrast agent with a K-edge in the diagnostic energy range (e.g. gadolinium or gold) is injected in the patient, SPCCT can also reconstruct the material map of this agent. However, the sensitivity of K-edge SPCCT is limited and may be improved by advanced iterative reconstruction techniques. One of them is one-step reconstruction [1] which directly reconstructs 3D material maps from energy-resolved sinograms:



The CREATIS laboratory has studied the ability of SPCCT to image myocardium ischemia in small animals with K-edge contrast agents on the prototype scanner of the CERMEP (www.cermep.fr). SPCCT images have been acquired before sacrificing the animal for a reference histological characterization.

Objective

The goal of this master is to investigate image quality improvement obtained by one-step reconstruction with respect to two-step approaches for imaging myocardium ischemia with a K-edge contrast agent.

Tasks

- Adapt and apply one-step reconstruction to K-edge acquisitions using RTK (www.openrtk.org) in collaboration with Pierre-Antoine Rodesch (XCITE lab, Canada),
- Characterize image quality (noise, spatial resolution) for a range of hyper-parameters,
- Collaborate with Salim Si-Mohamed (radiologist in the CREATIS team Myriad) to evaluate the pre-clinical benefit of one-step reconstruction over two-step reconstruction using the histological characterization as a reference.

Required skills

- **Education**: master student in image processing or medical physics.
- **Scientific interests**: applied mathematics, computer sciences (medical image processing), medical physics.
- **Programming skills**: Python, C++ (ITK, RTK).
- **Languages**: command of English required, French optional.

Practical information

- **Supervision**: Simon Rit.
- **Location**: Mainly at the Centre Léon Bérard, Lyon, France.
- **Period**: 2023

- **Salary (net)**: about 600 euros/month.
- Send CV, recent transcripts and a brief statement of interest by email to Simon Rit (simon.rit@creatis.insa-lyon.fr).

References

[1] C. Mory, B. Sixou, S. Si-Mohamed, L. Boussel, and S. Rit. Comparison of five one-step reconstruction algorithms for spectral CT. *Phys Med Biol*, 63:235001, November 2018.

[2] K. Taguchi and J.S. Iwanczyk. Vision 20/20: Single photon counting x-ray detectors in medical imaging. *Med Phys*, 40(10):100901, Oct 2013.