

Context

The CREATIS laboratory is actively investigating computed tomography (CT) reconstruction algorithms. The radiotherapy department of the Léon Bérard center has acquired a new diagnostic x-ray CT scanner for radiotherapy planning. In this context, we are starting a new collaboration with Siemens healthcare aiming at improving image quality of diagnostic CT scanners. This project requires access to acquired x-ray projection images before tomographic reconstruction and the description of the corresponding scanner geometry, which we will access for the first time on this scanner. This master fellowship will lay the foundation for a **CIFRE PhD fellowship funded by Siemens**.

Data consistency conditions (DCCs), also known as range conditions, refer to mathematical relationships between different x-ray projections [1]. They are known for a parallel beam geometry as the Helgason-Ludwig conditions. Research is still active for divergent geometries but recent developments suggest that new DCCs for cone-beam CT can be used to improve the quality of CT images [2].

Objective

To investigate the use of DCCs for correcting projections prior to tomographic reconstruction and, eventually, improving the quality of CT images.

Tasks

- Convert Siemens data to a format understood by the Reconstruction Toolkit (RTK), an open-source toolkit for 3D tomographic reconstruction developed by CREATIS mainly.
- Implement the verification of Data Consistency Conditions (DCCs) in RTK.
- Identify artifacts and check on simulations and real data that they can be seen by DCCs.
- Develop a correction algorithm with a few parameters for these artifacts.
- Identify the correction parameters such that DCCs are verified.

Required skills

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

Practical information

- **Supervision:** Simon Rit and Jean Michel Létang
- **Location:** Mainly at the Centre Léon Bérard, Lyon, France.
- **Period:** 2019 (duration negotiable).
- Send CV, recent transcripts and a brief statement of interest by email to Simon Rit (simon.rit@creatis.insa-lyon.fr).

References

- [1] R. Clackdoyle and L. Desbat. Full data consistency conditions for cone-beam projections with sources on a plane. *Phys Med Biol*, 58(23):8437–8456, Dec 2013.
- [2] J. Lesaint, S. Rit, R. Clackdoyle, and L. Desbat. Calibration for circular cone-beam CT based on consistency conditions. *IEEE Transactions on Radiation and Plasma Medical Sciences*, 1(6):517–526, November 2017.