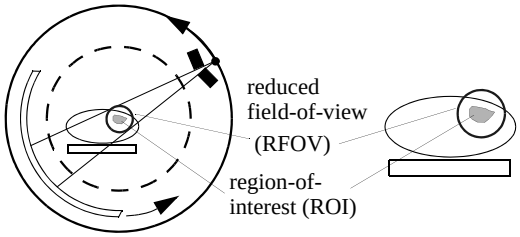
PhD fellowship: region-of-interest CT reconstruction for dose reduction

https://www.creatis.insa-lyon.fr/site7/fr/node/46603

Context

Region-of-interest (ROI) computed tomography (CT) is the tomographic reconstruction from projections that are truncated laterally when the field-of-view does not fully cover the patient (see figure). Analytic reconstruction algorithms have been developed for ROI tomography in the past 20 years [1]. The purpose of the ANR ROIdoré project is to investigate these algorithms for dose reduction while keeping an equivalent reconstructed image quality. This is a collaborative project between TIMC (Grenoble) and CREATIS (Lyon).



Objective

The purpose of this PhD fellowship is to develop and analyze inversion algorithms for ROI reconstruction to obtain equivalent image quality compared to a full field-of-view CT. Both analytic and iterative reconstruction techniques will be investigated. There is currently no known analytic solution but the problem can be linked to the inversion of the one-dimensional (1D) truncated Hilbert transform which has a unique stable solution [3]. Instead, one can also do a conventional two-dimensional (2D) or three-dimensional (3D) iterative CT reconstruction [2].

Research program

The PhD fellow will approach both types of solutions for ROI CT reconstruction. First, he/she will investigate a numerical inversion of the truncated 1D Hilbert transform. Second, existing iterative reconstruction algorithms will be adpated to ROI CT. The investigations should determine under which circumstances equivalent image quality can be reached. The developments will use and enhance the Reconstruction Toolkit (RTK, `http://www.openrtk.org`).

Required skills

- **Education**: master in applied maths or image processing.
- **Scientific interests**: applied maths, 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 (simon.rit@creatis.insa-lyon.fr).
- **Location**: Centre Léon Bérard, Lyon, France, with regular meetings in Grenoble.
- **Period**: three years starting in 2018.
- **Salary (net)**: 1400 euros/month.

Send CV, master marks and a brief statement of interest by email to Simon Rit (simon.rit@creatis.insa-lyon.fr).

References

[1] R. Clackdoyle and M. Defrise. Tomographic reconstruction in the 21st century. region-of-interest reconstruction from incomplete data. 27(4):60–80, 2010.

[2] R. Clackdoyle, F. Noo, F. Momey, L. Desbat, and S. Rit. Accurate transaxial region-of-interest reconstruction in helical CT? *IEEE Transactions on Radiation and Plasma Medical Sciences*, 1(4):334–345, July 2017.

[3] M. Defrise, F. Noo, R. Clackdoyle, and H. Kudo. Truncated Hilbert transform and image reconstruction from limited tomographic data. *Inverse problems*, 22(3):1037, 2006.