Master fellowship
Exponential Data Consistency Conditions for Patient Motion Detection and Correction

https://www.creatis.insa-lyon.fr/site7/en/node/47160

Context

The ANR project SPECT-Motion-eDCC is a collaborative project between CREATIS, TIMC, OHI and LUMEN. Single photon emission computed tomography (SPECT) is a technique for imaging the 3D distribution of a radioactive tracer that has been administered to a patient to track certain biological functions. The long acquisition times (10-40 minutes) of SPECT make them prone to patient motion which decreases image quality. Exponential data consistency conditions (eDCC) are mathematical equations [1] that should be verified by the input data of SPECT reconstruction algorithms. Inconsistencies might be used to correct input data, e.g., to improve correction of the attenuation [2].

Objective

The goal of this master project is to implement and evaluate the ability of eDCC to detect patient motion during SPECT acquisitions and to use this information for motion correction. The investigations will focus on Monte Carlo simulations of clinical SPECT scanners with a parallel collimator as those available at the LUMEN.

Tasks

- Select patient data from which SPECT acquisitions will be simulated,
- Simulate SPECT projections with patient motion using GATE,
- Implement eDCC for the parallel geometry [1] and evaluate their ability to detect motion,
- Evaluate the impact on SPECT images (after reconstruction with RTK) and investigate correction techniques.

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**: 2022 (duration negotiable up to 8 months).
- **Salary (net)**: 600 euros/month.
- Funding for a **PhD fellowship** is available to continue the investigations after the master fellowship.
- Send CV, recent transcripts and a brief statement of interest by email to Simon Rit (simon.rit@creatis.insa-lyon.fr).

References

[1] V. Aguilar, L. Ehrenpreis, and P. Kuchment. Range conditions for the exponential Radon transform. *Journal d'Analyse Mathématique*, 68(1):1–13, 1996.

[2] R.G. Wells and R. Clackdoyle. Feasibility of attenuation map alignment in pinhole cardiac SPECT using exponential data consistency conditions. *Med Phys*, 48(9):4955–4965, 2021.