



HAL
open science

Experimental evaluation of rigid patient motion detection and correction in SPECT with exponential data consistency conditions

My Hoang Hoa Bui, Antoine Robert, Simon Rit, Ane Etxebeste

► To cite this version:

My Hoang Hoa Bui, Antoine Robert, Simon Rit, Ane Etxebeste. Experimental evaluation of rigid patient motion detection and correction in SPECT with exponential data consistency conditions. 2024 IEEE Nuclear Science Symposium (NSS), Medical Imaging Conference (MIC) and Room Temperature Semiconductor Detector Conference (RTSD), Oct 2024, Tampa, United States. 10.1109/NSS/MIC/RTSD57108.2024.10655961 . hal-04778603

HAL Id: hal-04778603

<https://hal.science/hal-04778603v1>

Submitted on 12 Nov 2024

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Experimental evaluation of rigid patient motion detection and correction in SPECT with exponential data consistency conditions

M.H.H. Bui¹, A. Robert¹, S. Rit¹, A. Etxebeste¹

¹ CREATIS; CNRS UMR 5220; INSERM U 1044; Université de Lyon; INSA-Lyon, Université Lyon 1, Lyon, France

Abstract

Rigid patient motion may cause artifacts in the reconstructed SPECT images. This study evaluated a fully data-driven method exploiting exponential data consistency conditions (eDCCs) —equations describing redundancies in SPECT measurements— to estimate and correct for rigid patient motion on experimental data. We minimized the pairwise inconsistency of projections with a noise-aware metric implementing eDCCs. The method led to a significant improvement in image quality. For instance, for a 20 mm motion in the middle of the acquisition in the axial or vertical directions, the activity recovery coefficient (ARC) for the biggest sphere (37 mm diameter) of the NEMA IEC phantom was improved from 0.41 (non-corrected projections) to 0.58 (motion-corrected projections), i.e. the same ARC as the one obtained with reference motion-free projections.

Acknowledgment

This work was supported by grant ANR-21-CE45-0026 (SPECT-Motion-eDCC) from the French National Research Agency (ANR) and was performed within the framework of the SIRIC LYriCAN INCa-INSERM-DGOS-12563 and the LABEX PRIMES (ANR-11-LABX-0063) of Université de Lyon, within the program "Investissements d'Avenir" (ANR-11-IDEX-0007) operated by the ANR.

References

- [1] Kyme, A. Z., & Fulton, R. R. (2021). Motion estimation and correction in SPECT, PET and CT. *Physics in Medicine & Biology*, 66(18), 18TR02. DOI: 10.1088/1361-6560/ac093b.
- [2] Wells, R. G., & Clackdoyle, R. (2021). Feasibility of attenuation map alignment in pinhole cardiac SPECT using exponential data consistency conditions. *Medical Physics*, 48(9), 4955–4965. DOI: 10.1002/mp.15058.
- [3] Robert, A., Sarrut, D., Etxebeste, A., et al. (2023). Ability of exponential data consistency conditions to detect motion in SPECT despite other physical effects. In *17th International Meeting on Fully 3D Image Reconstruction in Radiology and Nuclear Medicine* (pp. 337–340). Stony Brook, NY, United States.
- [4] Natterer, F. (2001). *The Mathematics of Computerized Tomography*. Classics in Applied Mathematics. Society for Industrial and Applied Mathematics.
- [5] Nelder, J. A., & Mead, R. (1965). A Simplex Method for Function Minimization. *The Computer Journal*, 7(4), 308–313. DOI: 10.1093/comjnl/7.4.308.
- [6] Rit, S., Vila Oliva, M., Brousmiche, S., et al. (2014). The Reconstruction Toolkit (RTK), an open-source cone-beam CT reconstruction toolkit based on the Insight Toolkit (ITK). *Journal of Physics: Conference Series*, 489. DOI: 10.1088/1742-6596/489/1/012079.