OpenDose3D, an open-source software for advancing clinical molecular radiotherapy dosimetry

J. Fragoso-Negrin[1,2,3], A. Vergara Gil[4], L. Santoro[2,3], J.P. Pouget[3], P. Kotzki[2,3], E. Deshayes[2,3], S. Vauclin[1], M. Bardiès[2,3]

1. DOSIsoft SA, Cachan, FRANCE

2. IRCM, UMR 1194 INSERM, Université de Montpellier and Institut Régional du Cancer de Montpellier (ICM), Montpellier, FRANCE,

3. Département de Médecine Nucléaire, Institut Régional du Cancer de Montpellier (ICM), Montpellier, FRANCE,

4. BIOMEDIQA GROUPE, Villeneuve-d'Ascq, FRANCE

Introduction: The increasing adoption of molecular radiotherapy (MRT) calls for robust and accurate tools to perform clinical dosimetry. Several software solutions have emerged, including commercial FDA-cleared or CE-marked, and in-house academic software. In this context, we present OpenDose3D (version 1), a freely available and open-source software intended for both clinical dosimetry research purposes and benchmarking of clinical dosimetry software.

Methods: OD3D is a module within the 3D Slicer software (Fedorov et al. 2012), accessible through the radiotherapy extensions section. Being a part of 3D Slicer, OD3D benefits from advanced tools for 3D image manipulation and segmentation.
Essential steps of the clinical dosimetry workflow (CWD) are included in OD3D.

- A specific SPECT sensitivity calibration and recovery coefficient module was created (Figure 1).
- Two different Clinical Dosimetry Workflows (CDWs) are disponible in the software, depending on how time-dependent variable are dealt with: (1) activity, cumulated activity and absorbed dose or (2) activity – absorbed dose rates and absorbed dose.
- In addition, an attempt to automatize most steps is currently tested.

Sanity checks verify that patient images and calibrations were acquired and reconstructed using the same protocol. Registration can be carried out in Rigid or Elastic mode. Organs at risk contouring is performed manually or automatically (Wasserthal et al. 2023). Absorbed dose rate images are calculated assuming Local Energy Deposition or by convolution of Voxel S Values. Additionally, Monte Carlo (GATE) macros can be automatic created, and results can be imported during/after the simulation. Different models of time activity/ADR curve fitting are available, and automatic selection of the best-fit is also an option.

Results: OD3D proposes a wide range of features, including automatic segmentation, absorbed dose calculation for an extensive list of radioisotopes (Figure 2), and Monte Carlo

simulations. The software offers different CDW and attempts to decrease operator dependent sources of variation. Furthermore, unlike traditional "black box" solutions, OD3D generate intermediate results, which improve traceability and represent a valuable tool for benchmarking.

Conclusion: OD3D contributes to the advancement of personalized MRT and facilitates the standardization and improvement of clinical dosimetry practices.

References:

Fedorov, et al. *Magnetic Resonance Imaging* 30 (9): 1323–41.

Wasserthal et al. arXiv. https://doi.org/10.48550/arXiv.2208.05868.

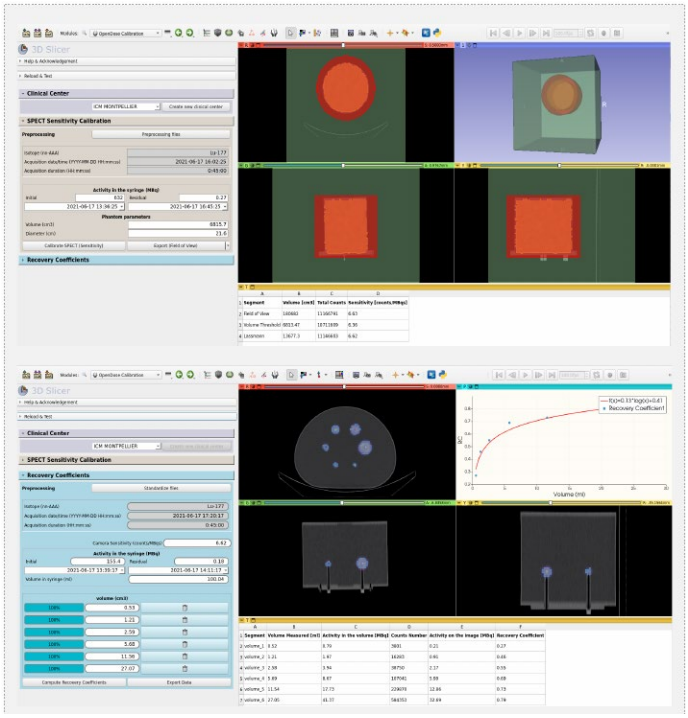

Figure 1: OD3D Calibration module includes SPECT sensitivity calibration and recovery coefficients determination.

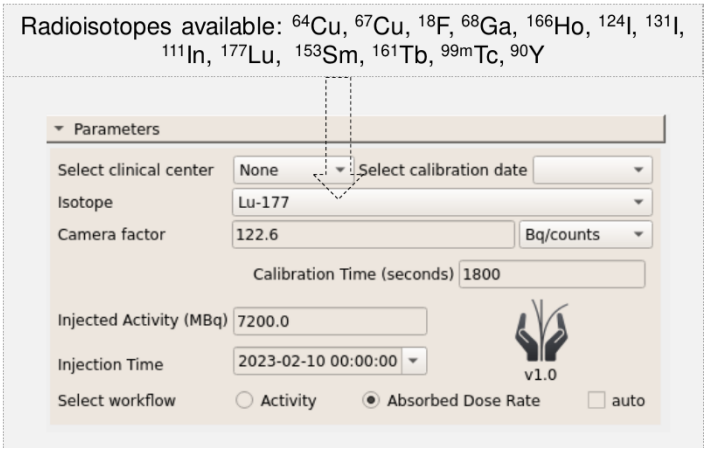

Figure 2: OD3D parameters selection. List of radioisotopes available.