Documentation DoseCV

2024

Summary

1. Overview

DoseCV perform the conversion of dosimetric measurements related to simulations generated from the new Phantoms made available by ICRP. Once the information has been filled in correctly, the user will have access to 6 spreadsheets containing information at different data granularities, describing the result of the Dose Coefficient (Dc) in the units of (pGy.cm²), CC (msv/Gy.cm²) or in real dose units, for different organs and tissues.

2. History Modifications

Data	Modification	Reason
26/12/23	Creation	Creation and implementation of the program
12/10/24	Modification	Implementation of the CC calculation
22/12/24	Modification	Implementation of dose calculation in real units

3. Language and Libraries

The software was developed using the Python language and has so far utilized 4 libraries: pandas *(used for manipulating and analysing data, offering flexible data structures that allow you to work with data of different types and formats in a simple and objective way)*; re *(a library native to the language that provides functionalities for working with regular expressions, which are used to match and manipulate text based on patterns)*; pysimplegui *(allows you to develop user interfaces in a simple way)*; pyinstaller *(used to 'package' Python programs into independent executable files)* to transform the code into an executable file on the Windows operating system

4. Software Flowchart

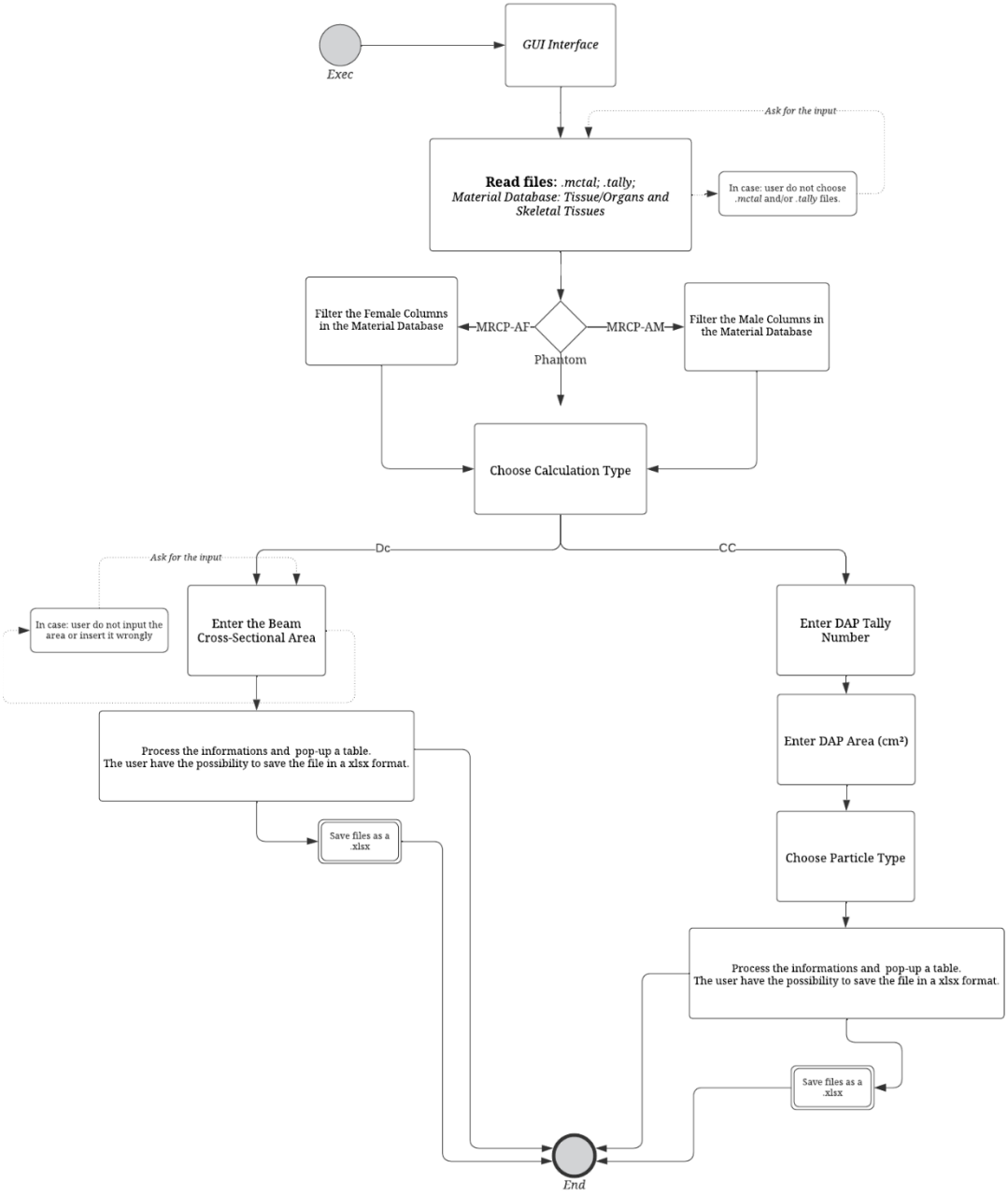

Image 1: Software Flowchart

5. Data Processing Flowchart

Image 2: Data processing flowchart.

6. Software Interface

The software interface has the following layout:

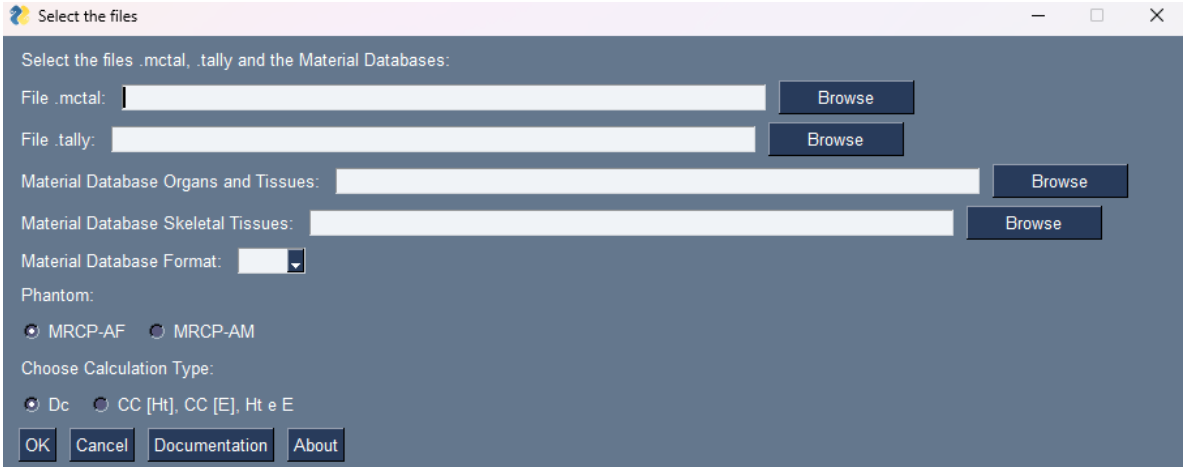

Imagem 3: Software Interface.

Below, we will comment on what to select in each of the above fields. At any time, the user can hover the cursor over the empty fields and wait for the tooltip that details what should be filled in the respective field. It is recommended that the user select the 'Browse' option in the right-hand corner and manually select the file within the respective folders that contain it. It is possible to enter the path + file name manually, but to avoid errors, manual selection is recommended. DoseCV will only analyze one simulation at a time (so don't select more than one file per field).

- File .mctal: Select the simulation output file, usually described as 'mctal'.
- File .tally: Select the simulation output .tally file, usually described as 'Name.tally'.

- Material Database Organs and Tissues: In this field, the user must select the file containing the organ and tissue description information. The file should contain the following Header layout:

Tissue/organ	Tally Name	Tally	Male mass(g)	Female mass(g)	wt	Type

  - To help users, the Organs and Tissues spreadsheet will be made available with DoseCV in the GitHub repository.
- Material Database Skeletal Tissues: In this field, the user must select the file that contains the Skeletal Tissues description information. The file should contain the following Header layout:

Bonesite	Bonesite Detail	Tally	Male - Active marrow mass(g)	Male - Endosteum mass(g)	Female - Active marrow mass(g)	Female - Endosteum mass(g)	wt

  - To help users, the Skeletal Tissues spreadsheet will be made available with DoseCV in the GitHub repository.
  - It is important to emphasize that the biggest difference between this database and the one provided by the ICRP is the grouping of genders. In the layout proposed above, a description prefix (‘Male -’ and ‘Female -’) was added to the mass value fields (Active Marrow Mass and Endosteum Mass).
- Material Database Format: Choose the extension format of the material files you chose earlier. It is important that they both have the same extension (either .xlsx or .csv).
- Select Phantom: Select the Phantom of the simulation (MRCP-AF or MRCP-AM). Important field to gather information from the material base.

- Choose Calculation Type:
    - If Dc:
        - Enter the Beam Cross-Sectional Area: Fill in the value in cm^2, where the area must be separated by a full stop (.) and not a comma (,).
    - If CC [Ht], CC[E], Ht and E.
        - Enter the KAP Tally Number: Fill in the tally number that identifies the KAP simulation object.
        - Enter the KAP Tally Area (cm^2): Fill in the value in cm^2, where the area must be separated by a full stop (.) and not a comma (,).
        - Enter de KAP, Air (Gy): Fill in the dose value of the simulation object, where the area must be separated by a full stop (.) and not a comma (,).
            - If the user fills it in, the Ht and E values will be shown in the results. If the user does not fill this in, the Equivalent Dose and Effective Dose values will be displayed in Conversion Coefficient (CC) units.
        - Select the Particle Type: Select whether the simulation was based on Photons, Electrons or Muons.

- Observações:
    - No previously selected files can be open at the same time as the software is running.
    - It can be seen that in most cases, the example tables (‘Skeletal Tissues’ and ‘Organs and Tissues’) will be the main ones used during the software use. The possibility of modification has been proposed, as users may come to use different components for research purposes.

7. DoseCV

After filling in the information described in the previous topic, DoseCV will carry out the calculations and then display a table with the following layout on the screen for the user:

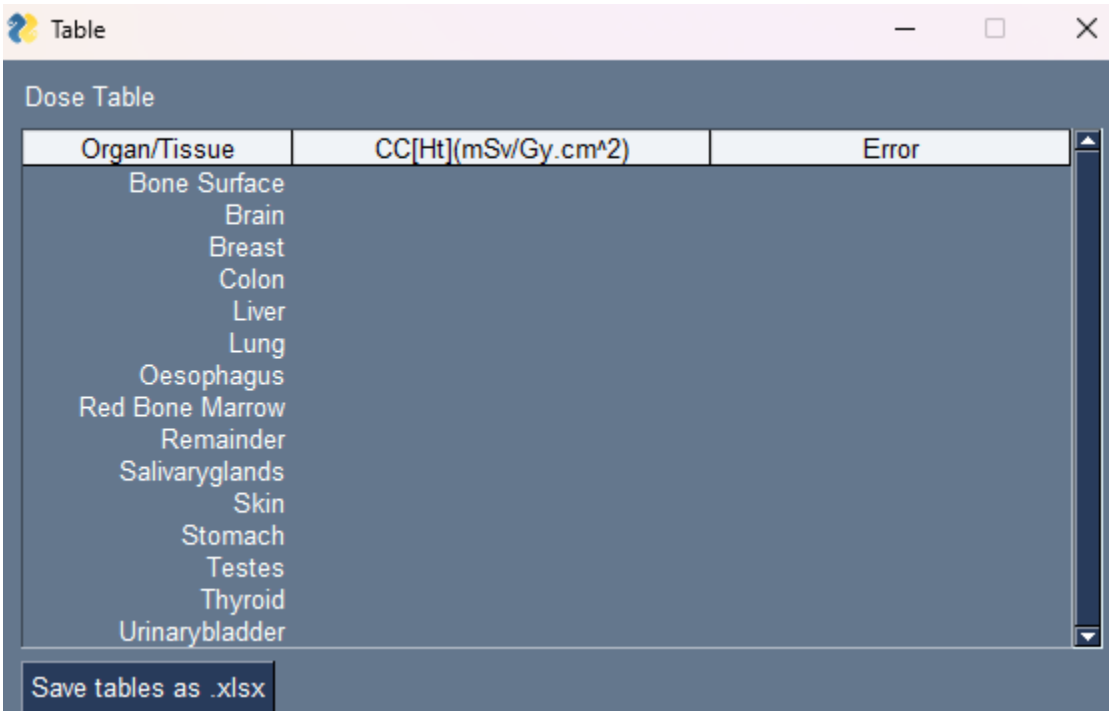

Image 4: Table generated from a simulation. It has no values, as it is just a test display to demonstrate in the documentation. When generating your information, some organs and tissues may not coincide with the information above. In the test above, the display is CC[Ht], but the field is dynamic and directly dependent on the user's choices, so there may be differences.

The user has the option of extracting a file with the extension .xlsx, which contains 6 spreadsheets describing the calculations. To do this, the user must select the option 'Save Tables as .xlsx', where the following pop-up will be displayed.

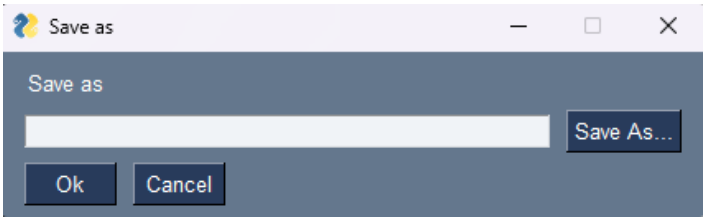

Image 5: Pop-up to save a xlsx file.

The user must then click on ‘Save As...’, select a folder and enter a name for it, as shown in the image below:

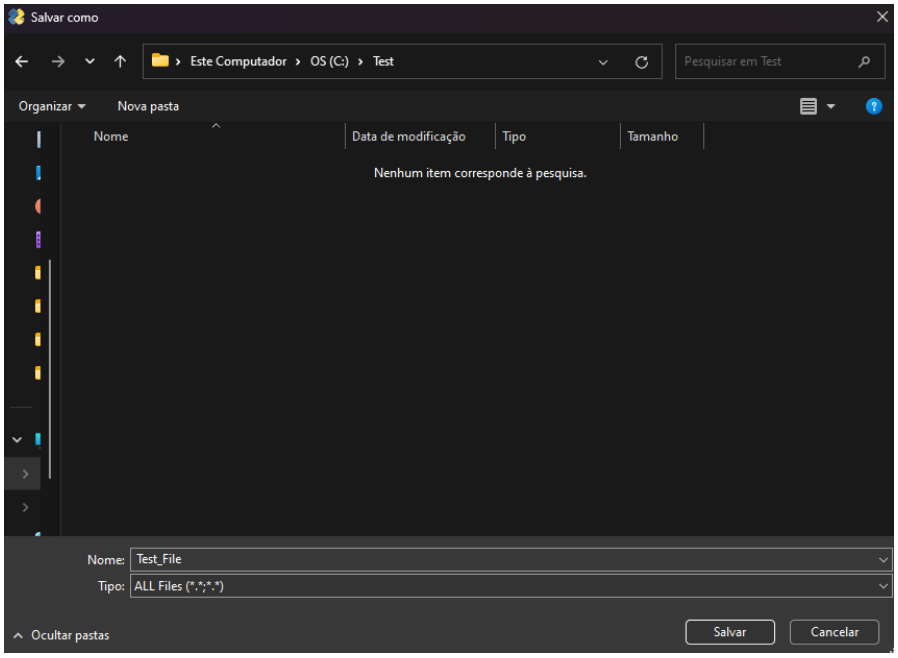

Image 6: Screen saving demonstration. The user doesn't need to worry about the ‘Type’ option, as DoseCV will save in .xlsx format by default.

After clicking on ‘Save’, the user will be directed to the same screen shown in Image 5. Next, all they must do is click on ‘Ok’:

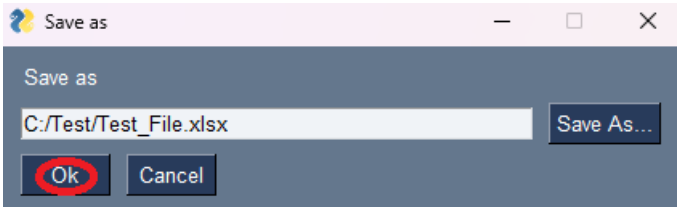

Figura 7: Demonstration of how to save the results sheets.

8. Generated Tables

After saving the previously generated tables, the user will have a file containing a total of 6 tables:

- Dc/CC [Ht], CC[E], Ht and E: Contains a summarization of the Dc or CC [Ht]/Ht value of tissues and organs, with Red Bone Marrow and Bone Surface grouped according to the demonstration standard in the documentation itself, along with the associated error.
- Dc Group/CC Group: Differentiation of groups of tissues and organs with the inclusion of individual Dc/CC calculations and their associated error by organ and Remainders. Note: this table does not include information on Skeletal Tissues.
- Dc Detailed/CC Detailed: Dc/CC calculation and its associated error with calculation breakdown by structure in the simulation. If an organ has two or more Mesh Structures within the simulation, the breakdown of each one will be displayed here. Note: this table does not include information on Skeletal Tissues.
- Assistant Table: It contains all the detailed information needed to carry out the Dc/CC calculations, from the 'Energy deposition (MeV/g/source-particle)' and its error to the final Dc/CC calculation. Note: this table does not include information on Skeletal Tissues.
- Skeletal Tissue Detail: Skeletal Tissue information will be here. It contains the masses corresponding to the simulations that were compatible with the material base and the D_{skel} and D_{tm50} values, along with the 'Energy deposition (MeV/g/source-particle)' and its associated error.
- Others: This will display all the organs that have been simulated but have not been matched in the material base, thus compromising the Dc calculation. If the user does not find a Dc/CC [Ht], CC[E], Ht and E value in one of the above tables and it is in this spreadsheet, check that the simulated objects in question has values in the material bases.
- For CC[Ht], CC[E], Ht and E, there is the Effective Dose sheet: it calculates the effective dose and its error.