RODOMS User Manual

May 2017

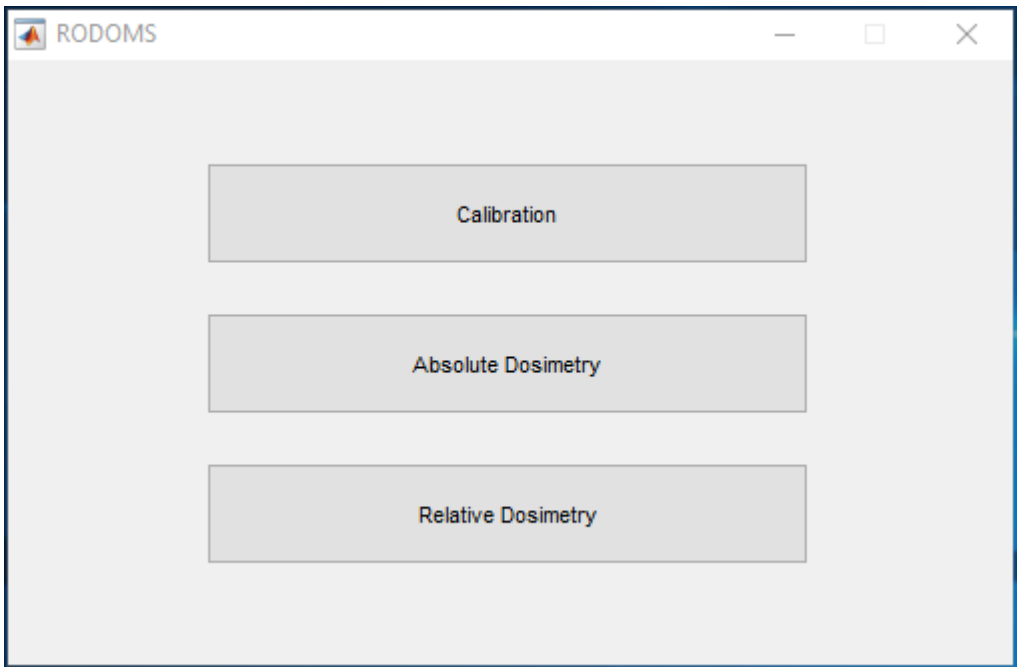
Contents

1. RODOMS launch interface

This software was written to facilitate film QA. For absolute dosimetry, a calibration function is obtained in the calibration process. The same calibration function will be loaded later when user performs absolute dosimetry. Alternatively, RODOMS can be used for relative dosimetry. A linear dose response is established by adjusting scanning parameters at calibration. QA film scanned using the same scanner setting can then be used directly for relative dosimetry, subject to a linear scaling, which will be automatically applied by the software.

At the start of the RODOMS program, the application launch interface is displayed. From here user can select from the following three applications:

- Calibration (see section 2)
- Absolute Dosimetry (see section 3)
- Relative Dosimetry (see section 4)



2. Calibration

The unexposed film and calibration film should be prepared as follows:

- The calibration film strips should be taped together and scanned as one image.
- Both films should be scanned at 127 dpi.
- Both scans should have the same dimension and scanner settings.

The film calibration application is activated by clicking the 'Calibration' button on the software launch page.

The steps to be taken are numbered on the push buttons. Please follows them in order:

1. **Load Unexposed Film**

User selects the path where the film is saved. After the first file is loaded the selected path will be remembered and user will be directed to the same folder (with the option to change path).

2. **Load Calibration Film**

By default, user will be directed to the same directory where the unexposed film was uploaded from.

3. **Enter and Record Calibration Dose**

In the column provided, enter the calibration dose in cGy. Up to 18 dose levels are supported. If less than 18 levels were used, simply leave the unused cells empty.

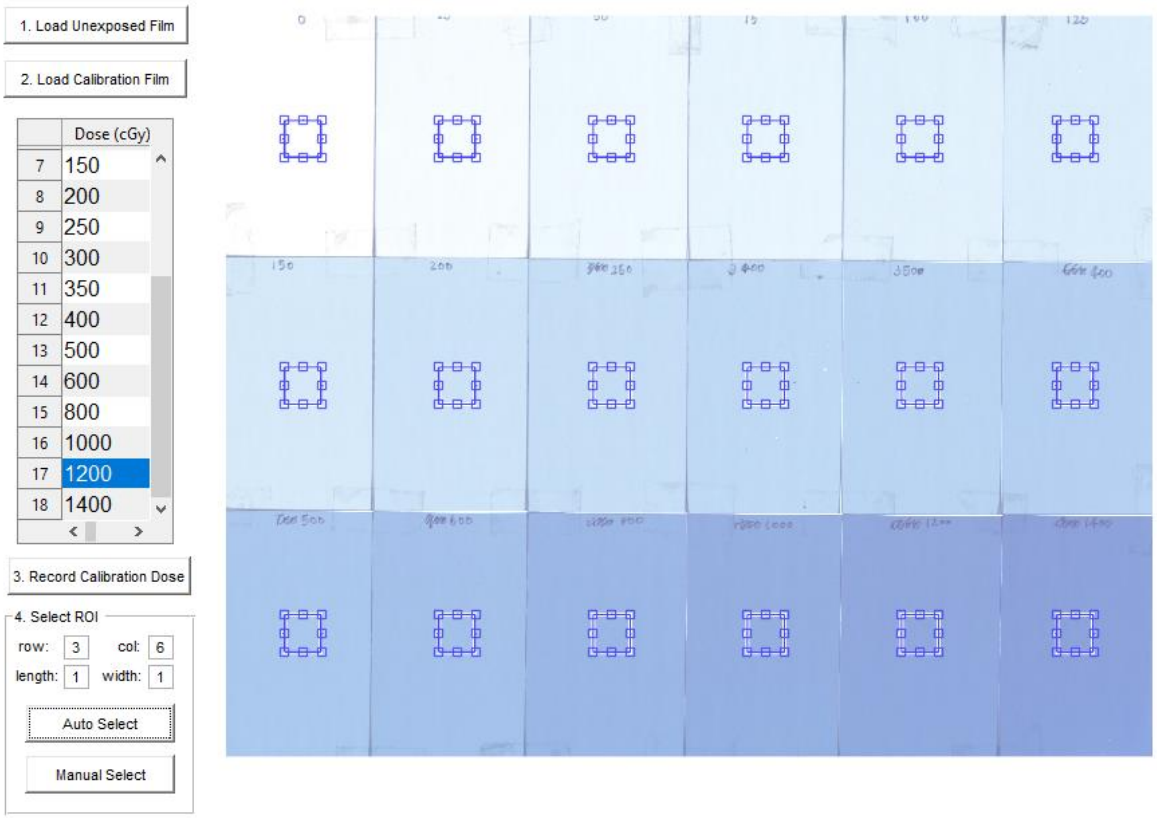
Click on **Record Calibration Dose**.

4. **Select ROI**

The ROIs of each dose region can be selected using two methods:

- Auto selection

  Enter the number of rows and columns in the calibration film, and the desired length and width in cm of the ROI, then click on '**Auto Select**'. A rectangular ROI will be placed in the centre of each dose region automatically. Please note that the software will read in each region from left to right then top to bottom. Therefore please ensure the dose levels entered in step 3 are in the same order.



- Manual selection

  Alternatively, user can choose to manually select ROIs in each region. This is achieved by clicking on '**Manual Select**'. Use the mouse to draw a rectangle in the first dose region. A second rectangle of the same size will appear at the top left corner. User needs to drag the selection to the desired location and double click to accept. Depending on the number of dose levels entered, subsequent ROIs will appear and user needs to repeat the previous step, until ROIs for all dose regions are selected.

5. Select Color Channel

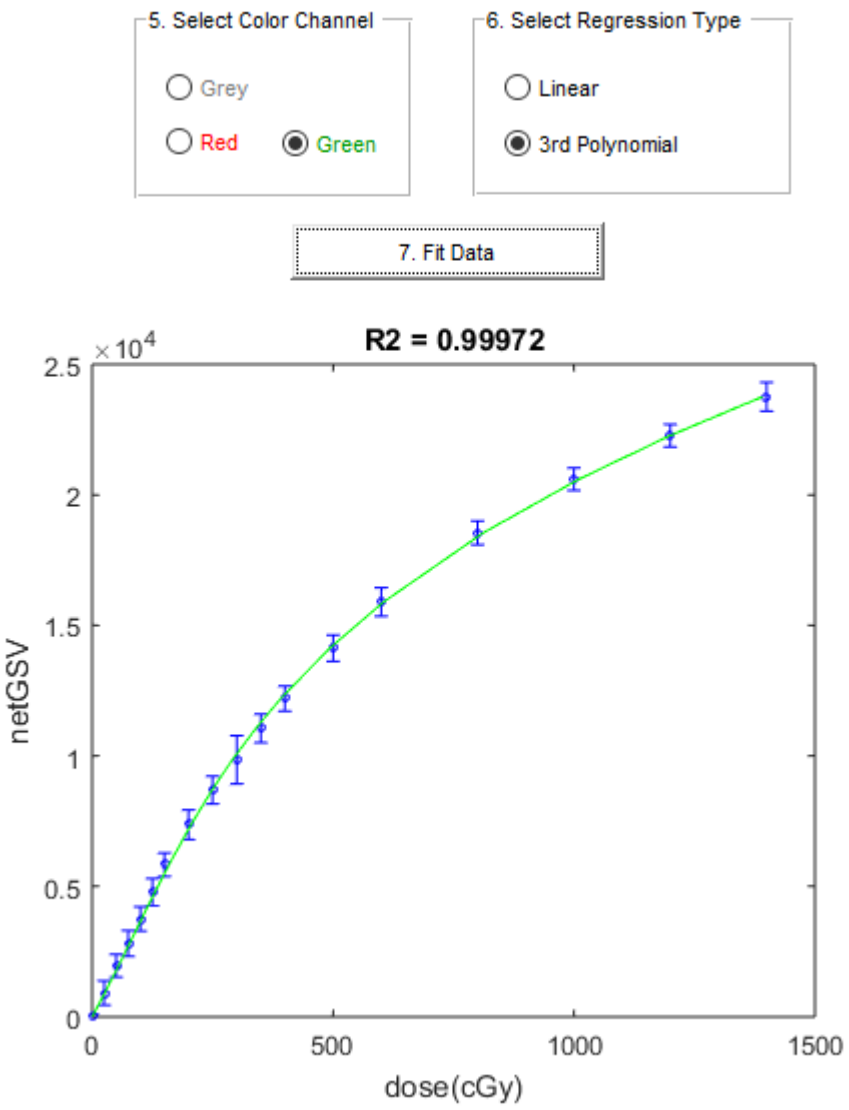
Select the color channel to be analysed. If the films were scanned as greyscale image, choose 'Grey'. If the films were scanned as RGB image, choose either 'Red' or 'Green'.

6. Select Regression Type

RODOMS fit netGSV (unexposed GSV minus calibration GSV for each ROI) to dose levels using either a linear (for relative dosimetry) or third order polynomial function (for absolute dosimetry).

7. Fit Data

Average netGSV, uncertainty (2 standard deviations) and selected fit-line will be displayed. R-squared value is also displayed at the top of the graph.



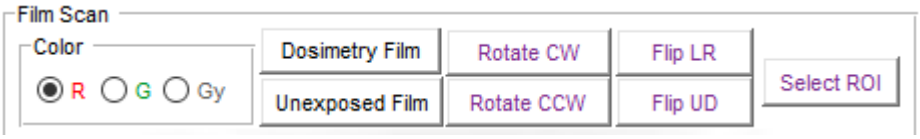
8. Save Calibration Data (for polynomial fit)

For absolute dosimetry using a third order polynomial fit, the calibration function should be saved as a csv file.

3. Absolute Dosimetry

This section outlines the procedure for absolute film dosimetry.

I. In the Film Scan panel, select the color channel to be analysed. For low dose applications (up to 5Gy), choose R; for high dose applications (up to 14Gy), choose G. If film was calibrated using greyscale, choose Gy.



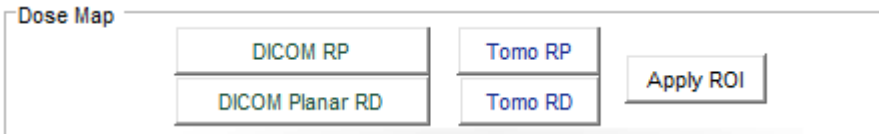
II. Click on **Dosimetry Film** and select the scanned dosimetry film.

III. Click on **Unexposed Film** and select the scanned unexposed film.

IV. [OPTIONAL] Perform rotation or/and flipping of film image as required.

V. [OPTIONAL] Select ROI to be analysed (and to exclude markings on the film).

VI. In the Dose Map panel, click on relevant button for the TPS and load the required files.



For RayStation or Eclipse, use the two buttons on the left to load DICOM plan and planar dose files. For TomoTherapy, use the two buttons in the middle to load DICOM plan and 3D dose files.

VII. Click on **Apply ROI**. A rectangle box will appear which has the same dimensions as the film image. Please keep the dimensions unchanged and drag the box to roughly the area on dose map corresponding with the film scan. Once satisfied with its positioning, double click the mouse to accept.

VIII. In the Image Processing panel, click on **Registration**. Translation and rotation will be applied to the film image so that its coordinates are matched to those of the dose map. Once the process is complete, a message box will pop up to indicate so. Please click on **OK**. Occasionally the registration will not be successful. In that case, click on **Reset** next to the Registration button, then repeat from step VII. This will generally fix the problem.

IX. [IN TESTING PHASE] Isocentre-shift calculation – this step tests whether the automatic image registration shifts the setup-marking determined isocentre to planned isocentre. Firstly, click on **H Laser**, then move mouse over to the film image and click on either the left or right laser. Next click on **V Laser**, then move mouse over to the film image and click on either the top or bottom laser. Then click on **Calc Shift**, the distance in millimetre

between laser-determined and plan specified isocentre points in horizontal and vertical directions will be displayed in the relevant box.

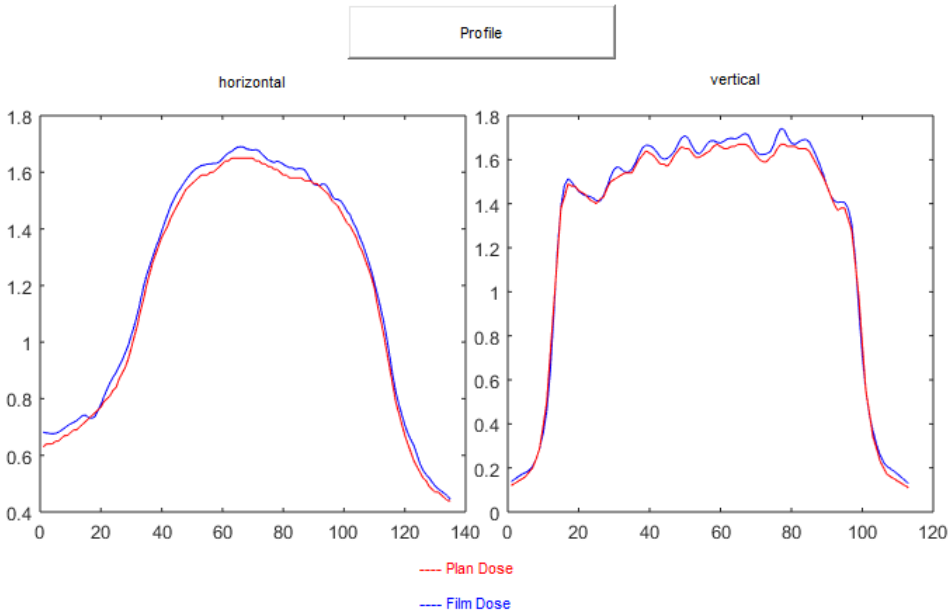
X. Click on **Refine ROI**, then drag the mouse over the film image to refine ROI, excluding any writing on the film and any white margin left as a result of image registration. If user wants to change the selection later on, click on **Reset** next to the Refine ROI button and redo the selection.

XI. Click on **Convert Film GSV to Dose**, the select the calibration file saved before (refer to section 2 – step 8).

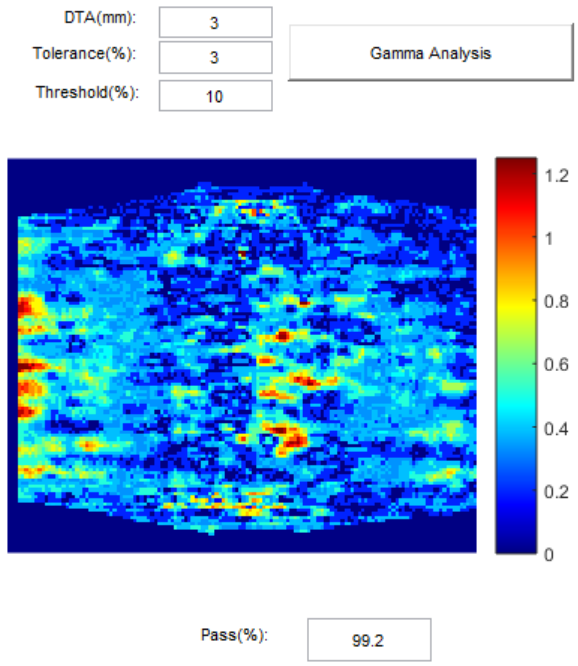
XII. [OPTIONAL] For absolute dosimetry, film intensity is scaled to dose using the calibration function. Theoretically no further scaling should be performed. Sometimes the calibration may go off a bit and a scaling function is added as an option to yield better result. Enter the scaling number (e.g 1.05) then click on **Scale**. Perform a profile comparison to see whether the result has improved. This scaling process can be repeated. Please note that each scaling is performed in addition to the previous calculation.

XIII. The QA Analysis panel provides both qualitative and quantitative tools and user may use them in any order.

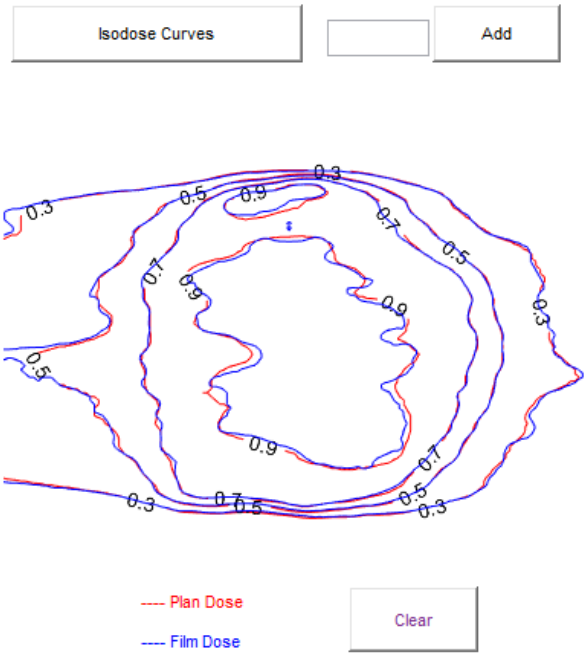
XIV. For profile comparison, click on **Profile**, then click anywhere on the film image. Plan calculated dose (shown in red) and film measured dose (shown in blue) profiles will be plotted together for comparison in horizontal and vertical directions. User can drag the selected point and move it across the film image. Profiles will be updated real time.



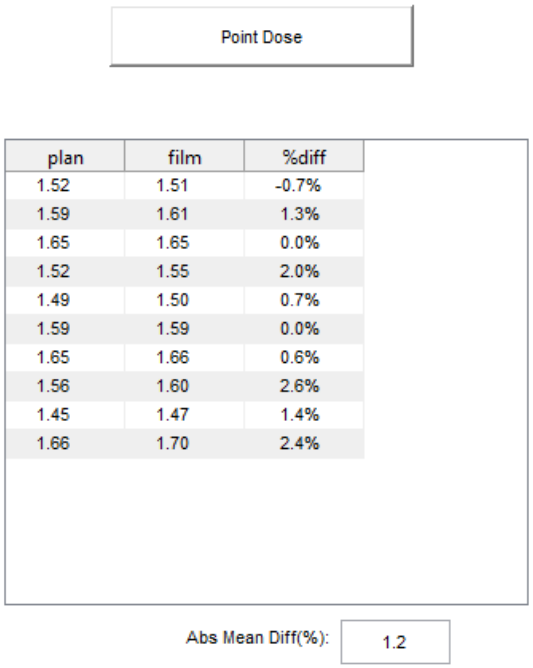
XV. For gamma analysis, input DTA in millimetres, and dose tolerance and threshold in percentage value, then click on **Gamma Analysis**. Gamma map and statistics will be generated.



XVI. Clicking on **Isodose Curves** will produce the default isodose curves (30%, 50%, 70%, 90%). User can also request a different isodose level by inputting the desired isodose percentage, then click on **Add**. If user wants to clear the figure, please press the **Clear** button and start again.



XVII. For point dose comparison, click on **Point Dose**, then move mouse over to the film image and click on 10 different points (please make sure to have 10 clicks). Plan calculated dose and film measured dose will be shown in the given table together with percentage difference. The absolute mean percentage difference is also shown below the table.



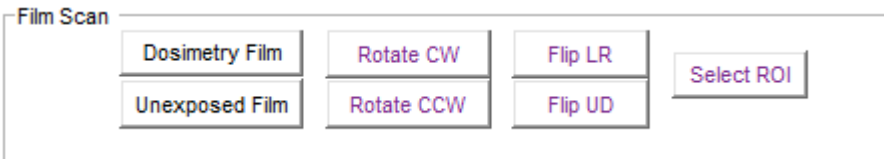
XVIII. Enter the Physicist name and date (press enter for current date), then click on **Report**. A PDF report will be generated and user can save it to a desired location.

XIX. Click on **Restart** to start a new analysis.

4. Relative Dosimetry

This section outlines the procedure for relative film dosimetry.

I. Click on **Dosimetry Film** and select the scanned dosimetry film (in greyscale).

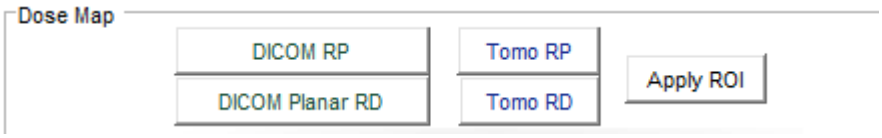


II. Click on **Unexposed Film** and select the scanned unexposed film (in greyscale).

III. [OPTIONAL] Perform rotation or/and flipping of film image as required.

IV. [OPTIONAL] Select ROI to be analysed (and to exclude markings on the film).

V. In the Dose Map panel, click on relevant button(s) for the TPS and load the required dose map file(s).



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VI. Click on **Apply ROI**. A rectangle box will appear which has the same dimensions as the film image. Please keep the dimensions unchanged and drag the box to roughly the area on dose map corresponding with the film scan. Once satisfied with its positioning, double click the mouse to accept.

VII. In the Image Processing panel, click on **Registration**. Translation and rotation will be applied to the film image so that its coordinates are matched to those of the dose map. Once the process is complete, a message box will pop up to indicate so. Please click on OK. Occasionally the registration will not be successful. In that case, click on **Reset** next to the Registration button, then repeat from step VII. This will generally fix the problem.

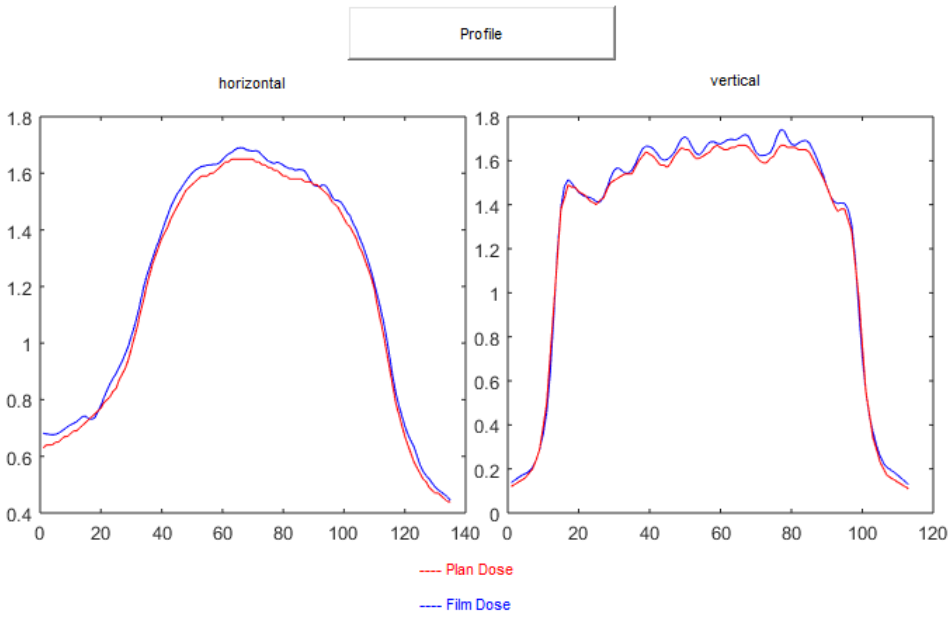
VIII. [IN TESTING PHASE] Isocentre-shift calculation – this step tests whether the automatic image registration shifts the setup-marking determined isocentre to planned isocentre. Firstly, click on **H Laser**, then move mouse over to the film image and click on either the left or right laser. Next click on **V Laser**, then move mouse over to the film image and click on either the top or bottom laser. Then click on **Calc Shift**, the distance in millimetre between laser-determined and plan specified isocentre points in horizontal and vertical directions will be displayed in the relevant box.

IX. Click on **Refine ROI**, then drag the mouse over the film image to refine ROI, excluding any writing on the film and any white margin left as a result of image registration. If user wants to change the selection later on, click on **Reset** next to the Refine ROI button and redo the selection.

X. Click on **Dose Scaling**, then position the cursor to roughly the centre of the dose map and double click to accept. It should be noted that the program samples along the horizontal line of the selected point and uses all pixels from the left most position to the selected point to calculate a regression best-fit function to convert film intensity readings to dose. The sampling should cover the dose range of the particular case on hand. Normally this will be achieved by placing the selection somewhere near the centre of the dose map. However if the dose distribution is asymmetrical, user will need to place the selection point at a position where a good coverage of dose range can be achieved. If user wants to change the position later on, click on **Reset** next to the Dose Scaling button and redo the selection.

XI. The QA Analysis panel provides both qualitative and quantitative tools and user may use them in any order.

XII. For profile comparison, click on **Profile**, then click anywhere on the film image. Plan calculated dose (shown in red) and film measured dose (shown in blue) profiles will be plotted together for comparison in horizontal and vertical directions. User can drag the selected point and move it across the film image. Profiles will be updated real time.



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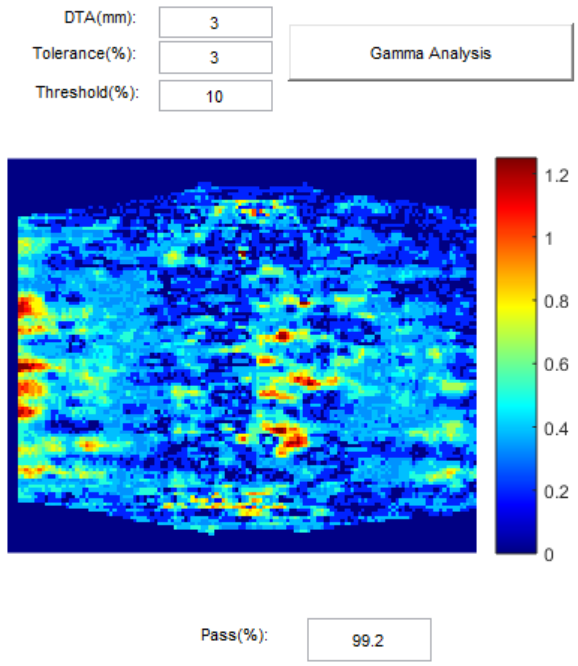

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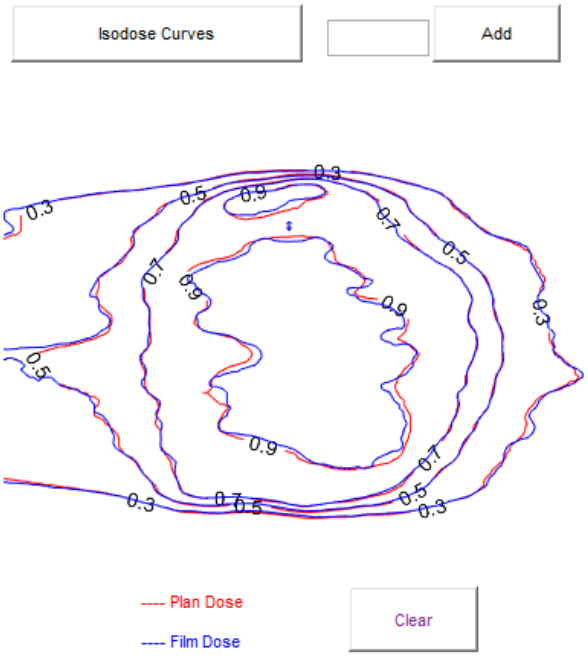

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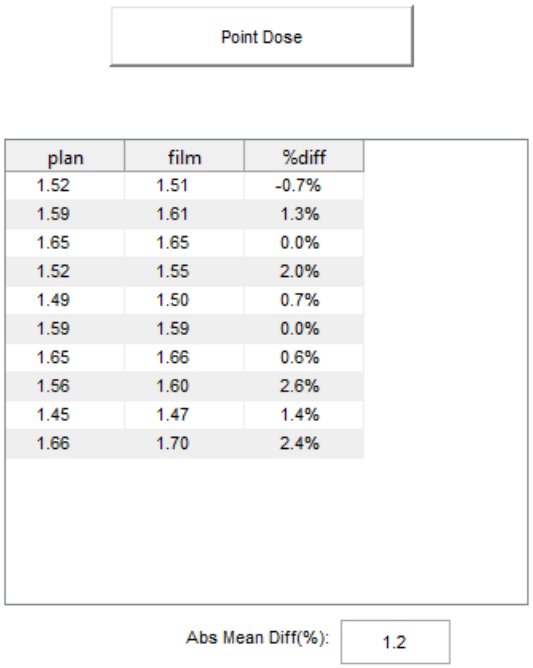


XX. Enter the Physicist name and date (press enter for current date), then click on **Report**. A PDF report will be generated and user can save it to a desired location.

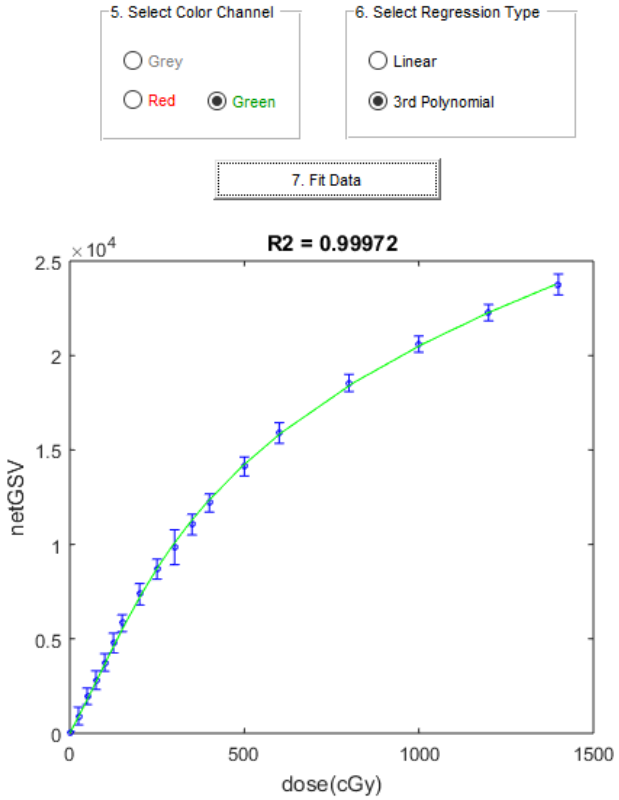
XXI. Click on **Restart** to start a new analysis.

5. REV Film Calibration and Scanner Settings Summary

EBT3 film from batch #11091602 was calibrated on Kenny on 10 May 2017 for both relative dosimetry (linearity method) and absolute dosimetry for dose up to 14Gy. The results and recommended scanner settings are summarised below.

5.1 Absolute Dosimetry, High Dose (up to 14Gy)

At high dose range (up to 14Gy), green channel is recommended for absolute dosimetry.



The following scanning settings should be used:

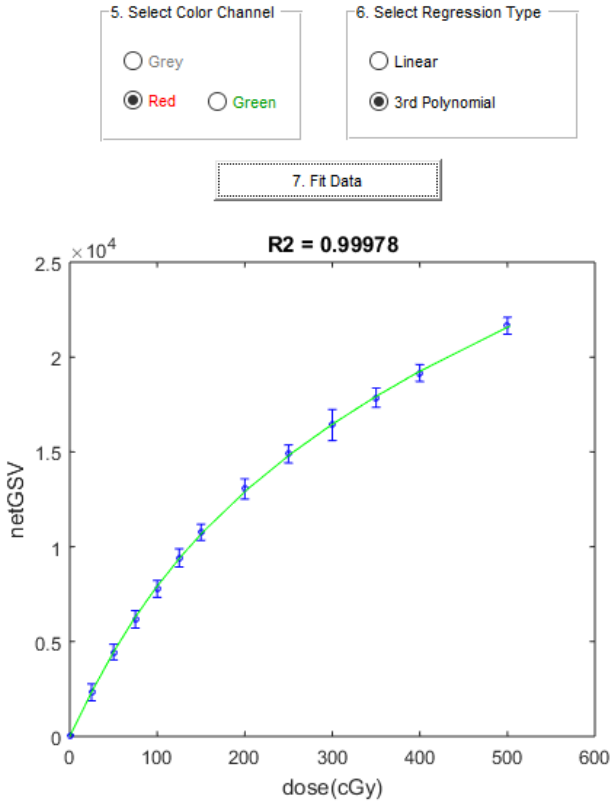
Color adjustment options	Off
Resolution (dpi)	127
Color format	48-bit RGB
File format	TIFF

Calibration file is saved to:

G:\PHYSICS\06 Dosimetry Equipment\15 Film Dosimetry\EBT3\REV film calibration 20170510\exposure 14h\calibration GREEN 14Gy.csv

5.2 Absolute Dosimetry, Low Dose (up to 5Gy)

At low dose range (up to 5Gy), red channel is recommended for absolute dosimetry.



The following scanning settings should be used:

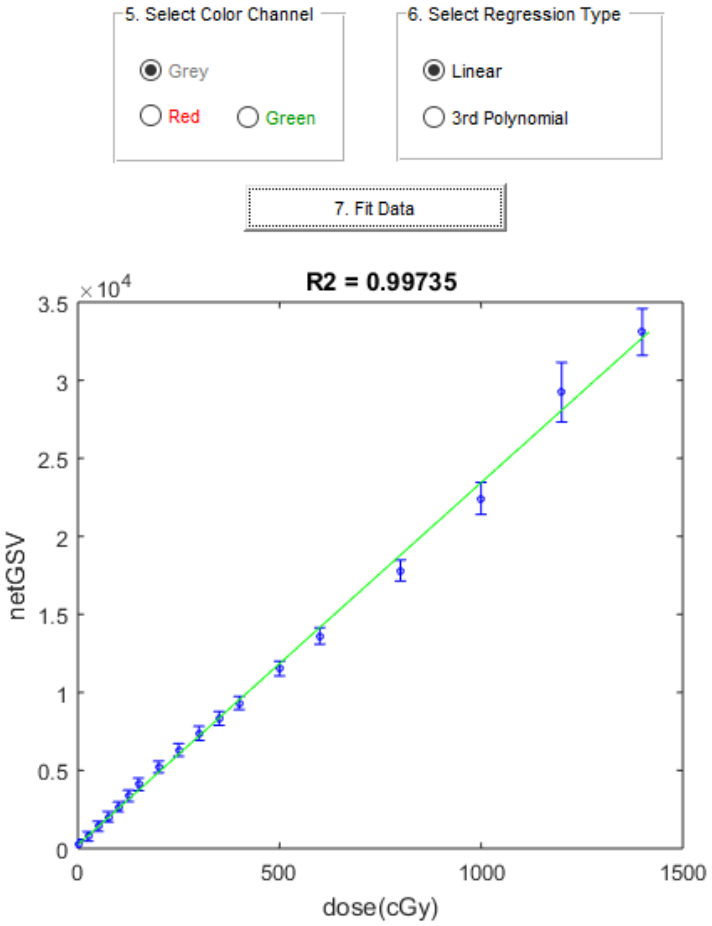
Color adjustment options	Off
Resolution (dpi)	127
Color format	48-bit RGB
File format	TIFF

Calibration file is saved to:

G:\PHYSICS\06 Dosimetry Equipment\15 Film Dosimetry\EBT3\REV film calibration 20170510\ exposure 14h\calibration RED 5Gy.csv

5.3 Relative Dosimetry

EBT3 film is suitable for relative dosimetry for dose up to 14Gy and greyscale image is recommended.



The following scanner settings should be used. calibration film and an unexposed film were scanned with the following parameters:

Color adjustment options	On
Resolution (dpi)	127
Auto-exposure	On
Histogram r	4
Brightness	-10
Contrast	+10
Color format	16-bit greyscale
File format	TIFF