

LABVIEW Package

Labview (Laboratory Visual Instrument Engineering Workbench) is a graphical programming language used as a powerful and flexible instrumentation and analysis software system in industry and academia. Labview uses the graphical programming language G to create programs called Virtual Instruments or VI in a pictorial block diagram form which eliminates many syntactical details of other programming languages that use a text based programming approach. Labview also includes many tools for data acquisition, analysis and display of results. The analysis library contains a multiple of functions in signal generation, signal processing, filtering and statistics. Labview is available for all the major platforms and is easily portable across platforms. Labview can also make executable files that work without the source code.

Objective

The objective of this work is to propose a friendly and quick post processing code written in Labview package named “Programa Matriz”, that serves as support for MCNP5 image simulation.

2. THE PROGRAMA MATRIZ

The *Programa Matriz* is a post-processing program developed in the Labview version 8.0 that converts the radiographic output files from MCNP5 to forms compatible with various external graphics packages. The *Programa Matriz* is shown in the Figure 3.



Fig. 3. Programa Matriz.

Characteristics

- ❖ The program is an executable, that is, it works without Labview source code;
- ❖ The user does not need to program in Labview;
- ❖ The program has a friendly interface;
- ❖ The program is compatible with various external graphics packages, like Matlab, TecPlot and GNUPlot.

- ❖ It giving the largest and smaller image pixel value to normalization finalities.
- ❖ It permit the obtaining of this negative and positive image format (image inversion).
- ❖ The program giving the output file in .doc, .xls and .txt.
- ❖ It is compatible with other MCNP functions such as Lattice and Mesh Tallies.

3. MATERIALS AND METHODS

Analysis of the Programa Matriz

Output files of MCNP5 radiographic tally were processed with *Programa Matriz* and converted to images through the Matlab software. Unsharpness were determined in the simulated image and compared with analytical values to verify the image accuracy. Moreover, a visual analysis of the behavior of the image contrast to several thickness and source energy were done.

3.1 Unsharpness Calculation

Radiographic images of an aluminum disc with 1cm diameter and 0.1cm of thickness was simulated to unsharpness analysis. The source-to-object distance used was 100cm and the object-to-detector was 25cm and 50cm. The source is a 0.3 cm diameter disc of 60 keV energy. The Figure 4 show the geometry used in unsharpness determination.

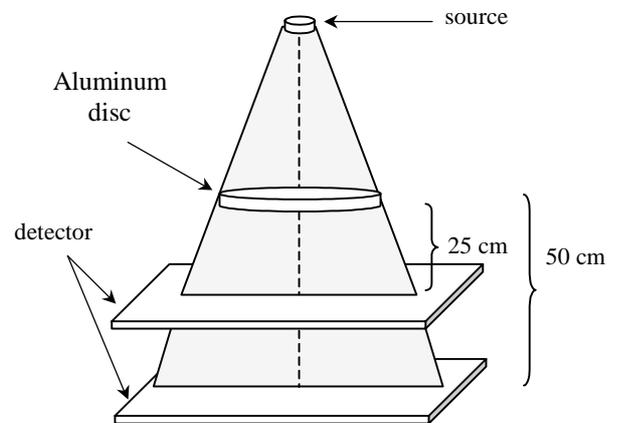


Fig. 4. Geometry used in unsharpness determination.

The unsharpness in simulated image was obtained through profile analysis, and the analytical unsharpness (U_g) was calculated through the Equations [3]:

$$U_g = F(M - 1) \quad (1)$$

$$M = (a + b) / a \quad (2)$$

where:

F: focal size

a: source-to-detector distance

b: object-to-detector distance

3.2 Image Contrast Analysis

Figure 5 present MCNP geometry of a aluminum step wedge test used to visual analysis of the behavior of the image contrast to several thickness and source energy. This test object is comprised of ten air cylinders of 0.635cm diameter, with five sets of cylinders of height equal 0.1016cm (a), and height equal 0.0508cm (b).

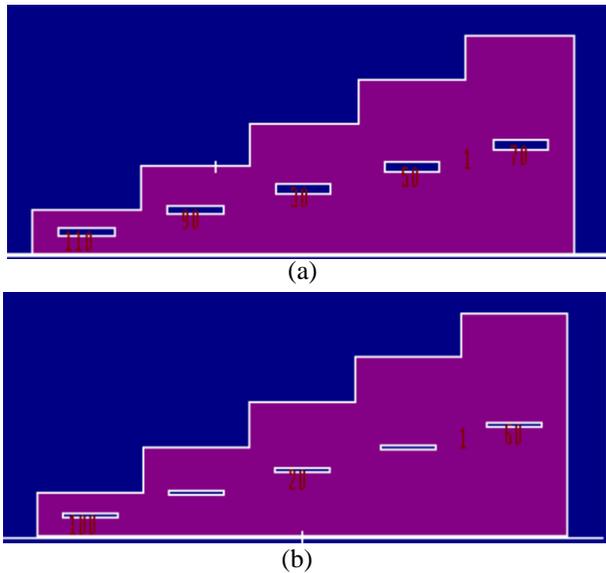


Fig. 5. Aluminum step wedge test.

The source-to-detector distance used was 150cm and the object was closed to the detector. The source is a 0.3 cm diameter disk.

Images were obtained to three different energies: 30keV, 60keV and 90keV.

4. RESULTS

4.1 Unsharpness

The Figures 6 and 7 show the aluminum disc simulated image.

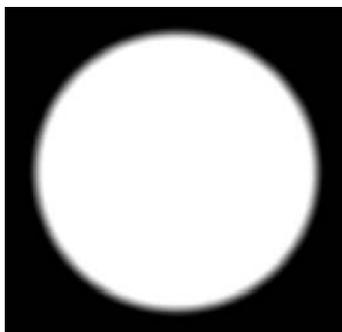


Fig 6. Aluminum disc simulated image with 25 cm object-to-detector.



Fig 7. Aluminum disc simulated image with 50 cm object-to-detector.

The calculated profile from Figures 6 and 7 are shown in the Figures 8 and 9.

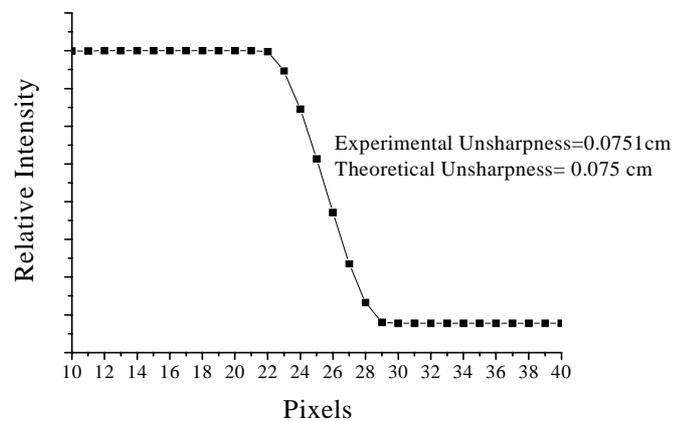


Fig 8. Profile from aluminum disc simulated image with 25 cm object-to-detector distance

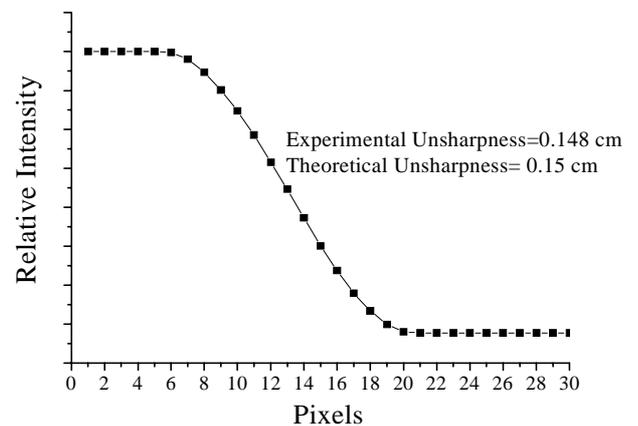


Fig 9. Profile from aluminum disc simulated image with 50 cm object-to-detector distance

The profile analysis in Figures 8 and 9 to present unsharpness values of 0.0751 and 0.148 cm, respectively. The simulated results show good agreement with analytical values, 0.075 and 0.15 cm, with a percentile difference of 0.1 % and 1.3 %.

4.2 Image Contrast

The Figure 10 illustrates the behavior of the image contrast of a aluminum step wedge to several source energy.

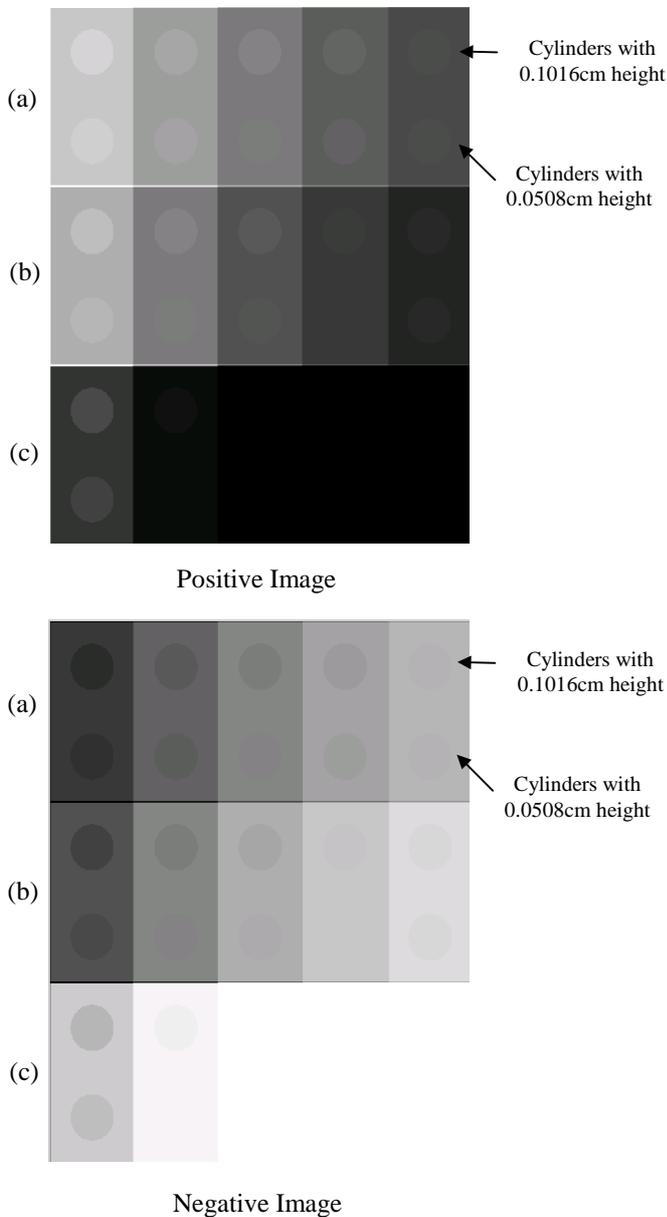


Fig. 10. Aluminum step wedge test image to three different energies: (a) 90 keV; (b) 60 keV; (c) 30 keV.

Through those images can be observed that the visualization of the air cylinders of 0.1016cm height is better than air cylinders of 0.0508cm height. Furthermore, was also observed that with increase of the photons energy and decrease of the step thickness, there is increase of the image dark (negative image). This occur because the amount of radiation that penetrates through a specific material is determined by photons energy and thickness of the material. The behavior of relative exposure to each step of the image is shown in the Figure 11.

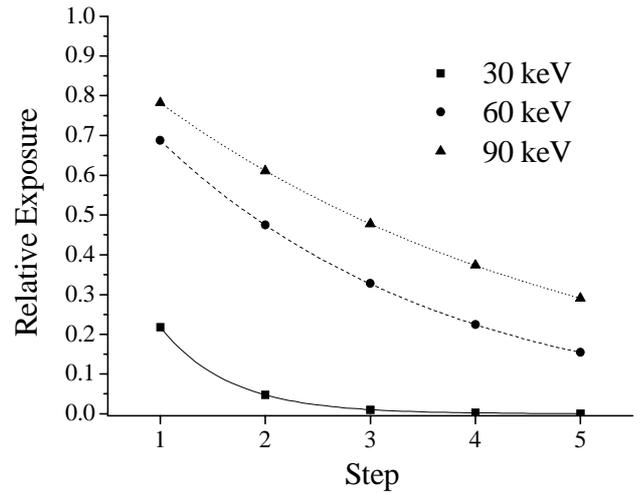


Fig. 11. The relative exposure.

Through the Figure 11 can be observed that the relative exposure in the detector increases with the photons energy and decreases with the step thickness as waited theoretically.

5. CONCLUSION

The geometric and physical parameters calculated through the simulate images data with MCNP5, post-processed using the *Programa Matriz*, show good agreement with teorical values, what shows that the *Prgrama Matriz* works correctly with MCNP5.

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