Building x-ray phantoms

Built three x-ray phantoms using Python functions. These functions will be called from the main program. The format of such phantoms is shown in the appendix. The basic shapes of the phantoms will be cubes/prisms, for simplicity. The breast phantom will be composed of a series of cubes of different materials inserted in an air-density cube.

The functions to be built will be called *cube_phantom_h(), cube_phantom_nh(),* and *breast_phantom()* and will include the following parameters:

Input → 2 parameters:

  i) Size. Use powers of 2, for the dimensions.
  ii) Energy of the x-ray beam.

Output→ Numpy array (3D), whose values will be the corresponding linear attenuation coefficients. These values will depend on the type of material used to build each part of the phantom. They will be obtained from the attached CSV files.

Note.- each student has to bring a zip file called *lastName_Name_P3.zip*, to the following address: *pablogtahoces@gmail.com*. The subject of the e-mail should be IPBMA_P3. Inside the zip should be included:
-   A jupyter notebook showing how the software works (see the example).
-   A .py file with the Python functions created.
-   All the necessary files to verify the correct operation of the application.

Appendix

Cube_Phantom_h.- phantom of cubic shape, composed of 2 cubes of different density and dimension, the one inserted into the other. The internal cube should be composed of a material of bone density, and the size of each edge is half the size of the edge of the external cube. The outer cube should be composed of a material of soft tissue density (Fig. 1).
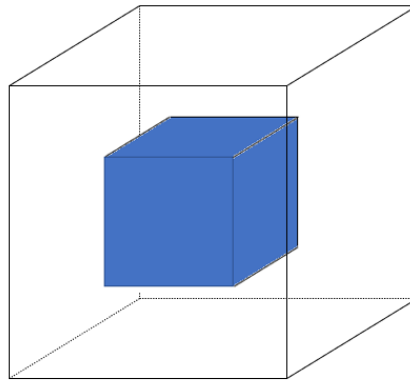

Figure 1

Cube Phantom_nh.- phantom of cubic shape, composed of 2 cubes of different density and dimension, one inserted in the other. The internal cube should be composed of a material of soft tissue density and the size of each edge is half the size of the edge of the external cube. The external cube should be composed of two equal sections. The first will be filled with air, and the second with water (Fig. 2).
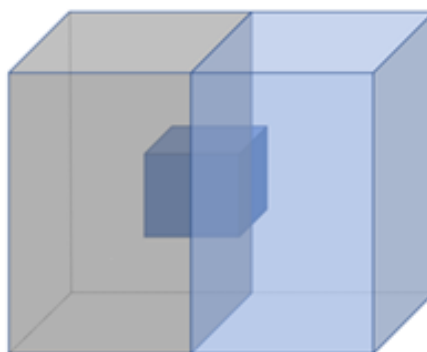

Figure 2

Breast Phantom.- phantom with an asymmetric shape, which simulates a breast. It comprises several cubes of different materials and sizes inserted into each other. The material densities try to simulate those found inside a real breast: fat (adipose tissue, orange color), breast parenchyma (breast tissue, gray color), and possible mass (soft tissue, brown color). The phantom will be stored as a 3D array, the parts not occupied by the figure corresponding to air density. There are three different sizes for the cubes that compose it. The size of the soft tissue cube's edge will be half the size of the breast tissue cube (Fig. 3).
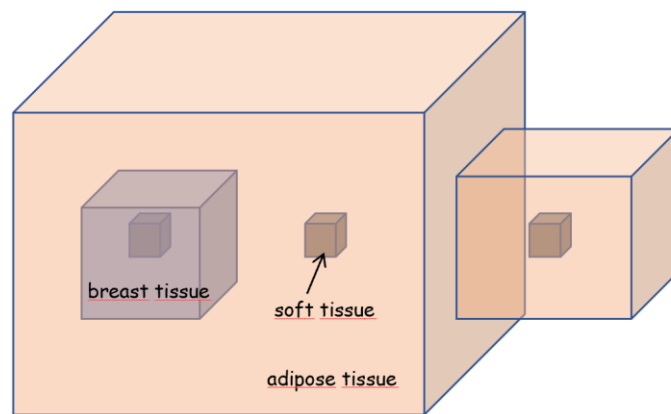

Figure 3