Lab 3

Medical Imaging

IST 2020-2021

Consider the SPECT imaging of the 2D phantom stored in `activity.mat`, containing a number of hot spots of different sizes, with FOV = 256 x 256 mm^2, assuming a parallel beam geometry, with a rotation increment of 1º and maximum number of photon counts of 2500. Please note that, given that a 2D phantom is considered, only 1 of the 2 dimensions of the gamma camera is used in this simulation.

1. Load the phantom, get its dimensions, and display it.

2. Simulate the sinogram and reconstructed SPECT image of the phantom by filtered back-projection including noise in your simulation. Make sure to constrain the reconstructed image to have the same size as the phantom.

3. Define appropriate ROIs for the big, the medium and one of the small hotspots (using `roipoly`).

4. Illustrate and quantify the partial volume effects (PVE's) suffered by each hot spot by:
    a. plotting intensity profiles through the different hot spots; and
    b. comparing their average intensities in the phantom (ground truth) and in the reconstructed image.
    c. showing the effects of changing the spatial resolution and/or the SNR.

    Note: Make sure to normalize both the phantom and the reconstructed image (to 1) so that the intensities are comparable between images.

Note: to control the level of noise added when using the functions `random_noise/imnoise` (for Python/Matlab), try changing the maximum number of photon counts.