PHYS 540 Assignment 2: CT

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1. (/5) Discuss the advantages and disadvantages of 3rd generation CT scanners over 4th generation CT scanners.

2. (/5) Discuss the tradeoffs that occur when decreasing voxel size in CT imaging.

3. (/5) Describe beam hardening in CT imaging. Explain the effects of beam hardening on CT images. Can beam hardening artefacts be removed or compensated for?

4. (/15) In this problem you are to perform a simple and filtered reconstruction on a test object. Use a computer (as opposed to hand-calculations). You can use either a mathematical package (e.g. Matlab) or write your own code (e.g. in C).

To begin, construct a simple test pattern consisting a non-attenuatig medium with an attenuating block in its centre. Construct the medium to be a square matrix, 21×21 pixels in size. Give this medium a linear attenuation coefficient µ = 0 mm−1 . The central 3×3 pixel area is attenuating, set the attenuation coefficient of this region to be µ = 5 mm−1. Each pixel should be 1×1 mm.

(a) (/2) Consider 3 views: 0◦ (top → bottom), 45◦ (diagonal), and 90◦ (left → right). Calcu late the projection for each view. Plot each projection. The combination of the project tions is a sinogram.

(b) (/5) Use the 3 views from part (a) to calculate a simple backprojection. Plot a grayscale image of the simple backprojection.

(c) (/5) Using the same views as in part (a), calculate a filtered backprojection. For a filter use: y =ρo(2sinc(2ρoR) −sinc2(ρoR)) where ρo = 0.7 is a constant and R is the radial distance from the centre of the image, R=−3,−2,−1,0,1,2,3. Using this discrete dataset, y →−0.1074,0.1368,−0.3398,0.6000,−0.3398,0.1368,−0.1074 Plot a grayscale image of the filtered backprojection.

(d) (/3) Demonstrate that the second image (filtered backprojection) is an improvement over the first (simple backprojection) by calculating a rough 1/r blurring for both images. To do this, calculate the average pixel value for rings of varying radius centred on the image. Each ring is taken to be 1 pixel wide