

## 18.325 :: Homework 3 :: Fall 2012 :: Due Th Nov 22

In this problem set we will form an image from a fan-beam CT dataset.

Download and load the dataset in Matlab with `load siemens.mat`

The array  $g$  is a sinogram. It has 513 rows, corresponding to uniformly sampled offsets  $t$ , and 360 columns, corresponding to uniform, all-around angular sampling with 1-degree steps in  $\theta$ . The acquisition is fan-beam: a transformation is needed to recover the parallel-beam geometry. The fan-beam geometry manifests itself in that the angle depends on the offset  $t$  in a linear fashion. Instead of being just  $\theta$ , it is ( $1 \leq t \leq 513$  is the row index)

$$\theta + \frac{t - 257}{256}\alpha,$$

with

$$\sin \alpha = \frac{1}{2.87}.$$

Imaging from a parallel-beam sinogram is done by filtered backprojection. Filtering is multiplication by  $\omega$  in the  $\omega$  domain dual to the offset  $t$ . Backprojection of a sinogram  $g(t, \theta)$  is

$$I(x) = \sum_{\theta} g(x \cdot e_{\theta}, \theta),$$

where  $e_{\theta}$  is  $(\cos \theta, \sin \theta)^T$ . (Why is this the same thing as what we saw in class?) Form the image on a grid which has at least 100 by 100 grid points (preferably 200 by 200). You will need an interpolation routine since  $x \cdot e_{\theta}$  may not be an integer; piecewise linear interpolation is accurate enough (`interp1` in Matlab).

In your writeup, show your best image, your code, and write no more than one page to explain your choices.