Medical Image Processing - Assigment 1

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1 X-Ray Computed Tomography : Radon Transform

(a)

The suitable value of the step size Δs:

Consider the equations for a point P (x,y) on a line L (t,θ):

$$x = t * cos(\theta) - s * sin(\theta) \tag{1}$$

$$y = t * sin(\theta) + s * cos(\theta) \tag{2}$$

Eliminating t, we get

$$s = y * cos(\theta) - x * sin(\theta) \tag{3}$$

Using (3), we obtain

$\frac{\partial s}{\partial x} = -sin(\theta)$ and $\frac{\partial s}{\partial y} = cos(\theta)$

To cover all the points, we need Δx and Δy less than 1.

Therefor, a good choice is

$$\Delta s \leq \min\{|sin(\theta)|, |cos(\theta)|\}$$

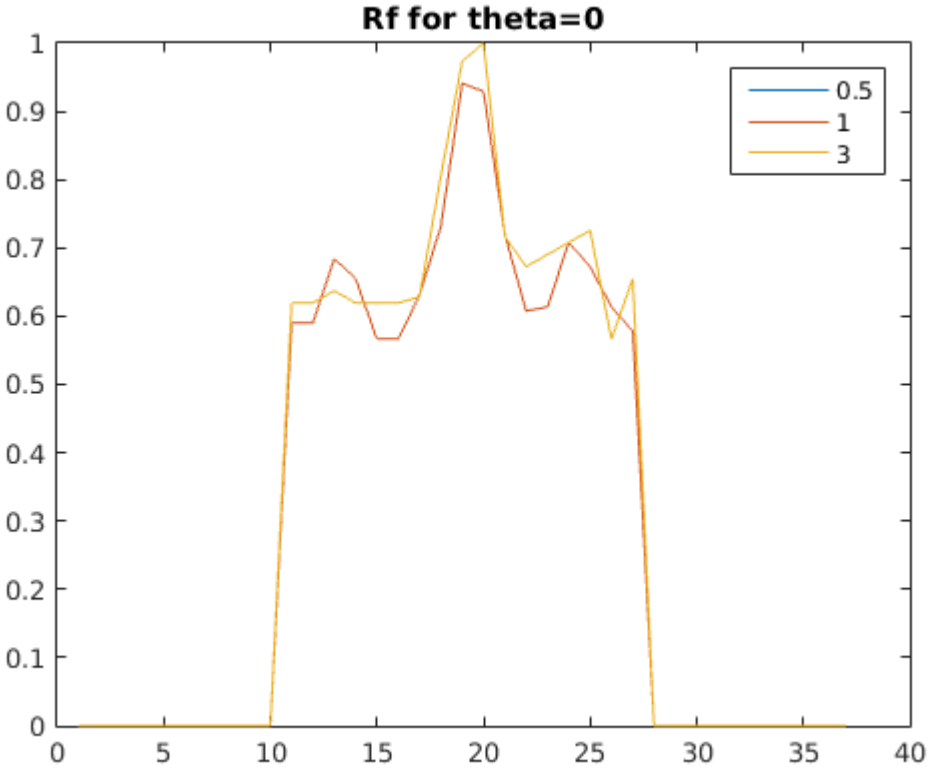
Interpolation scheme:

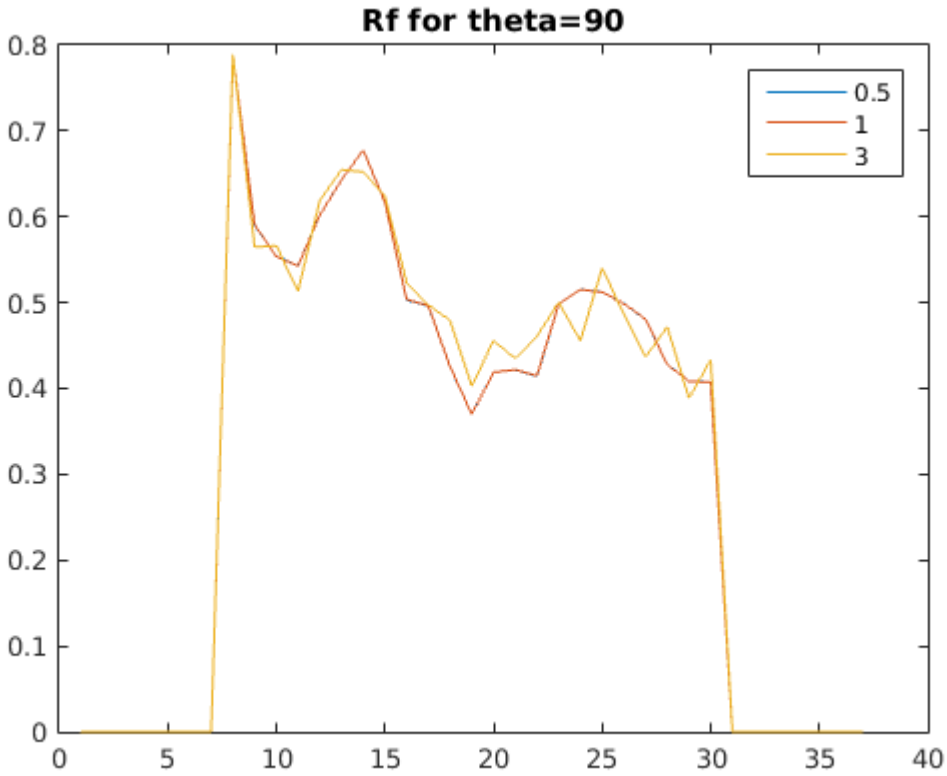
A suitable interpolations scheme will be bilinear interpolation as it the value at any point within the grid will be similar to that of the neighboring grid points.

(c)

For the full images, the samples are too low to draw inferences. The results can be found in /images. One can observe that the results are almost similar for s=0.5 and s=1. The output for s=3 appears more grainy.

For $\theta = 0$ and $\theta = 90$ degrees,





In both the plots, we can see that s=0.5 and s=1 produce almost similar outputs. Also both of them capture data better than s=3, which tends to oversmooth the data.

(d) Radon and inverse radon transform gives perfect results when the domain is continuous. However, we operate in the digital domain and hence the accuracy is bounded by the discretization. As discretization in both t and θ becomes more fine, the resolution improve. However, the patient has to be exposed to more radiations, which posses health hazards.

Hence, we have a trade-off between the resolution and the exposure.

(e) Choosing $\Delta s >> 1$, the X-Y grid is not covered properly, and we will get coarse results.

As evident from the results, choosing a Δs too small does not provide much improvements and hence a Δs less than 1 but greater than 0.5 is suitable.