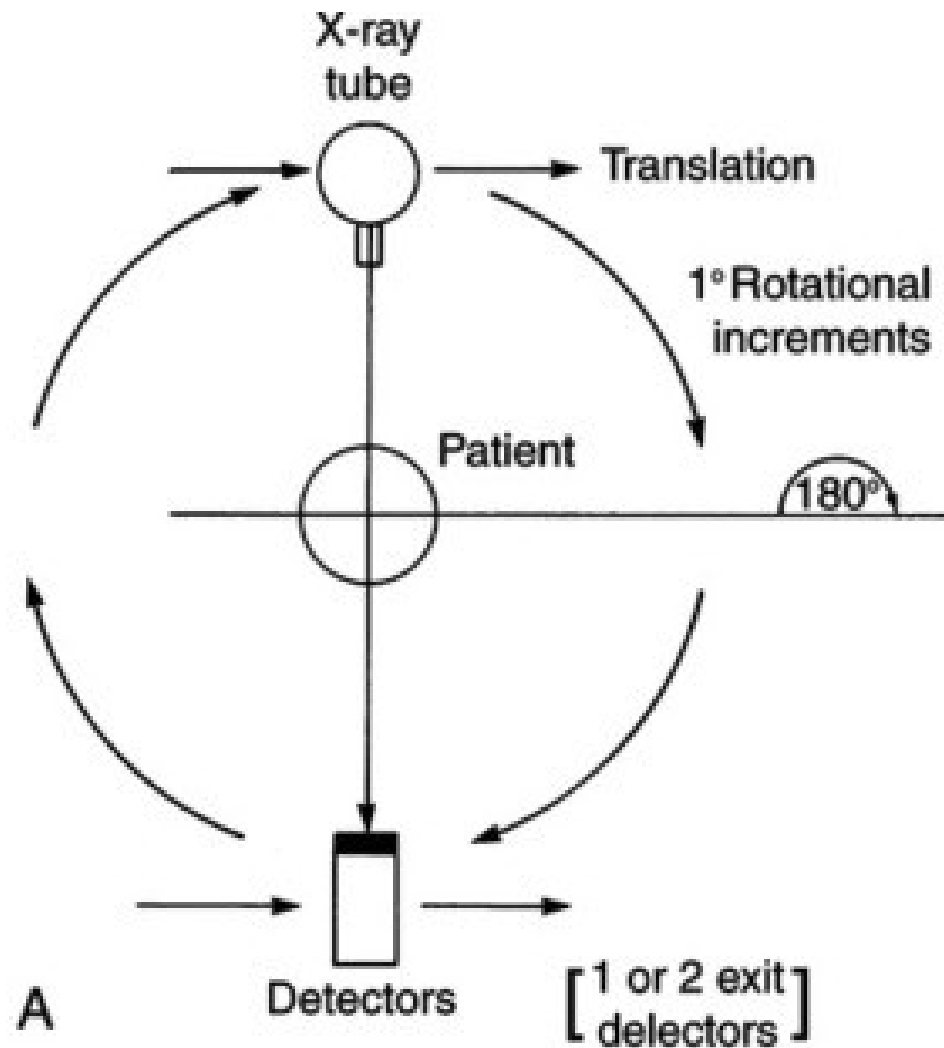


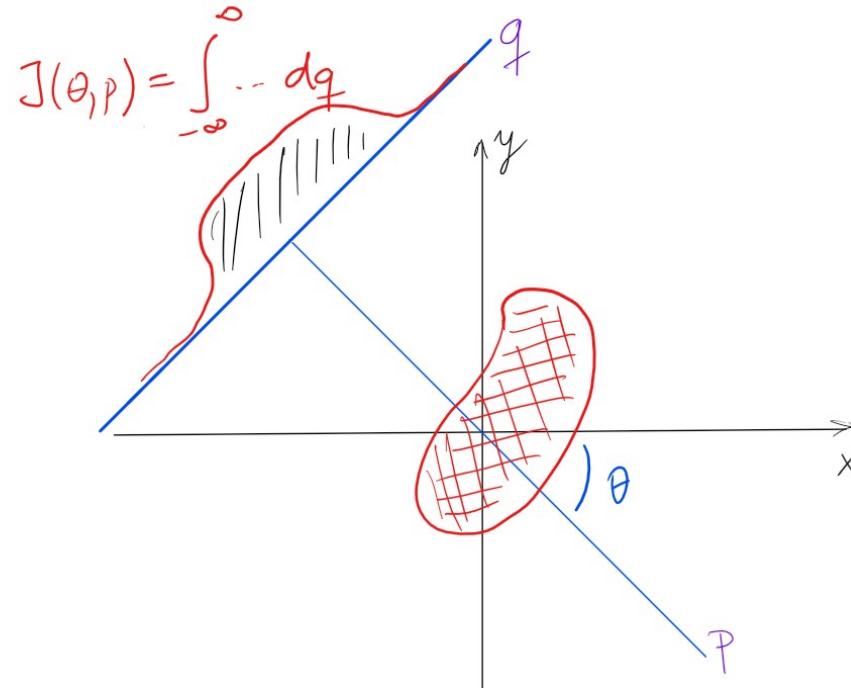


# Lab10 CT forward projection

# First generation CT



# Radon transform



$$J(\theta, p) = \int_{-\infty}^{\infty} f(p \cdot \cos(\theta) - q \cdot \sin(\theta), p \cdot \sin(\theta) + q \cdot \cos(\theta)) dq$$

$\theta$  – angle of normal vector

$p$  – distance from the origin

$q$  – distance alongside the projected line

# Image transformations

- Image – function defined over a grid  
 $I(\mathbf{x}, \mathbf{y})$   
 $\mathbf{x}, \mathbf{y}$  – coordinate vectors  
 $\mathbf{x} \times \mathbf{y}$  – grid, cartesian coordinate system
- Image transformation  
transformation of the grid  
interpolation

# HW Task 1

**Find the smallest range  $[-p_m, p_m] \times [-q_m, q_m]$  needed so that all points from  $(x, y) \in [-x_m, x_m] \times [-y_m, y_m]$  fall into this range. Provide either a graphical or an analytical solution.**

When rotating a rectangle, either the corners are clipped or the image size increases. In order to construct the sinogram properly, we have to keep the image dimensions fixed and avoid to loss of information.

# HW Task 2

## Discretize the Radon function

$$J(\theta, p) = \int_{-\infty}^{\infty} f(p \cdot \cos(\theta) - q \cdot \sin(\theta), p \cdot \sin(\theta) + q \cdot \cos(\theta)) dq$$

Now, we are working with images composed of pixels, not abstract 2D functions.

# HW Task 3

## Implement *myRadon* function

inputs

*img* - image

*theta* - vector of angles

output

*sinogram*

useful functions

*linspace, meshgrid, ndgrid, interp2,*

*sind, cosd, sum*

*imshow, imagesc*

# HW Task 4

**Transform the Shepp-Logan phantom (matlab function phantom) of size 256 px for projection angles  $\theta \in \{0^\circ, 1^\circ, 2^\circ, \dots, 179^\circ\}$  with your function. Show the input and the resulting sinogram. Pay attention to labelling the axis correctly.**

You may want to check your results against the results from function *radon*





# Questions?