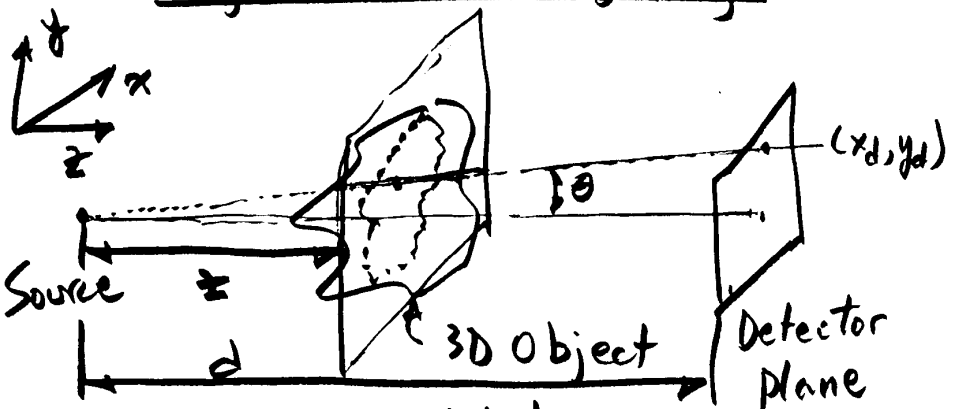
IMAGE RECONSTRUCTION

start with non-image data, reconstruct an image from that data

examples

- ✓ Computed tomography
  - synthetic aperature radar (SAR)
  - magnetic resonance imaging
  - coded aperture imaging
  - 3D from 2D

Projection Radiography



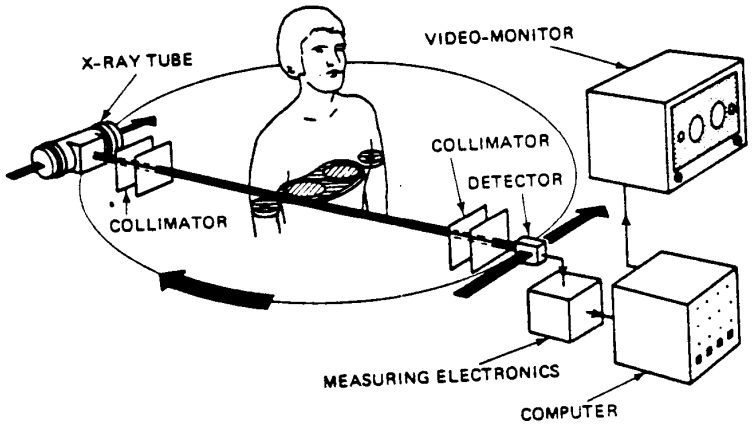
Intensity incident at detector plane

$$I_d(x_d, y_d) = I_i(x_d, y_d)\, e^{-\frac{1}{\cos\theta}\int_0^d \mu_0\left(\frac{x_d}{m(z)}, \frac{y_d}{m(z)}, z\right) dz}$$

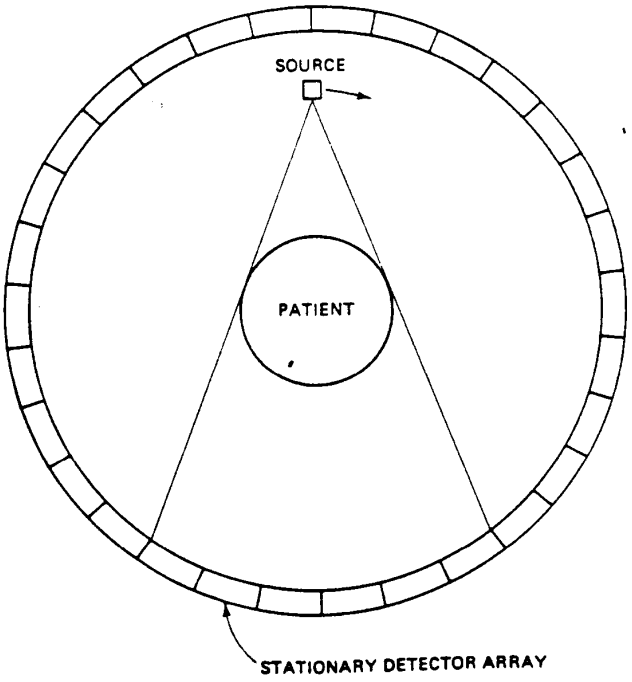
$m(z) = \frac{d}{z}$ depth dependent magnification

COMPUTED TOMOGRAPHY

Scanning Systems for Computed Tomography:



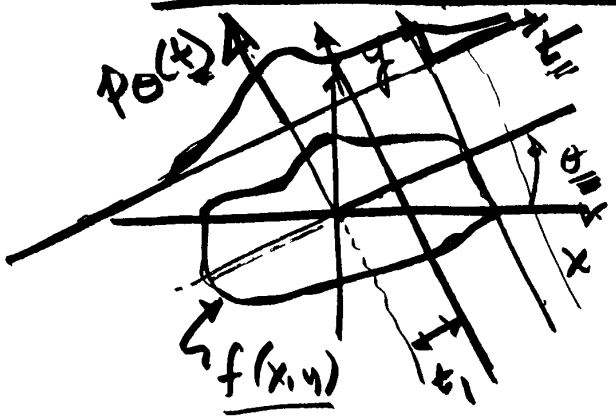
First Generation System



Fourth Generation System

$\mu_0(x, y, t)$ - attenuation function

RADON TRANSFORM



unknown object attenuation $f(x,y)$

Ray: $x\cos\theta + y\sin\theta = t_1$

Ray integral: ← 1-D impulse sheet

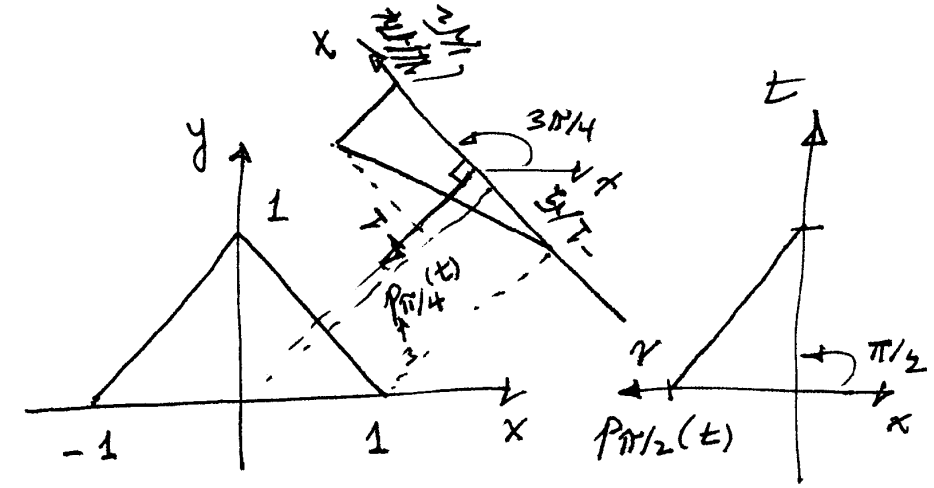
$$p_\theta(t_1) = \iint f(x,y)\,\delta(x\cos\theta + y\sin\theta - t_1)\,dx\,dy$$

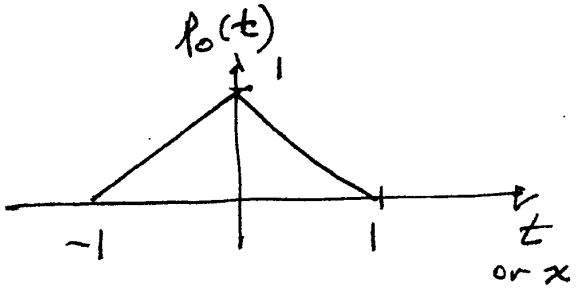
Projection:

$p_\theta(t)$, $-\infty < t < \infty$, θ - fixed

Radon transform:

$p_\theta(t)$, $-\infty < t < \infty$, $-\pi \le \theta < \pi$



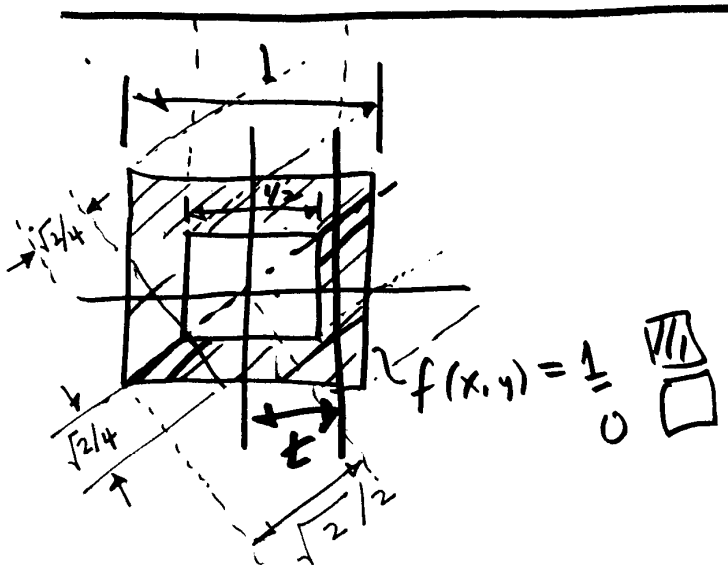


θ is angle between t axis & x axis.

Note that $\rho_\pi(t) = \rho_0(t)$, $\rho_{3\pi/2}(t) = \rho_{\pi/2}(t)$ etc.

Reconstruction Problem:

Recover $f(x,y)$ from its Radon transform.

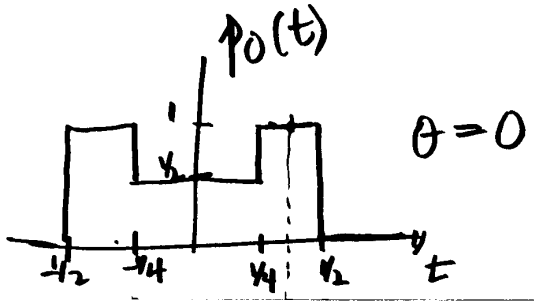


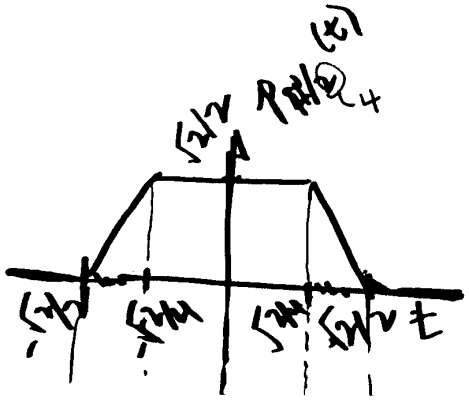
Announcements

HW's 7, 8, 9

Crib sheet 8½ x 11 2-sides handwritten

no subband coding


$p_0(t)$
$\theta = 0$
t


t