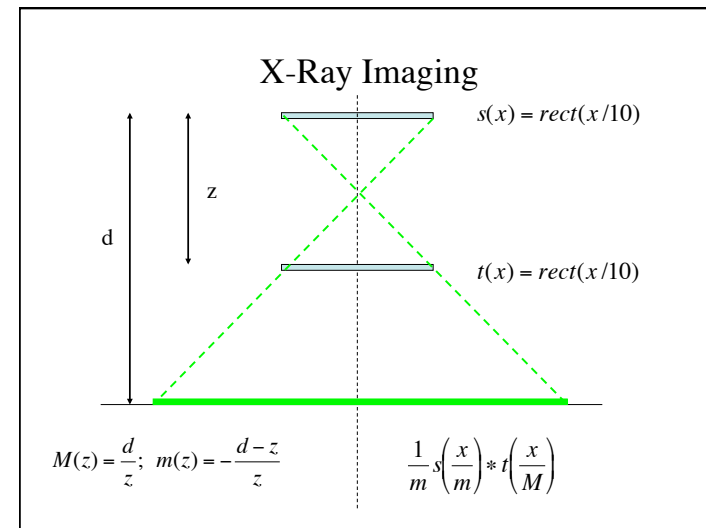
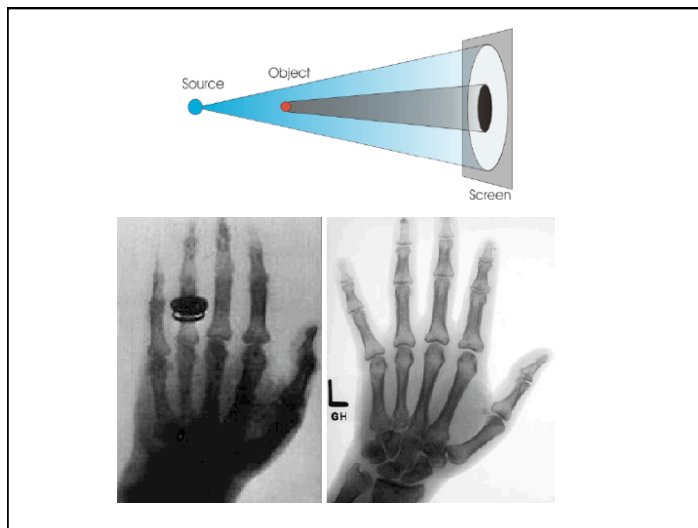
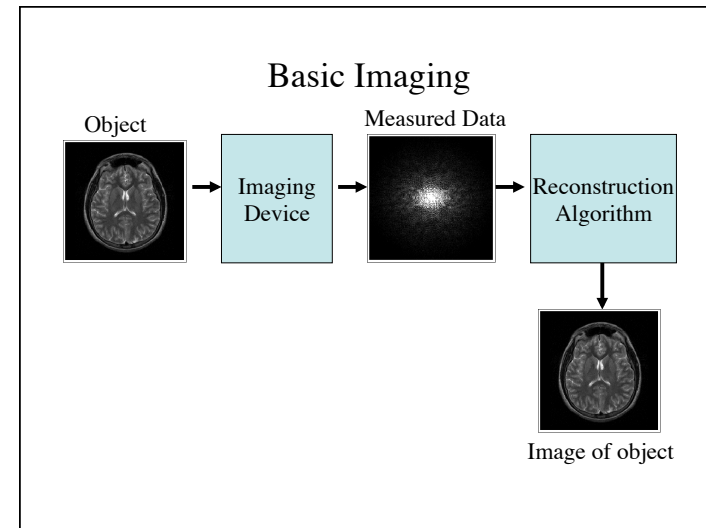
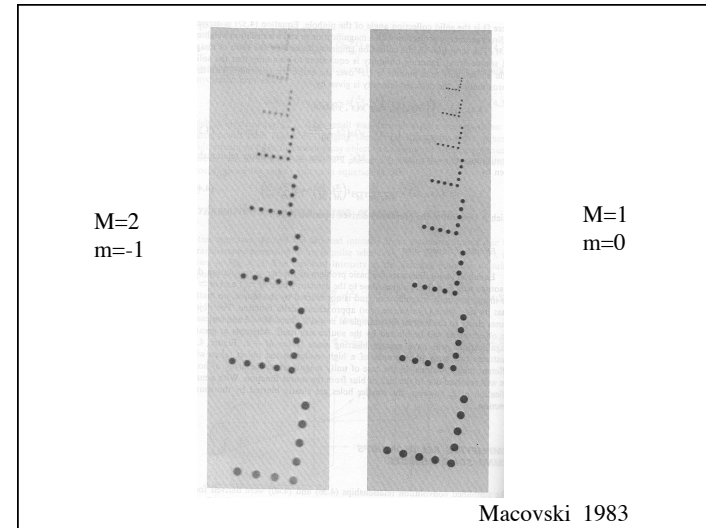
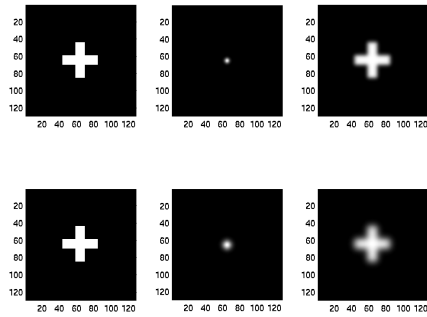


Bioengineering 280A
Principles of Biomedical Imaging

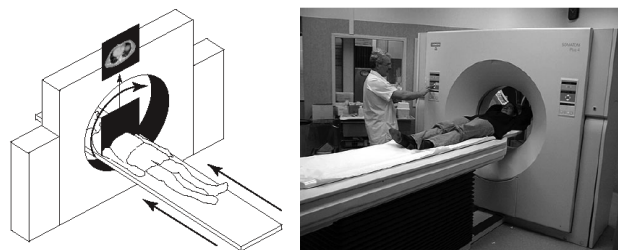
Fall Quarter 2013
Course Recap and Future Directions



Convolution

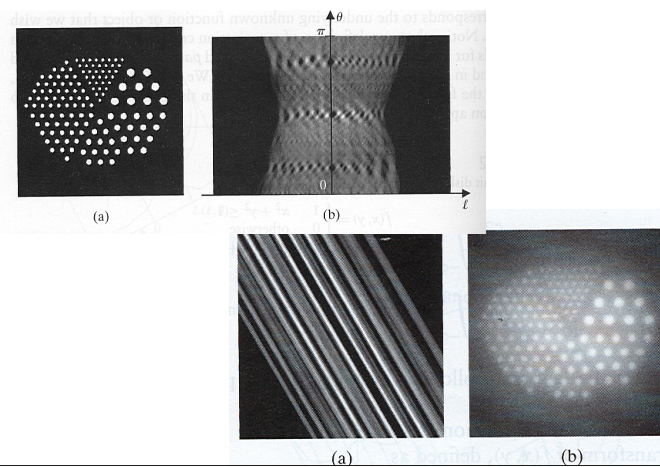


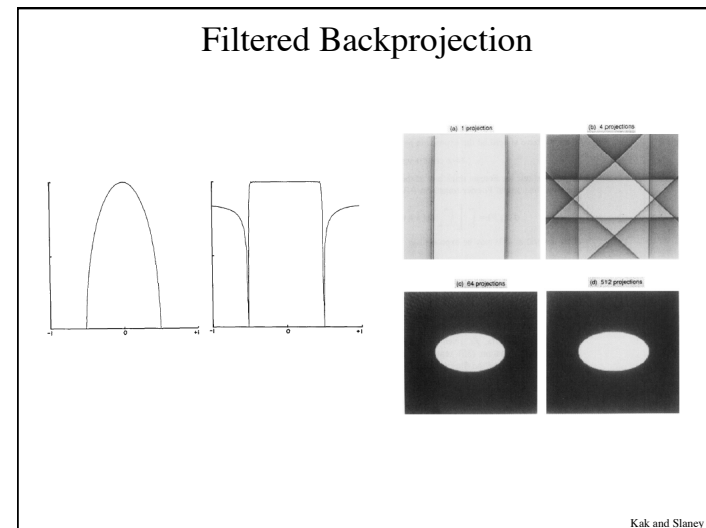
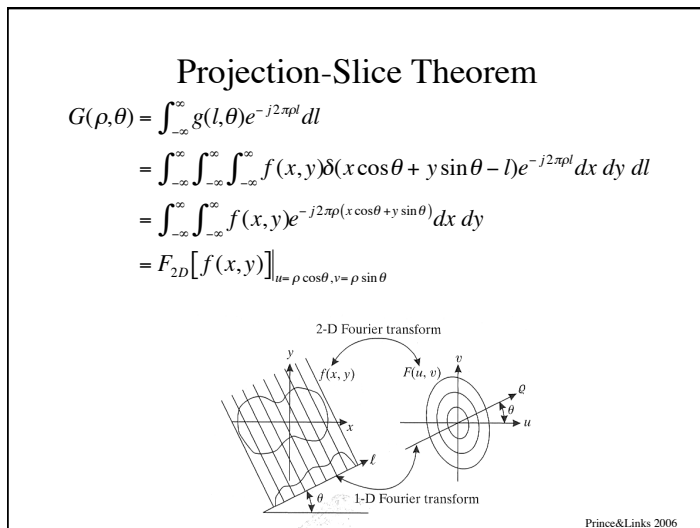
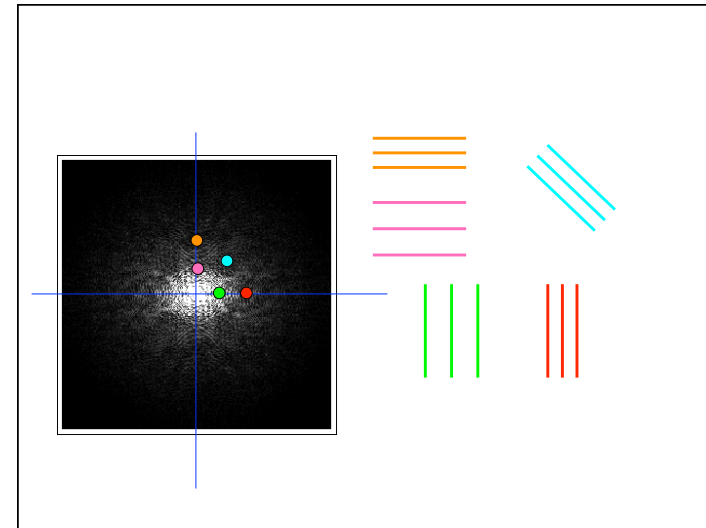
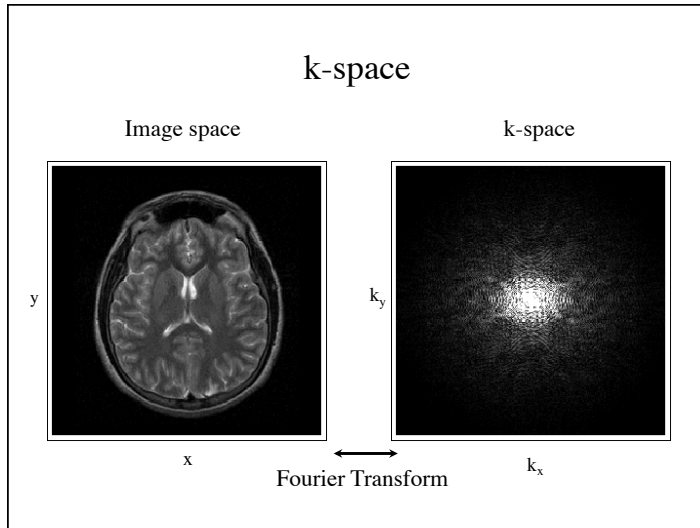
Computed Tomography



Suetens 2002

Backprojection





Example

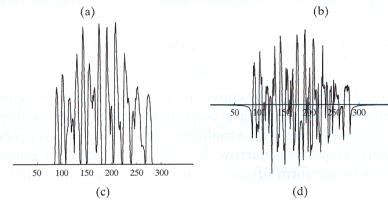
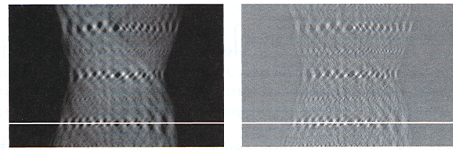
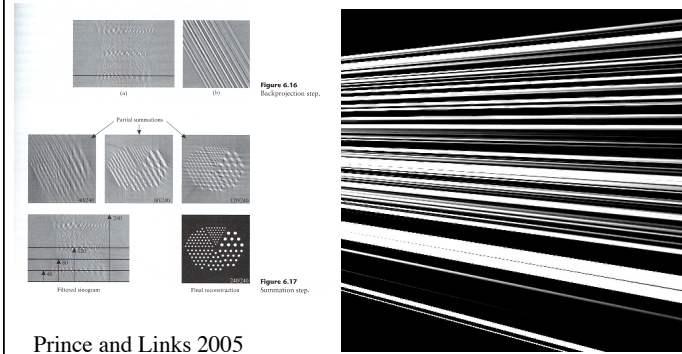


Figure 6.15
Convolution step:
(a) Original sinogram;
(b) filtered sinogram;
(c) profile of sinogram row [white line in (a)]; and
(d) profile of filtered sinogram row [white line in (b)].

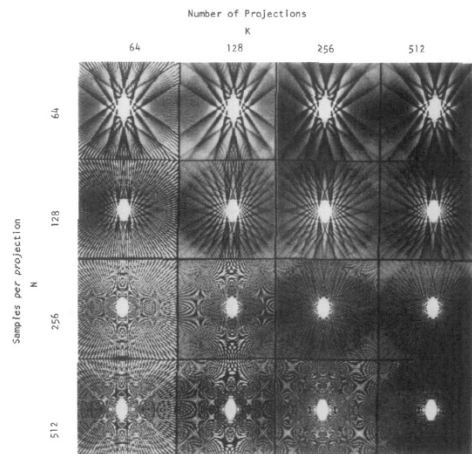
Prince and Links 2005

Filtered Backprojection



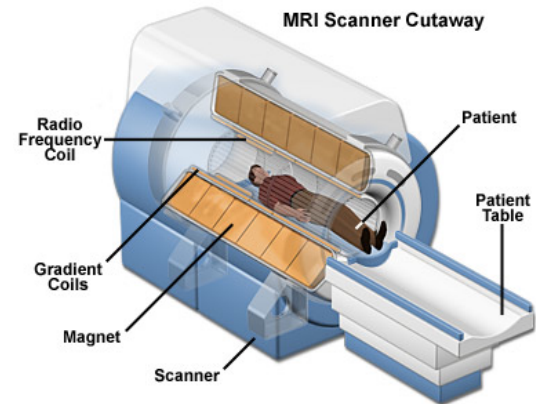
Prince and Links 2005

Seutens 2002

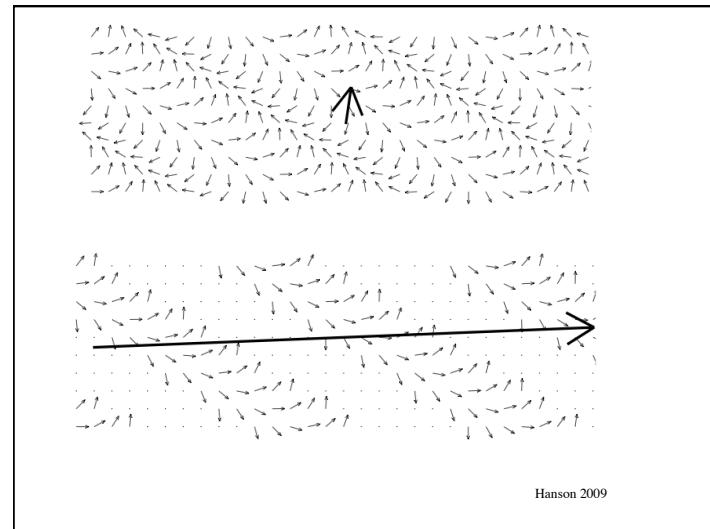
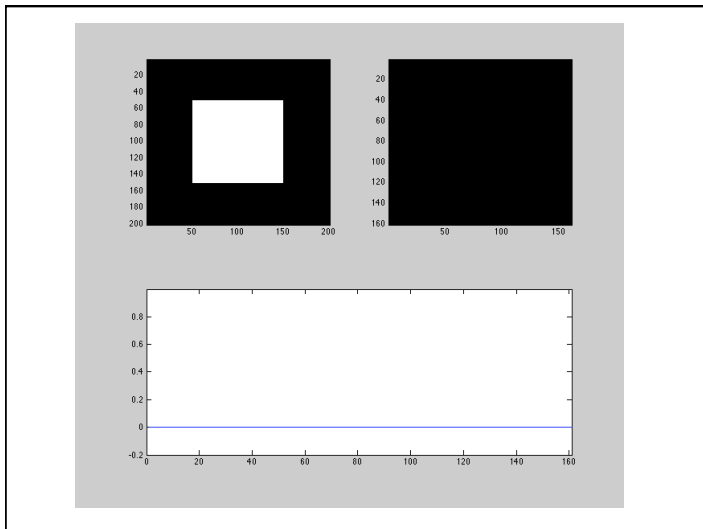
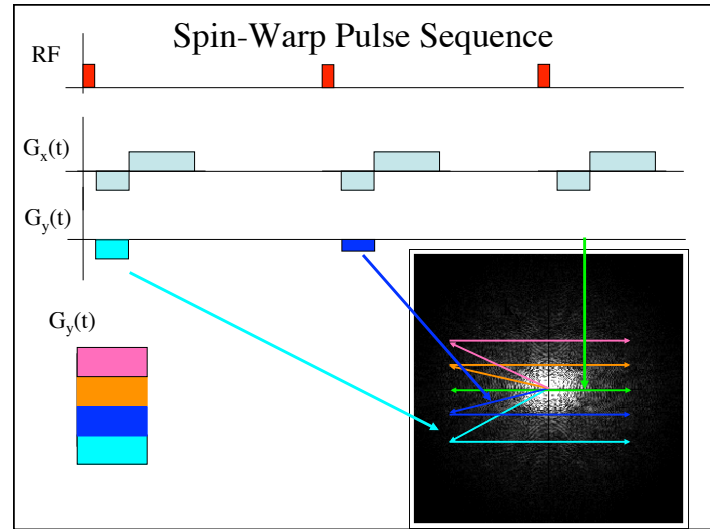
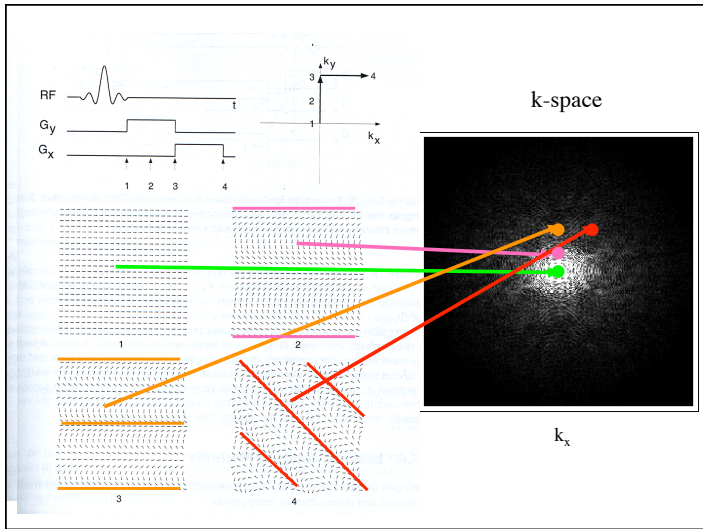


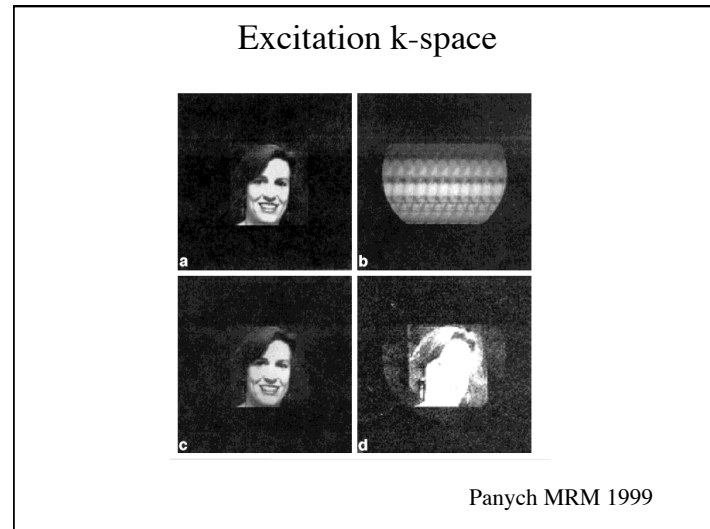
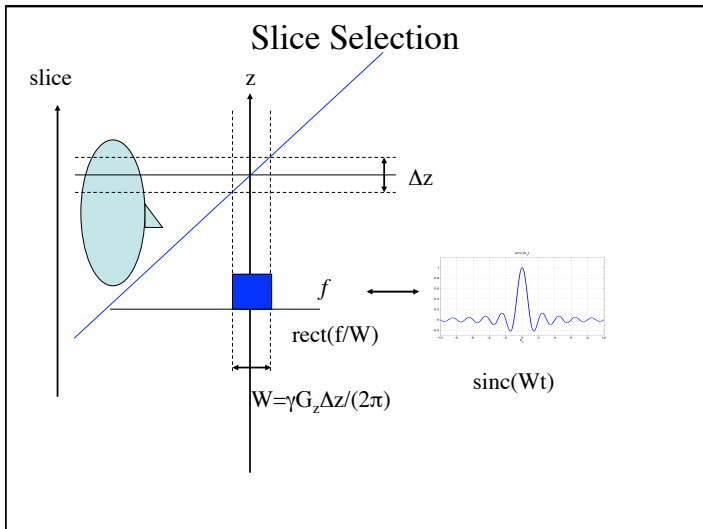
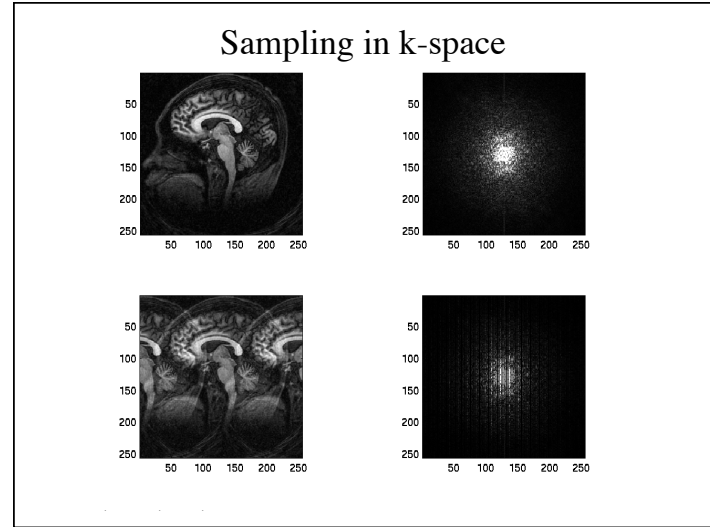
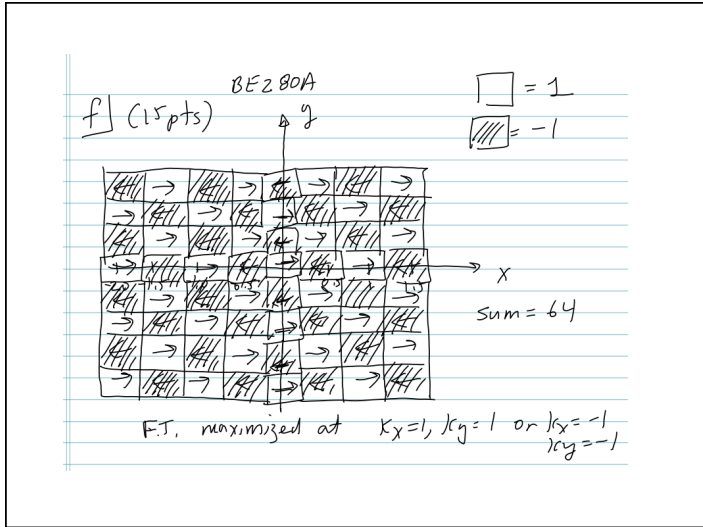
Kak and Slaney

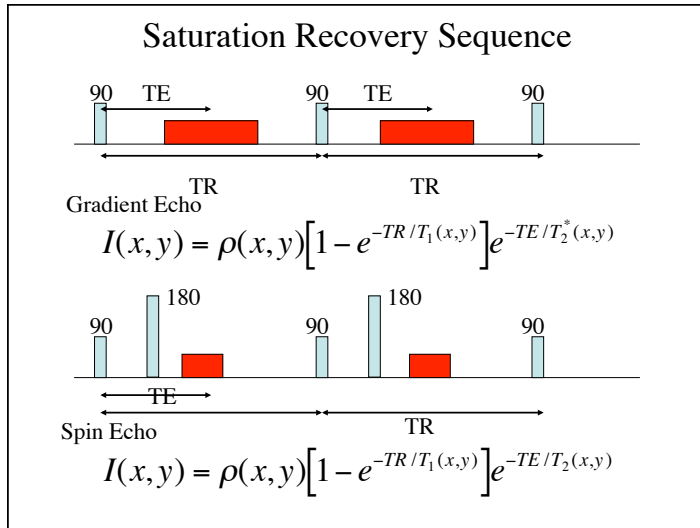
MRI System



<http://www.magnet.fsu.edu/education/tutorials/magnetacademy/mri/fullarticle.html>

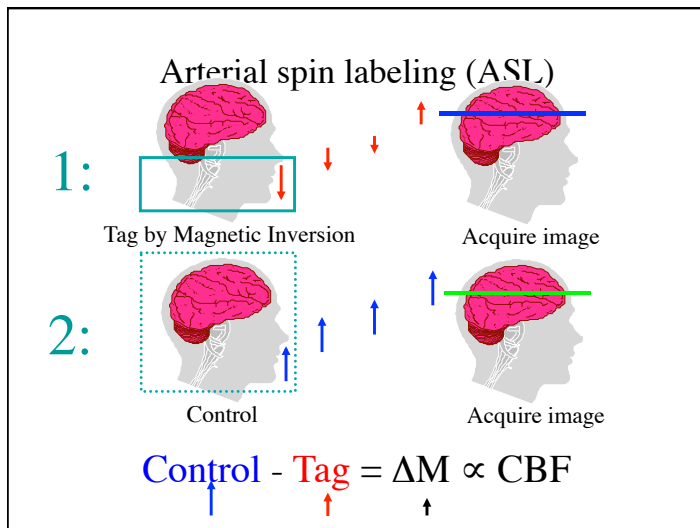






Example

Tissue	Proton Density	T1 (ms)	T2 (ms)
Csf	1.0	4000	2000
Gray	0.85	1350	110
White	0.7	850	80



Whole brain non-invasive measures of Cerebral Blood Flow obtained with arterial spin labeling (ASL) MRI (Courtesy of D. Shin)

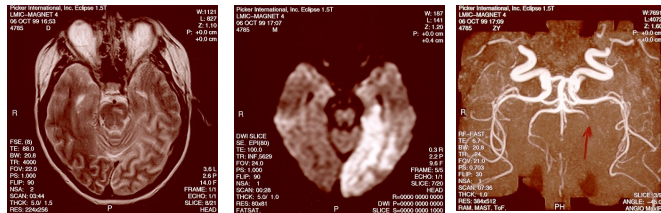
Vascular territory imaging using vessel-encoded ASL (Wong 2007)

Diffusion Weighted Images

T2 weighted

Diffusion Weighted

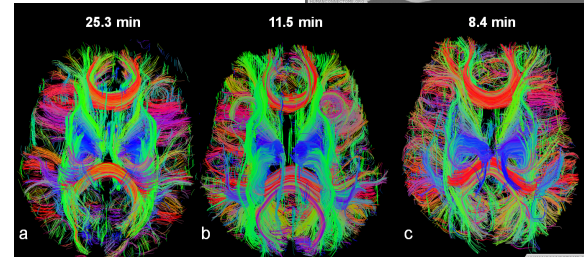
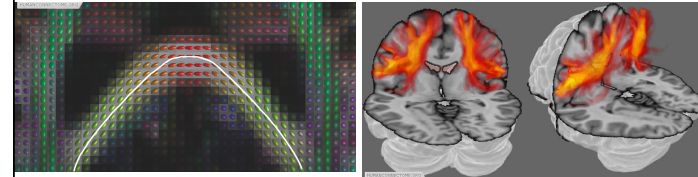
Angiogram



After a stroke, normal water movement is restricted in the region of damage. Diffusivity decreases, so the signal intensity increases.

<http://lehighmri.com/cases/dwi/patient-b.html>

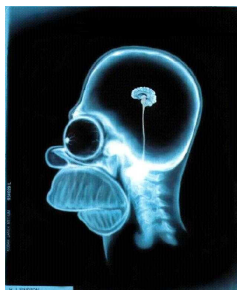
Diffusion MRI Tractography



from the Human Connectome Project

fMRI

MRI studies brain anatomy.

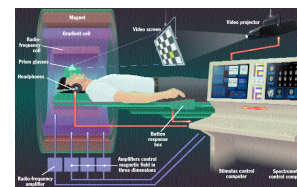


Functional MRI (fMRI) studies brain function.

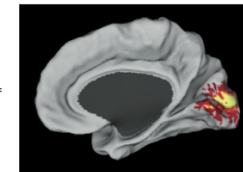


http://defiant.ssc.uwo.ca/Jody_web/fmri4dummies.htm

Task-Related BOLD fMRI

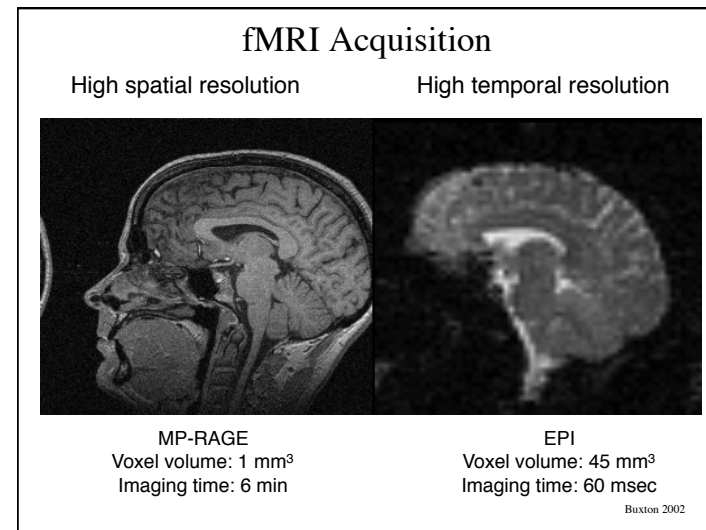
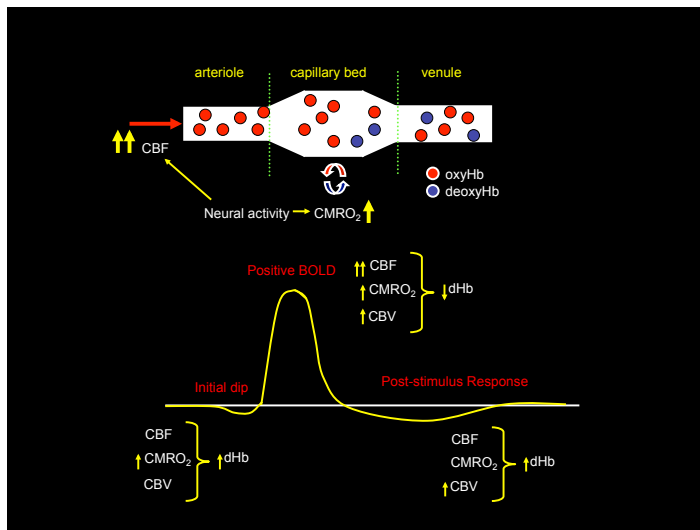
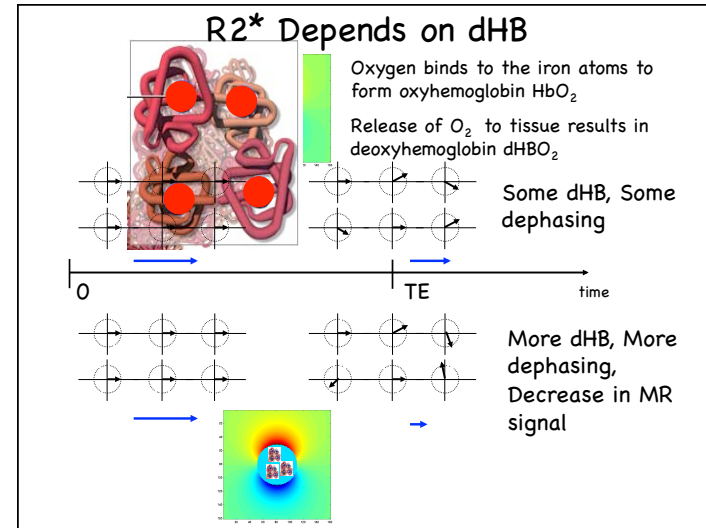
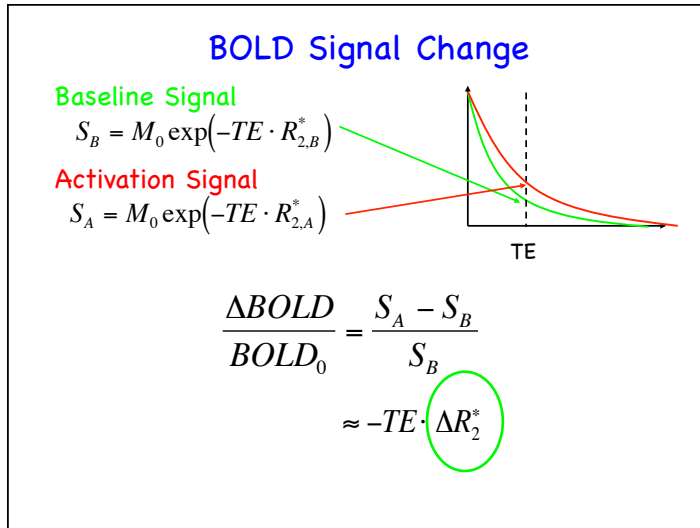


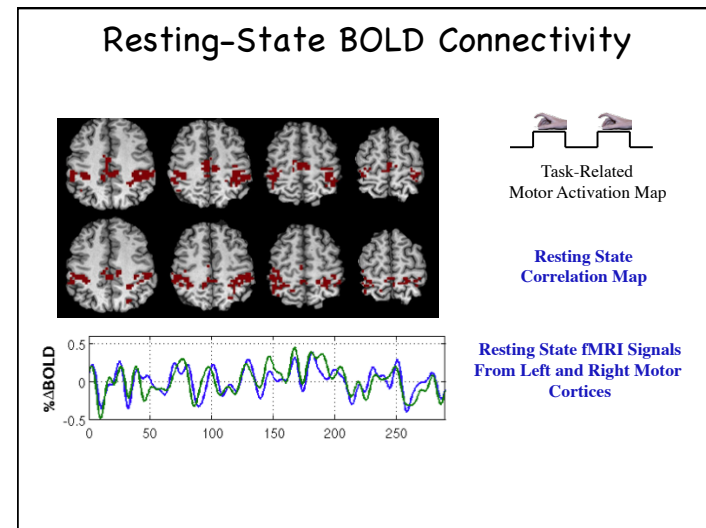
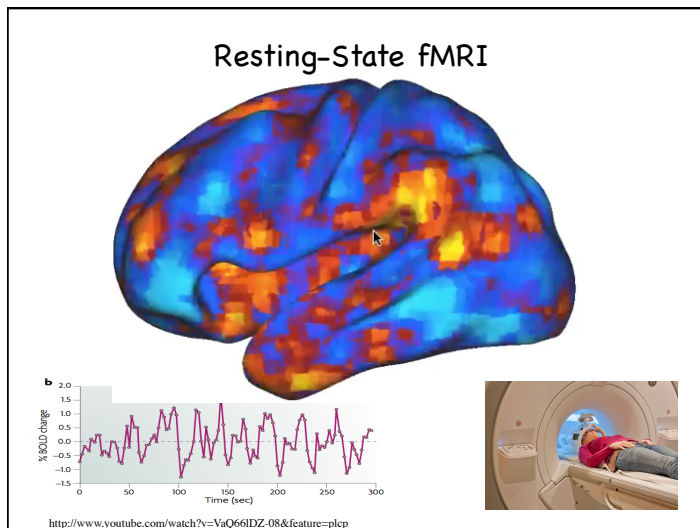
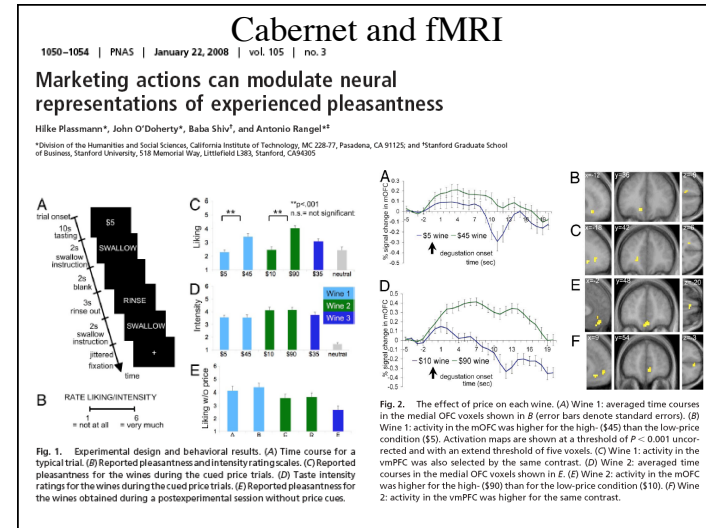
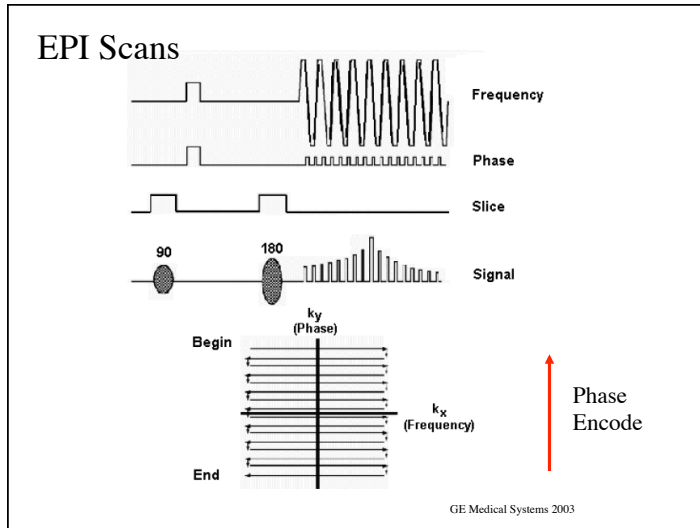
Open - Closed =

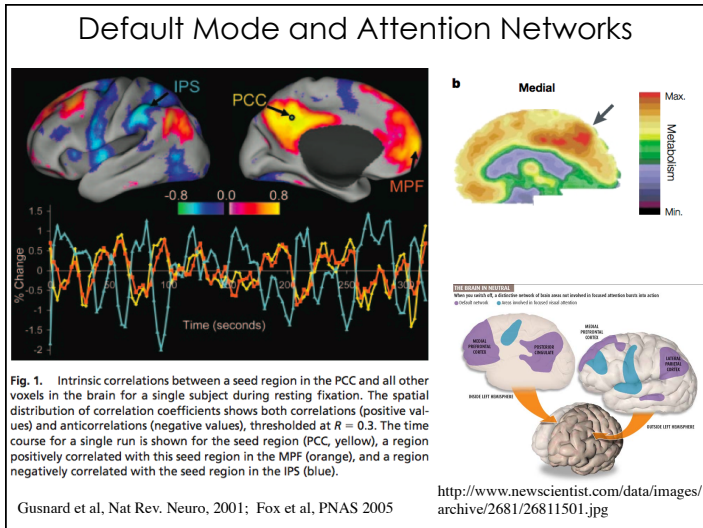


http://defiant.ssc.uwo.ca/Jody_web/fmri4dummies.htm

Fox and Raichle 2007







The NIH Human Connectome Project

WU-Minn Consortium Harvard/MGH-UCLA Consortium Neuroscience Blueprint

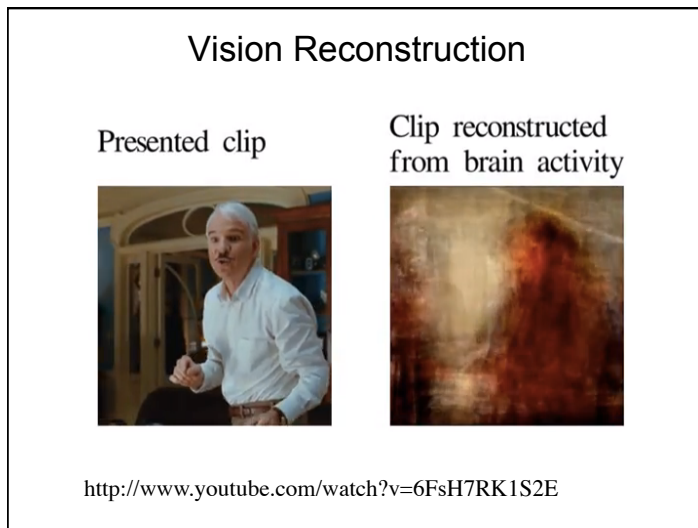
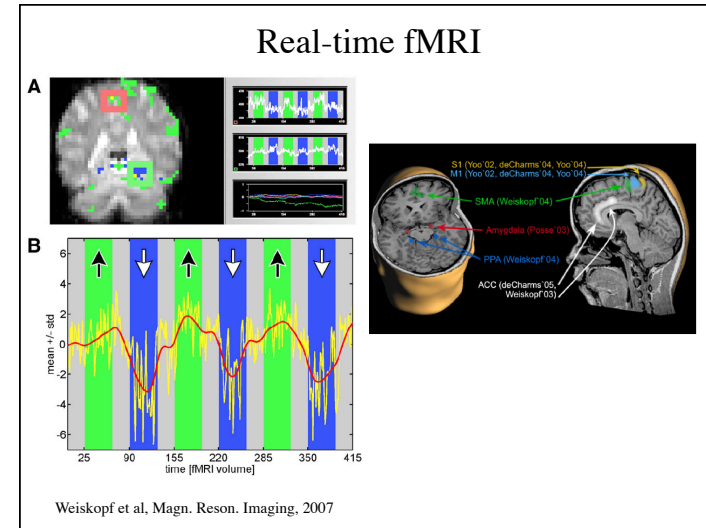
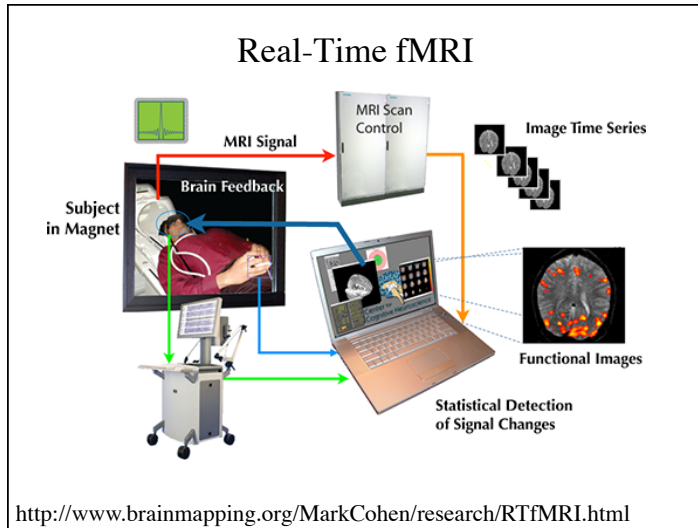
HUMAN Connectome PROJECT

Mapping structural and functional connections in the human brain

Home About the Project Documentation Using the Connectome Contact Us Collaboration Extranet

Connectome Protocol:
 8 simultaneous slices
 2 mm isotropic resolution
 TR 720 ms; TE = 32 ms

Nova 32 channel



Timeline

Michael Crichton, 1999

“Most people”, Gordon said, “don’t realize that the ordinary hospital MRI works by changing the quantum state of atoms in your body ... But the ordinary MRI does this with a very powerful magnetic field - say 1.5 tesla, about twenty-five thousand times as strong as the earth’s magnetic field. We don’t need that. We use **Superconducting QUantum Interference Devices, or SQUIDS**, that are so sensitive they can measure resonance just from the earth’s magnetic field. We don’t have any magnets in there”.

J. Clarke, UC Berkeley

