

Magnetic Resonance Physics

High Field NMR and MR Imaging

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Laby Building - Level 3 - Rooms 304, 307 & 308

Hardware

Magritek and Cryogenic, UK MRI System



Probes

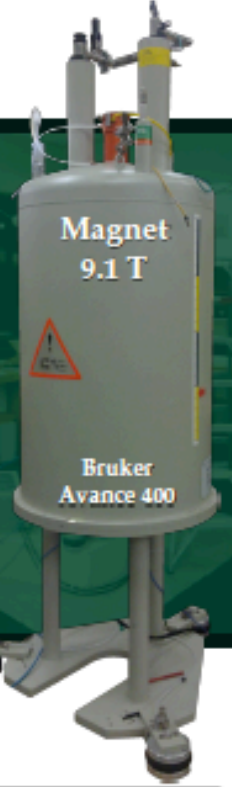


Magnet - 1.5 T

High Field NMR Spectrometer



Probe



Magnet 9.1 T

Bruker Avance 400

Applications and Results

MRI System

Sergei Obruchkov & Robin Dykstra

Clinical MRI system

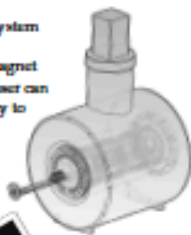


- High cost, expensive to maintain
- 1.5 T cryogen cooled superconducting magnet
- Advanced functionality for clinical work

Point And Shoot pre-clinical MRI system

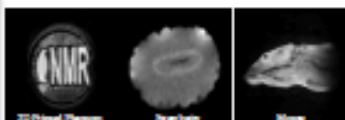


- Low cost and low maintenance MRI system
- 1.5 T cryogen free superconducting magnet
- Open framework, user can expand functionality to meet their needs



Imaging Capabilities

- 2D & 3D imaging
- Sub millimeter imaging resolution (0.5 mm)
- Optimized for animal research



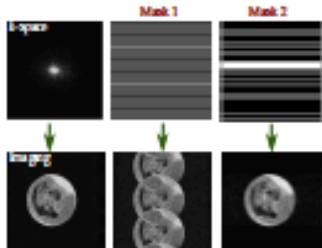
Fast MR Imaging

Fangrong Zong & Robin Dykstra

Motivation

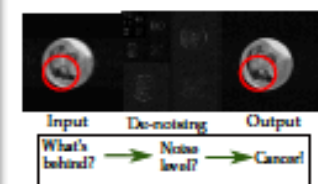
- Carcinous tissue detection by using MRI
- The number of measurements is proportional to the scan time
- Reduce total cost
- Undersampling k-space data - easy realized in hardware

Full-sampling vs. Under-sampling



- (a) Full-sampling. Clearest imaging output with the cost of long clinic time;
- (b) Uniform under-sampling (violating Nyquist rules). Blur imaging with "ghost" effect;
- (c) Random under-sampling. Blur imaging.

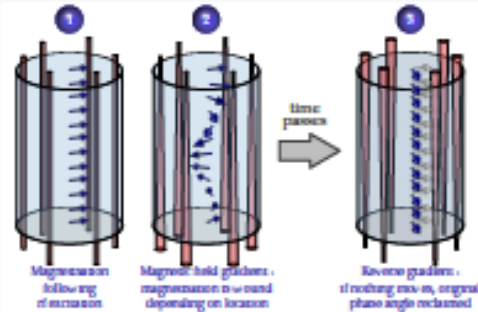
Imaging reconstruction



What's behind? -> Noise level? -> Cancel

Velocimetry

Tim Brox, Stefan Kuczera & Bradley Douglass



The fatness of the red lines indicates the strength of the magnetic field at that place

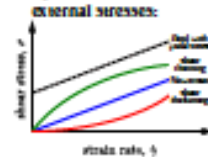
Between stage 2 and 3, as any nucleus jumps three places "down", the angle will be three times the beat size. Of course, in general, fluid will move more or less quickly in various positions - we can see that too

This is just like $speed = \frac{distance}{time}$ but our "distance" is an angle

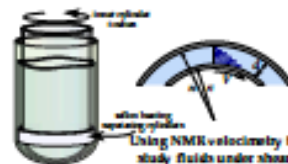
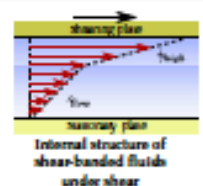
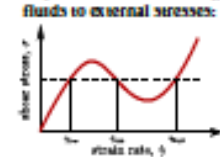
Rheology of Soft Matter

Tim Brox, Stefan Kuczera & Bradley Douglass

Response of fluids to external stresses:

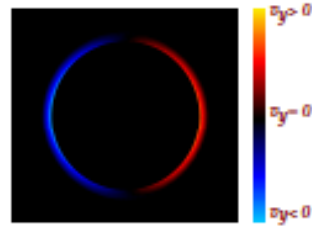
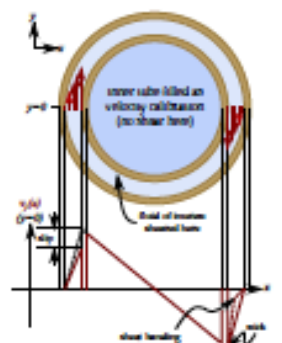


Response of shear-banded fluids to external stresses:



Using NMR velocimetry to study fluids under shear

Exploring the influence of wall-slip on shear-banded fluids



Two dimensional image of one velocity component