

Using the GRID for brain
Imaging.
Research & Clinical
Applications

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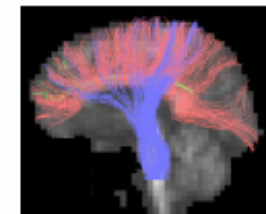
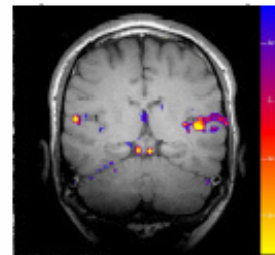
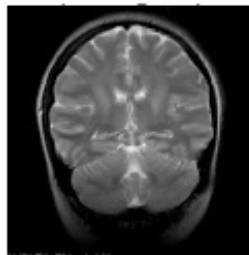
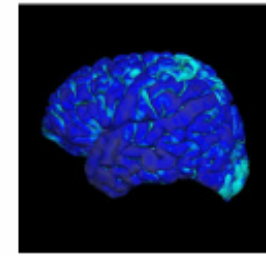
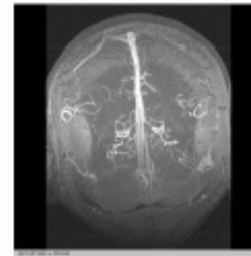
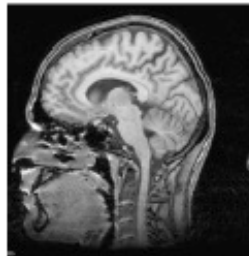
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What is Brain Imaging?

- Magnetic Resonance Imaging (MRI)
 - Uses proton ‘spin’ in large magnetic field
- Magnetoencephalography (MEG)
 - Direct measure of the magnetic field around the head produced by neural currents

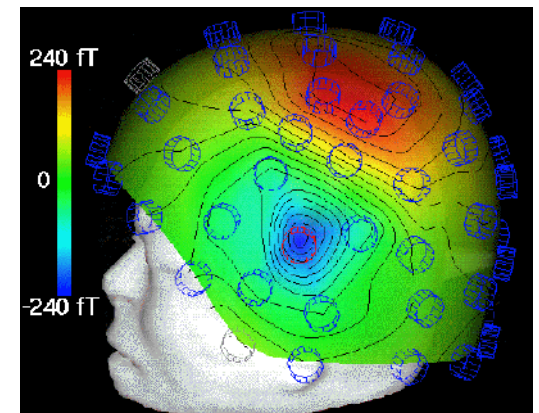
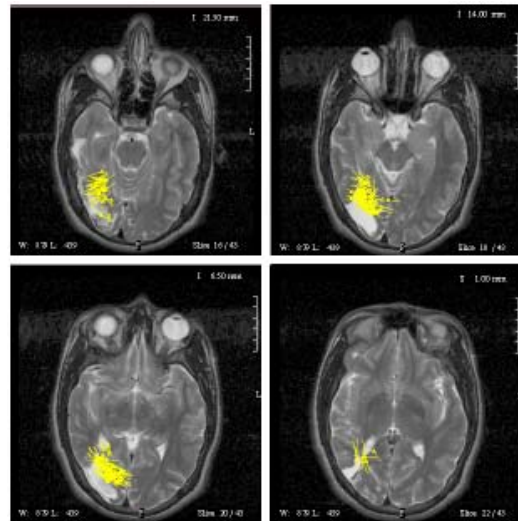
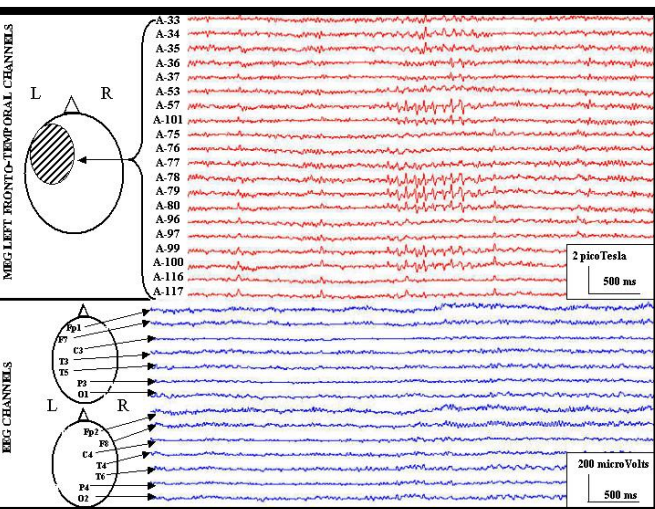
Facilities in YNiC

- Magnetic Resonance Imaging (MRI)
 - 3 Tesla short bore scanner
 - Used for structure, sub-millimetre accuracy
 - chemistry,
 - blood flow
 - Diffusion studies
 - fMRI



Facilities in YNiC

- Magnetocencephalography (MEG)
 - 248 channel whole head device
 - Direct measure of neural activity
 - Millisecond accuracy
 - Maps of neural activity



Brain imaging data

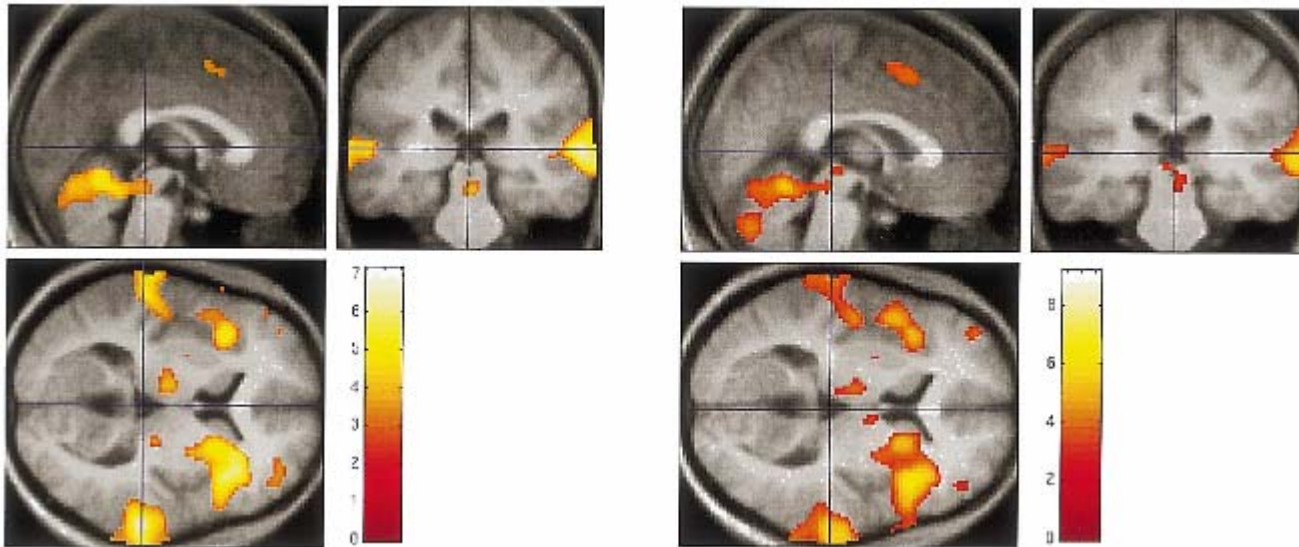
- Large data sets
 - fMRI up to 2 GBytes/hour
 - MEG = normally also 2 GBytes/hour but can reach peaks of up to 20GBytes/ hour
 - Centre is active up to 16 hours per day
 - Typical data storage is about 40 GBytes/day

Why do we need the GRID?

- The data has to be analysed (quickly)
 - Processing is often the same for each voxel of brain data
 - For example the same process might be applied to 1.3Million time series
- Need a simple way of allowing users to process data without having to be in the Centre
- Need to support large scale simulations, pattern matching research, algorithm development

Simple Example

- **Functional MRI**



melody

rhythm

Does it explain symptoms?

- e.g. Auditory hallucinations?
- fMRI
- External voices – internal voices



What can we do that we couldn't do before?

- A key issue is examining the connectivity of the brain
- We 'fit' a nonlinear dynamic model between time-series extracted from each voxel of brain using MEG
- Finding the parameters of the fit is extremely computer intensive
- We use 130 processors to solve the problem
- Problem that took months to solve now takes minutes

How have we implemented the GRID?

- Cluster of Apple G5 computers
- 4 RAID arrays
- SUN GRID Engine

Staffing?

- Two
 - PhD in a biological subject
 - Postdoc in maths
 - Implemented GRID basic structure in four days
- Now have a dedicated IT manager but mainly for development work.
- No software maintenance or major problems since installation

Cost?

- Cluster nodes about £2K
- RAID about £10K for 5 TeraBytes
- Desktops can be very cheap
- Easy support for OSX or Linux

New development

- Simple GUI for job submission
- Extension to use other GRIDS
- Support for other users
 - Analysis of Spectra
 - Boundary element modelling
 - Large scale simulation of linked non-linear differential equations - use of linked processors
 - Automated fault diagnosis
 - Real-time control of scanners
 - Image analysis for hospitals

Tips

- Good advice available from White Rose GRID team
- Some manufacturers are just box shifters - look for support
- Make sure that you have enough memory and storage - I filled 3Terabytes one weekend - it is easy to run 10,000s of jobs!

Summary

- GRID - simple to use high performance computing
- Apple G5 has proved to be good platform
- Enormous potential for commercial and research exploitation