Imaging Critters
Why and How?

Prof Graham Galloway
National Imaging Facility
National Imaging Facility

‘Exploring Inner Space’
Exploring Inner Space
Honey Bees
Drosophila 3D High Resolution Imaging

Method: Gradient Echo 3D
FOV: (4.2 x 2.1 x 2.1) mm³
Matrix: 256 x 128 x 128
Resolution: 16.4 µm isotropic voxel
TR: 50 ms
TE: 5 ms
Averages: 24
T_{exp}: 5h 27 min

4 slices from the 3D data
Method: Chemical Shift Selective Gradient Echo 3D

FOV: (3.2 x 2.2 x 2.2) mm³
Matrix: 64 x 64 x 64
Resolution: (50 x 34 x 34) µm
TR: 50 ms
TE: 2.1 ms
Averages: 4
T_exp: 13 min.

Water

Fat

Courtesy of B. Simon, A. Teleman, S. Cohen, M. Sattler, EMBL, Heidelberg
Drosophila 3D High Resolution Imaging

After the oral application of contrast agent Magnevist GdDTPA

Regions of contrast agent

A

B

C

Courtesy of Christian Spenger, Johanna Öberg, Karolinska Institut, Stockholm and Fiona Kerr, University Collage, London
Drosophila Fly iv vivo

Magnevist plus apple juice

Five 3D SpinEcho experiments,
Started after 70 minutes respectively,
Matrix: 128 x 96 x 96
FOV: 4.6 x 2.3 x 2.3 mm
Res: 36 x 24 x 24 mm, TR: 100 ms,
TE: 2.35 ms,
Averages: 4,
Time 60 min. for each 3D experiment
Exploring Inner Space

Anglefish
CT scan of a deep sea fish: Melanocetus johnsoni, anglerfish “Black Devil”

X-ray source with the voltage set to 50 kV and the current set to 150 µA. The scans were performed using 360° rotation with 360 rotation steps with a high magnification and a binning factor of 2. The exposure time was $2 \times 3250$ ms with an effective isotropic voxel size of 17 µm. The total scanning process took approximately 2hr30min.
CT scan of a Cetomimidae: “Whale fish”

X-ray source with the voltage set to 50 kV and the current set to 250 µA. Isotropic voxel size of 53 µm. The total scanning process took 30min.
CT scan of a Melamphaidae: “Big scale fish”

X-ray source with the voltage set to 60 kV and the current set to 300 µA. Isotropic voxel size of 53 µm. The total scanning process took 35 min.
CT scan of a Myctophid: “lantern fish”

X-ray source with the voltage set to 55 kV and the current set to 300 µA. Isotropic voxel size of 36 µm. The total scanning process took 60 min.
Lantern Fish

Exploring Inner Space
X-ray source with the voltage set to 80 kV and the current set to 270 µA. The scans were performed using 360° rotation with 360 rotation steps with a medium-high magnification and a binning factor of 2. The exposure time was 1400 ms with an effective isotropic voxel size of 27.9 µm. The total scanning process took approximately 20 minutes.
What sort of crocodile is it?
I don’t know

Where does it come from?
I don’t know

What time of year was it captured?
I don’t know

Is it any use to a collection?
I DOUBT IT!!!
Bunya Nut
Growth rates and erosion of Montastraea corals from Belize

X-ray source with the voltage set to 80 kV and the current set to 500 µA. The scans were performed using 360° rotation with 180 rotation steps with a low magnification and a binning factor of 4 with beam hardening correction. The exposure time was 170 ms with an effective isotropic voxel size of 106 µm. The total scanning process took approximately 10 minutes.
Exploring Inner Space

- Getting data to Compute
  (from scanners and to clusters/cloud)
  1 run == 2TB temporary data, 400GB output

- Long term archiving/retrieval
  (keeping things in sync)

- Capturing Meta Data
  - Research Data Australia

- Re-analysing data
Characterisation VL

Research Environments for Exploring Inner Space
Exploring Inner Space

The National Imaging Facility: Nodes located in Queensland, New South Wales, Victoria, South Australia & Western Australia

Large Animal Research & Imaging Facility

- The University of Western Australia
- SAHMRI
- The University of Adelaide
- UniSA
- Swinburne University of Technology
- The Florey Institute of Neuroscience & Mental Health
- Monash University
- University of Western Sydney
- The University of Melbourne
<table>
<thead>
<tr>
<th><strong>Exploring Inner Space</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NIF Infrastructure</strong></td>
</tr>
<tr>
<td>Wholebody 7T MRI</td>
</tr>
<tr>
<td>Preclinical comb. MR/PET</td>
</tr>
<tr>
<td>9.4T MRI animal system</td>
</tr>
<tr>
<td><strong>Research Cyclotron</strong></td>
</tr>
<tr>
<td>Radiochemistry hotcells &amp; synthesis units</td>
</tr>
<tr>
<td>Small animal PET/SPECT/CT, PET/CT &amp; CT</td>
</tr>
<tr>
<td>9.4T MRI animal system</td>
</tr>
<tr>
<td>Wholebody 3T MRI</td>
</tr>
<tr>
<td>Siemens CT &amp; PET scanners</td>
</tr>
<tr>
<td><strong>11.7T MRI scanner</strong></td>
</tr>
<tr>
<td><strong>7T MRI scanner</strong></td>
</tr>
<tr>
<td><strong>4.7T MRI scanner</strong></td>
</tr>
<tr>
<td><strong>3T MRI</strong></td>
</tr>
<tr>
<td>Informatics capability</td>
</tr>
<tr>
<td>Facility</td>
</tr>
<tr>
<td>----------</td>
</tr>
<tr>
<td>Large Animal Research &amp; Imaging Facility</td>
</tr>
<tr>
<td>316 channel MEG system</td>
</tr>
<tr>
<td>Monash University</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>The University of Western Australia</td>
</tr>
</tbody>
</table>
• Provide *expertise* in the area of technology supported by the node;
• Ensure appropriate ethical, radiological & biological clearances;
• Organise education/training programs for potential end-users;
• Facilitate Access & provide advice of research structure & protocols.
• Support the specific technologies;
• Undertake the roles of the Facility Fellows;
• Responsible – rolling out enabling technologies to the wider research community;
• Facilitate the collaborative development of technology, thus ensuring that max. benefit is achieved by this opportunity for national collaborative research.
• Developing common platforms & databases of normative data to enable imaging research nationally;
• Responsible for the roll out of an Informatics system to other NIF sites;
• Integration of the NIF with ANDS;
• Databasing & atlasing of large cohorts (n=10,000+);
Exploring Inner Space

Lead Institution

THE UNIVERSITY OF QUEENSLAND

NCRIS
National Research Infrastructure for Australia
An Australian Government Initiative

Unincorporated Joint Venture Agreement (UJVA)

State Funding Agreement

Queensland Government
New South Wales Government
Government of South Australia
WESTERN AUSTRALIA
ACKNOWLEDGEMENTS

Far too many to mention

CAI – UQ

NIF nodes

Monash – MASSIVE

ANDS

NeCTAR