Brain mapping with `nru_view`

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Outline of the talk

- Definition of the visualisation problem
- The authors solution
- A demonstration of the program

The visualisation problem

Creation of a 3d image of an activated brain from

a) A PET activation dataset, showing activation of a subjects brain

b) An NMR[1] scan for visualisation of the brain anatomy of the subject

The data are volume data - $f(x, y, z)$

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[1] In medical application this type of data is often refered to as MR

The wanted image

The final rendered image should contain

- Visible brain surface
- Slices though the volumes
- Colouring representing different degrees of activation - PET data
- Information on brain anatomy - NMR data

The colouring should be applied, such that anatomy and activiation are simultaneously visible on slices, as well as the brain surface

Other wanted features

The final program should feature

- A graphical user interface for easy control by non-technicals
- Hopefully be fast enough for practical use
- Production of popular, good looking illustrations, as programs for quantitative analysis exist

The solution

Implemented using `matlab` version 5.3, featuring

- `isosurface` - a routine for findning isosurfaces in volume datasets
- All kinds of numerical techniques have been implemented - ease of use
- Graphical user interfaces are (relatively) simple to implement

A drawback is that `matlab` is *slow* for some purposes - including `for`-loops etc. `matlab` is really a scripting language - or a high level interpretation language.

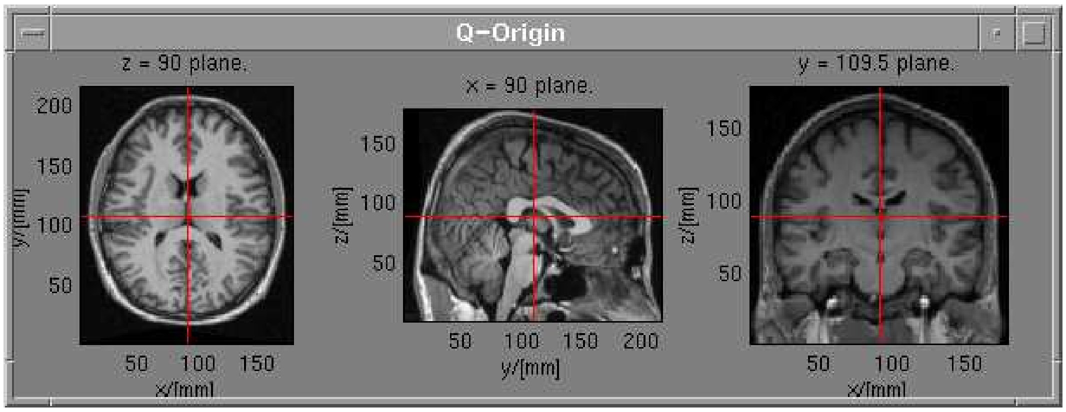
Image objects

Main objects of the final image:

- Brain surface - created as an isosurface in the NMR dataset
- Slices - axis parallel planes, intersecting the volumes - only drawn *inside* the brain surface
- Lights - point sources of light, for creation of light/shadow effects on brain surface and slices - enhancement of 3d effect

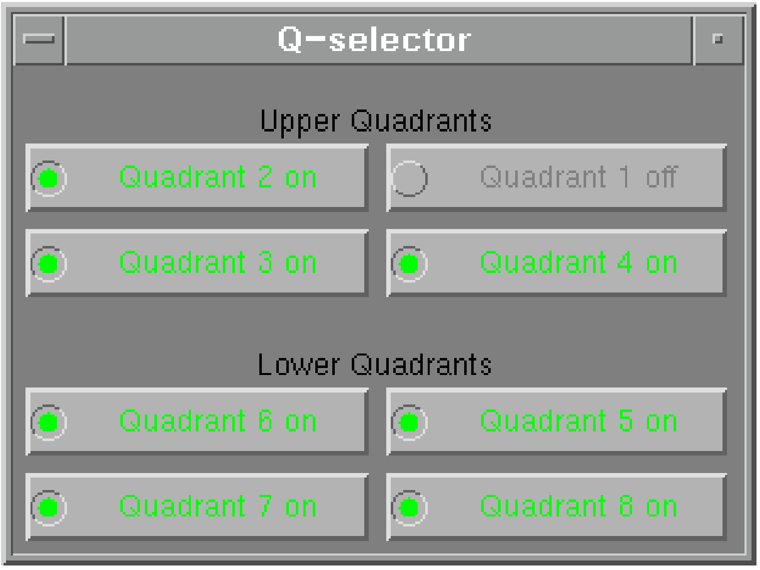
Adjustable parameters - 1

- Quadrant origin - definition of the intersection point of the three slices - dividing the volume into 8 subvolumes.



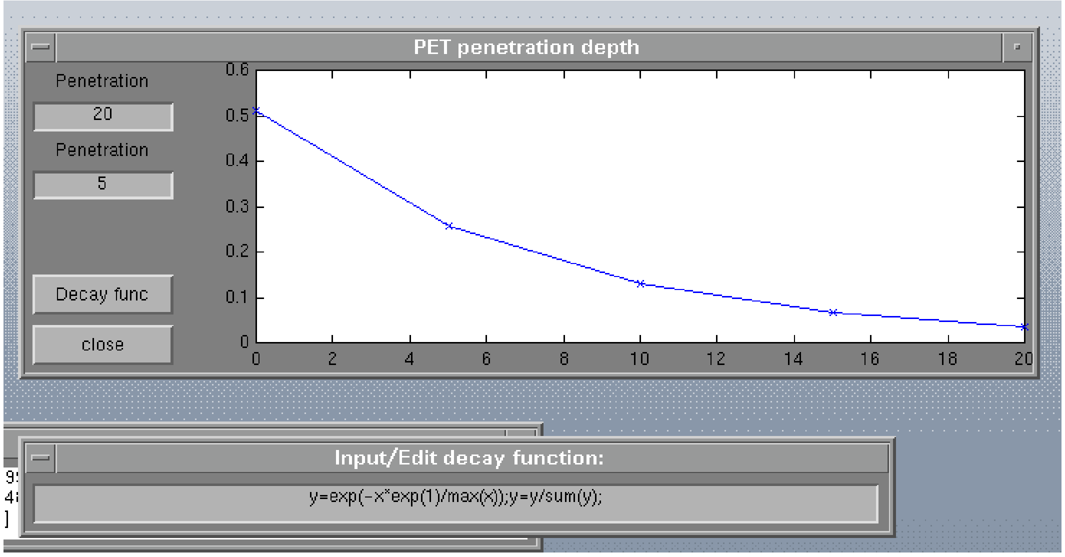
Adjustable parameters - 2

- The brain surface can be made invisible in each of the 8 subvolumes - revealing the interiour activation and anatomy.



Adjustable parameters - 3

- Depth function - the function defining how the activation below each surface point is projected onto the surface.



PET penetration depth

Penetration: 20

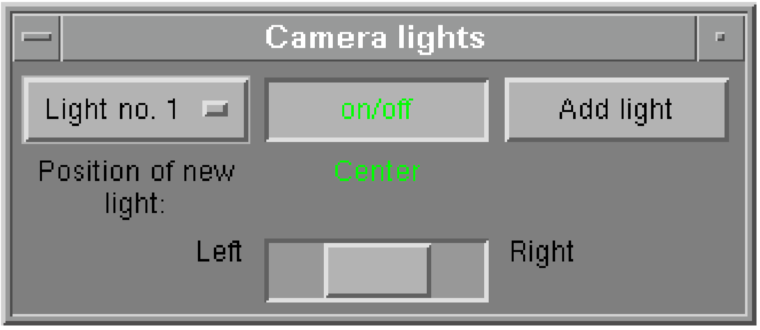
Penetration: 5

Input/Edit decay function:

```
y=exp(-x*exp(1)/max(x));y=y/sum(y);
```

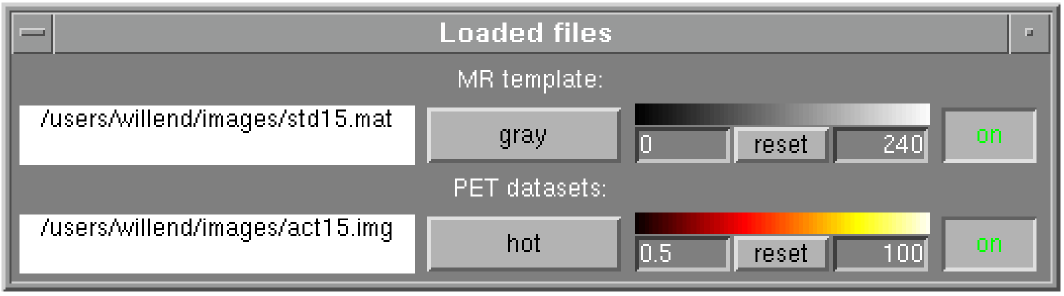
Adjustable parameters - 4

- Lightsource positions - new lightsources can be added at wanted positions for 3d experience.



Adjustable parameters - 5

- Colormaps - the colormaps of the PET activation and the brain anatomy can be chosen freely.



Loaded files

MR template:

/users/willend/images/std15.mat

gray

0

240

PET datasets:

/users/willend/images/act15.img

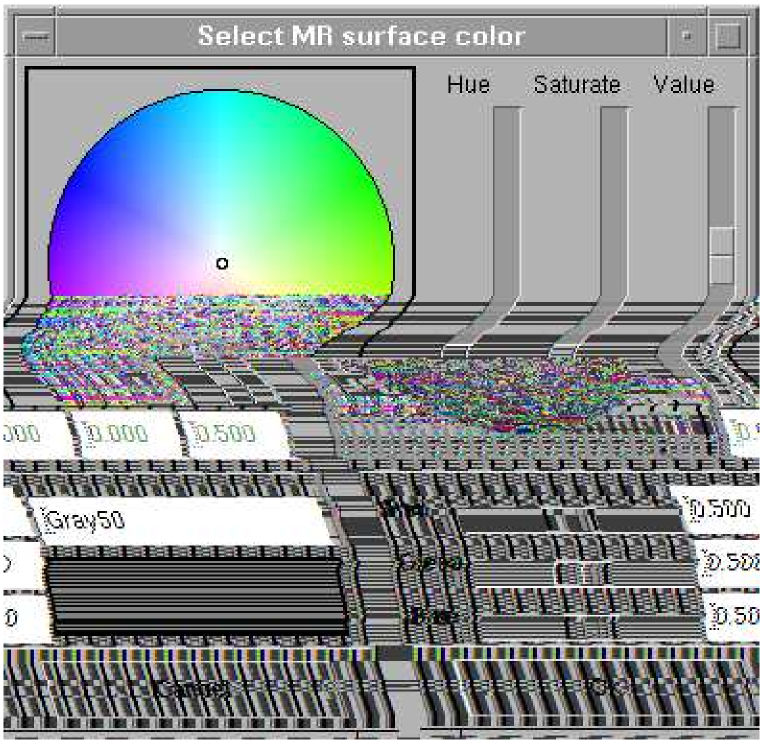
hot

0.5

100

Adjustable parameters - 6

- Other colors - the figure background color and the base color of the brain surface can be freely selected.



Adjustable parameters - 7

- Direction of view - the brain orientation in space can be changed online[2].

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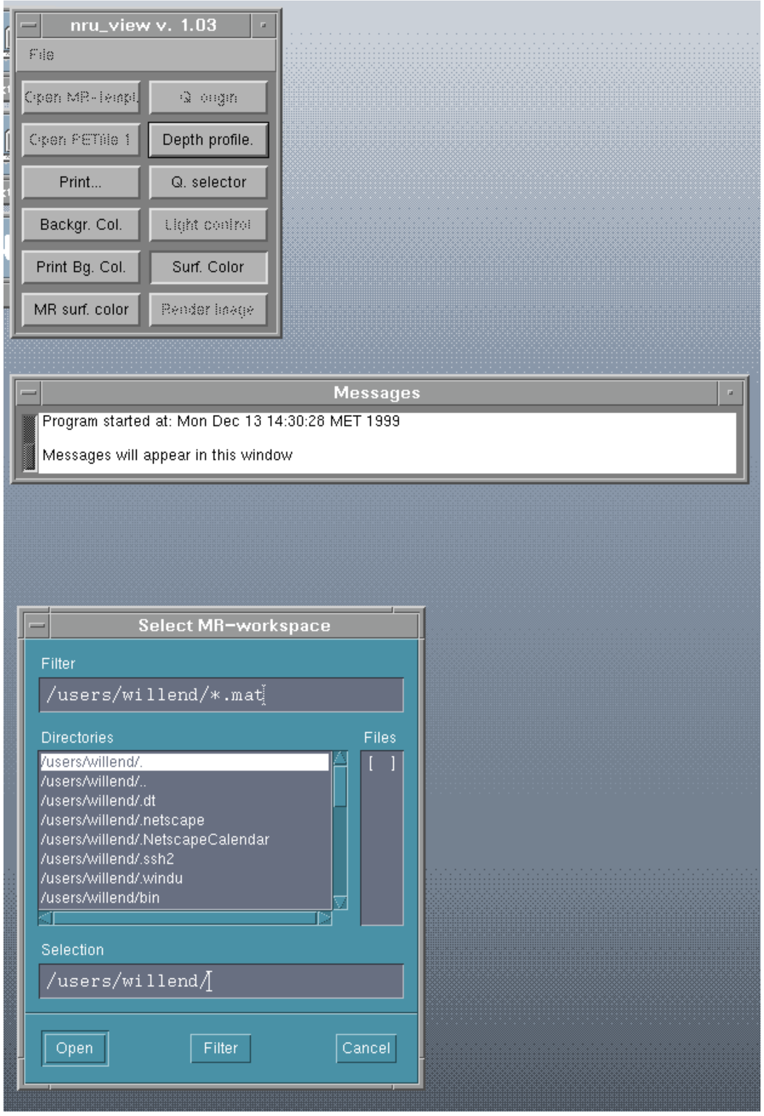
[2] This requires a bit patience, though.

Program demonstration - 1

- Initial program state

Program demonstration - 2

- Load an NMR dataset



Program started at: Mon Dec 13 14:30:28 MET 1999

Messages will appear in this window

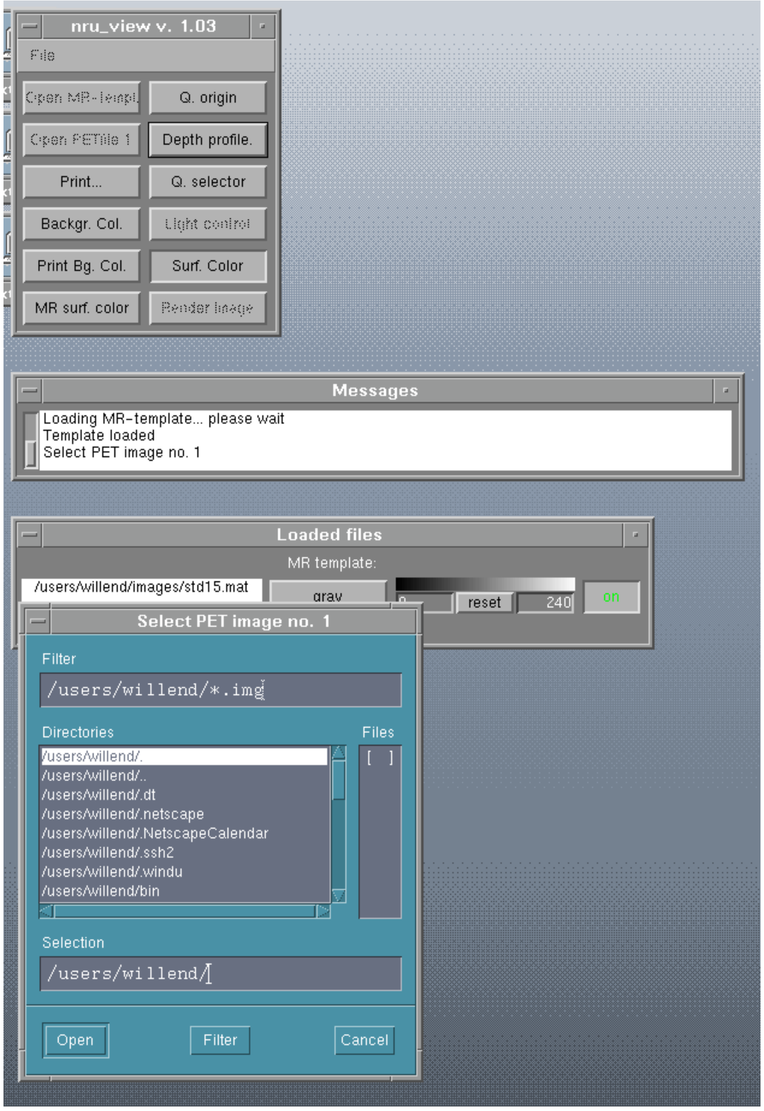
Filter: /users/willend/*.mat

Directories:
/users/willend/.
/users/willend/..
/users/willend/.dt
/users/willend/.netscape
/users/willend/.NetscapeCalendar
/users/willend/.ssh2
/users/willend/.windu
/users/willend/bin

Selection: /users/willend/

Program demonstration - 3

- Load a PET dataset



Loading MR-template... please wait
Template loaded
Select PET image no. 1

/users/willend/images/std15.mat

Filter: /users/willend/*.img

Directories:
/users/willend/.
/users/willend/..
/users/willend/.dt
/users/willend/.netscape
/users/willend/.NetscapeCalendar
/users/willend/.ssh2
/users/willend/.windu
/users/willend/bin

Files: [ ]

Selection: /users/willend/