Analysis of MR-Diffusion Tensor Images at 3T

vlemed04 (Matthan Caan)

Quantitative Imaging group TU Delft, Radiology department AMC

Internal symposium VL-e 09-11-06

Team:

Prof. dr ir C.A. Grimbergen (AMC, Medical Physics)
Prof. dr G.J. den Heeten (AMC, Radiology)
Dr S. Olabarriaga (VL-e 1.3)
Prof. dr ir L.J. van Vliet (TU Delft, Quantitative Imaging, Imaging Science and Technology)
Dr F.M. Vos (AMC Radiology, TU Delft QI IST)

Analysis of 3T DTI data

Development of algorithms for analyzing DTI data.

Because of complex computations and high amounts of data, extensive resources are needed.

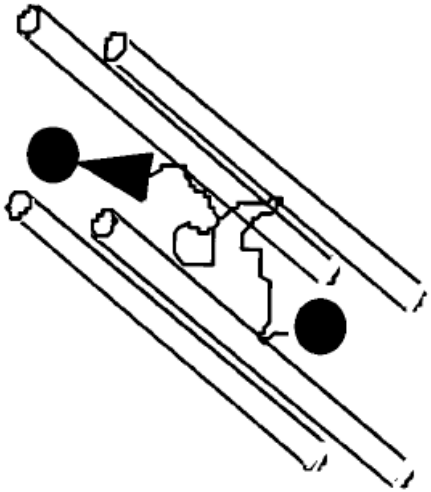
These are provided and used within the VLe context.

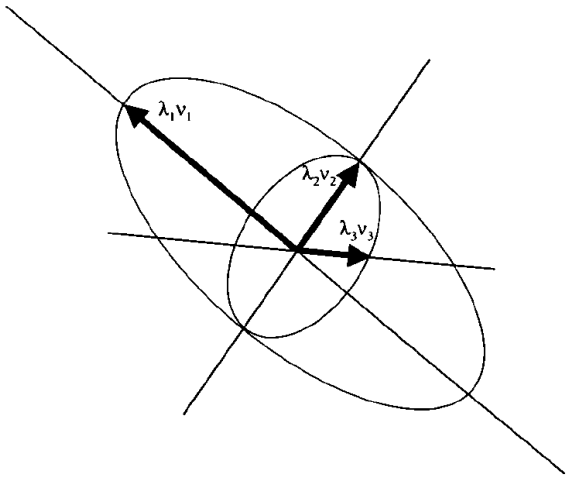
Diffusion reveals Brain Structure

Anisotropic diffusion of water between nerve tracts is characterized by a second-order symmetric tensor.

$$D = \begin{pmatrix} D_{xx} & D_{yx} & D_{zx} \\ D_{xy} & D_{yy} & D_{zy} \\ D_{xz} & D_{yz} & D_{zz} \end{pmatrix}$$

Eigenvectors v_i and -values λ_i of this tensor determine amount and direction of diffusion in each voxel.





PhD-project, 08-2005 / 07-2009

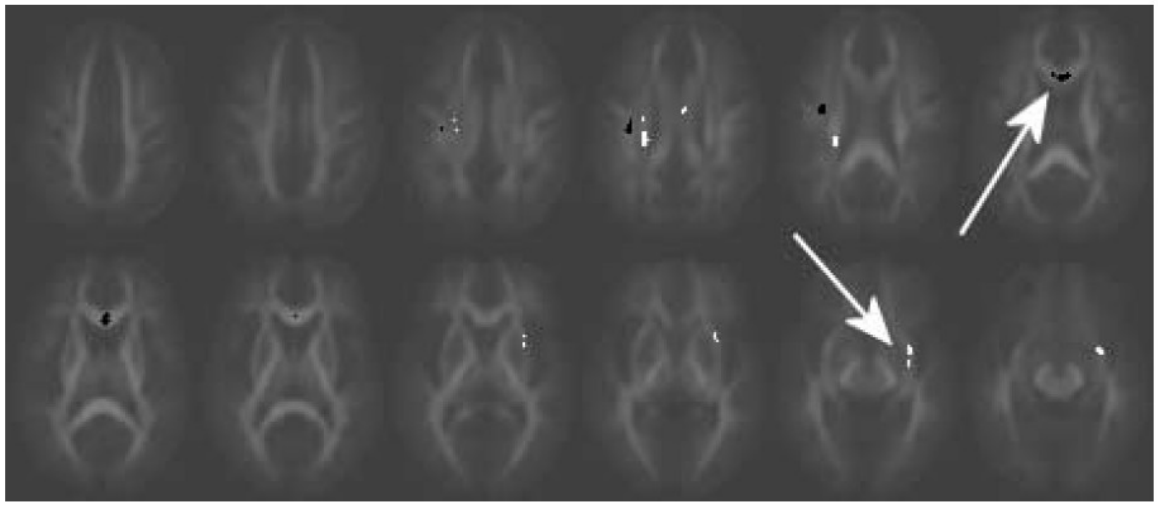
Current topics:

- Shaving in discriminant analysis: schizophrenia study
  - Optimized parameter settings for 3 Tesla data (T. Akkermans, BSc)
- Detection of crossing fibers (A.W. de Vries, MSc)
- White matter connectivity (G. Khedoe, MSc)
- Non-rigid registration of DTI
- Connectivity around a tumor pre/post operation, combined DTI/fMRI (F. Hoefnagels, PhD)

Shaving algorithm

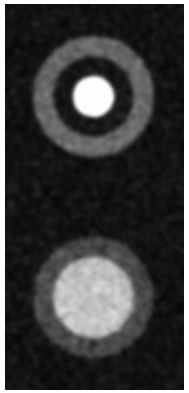
Comparitive study to schizophrenia:
using a machine learning framework, the combination of regions with changed anatomy is automatically extracted.

Results in 1.5T data (voxelsize 2x2x6 mm)



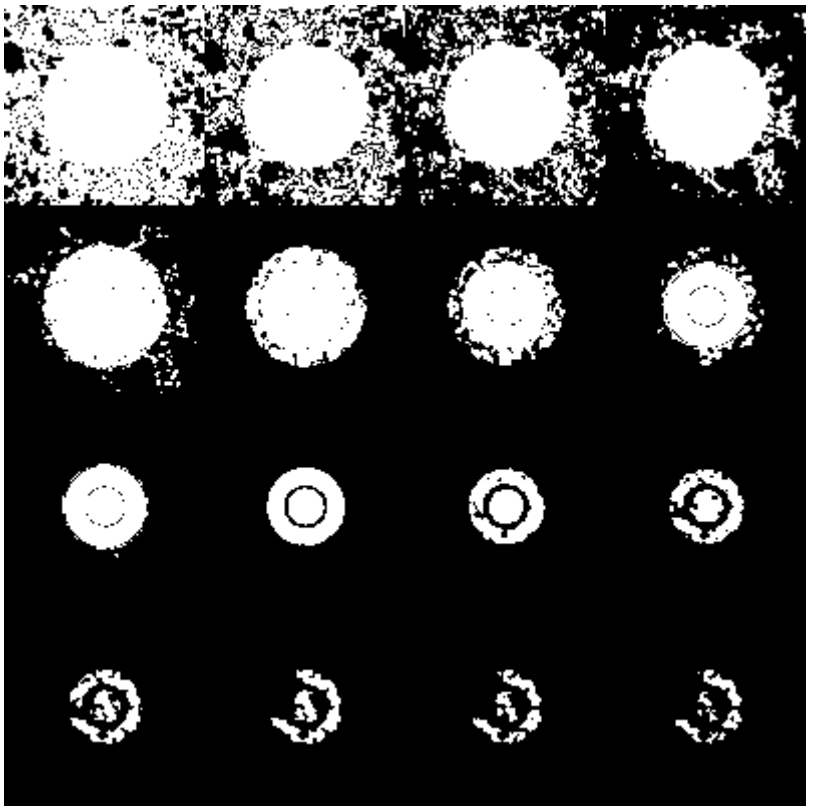
Shaving: example

Iteratively discard voxels:



‘patients’

‘controls’



white: remaining voxels

Implementation on the grid

VLe Proof Of Concept (POC) environment:
virtual machine, plug ‘n play access to grid-resources.

Data is stored and accessed at the Storage Resource Broker (SRB).

Scripts developed by Silvia ease a parameter sweep:

```
data = “schiz_study.mat”
param_set = “1 2 3 4 5 6 7 8 9 10”
for param in $param_set do
  command = “matlab –r crossvalidation.m $data $param”
done
```

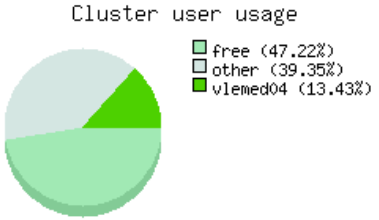
Torque Report for Fri, 30 Jun 2006 10:08:30 +0200

Get Fresh Data

SARA HPC > Matrix Cluster > Joblist > **user: vlemed04**

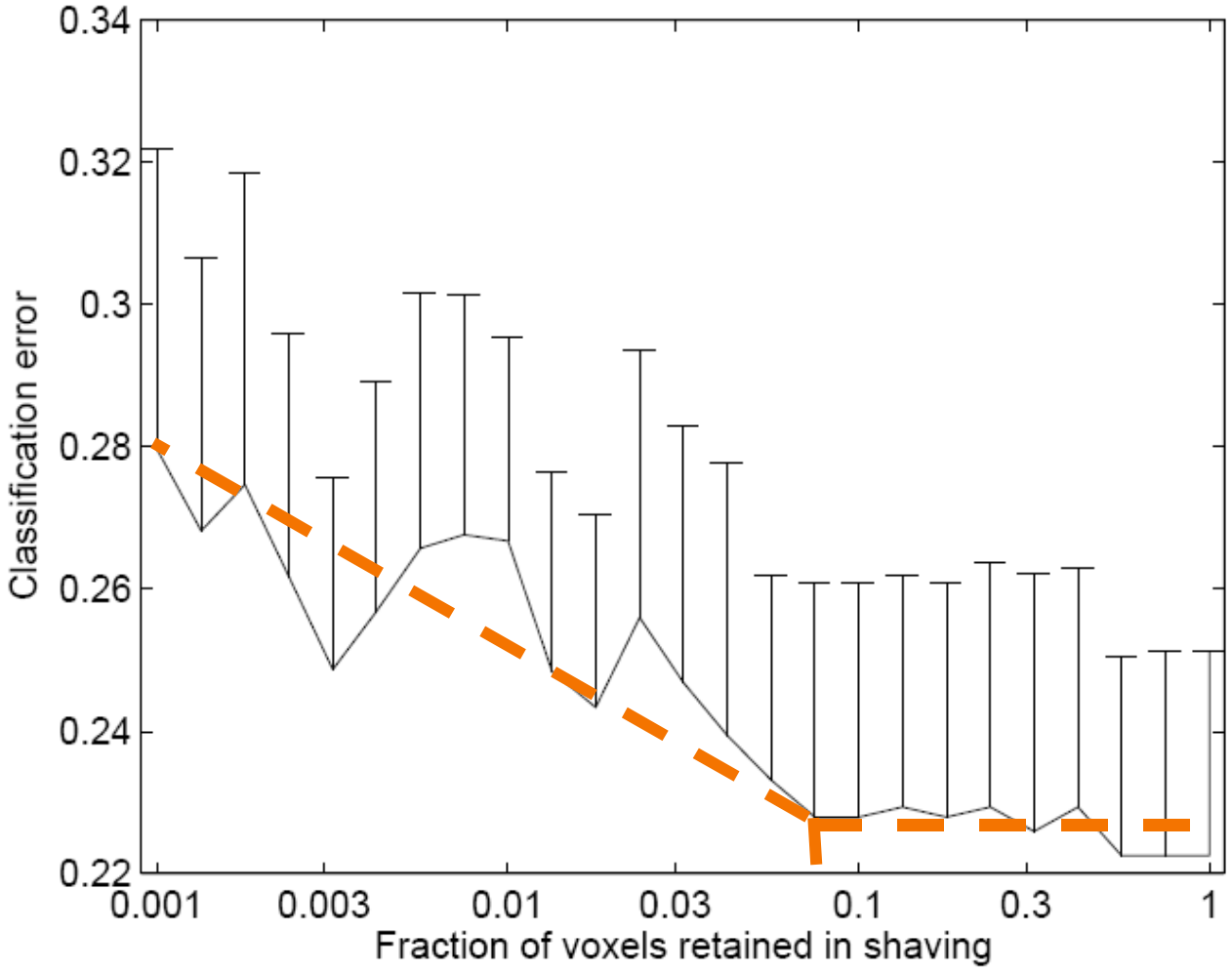
Batch	Jobs	Nodes	Cpus
Capacity		36	72
Running	23	19	31
Queued	1528	1528	1528
Total	1551	1547	1559
Free		17	41
View	10	8	10

Last updated: Fri 30 Jun 2006 10:08:00



Id	S	User	Queue	Name	Req. CPU time	N/P	Queued	Started	Runningtime
122854	R	vlemed04	short	STDIN	4:00:00 hours	1/1	Fri 30 Jun 2006 09:30:02	Fri 30 Jun 2006 10:04:38	03:22 minutes
122853	R	vlemed04	short	STDIN	4:00:00 hours	1/1	Fri 30 Jun 2006 09:29:30	Fri 30 Jun 2006 10:03:35	04:25 minutes
122852	R	vlemed04	short	STDIN	4:00:00 hours	1/1	Fri 30 Jun 2006 09:28:57	Fri 30 Jun 2006 09:54:59	13:01 minutes
122851	R	vlemed04	short	STDIN	4:00:00 hours	1/1	Fri 30 Jun 2006 09:28:25	Fri 30 Jun 2006 09:47:09	20:51 minutes
122850	R	vlemed04	short	STDIN	4:00:00 hours	1/1	Fri 30 Jun 2006 09:27:53	Fri 30 Jun 2006 09:44:27	23:33 minutes
122849	R	vlemed04	short	STDIN	4:00:00 hours	1/1	Fri 30 Jun 2006 09:27:26	Fri 30 Jun 2006 09:37:50	30:10 minutes
122848	R	vlemed04	short	STDIN	4:00:00 hours	1/1	Fri 30 Jun 2006 09:26:55	Fri 30 Jun 2006 09:28:58	39:02 minutes
122847	R	vlemed04	short	STDIN	4:00:00 hours	1/1	Fri 30 Jun 2006 09:26:26	Fri 30 Jun 2006 09:28:43	39:17 minutes
122846	R	vlemed04	short	STDIN	4:00:00 hours	1/1	Fri 30 Jun 2006 09:25:48	Fri 30 Jun 2006 09:27:12	40:48 minutes
122845	R	vlemed04	short	STDIN	4:00:00 hours	1/1	Fri 30 Jun 2006 09:25:16	Fri 30 Jun 2006 09:25:17	42:43 minutes

Results



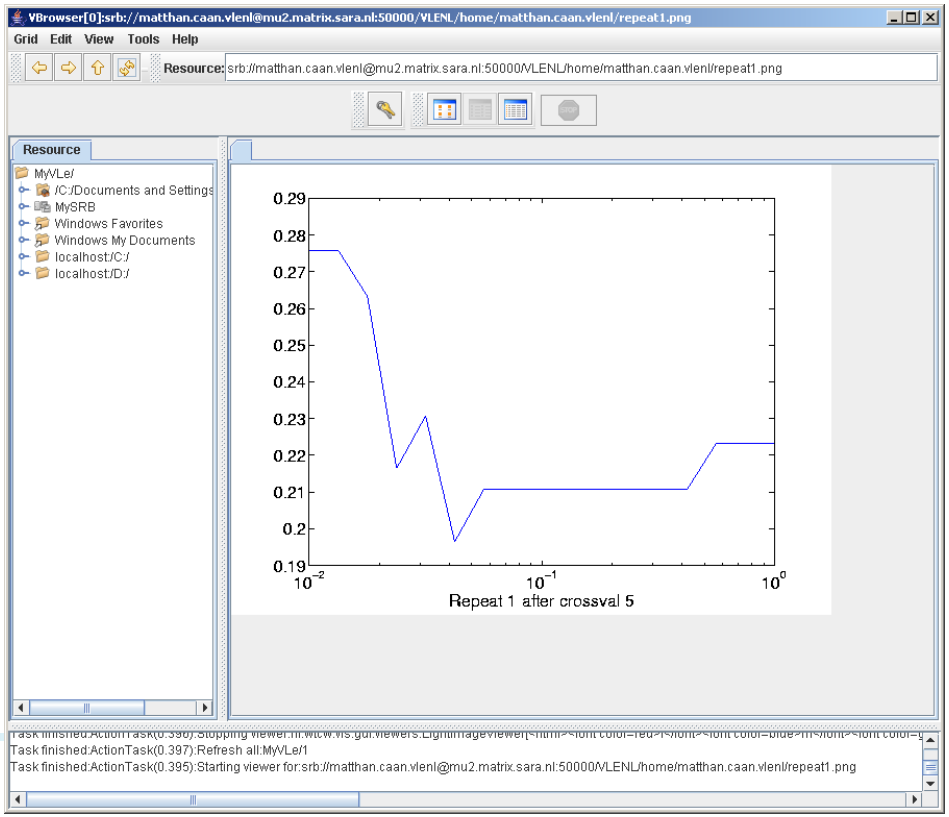
amc TU Delft vl·e

VBrowser

(Piter de Boer)

Easy access to your data at the SRB.

Follow the progress of your jobs online: matlab periodically updates a graph at the SRB.



Remarks during setup

Problems while setting up POC VM:

- virtual organisations unknown
- nameservers
- good estimation of expected duration needed

Information on the web a little fragmented, but reachable with some effort and google.

Matlab licensing ‘problem’:

- Using compiled code?
- Octave: open source matlab-clone

Excellent support@sara.nl (quick and useful response)

Next step: higher res 3T data

(dec 2006 – jul 2007)

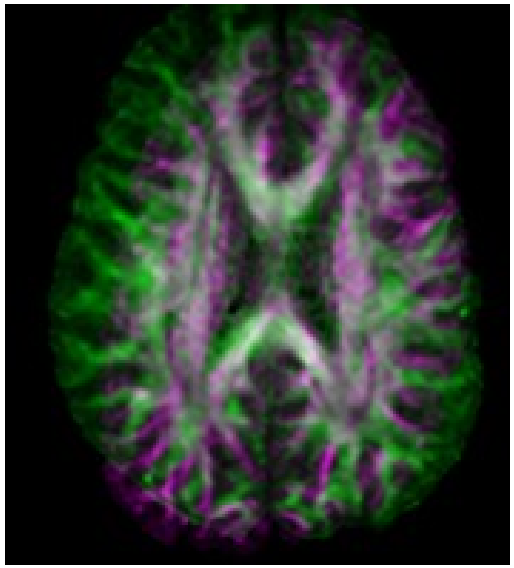
Bachelor's project Tom Akkermans

- Evaluate 3T schizophrenia study
- Optimize different parameters in algorithm
- Rewrite matlab scripts to make them understandable and reusable by others

Non-rigid registration of DTI

Bringing data in spatial correlation.

Algorithm development (2007)
Evaluation on larger amounts of data (2008)



Connectivity analysis

Research Friso Hoefnagels (Neurosurgery, AMC):
20 patients, pre- and post-scan of brain tumor surgery.
Probabilistic tracking using FSL: 40 days CPU-time needed.
2007/2008

Research Ganesh Khedoe (Applied Physics, TU Delft)
New methods for connectivity analysis.
Oct 2006 – Sep 2007.