

PHILIPS

Grid Architecture for Medical Applications

Jasper van Leeuwen
Healthcare Systems Architecture
Philips Research Europe
November 9th, 2006

TOC

- Team
- Previous work
 - GAMA
 - Full Volume Fiber Tracking
- Current activities
 - High Angular Fiber Tracking
 - Preparing for the Clinical Trial
- Plans
 - Near
 - Far

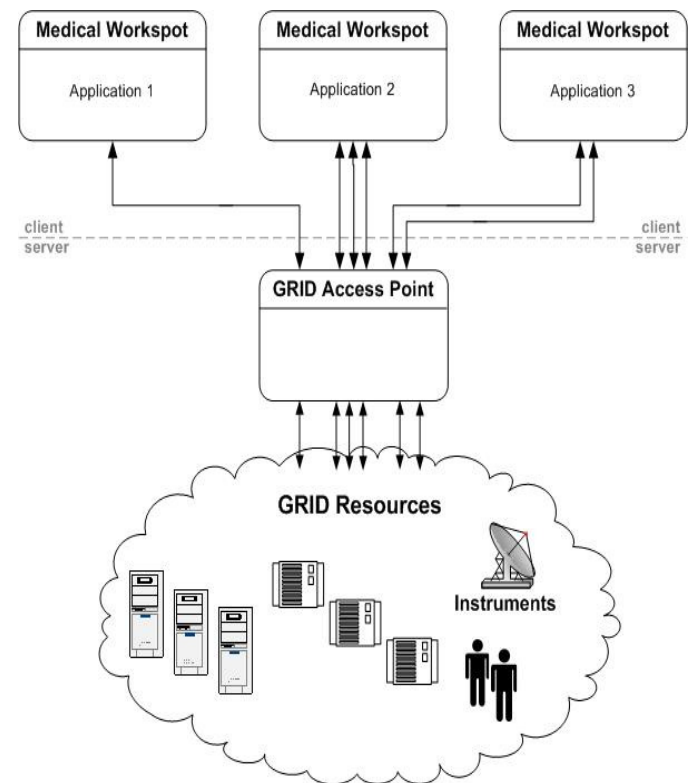
Team

- Anca Bucur
- Henk Obbink
- Jasper van Leeuwen
- Jeroen Vrijnsen (replacing Rene Kootstra)



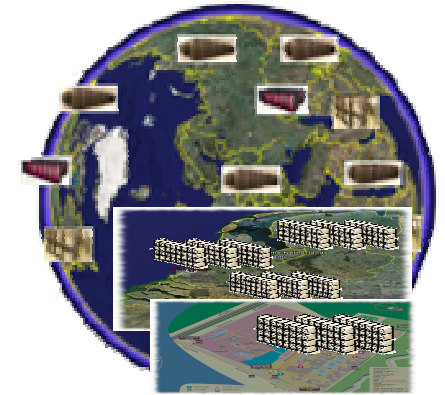
GAMA (1)

- Allows computationally intensive applications to use remote resources
- Simultaneously provides services to multiple users and access to multiple applications
- Windows-based interface in the hospital, compute-intensive part placed remotely
- Single Grid access point, handles requests and relays results



GAMA (2)

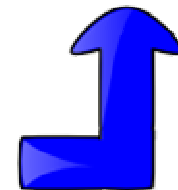
- Speed-up of existing applications with order(s) of magnitude
- New (unforeseen) healthcare applications become possible
- Transparent access to remote resources: computational and data
- Enables easy deployment and upgrade to new releases, new business models



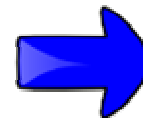
Grid resources,
remote clusters



Grid Access
Point



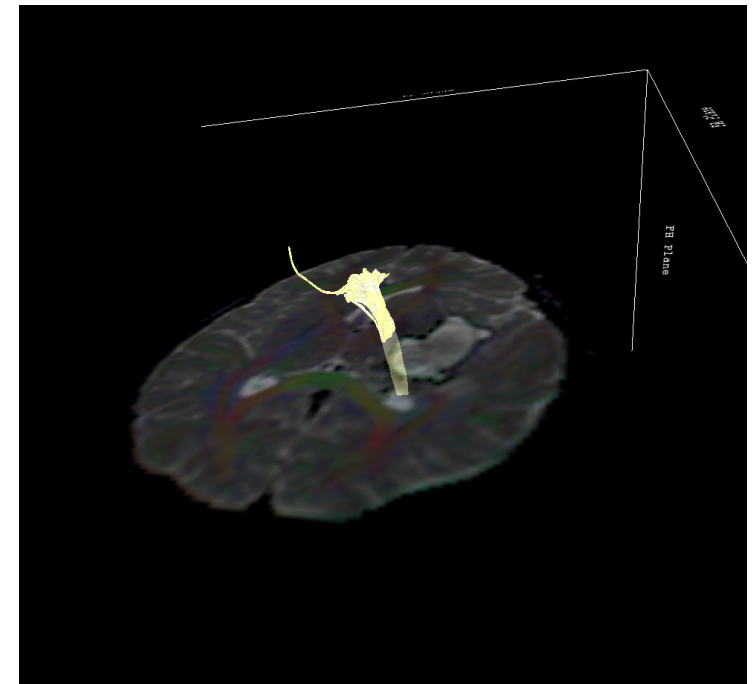
Modality



Client

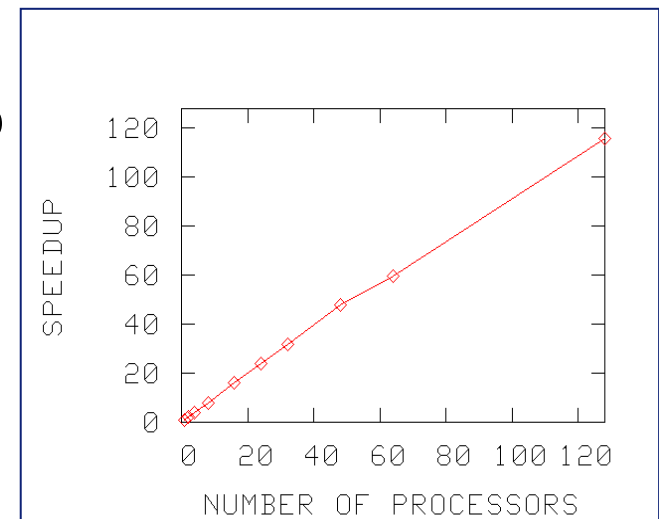
Full Volume Fiber Tracking

- Uses Diffusion Weighted MRI
- Fibers visualize anisotropic diffusion of water molecules in brain:
 - White matter tracts, areas active for different tasks
 - Connecting pathways between brain structures
- Clinical relevance: surgical planning, assisted neurosurgery, stroke detection, psychiatry
- Highly scalable distributed solution
- (<20s on 64 processors) for case study application



Scalability and performance

- Performance gain from distributing the computational algorithm over Grid resources
- Improved throughput, (almost) linear speedup
- The use of remote Grid resources introduced very small overhead, for standard network solution
- The use of local dedicated HPC resources could slightly improve performance



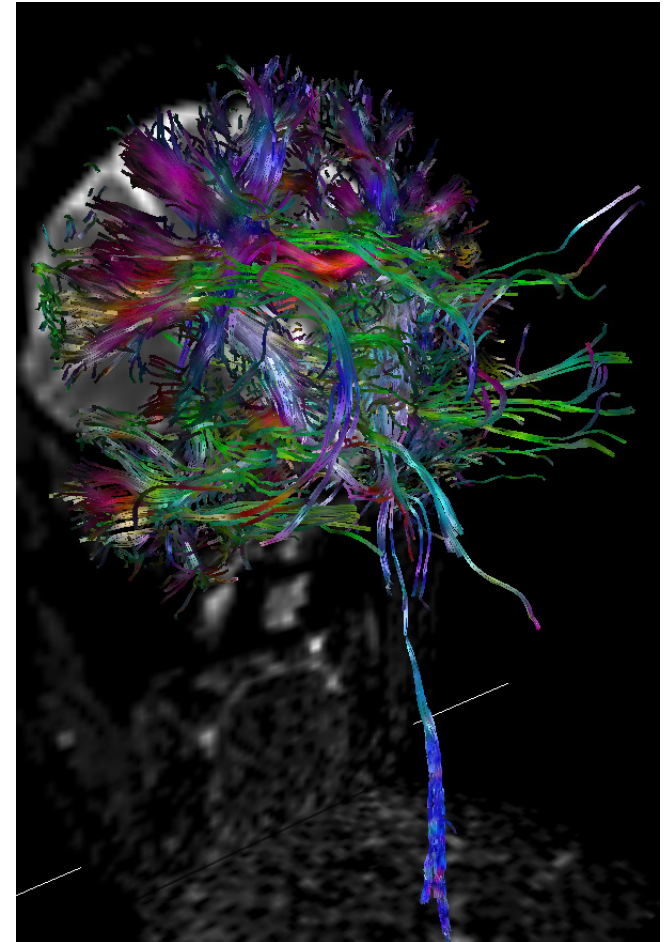
Application	Computation [s]	Transfer dataset (22.4 MB) [s]	Visualization [s]	Transfer parameters & results [s]	Communication [s]
Sequential	464.5	0	24.5	0	0
Grid-based, 128 nodes	8.8	14.5	24.5	1.0	2.0

TOC

- Team
- Previous work
 - GAMA
 - Full Volume Fiber Tracking
- Current activities
 - High Angular Fiber Tracking
 - Preparing for the Clinical Trial
- Plans
 - Near
 - Far

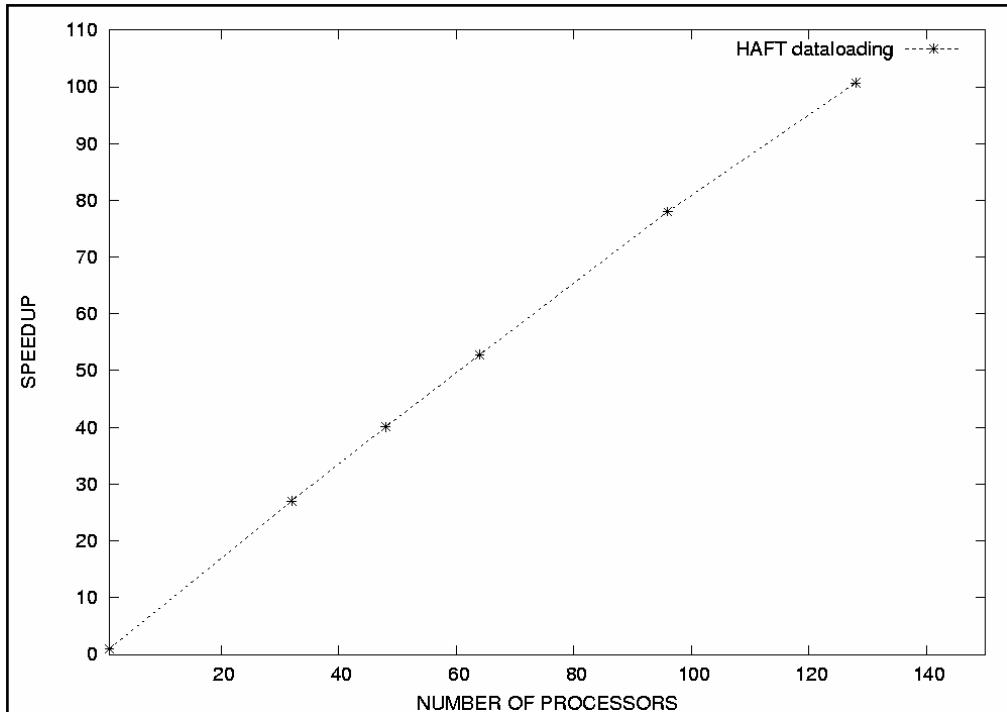
High Angular Fiber Tracking

- Handles fiber crossings within brain white matter
- Consists of two computationally phases: data loading and tracking of fibers
- Data loading is a Double Tensor Model fitting approach which is extremely computationally intensive.



Scalability results

- Performance gain from distributing the data loading algorithm over Grid resources

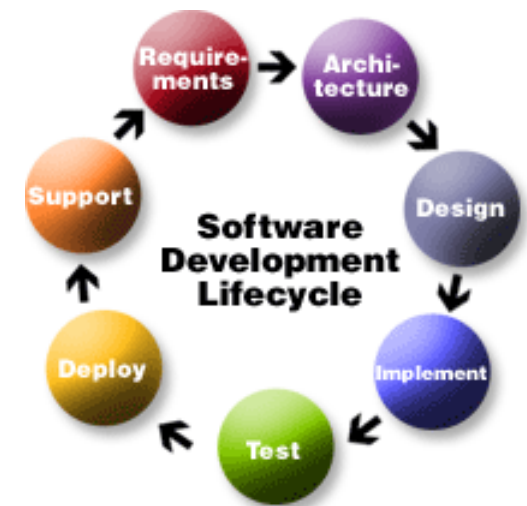


Preparing for the Clinical Trial

- Collaboration between AMC, PMS, and Philips Research
- Hypothesis: The goal is to measure FA along selected fiber tracts of the motor cortex (oncology patients, pre and post-surgical intervention). ROIs are determined via fMRI (foot, hand). In this study: compare the measurements obtained with high angular and tensor-based fiber tracking (HAFT, TFT).
- 20 enrolled patients; 2 scans per patient.

Preparing for the Clinical Trial – Encountered difficulties.

- Unexpected large size of acquired datasets
- Waiting times in the queue ⇒
workflow becomes batch mode instead of
interactive
- Lack of compute resources
- Implementation & testing:
 - Need for “development/testing queue”/support
 - Lack of parallel programming support
 - MPI has at some point worked
 - it should work now
 - ...



TOC

- Team
- Previous work
 - GAMA
 - Full Volume Fiber Tracking
- Current activities
 - High Angular Fiber Tracking
 - Preparing for the Clinical Trial
- Plans
 - Near
 - Far

Future

- Near
 - The clinical trial.
 - Incorporate feedback.
 - In case of success extended with more hypotheses.
 - Performance and scalability evaluation
- Far
 - Find relevant challenging applications.
 - Extend the architecture with a functional decomposition case.

