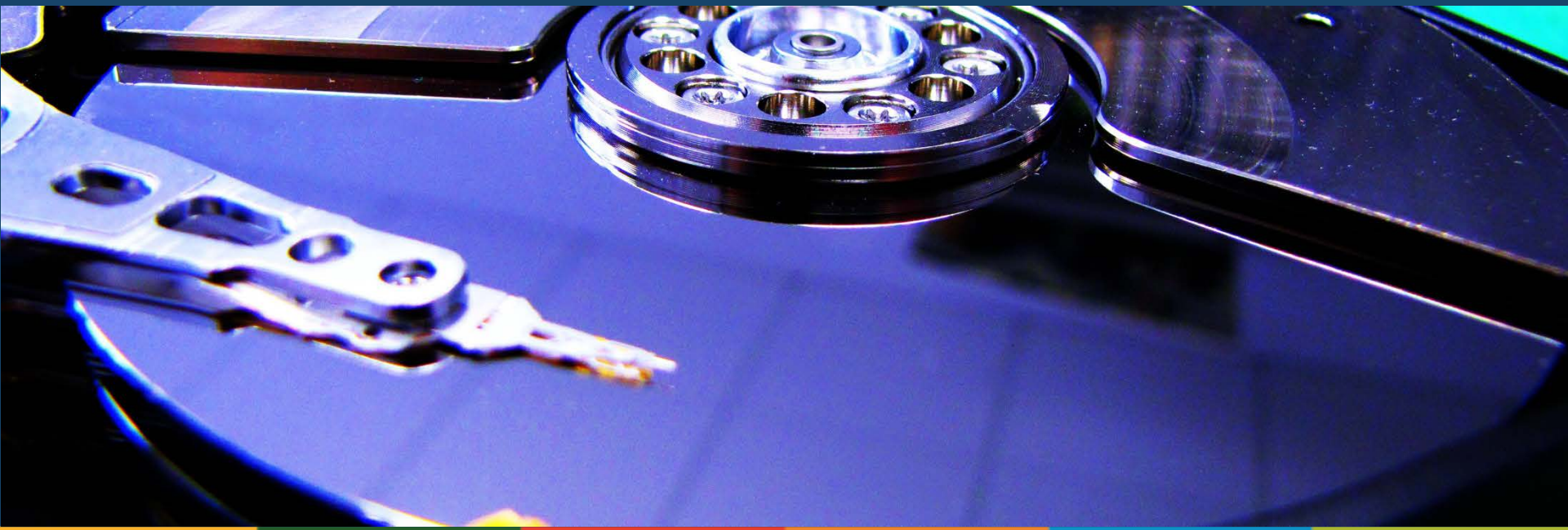


DLCL Neuroscience Report

All Hands Meeting @ Karlsruhe

Fall 2014

André Giesler



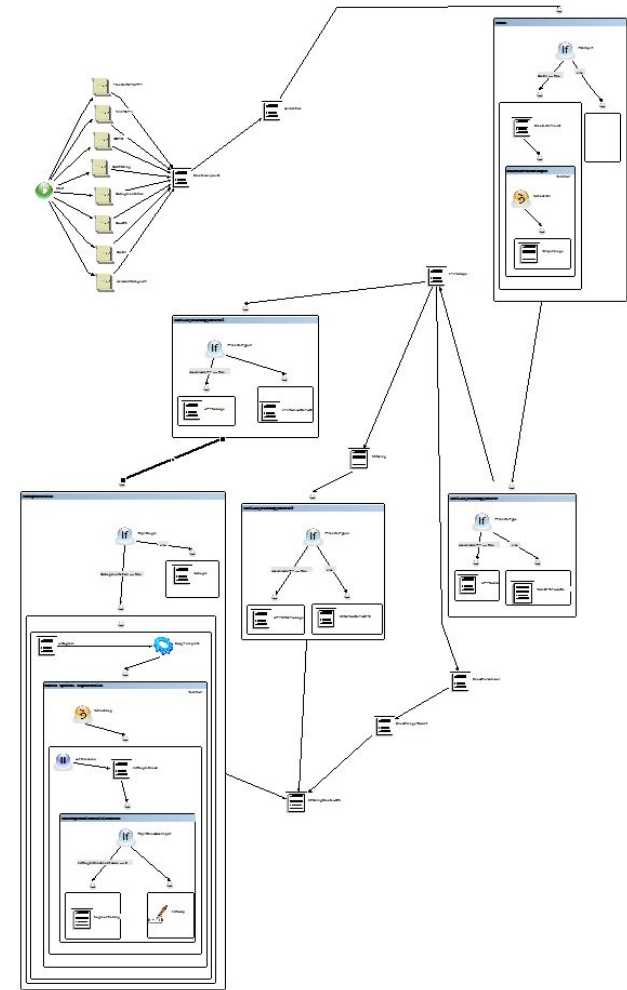
- Brief review to the thematic background of
 - Collaboration between INM-1 @FZJ and DLCL Neuroscience
 - Anatomical structure of the human brain on the level of nerve fibers
 - Understanding the connectivity of brain regions (regarding the function and neuro-degenerating diseases)
 - Long-term goal is a three-dimensional map of nerve fibers
 - For that purpose post-mortem brains are sliced and scanned
 - One method is the 3D-Polarized Light Imaging technique (PLI)
 - exclusively developed at INM-1
 - About 1500 slices of a post-mortem brain are imaged with a microscopic device using polarized light

Characteristics of PLI data life cycle

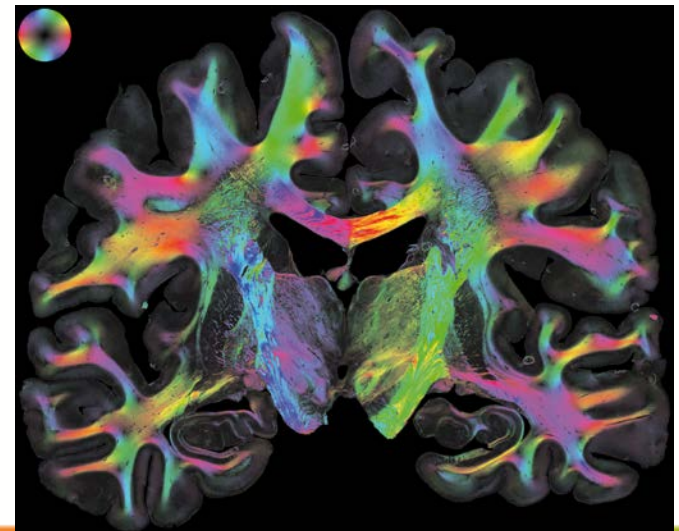


- Complex image processing from raw data to final product
- Chain of tools, e.g. calibration (compensate thermal effects, noises), segmentation (separating brain tissue from background), ...
- Multiple computation steps required
- Applications are executed manually by their respective developers
- Human interaction is required
- After one step in the chain is finished the developer of the next tool would retrieve the output data
- Additionally, applications are installed on different resources, so data must be transferred between storages and supercomputers
- Manual approach led to delays in the entire process

- Community is still transforming tools from sequential to parallel execution
- Also usage of GPUs is enabled
- Tools have been integrated step by step in a Unicore Workflow
- Established an automated data flow between tools, Supercomputers, and File Systems
- Optional use of UFTP or Shared File System
- User Interaction enabled to stop and re-run parts of the workflow



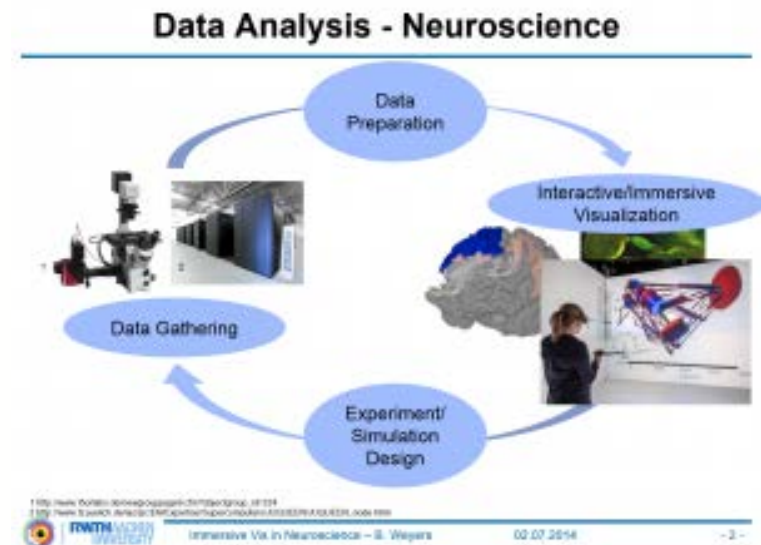
- Parameterization – to tailor the workflow for a particular set of machines and facilitate the portability
- Iterating over Arbitrary File Sets – Brain Slices consist of an unspecified number of tiles
- Data movement – reduce the data movement between single jobs to a minimum creating a central workflow storage
- Switching completely from NIFTI image format to HDF5, using HDF5 for collecting metadata
- Completing the workflow
 - Added missing tools (Last step from microscope directly to workflow)
 - Producing the final PLI image product (Fiber Orientation Map)



- Results are easier to reproduce
- The makespan of the entire PLI process could be reduced to hours rather than days and weeks
- Only the automated approach will allow an effective processing of large number of brain slices in the near future
- Boost for Unicore workflow engine
 - workflow takes Unicore and its workflow engine to new limits (processing up to 800 GB in one workflow in ~ 24hrs)
 - Implementation of new features and concepts (human interaction, iterating over file sets, parameterization)

Provenance and Workflows in data analysis of electrophysiological experiments

- Collaboration with INM-6@FZJ regarding Provenance Tracking
- Typically iterating with parameterized algorithms over consistent bulk of data > recognition of contexts > visualization
- Integrating Provenance to
 - increase reproducibility by including a useful tracking from the raw data up to the analysis result
 - reduce redundant calculations
 - enable query options of provenance data for users
- Suitable Provenance tool is Sumatra
- Workflow approach
 - Porting typical INM-6 chain of tools to Unicore
 - Integrating Sumatra framework in Unicore Workflow Engine



- PLI Workflow should act as pilot project. Other image processing use cases in the Human Brain Project context similar to PLI
- Brain Big Data Project
 - Scanning large data sets of brain slices in Düsseldorf and Jülich and transfer data to storage at JSC
 - Project still inactive since scanners are not yet installed
 - Technical solution already planned based on Jülich Aachen Data Exchange framework (JADE) → dCache installation
- SimLab Climate Science @ JSC – Technical support regarding data sharing between collaborating scientific partners → OwnCloud
- Neuroscience communities are not funded by LSDMA
→ Have to convince partners to collaborate with us

- Björn Hagemeyer, André Giesler, Oliver Bücken, Rajveer Saini, and Bernd Schuller
A Workflow for Polarized Light Imaging Using UNICORE
UNICORE Summit 2014
 - We have concentrated that publication on the achievements from the Unicore point of view
 - A major publication including the achievements of the whole PLI process depends on the „Yes“ of the community. They feel not yet ready for publishing.