OpenWalnut – An Open-Source Visualization System

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Outline

Outline

Available Tools

- MeVisLab (`www.mevislab.de`)
- Amira (`www.amira.com`)
- ParaView (`www.paraview.org`)
- VISH (`vish.origo.ethz.ch`)
- MedINRIA (`www-sop.inria.fr/asclepios/software/MedINRIA`)
- Mayavi (`mayavi.sourceforge.net`)
- SCIRun (`www.scirun.org`)
- Teem (`teem.sourceforge.net`)

Context

- Collaboration: Neuroscientists & Visualization Researchers
  - two different requirements to a visualization tool
    - Neuroscientist = End-User
    - Visualization Researcher = Developer

Requirements

- Open Source and free

- MeVisLab
- Amira
- ParaView
- VISH
- MedINRIA
- Mayavi
- SCIRun
- Teem

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- General Purpose (w.r.t. medical visualization)

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- General Purpose (w.r.t. medical visualization)
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- Easily extensible (flexibility)
- Easy to use (graphical user interface)
- Portable (Linux, Windows and MacOS X)

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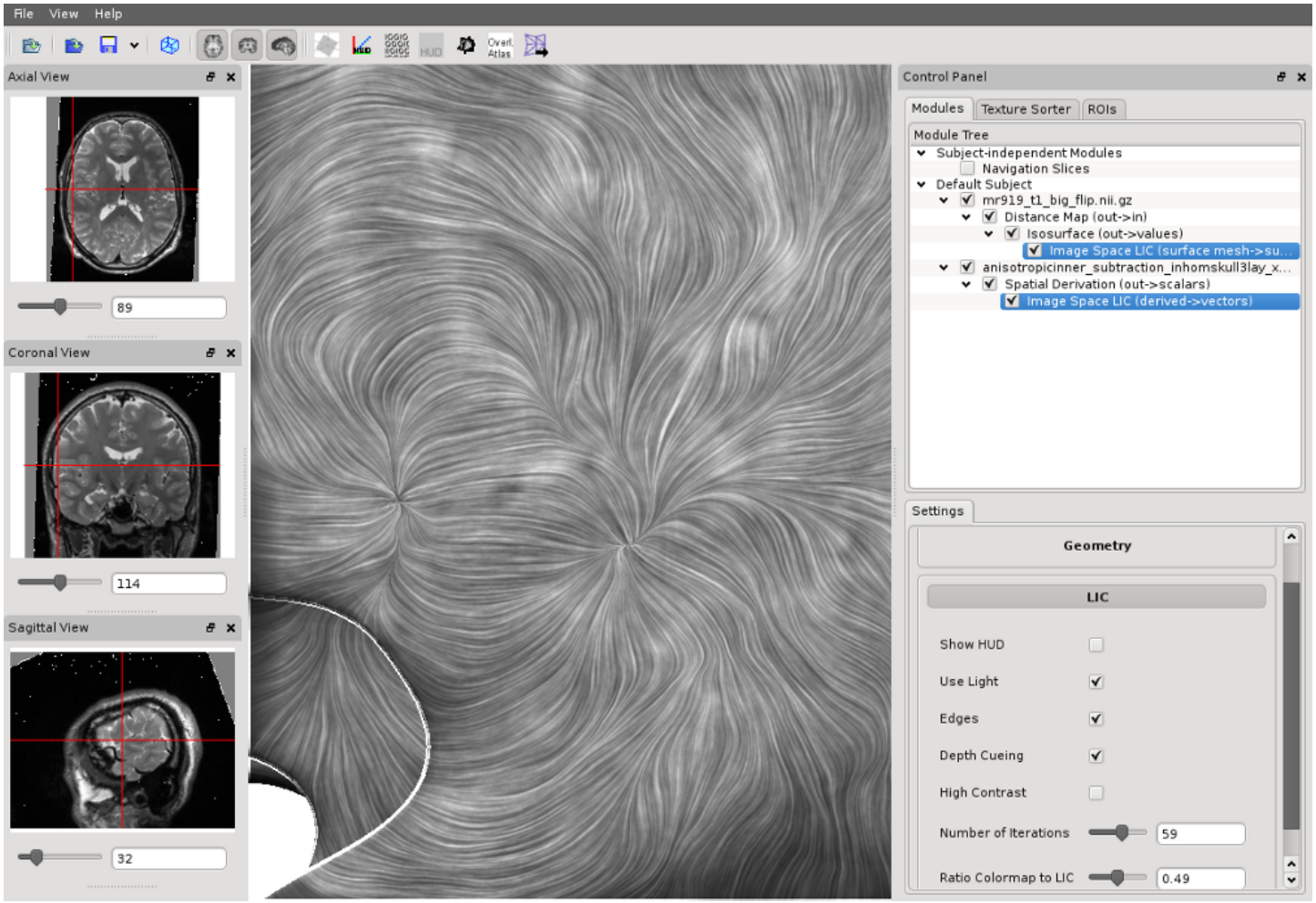
Outline

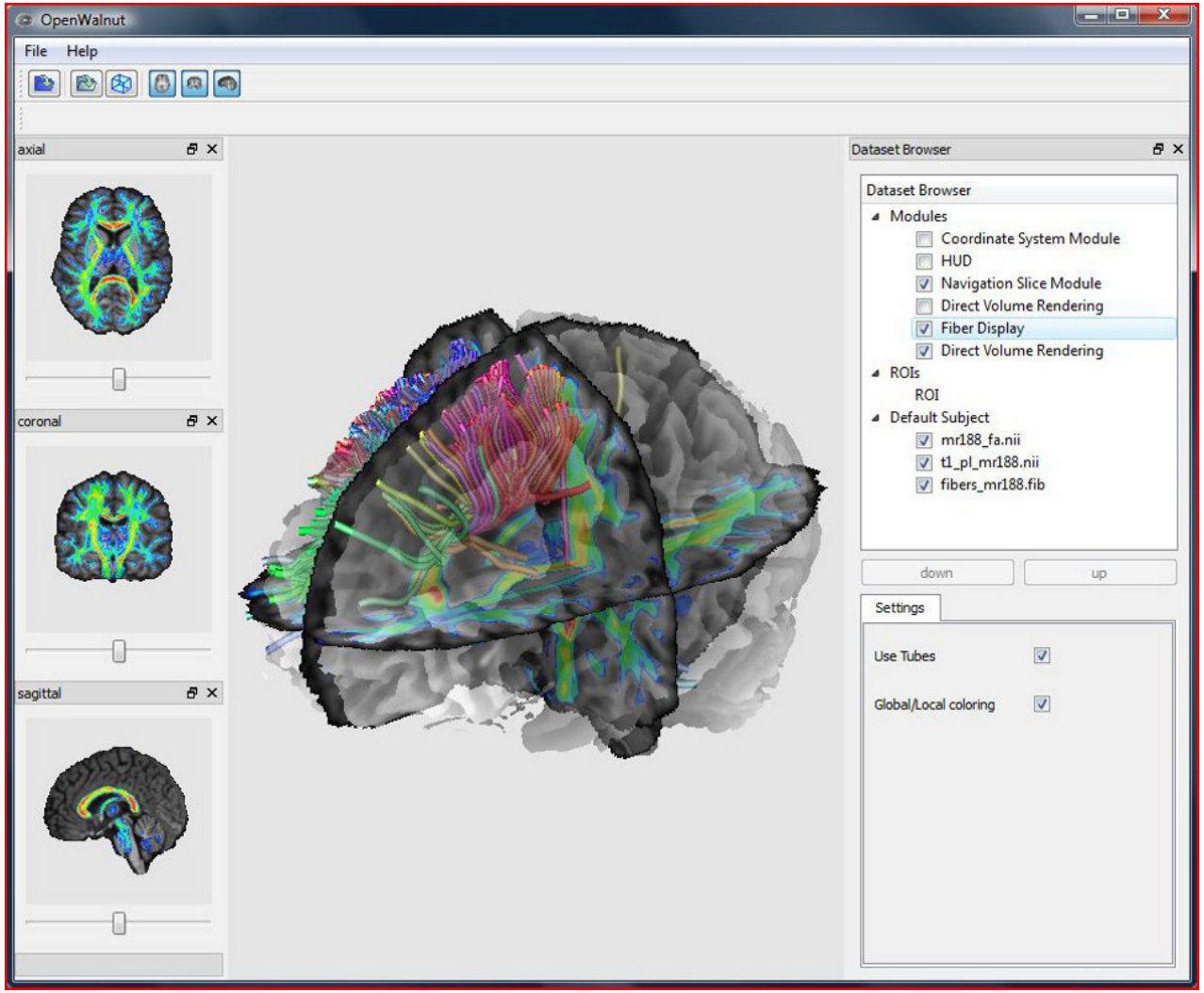
What is OpenWalnut today

- Multi-modal visualization tool
- Powerful framework
- Fast growing amount of algorithms and methods
- Actively developed
- Heavily used by:
  - Max Planck Institute for Cognitive- and Brain Sciences
  - Max Planck Institute for Neurology
  - Our group for all kinds of medical visualization research
- Other international groups began developing for/with OpenWalnut

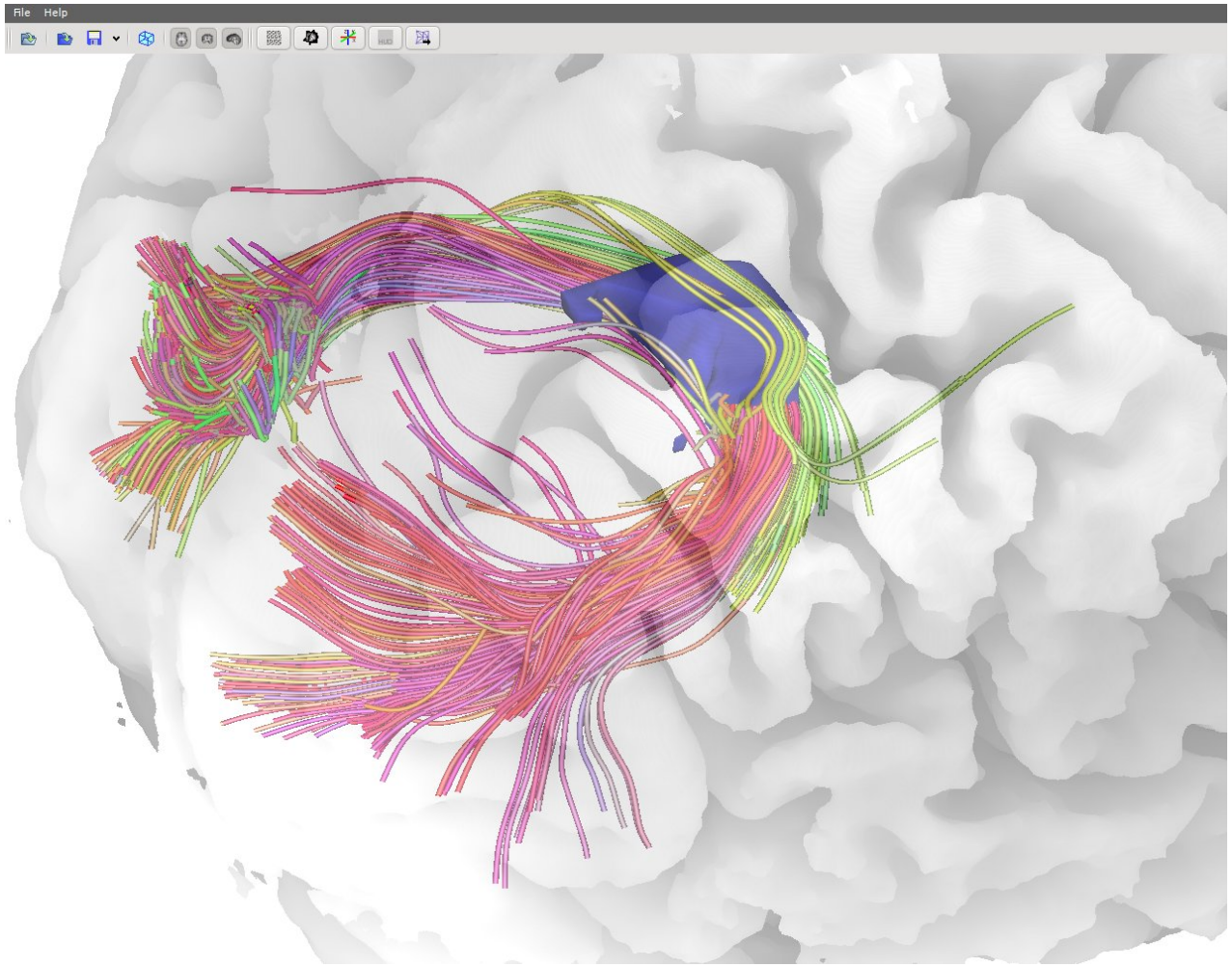
How it looks


File View Help
Axial View
89
Coronal View
114
Sagittal View
32
Control Panel
Modules
Texture Sorter
ROIs
Module Tree
Subject-independent Modules
Navigation Slices
Default Subject
mr919_t1_big_flip.nii.gz
Distance Map (out->in)
Isosurface (out->values)
Image Space LIC (surface mesh->su...
anisotropicinner_subtraction_inhomskull3lay_x...
Spatial Derivation (out->scalars)
Image Space LIC (derived->vectors)
Settings
Geometry
LIC
Show HUD
Use Light
Edges
Depth Cueing
High Contrast
Number of Iterations
59
Ratio Colormap to LIC
0.49

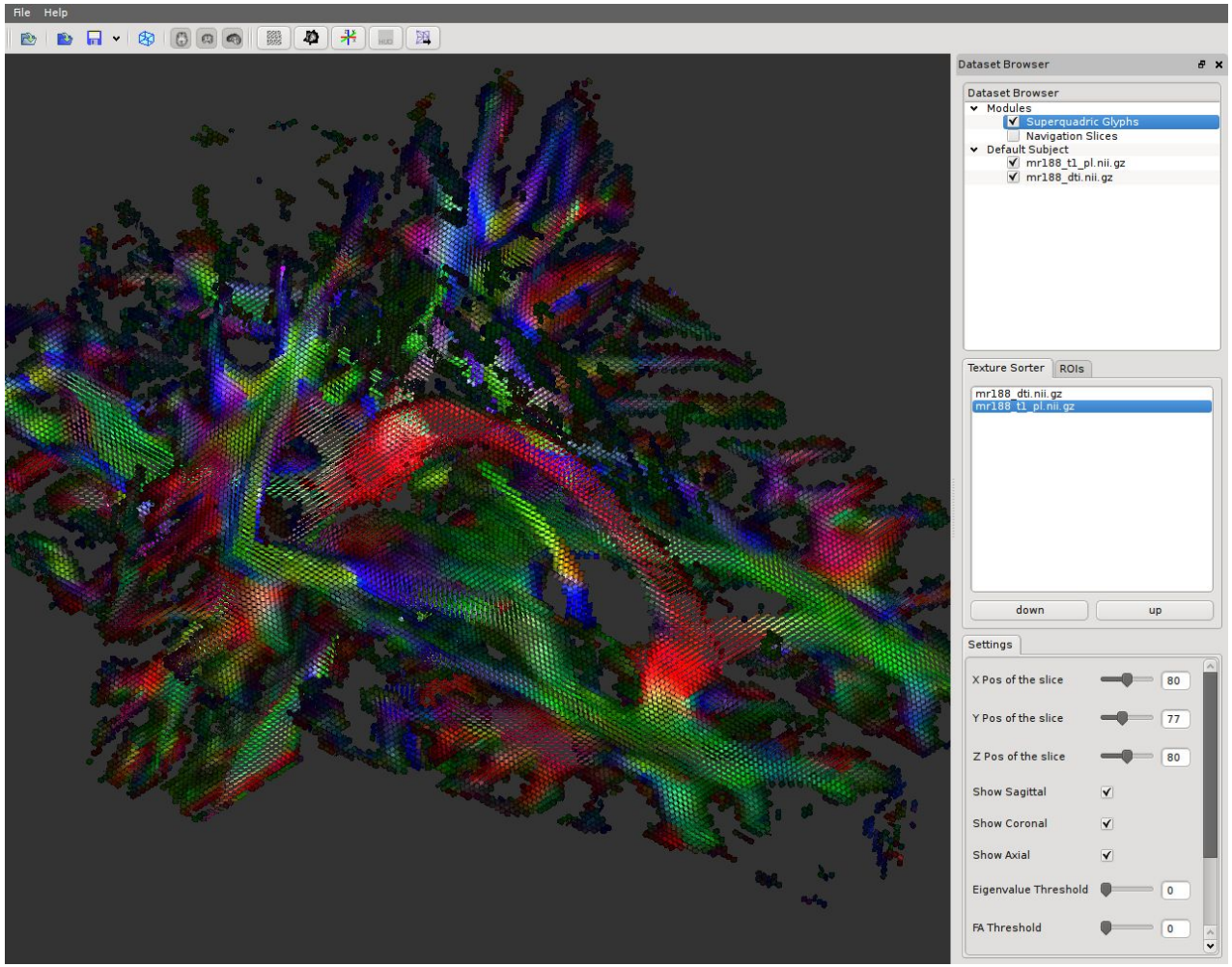
How it looks


OpenWalnut
File
Help
axial
coronal
sagittal
Dataset Browser
Dataset Browser
Modules
Coordinate System Module
HUD
Navigation Slice Module
Direct Volume Rendering
Fiber Display
Direct Volume Rendering
ROIs
ROI
Default Subject
mr188_fa.nii
t1_pl_mr188.nii
fibers_mr188.fib
down
up
Settings
Use Tubes
Global/Local coloring

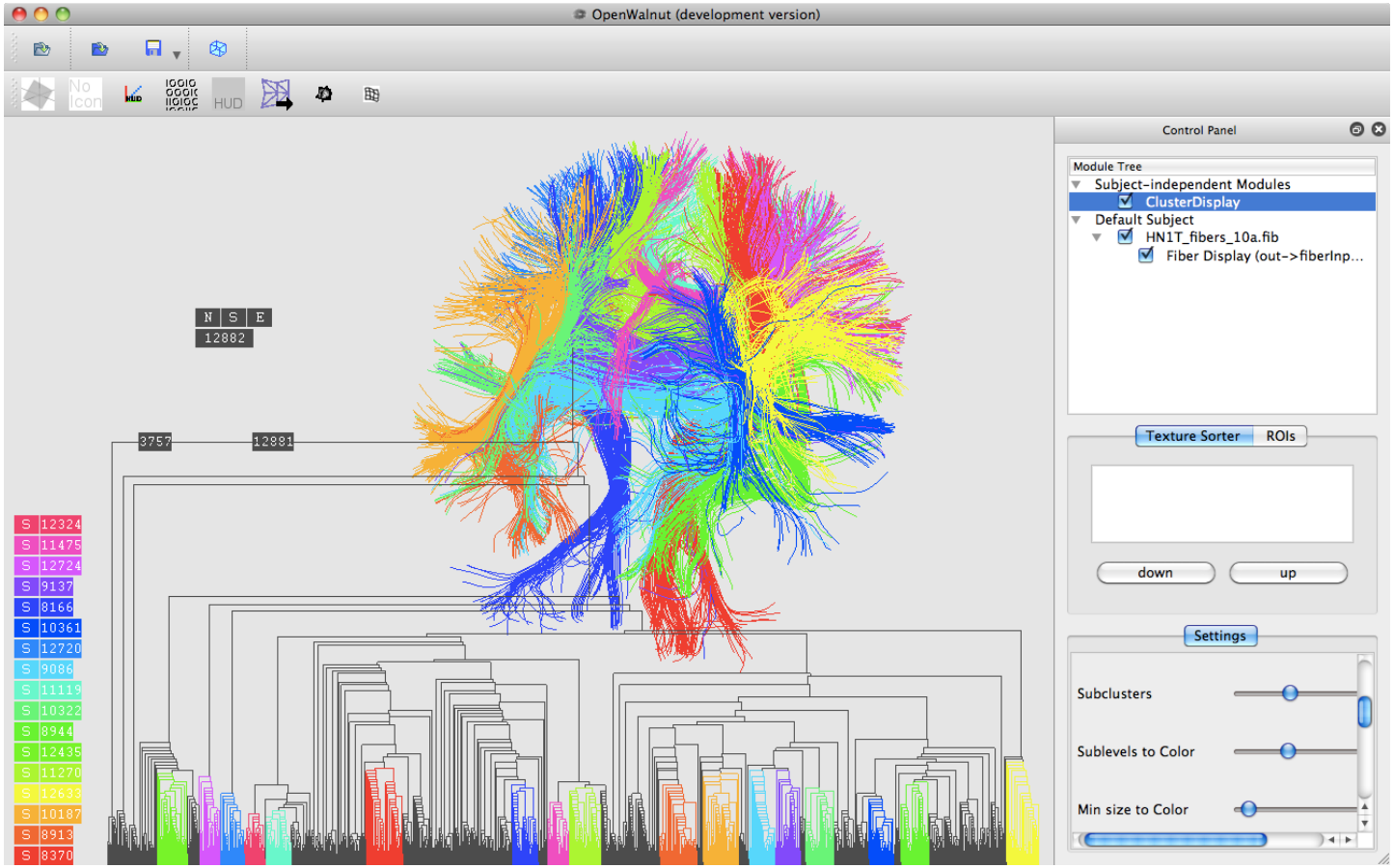
How it looks



How it looks


File Help
Dataset Browser
Dataset Browser
Modules
Superquadric Glyphs
Navigation Slices
Default Subject
mr188_t1_pl.nii.gz
mr188_dti.nii.gz
Texture Sorter
ROIs
mr188_dti.nii.gz
mr188_t1_pl.nii.gz
down
up
Settings
X Pos of the slice
80
Y Pos of the slice
77
Z Pos of the slice
80
Show Sagittal
Show Coronal
Show Axial
Eigenvalue Threshold
0
FA Threshold
0

How it looks


OpenWalnut (development version)
Control Panel
Module Tree
Subject-independent Modules
ClusterDisplay
Default Subject
HN1T_fibers_10a.fib
Fiber Display (out->fiberInp...
Texture Sorter
ROIs
down
up
Settings
Subclusters
Sublevels to Color
Min size to Color
N S E
12882
3757
12881

Developer Details

- Written in C++, extensively using Boost
- GUI with QT
- Graphics engine uses OpenSceneGraph
- Programmed with long code life-time and readability in mind
  - Extensive documentation with Doxygen
  - Unit-testing (cxxtest)
  - Strict Code-Style rules with automatic checking (cpplint)

External Lib Integration

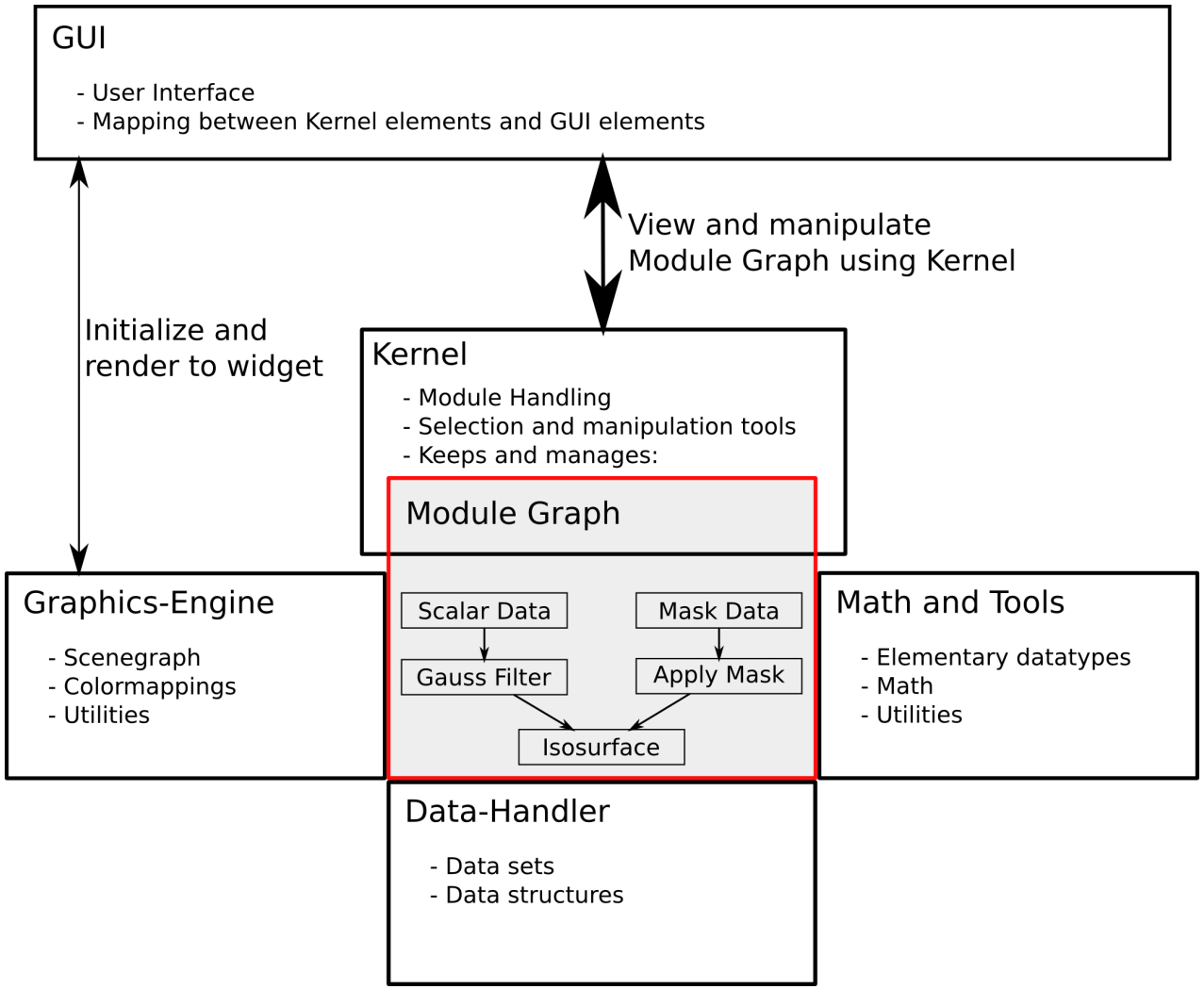
- CUDA integration
- Teem
- ITK
- Ossim
- FSL
- ...

Outline

Design Goals

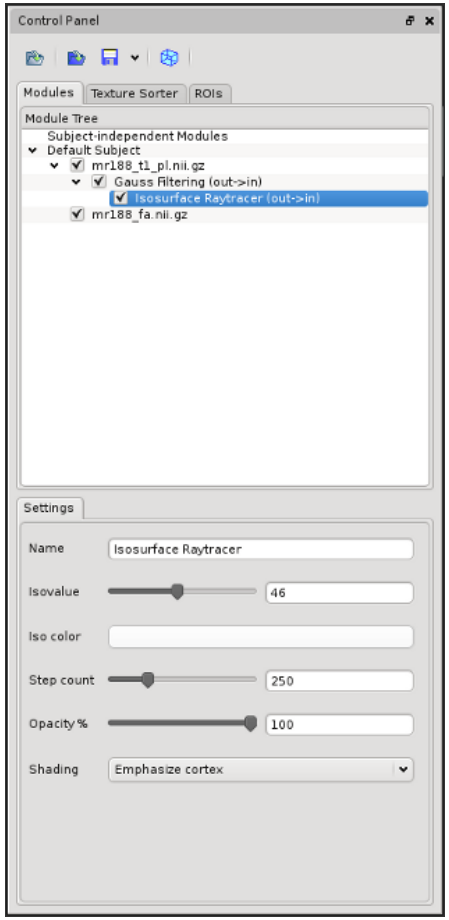
- Easy-to-use GUI
- Responsiveness
- Interactivity
- Flexibility
- Extensibility
- Only portable external libraries

Overview


GUI
- User Interface
- Mapping between Kernel elements and GUI elements
View and manipulate
Module Graph using Kernel
Initialize and
render to widget
Kernel
- Module Handling
- Selection and manipulation tools
- Keeps and manages:
Module Graph
Scalar Data
Mask Data
Gauss Filter
Apply Mask
Isosurface
Graphics-Engine
- Scenegraph
- Colormappings
- Utilities
Math and Tools
- Elementary datatypes
- Math
- Utilities
Data-Handler
- Data sets
- Data structures

The Module

- Own Thread
- Data In- and Output only through *connectors*
- Communication with User/GUI by *properties*
- Graphics Output using scenegraph
- No knowledge about other modules, GUI or loaded data
- Can be a container for other modules
- Push mechanism



Connectors

- Strictly typed by the kind of data transferred
- Automatic connection management
- GUI can provide list of compatible modules for an given connector to user
- Module get informed, or woke up if new data arrives on connector
- Automatic change propagation along module graph
- Abstract implementation allows many kinds of connectors (streaming, bidirectional, ...)

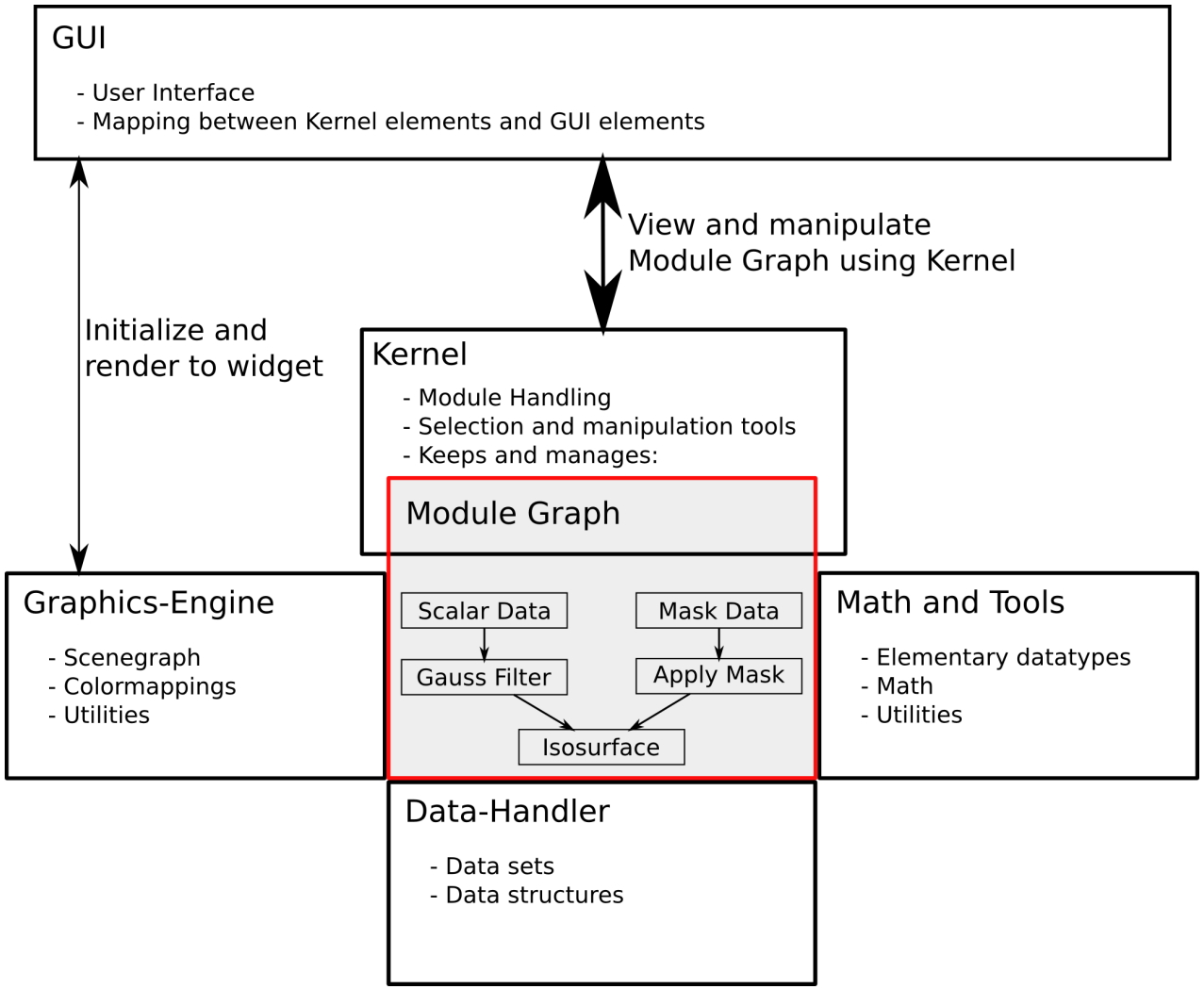
Properties

- Strictly typed (Bool, Floating Point Values, Integers, Strings, Filenames, Vectors, Matrices, ...)
- Possible to define value-constraints
  - Ensures always valid values
- Grouping of properties
- GUI implements widgets for handling them
  - According to type
  - Constraints
  - Grouping
- Propagation of changes

Container

- Modules can be module container
- Forwarding of properties and connectors from or to the internal module graph
- Allows hiding complexity
  - One module even for complex use cases
- Easy to re-use existing functionality

Overview II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Results

- Combines best out of two worlds
  - Flexible and extensible framework
  - Easy-to-use and interactive tool
- Strict separation of GUI and framework
- Exchangeable GUI and adaptable GUI
- Interactive and Responsible
- Portable

Future Work

- Integration of scripting features (arbitrary language via SWIG)
- Integration of OpenCL
- More features from Teem
- Several GUI's for several purpose or one flexible GUI
- More file types support

Interested?

- Website: `www.openwalnut.org`
- Videos: `www.youtube.com/user/OpenWalnutOrg`

Demo

- Demo

Thank You for Listening

Questions?