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J. Klein[1], F. Weiler[1], S. Barbieri[1], J. G. Hirsch[2], B. Geisler[1], H. K. Hahn[1]: **NeuroQLab - An Extendible Software Assistant for Efficient and Reproducible Evaluation of Neuroimaging Data (#4802).** Abstract presented at the ECR 2011 within the 'EIBIR presents: IMAGINE Workshop'.

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Purpose: Neuroimaging studies often need to process and quantify multimodal MR images capable of displaying a wide variety of structural and functional properties of the brain. We present a flexible and extendible software assistant (NeuroQLab) that supports the complete workflow for evaluating neuroimaging studies including preprocessing, structural and functional quantification and evaluation as well as a comprehensive visualization integrating the results.

Methods and Materials: NeuroQLab comprises assistants for preprocessing tasks such as registration, skull-stripping and non-uniformity normalization as well as some dedicated packages for quantitative analysis of anatomical and functional images.

A toolkit for DTI analysis allows for reconstructing white matter fiber tracts using deterministic or probabilistic algorithms. Fibers can be clustered to group anatomically related bundles. DTI-derived parameters can be measured along extracted tracts or within user-defined regions of interest including consideration of partial volume effects. Additionally, the uncertainty in the diffusion-weighted images is taken into account and confidence hulls around the bundles can be displayed. Activated fMRI areas can be visualized and used as regions of interest.

Another focus is put on volumetric brain analysis useful for measuring brain atrophy. NeuroQLab offers modules for determining whole brain volumetry, as well as ventricle, temporal horn, and spinal cord volumetry. A tissue mixture model with dedicated partial volume modeling is used, that allows both reducing and assessing the volumetric error at the same time. Additionally, a module for cortical thickness mapping is implemented to allow for assessment of local brain atrophy.

The software assistant is built upon an established platform for rapid prototyping, called MeVisLab, which facilitates fast integration of new features by user request as well as the adaption of given features to concrete clinical questions.

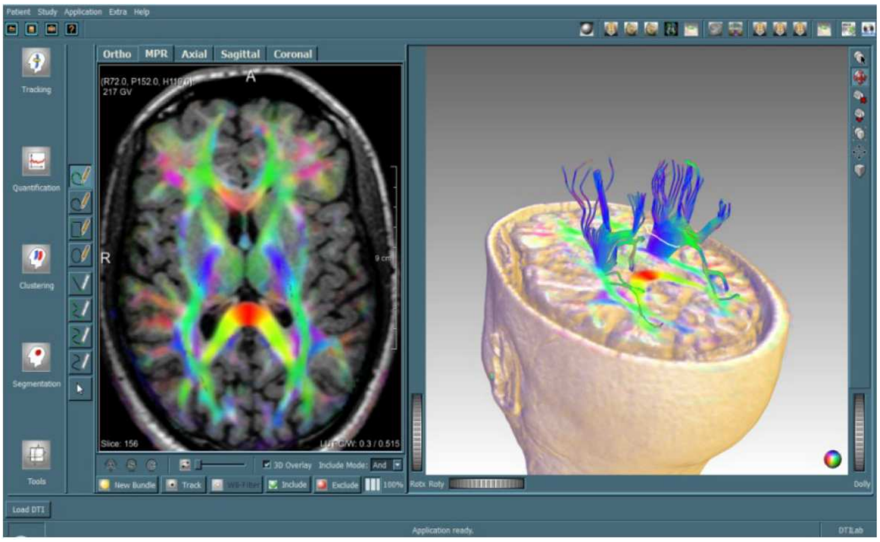
Results: NeuroQLab is a software assistant for use in neuroimaging studies. It comprises a number of tools for both basic processing steps and advanced analysis techniques required in a variety of neuro-related medical disciplines such as neurology, neuroradiology, neurosurgery and neuropsychology. It is currently used by about 30 clinical research partners of our institute in the context of a variety of clinical questions. Further, it has been used as the technical basis for numerous studies resulting in a variety of clinically driven scientific publications covering diseases like multiple sclerosis, schizophrenia, dementia and epilepsy.

Conclusion: The number of tools and features of the software assistant is being constantly expanded with techniques being included continuously. Our focus for current and future developments is on the inclusion of new methods for fiber tracking based on High Angular Resolution Diffusion Imaging (HARDI) techniques, non-linear registration methods, new quantitative measuring tools for monitoring and diagnosing dementia and related neurodegenerative diseases. Further, a software link to operation microscopes and neuro-navigation systems is planned for better integration of our software in the operation room for intra-operative software support.

Uploaded files:

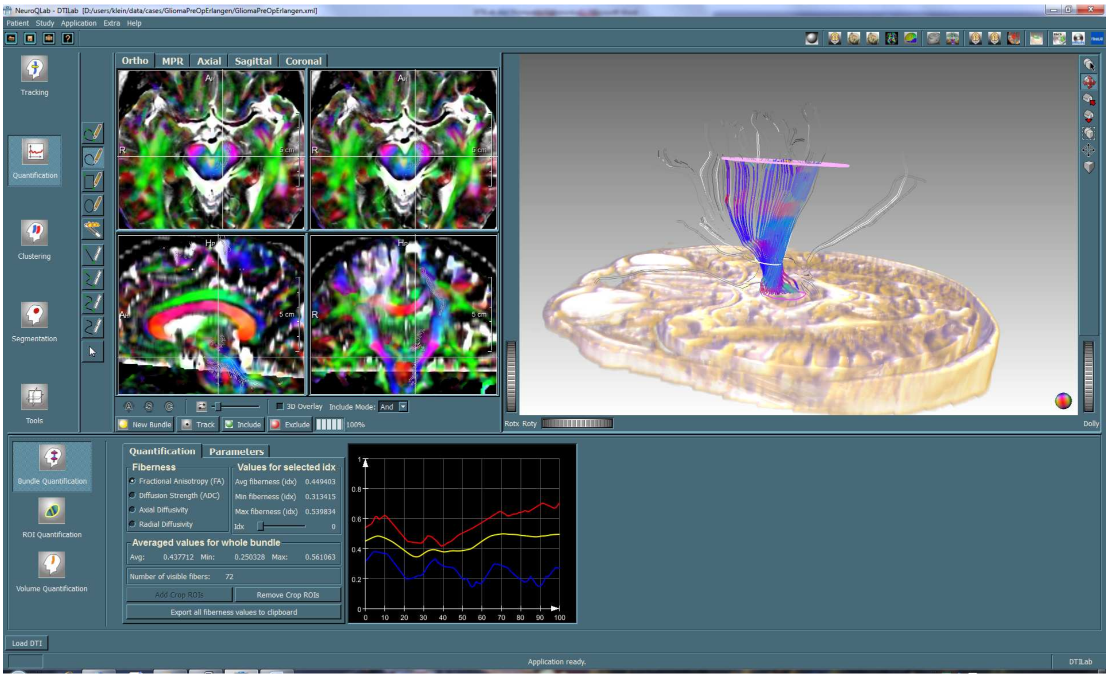
Two screenshots showing the main screen with application selection and the sub-menu.

(NeuroQLab1.png, 475.1 KB)



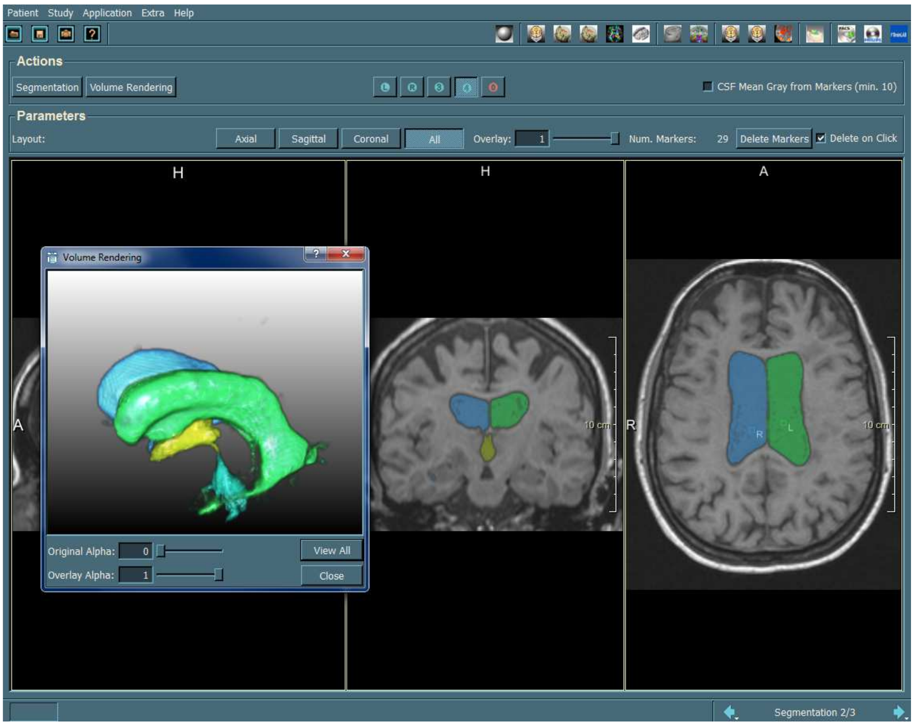
An example of synchronized 2d- and 3d-viewers, in this case showing DTI color-coded data and some reconstructed fiber tracts.
(NeuroQLab2.png, 675.1 KB)

Color enhanced rendering of the results of quantitative brain volumetry.
(NeuroQLab3.png, 560.8 KB)



DTI-based fiber tract quantification.

(NeuroQLab4.png, 1.4 MB)



Ventricle segmentation and volumetry.

(NeuroQLab5.png, 312.5 KB)