

# Development of “*NeuroAN*” for Real-time Image Registration and 3D-Visualization

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<http://neuroimage.yonsei.ac.kr>

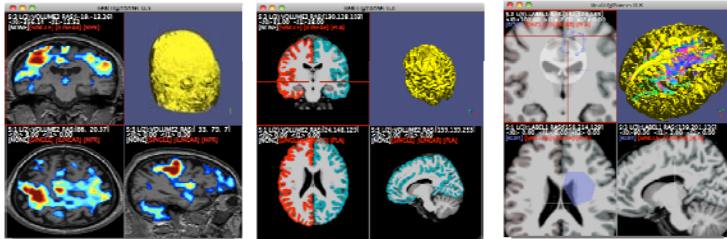
## Introduction

The three-dimensional image (3D) visualization as well as fast image registration can be a significance role to increase the accuracy of surgery. To provide an efficient tool for the intra-operative MRI-guided neurosurgery, we developed 3D image registration and visualization software, *NeuroAN*. We designed *NeuroAN* operating system independent (Windows, Linux, Mac OS X) using QT (trolltech.com).

## Anatomy of NeuroAN

### Multiple Layers Overlay

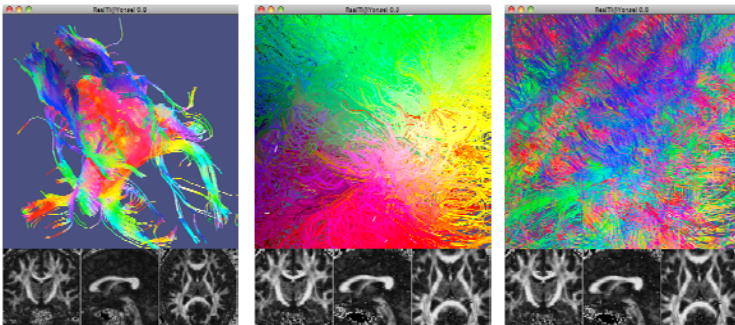
The overlay of multiple different layers is the key concept in the graphic applications to display the multiple images with the different transparencies. In the medical application, especially, it is inevitably required to visualize a structural image, functional MR images and the region of interest (ROI).



**Figure 1.** Overlay a functional image (left) and white matter template (middle) over the anatomical image. Draw ROIs and overlay over the white matter template (right).

### 3D Fiber Tractography

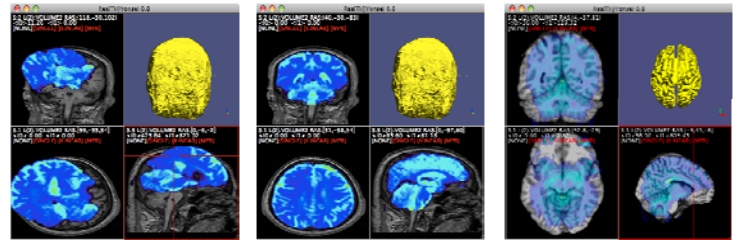
As an extension of DoDTI [1], a matlab-based fiber tractography tool, we implemented various fiber tractography methods into *NeuroAN* to analyze and visualize the diffusion tensor MRI data in an easily manner. High angular resolution diffusion imaging (HARDI) using Q-ball imaging or spherical harmonics are also implemented. Probabilistic fiber tractography can be used to quantify anatomical connectivity.



**Figure 2.** Example images of fiber tractography from the diffusion tensor image (DTI); corpus callosum (left), several zooms of the whole brain (middle and right).

### Image Registration : Mouse driven & Demon algorithm

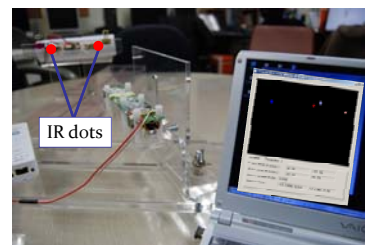
*NeuroAN* also provide an easy image registration in two ways. First, The general user can easily perform an image registration using mouse by rotating, translation and magnifying the image. Second, for the advanced researchers, *NeuroAN* automatically performs automatic images registration based on the Demon algorithm.



**Figure 3.** Process of mouse driven image registration; From left to middle image, EPI image is translated and rotated. PET image registration (right).

### Triangulation with Nintendo Wii

Real-time 3D image interface using Nintendo Wii is being integrated into *NeuroAN*. To utilize motion to guide image registration, we interfaced *NeuroAN* with Nintendo Wii-remote which is widely used in the research fields [2] due to its excellent feature for tracking the Infra-Red (IR) light source. Using the triangulation algorithm that requires the two cameras (i.e. two Wii-remotes), we got the absolute x,y,z positions of the objects (i.e. IRs). By combining this technique together with *NeuroAN*, clinicians can easily manage the image registration and visualization.



**Figure 4.** System configuration of the triangulation using Nintendo Wii for the real-time 3D image interface.

## Results and Conclusion

We developed *NeoruAN* for the variety purposes of neuroscience and clinical applications. For examples, surface mesh model of head and fiber tractography can be displayed on the *NeuroAN*. In addition, this program will give you an help to draw the region of interests (ROIs). We also explored the possibilities of clinical application of Wii-remote device. The 3D visualization technique based on Wii-remote is implemented in *NeuroAN*.

## References

- [1] Hae-Jeong Park, DoDTI website, <http://neuroimage.yonsei.ac.kr/dodti/>
- [2] Johnny Lee, Wiimoteprojects, <http://johnnylee.net/projects/wii/>