

# CRTC's Deformable Registration of pre-op MRI & iMRI for Brain Tumor Resection\*

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This is a progress report of a 10 year-long effort in Physics Based Non-Rigid Registration (PBNRR) [1]. The contributions from this collective effort are: (i) development an open sources software which is available to broader community through ITK and 3DSlicer [2], (ii) improvement of the mathematical model by adaptively (PAPBNRR) changing the geometry to incrementally approximate the tumor resection region [3,4], and (iii) improved the accuracy by an order of magnitude (in extreme tumor resection cases) compared to the original PBNRR method within the real-time constrains of the surgery [5] --first time ever completed in clinical studies using volume tracking [6,7]. Last but not least this effort contributed in the training of three PhD students (A. Fedorov, Y. Liu and F. Drakopoulos) fully capable to independently continue improving this method. There are many challenges ahead: (1) extensions to handle deep brain tumors with major topologic changes in the brain, (2) customize this method for Deep Brain Stimulation (DBS) utilizing additional radiopaque landmarks from flexible leads<sup>1</sup> and (3) use of Cloud Computing (CC)<sup>2</sup> to further improve the accuracy using a real-time computational intensive parametric search to reach below 2mm limit in the error. Our preliminary results for (2) and (3) are encouraging.

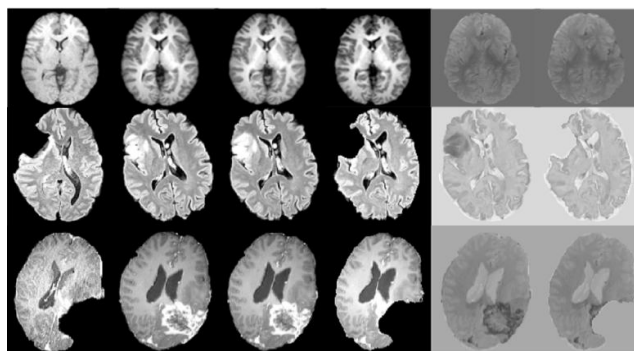


Figure 1. Three representative cases: Brain Shift (1<sup>st</sup> row), Complete Tumor Resection (2<sup>nd</sup> row) and Extensive Tumor Resection (3<sup>rd</sup> row) and 2D slices of 3D pre-op MRI (1<sup>st</sup> column) and iMRI (2<sup>nd</sup> col.) registered image by Rigid registration (3<sup>rd</sup> col.), PBNRR (4<sup>th</sup> col.) and PAPBNRR (5<sup>th</sup> col.) and difference of registered images between iMRI & PBNRR and iMRI and PABNRR.

## References

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