Processing of structural and diffusion MRI for real-time tractography-based nTMS

Dogu Baran Aydogan, Victor Hugo Souza, Risto Ilmoniemi

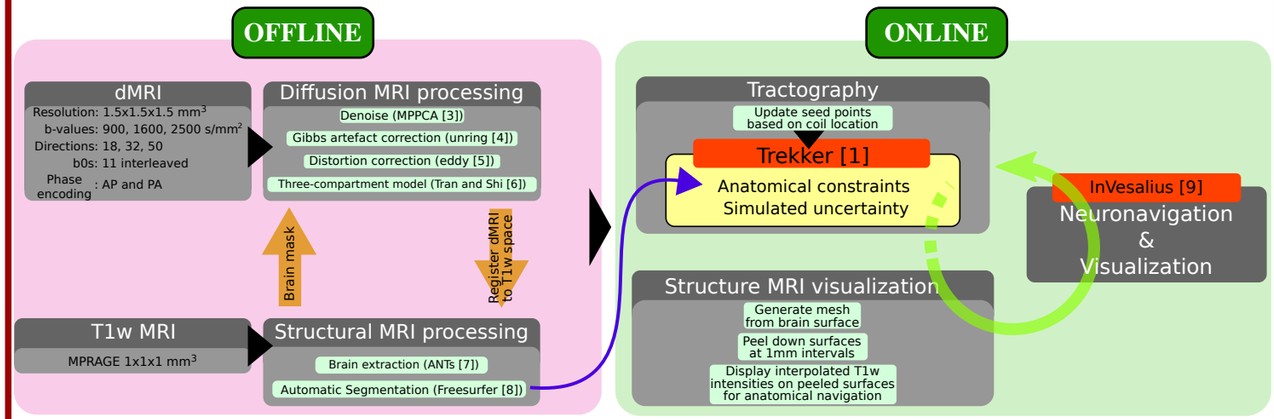
Department of Neuroscience and Biomedical Engineering, Aalto University School of Science, Espoo, Finland

Introduction

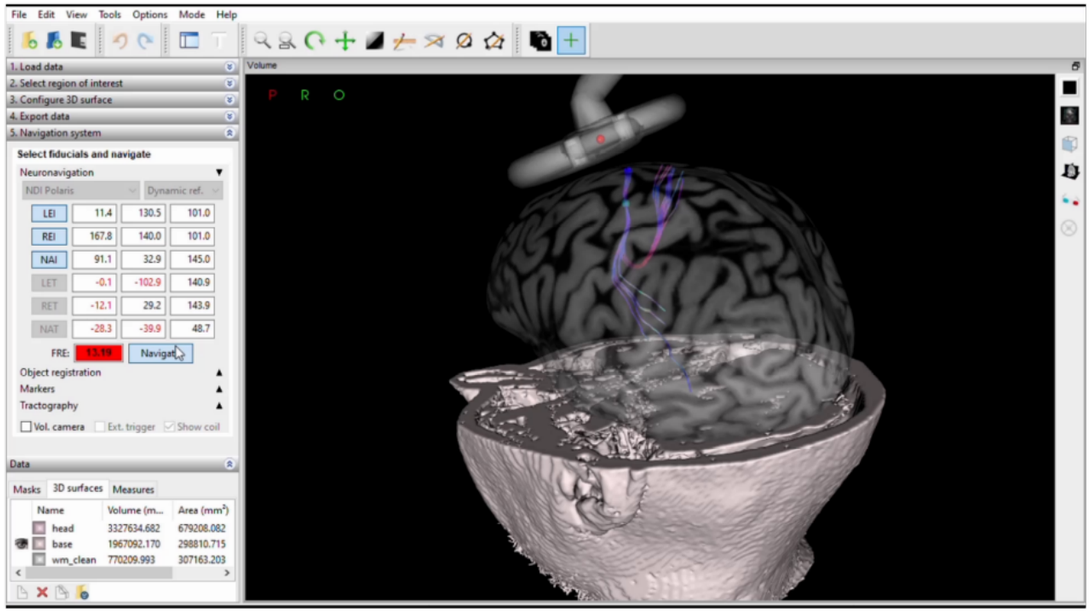
- Real-time information about the structural connections in the brain would be highly valuable when performing navigated transcranial magnetic stimulation (nTMS).
- This information can be obtained using diffusion MRI (dMRI) based tractography that can extract major structural connections in the brain, in-vivo and non-invasively.
- However, this has been challenging to achieve in real-time, mainly because obtaining reliable tractograms is in general a difficult task.
- To address this problem, we leveraged our in-house-developed fiber tracking tool, Trekker [1], that implements the state-of-the-art parallel transport tracking (PTT) algorithm [2]. Trekker is not only capable of producing highly organized streamlines owing to PTT, but it also can apply anatomical constraints in a real-time setting.

Method

Our approach is based on a modular framework which seamlessly integrates offline (preparatory) analysis output, with online (real-time) tractography and visualization.



Results and conclusion



- Real-time tractography-based nTMS holds great potential to improve TMS targeting, thereby helping to develop new treatments where connectivity plays a decisive role.
- Our work shows that this can be achieved by: (i) splitting the preprocessing part to be done offline and (ii) using a real-time tracker, enabling real-time adjustments for reliability.

References

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Core software

Fiber tracking with Trekker

https://dmritrekker.github.io/

Neuronavigation with InVesalius

https://invesalius.github.io/

baran.aydogan@aalto.fi

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Department of Neuroscience and Biomedical Engineering
Aalto University School of Science
nbe.aalto.fi

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ConnectToBrain

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