**Introduction**

- Human head models are generated from anatomical images and used to generate volume conductor for brain stimulation applications.
- Fast generation of personalized head models are needed for stimulation planning and other clinical use.
- This task is challenging as it requires a segmentation of all head tissues (many appears in low-contrast in MRI).

**Contribution**

- Deep convolutional neural network (CNN) architecture is proposed to segment all head tissues using T1-w MRI.
- The proposed architecture has single encoder track and multi-decoders with interconnections.
- Results indicate that head models generated using the proposed method are of strong matching brain stimulation results compared with those generated manually.

**Network architecture**

- 23 layer network with single input and N outputs.
- Individual decoders provide more robust design to avoid network confusion when segmentation labels are large.
- Interconnections provide feature exchange between different decoders. We have used two interconnections labeled by the blue arrows above.
- Segmentation is decided by high vote label and training is conducted with different slicing direction (axial, sagittal, and coronal).

**Transcranial Magnetic Stimulation (TMS)**

- Figure-eight TMS coil is located above hand motor area.
- Isotropic tissue conductivity is computed using Cole-Cole model for 10 kHz.

**Results**

- Leave-one-out cross-validation of 18 subjects and 13 tissues.
- Training to minimize cross entropy cost function using ADAM algorithm for 10 epochs and batch size = 2.
- High performance is achieved in brain tissues (e.g. GM, WM, and cerebellum) compared to non-brain tissues (e.g. dura, mucous, and blood vessels).
- Better dice coefficient can be achieved compared with conventional U-net architecture.

**Conclusion**

- High matching in both segmentation and induced electric field is observed between models generated using proposed method and golden truth.

More details are in our recent publication:
Rashed et al., NeuroImage 202,116132, 2019