Friedrich-Alexander-Universität
Faculty of Medicine

Uniklinikum Erlangen

Institute for Neuroradiology

An open multi-B0-multi-B1-CEST dataset of the healthy human brain

Felix Tyrach[1*], Jan-Rüdiger Schüre[1], Moritz Simon Fabian[1], Simon Weinmüller[1], Moritz Zaiss[1,2]
[1]*Institute of Neuroradiology, University Hospital Erlangen, Friedrich Alexander University Erlangen-Nürnberg, Erlangen, Germany*
[2]*Department Artificial Intelligence in Biomedical Engineering, Friedrich-Alexander-Universität Erlangen-Nürnberg, Erlangen, Germany*
**Felix.Tyrach@extern.uk-erlangen.de*

Introduction:

- CEST quantitatively described by Bloch-McConnell (BMC) equations
- First in-vivo multi-B0-multi-B1 dataset of a healthy human brain ready for BMC fitting and full quantification

Methods:

- 1 healthy subject on 2 scanners (MAGNETOM Prisma 3T and Terra.X 7T)
- Conventional Spin-Lock pulse train
  (10 pulses, DC = 50%,
  tp = 100 ms, td = 100 ms)
- Benefits: fast simulation similar to CW, without artifacts at decent B0/B1
- B1 levels of 0.3, 0.6, 0.9, 1.5, 2, 2.7, 4 µT
- Image readout: 3D snapshot-CEST GRE [1]
- Offsets for B1 < 4 µT equidistantly between -100 and 100 ppm with -6:0.25:6 ppm,B1 = 4 µT -6:0.5:6 ppm
- Offsets were interpolated for evaluation
- WASABI B1 and B0 mapping [2]
- Z-spectra from GM and WM with decent B0/B1 (B0: ±0.1 ppm, B1: ±5%)
- Within these regions, grey and white matter ROI were defined

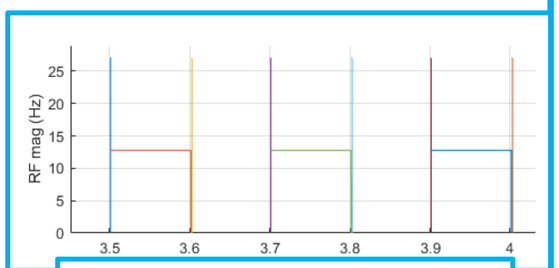

Figure 1: Spin-Lock pulse train

Results:

- Identification of suitable B0/B1 area (figure 2a,b)
- B1 and B0 maps from 7T (figure 2c,d)
- Z-spectra in grey and white matter for all B1 levels at 3T (figure 2e,f) and 7T (figure 2g,h)
- BMC fitting for GM and WM data are currently under investigation (figure 3)

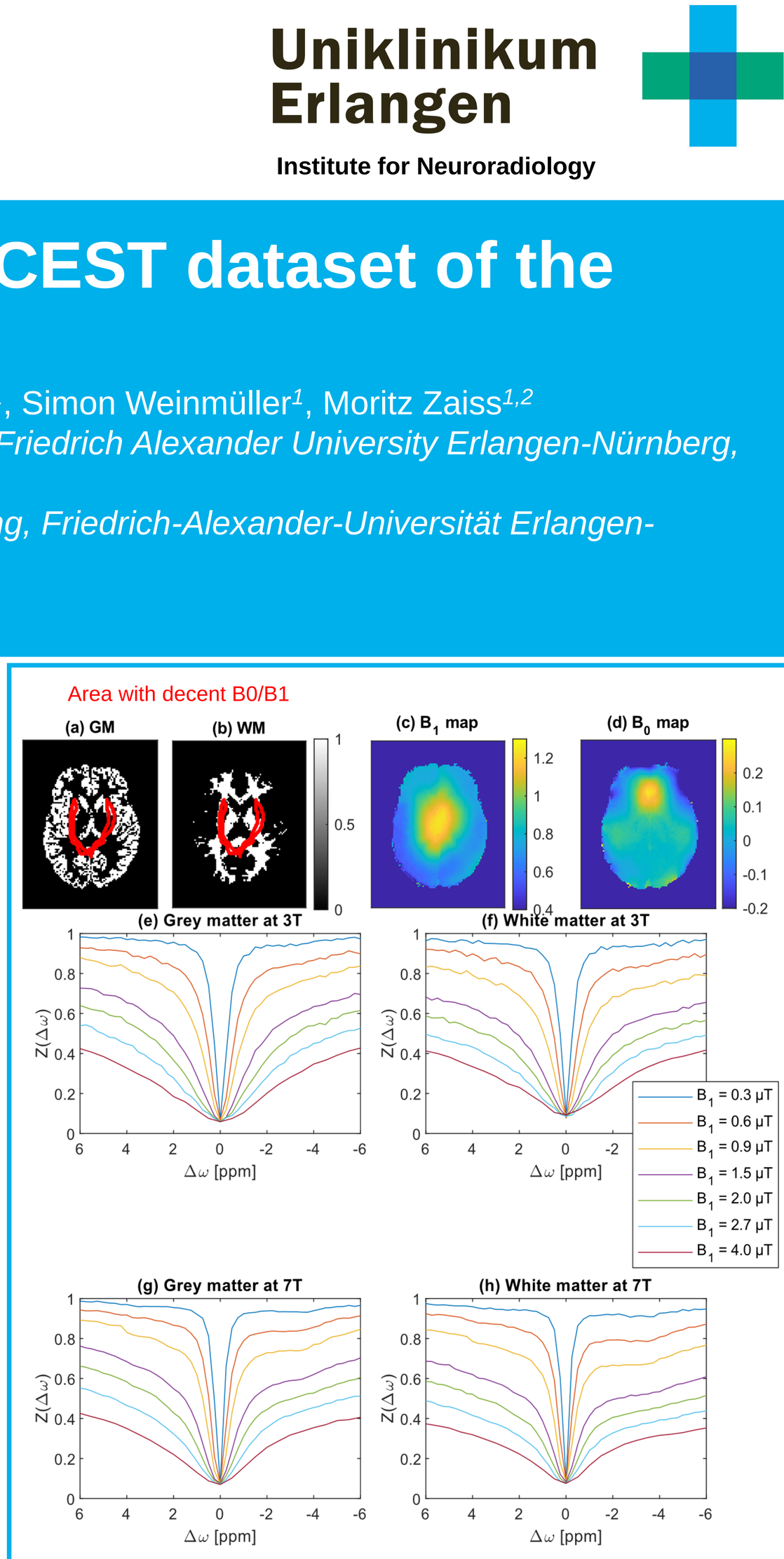

Figure 2: Segmentation, B1 and B0 map, Z-spectra at different field strenghts

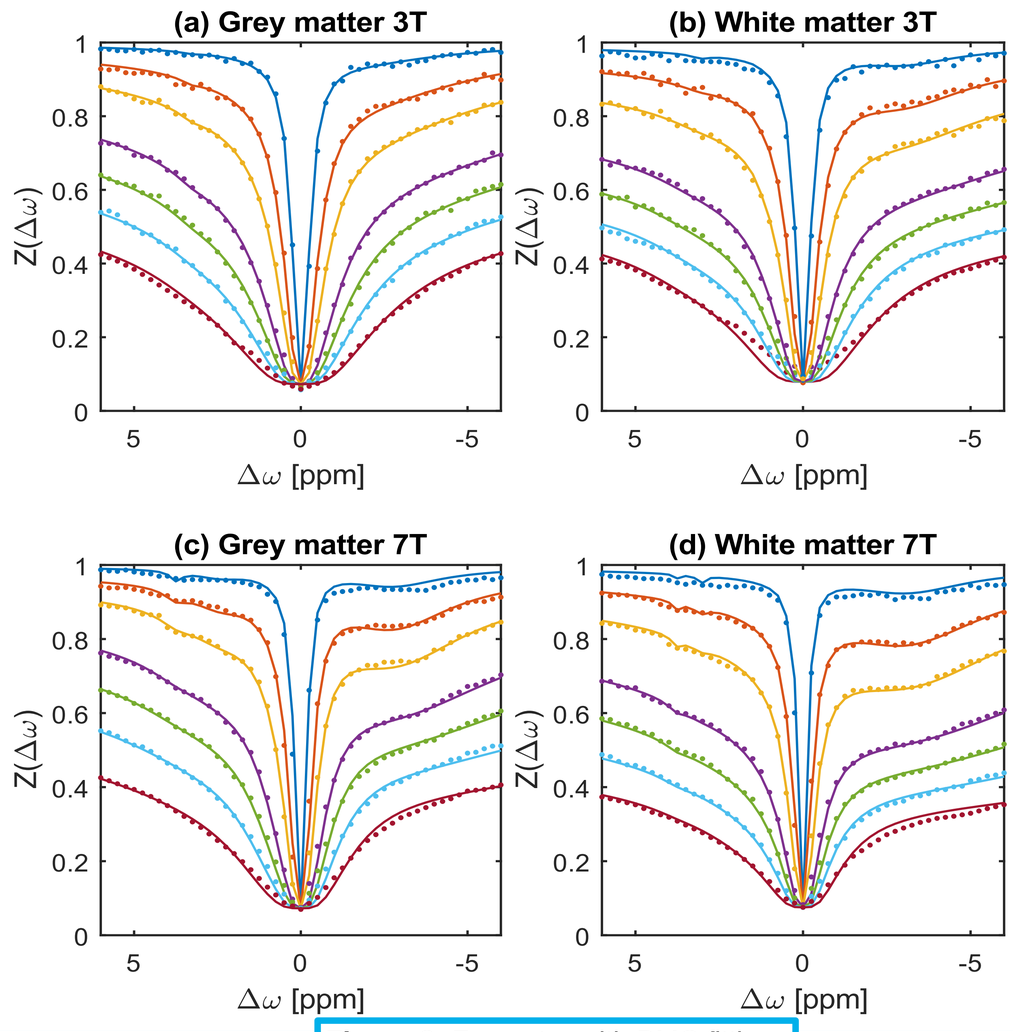

Figure 3: Z-spectra with BMC fitting

Outlook

- Publish data with exact definition of preparation and acquisition
- Invite other research groups to do BMC fitting
- Improve models and acquisition for deeper understanding of in vivo CEST
- Create library for prediction of fitting parameter with Deep Learning

https://github.com/cestsources/MultiB0_B1_qCEST_brain

References:

[1] M. Zaiss *et al.*, 'Snapshot-CEST: Optimizing spiral-centric-reordered gradient echo acquisition for fast and robust 3D CEST MRI at 9.4 T', *NMR in Biomedicine*, 2018, e3879
[2] P. Schuenke *et al.*, 'Simultaneous mapping of water shift and B1(WASABI)- Application to field-Inhomogeneity correction of CEST MRI data', Magnetic Resonance in Medicine, 2016