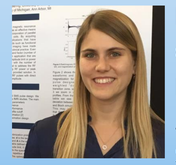
First In Vivo Images from an In-House Parallel Transmit (pTx) Coil for MRI at 7 Tesla



PRESENTER: **Sydney Williams**[1]

Co-authors: Sarah Allwood-Spiers[2], Paul McElhinney[1], Yuehui Tao[3], John E. Foster[2], David A. Porter[1], Shajan Gunamony[1,4]

1. Imaging Centre of Excellence, University of Glasgow
2. MRI Physics, NHS Greater Glasgow and Clyde
3. Siemens Healthcare Ltd., United Kingdom 4. MR CoilTech

BACKGROUND:

Clincal 7 T MRI

- Signal ↑, yielding
  - Resolution* ↑ 😊
  - Speed* ↑ 😊
- Susceptibility ↑ 😠
- Spectral resolution ↑ 😊
- Power deposition (SAR) ↑ ☹
- RF Wavelength ↓ ☹

7 T Siemens Terra

* trade-off between; inherent limits

→ pTx!

METHODS

- Build custom pTx coil (S. Gunamony) to mitigate RF inhomogeneity at 7 tesla:

S. Allwood-Spiers et al., "Development of a dual-mode head coil for human brain imaging at 7 Tesla", *In Preparation* → Look out for publication soon!

- Electromagnetic field simulation (P. McElhinney †)
- Temperature/safety testing (S. Allwood-Spiers†)
- Initial pTx field mapping and static pTx (*B1 shimming*) in healthy volunteers before full waveform pTx development

† other presentations at SINAPSE on these topics

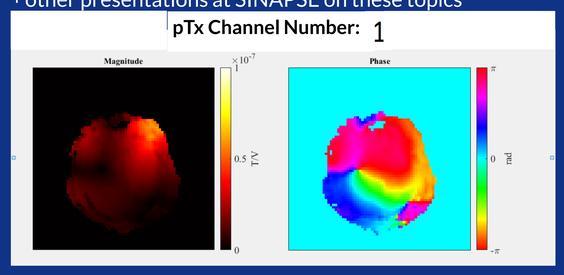


Figure 2. In pTx, individual transmission channels are controlled independently to craft a combined RF field that is more homogenous.

SINAPSE ASM 2020

IN A PILOT STUDY OF 9 HEALTHY VOLUNTEERS, **PARALLEL TRANSMIT (PTX) IMPROVES IMAGE QUALITY** IN 7 T BRAIN IMAGING

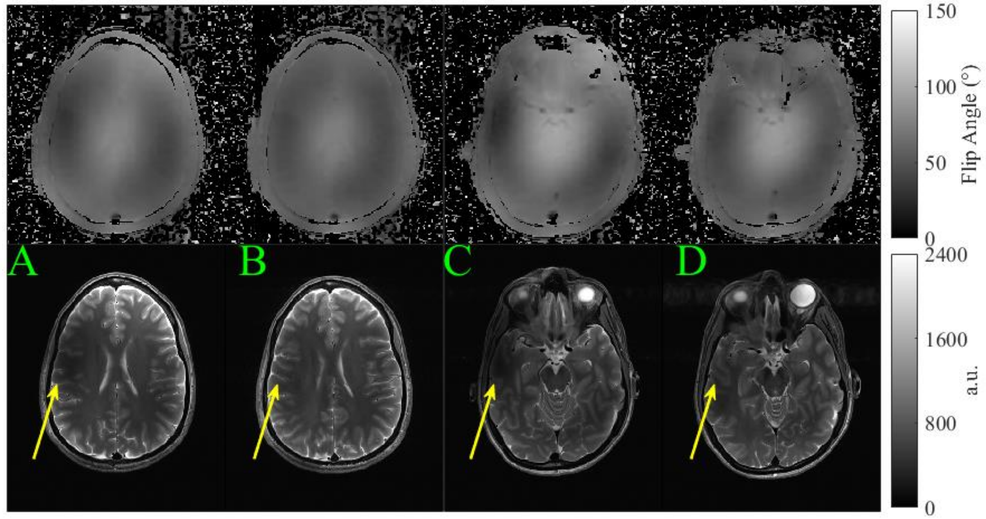


Figure 1. A,C) Single transmit (non-pTx) with signal and contrast loss shown by arrows B,D) B1 shimming, a simple version of pTx, improves signal and contrast loss

FULL ABSTRACT HERE

https://bit.ly/37EulMR

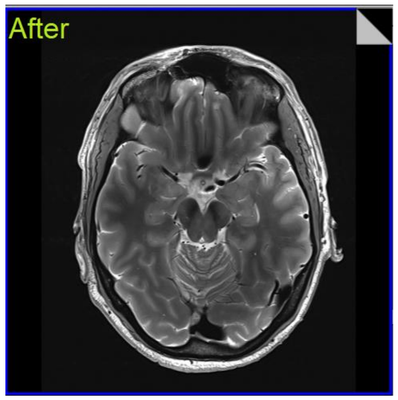


Figure 3. Resultant T2-weighted image in another volunteer using pTx with B1 shimming. We expect further improvements with full waveform pTx.

RESULTS

- To date, 9 healthy volunteers have been scanned with the custom-built pTx coil
- Static B1 shimming altered relative amplitude and phase of individual pTx channels to improve the RF field uniformity in 7 T MRI
- In 3 volunteers, B1 shimming pTx resulted in higher power deposition (SAR) than single transmit (sTx), in 1 volunteer SAR was the same, and in the other cases, B1 shimming produced lower SAR

Image Slice	|NRMSE|	Flip Angle Mean ± StDev (°)	Calc. Max. Local SAR (W/kg)	Meas. Max. Local SAR (W/kg)
Upper, sTx (A)	0.46	53.0 ± 19.8	3.5	3.9
Upper, pTx (B)	0.45	50.3 ± 16.0	3.6	3.9
Lower, sTx (C)	0.42	57.1 ± 22.1	3.5	3.9
Lower, pTx (D)	0.42	53.1 ± 18.0	3.6	3.9

Table 1. Comparison of conventional, single transmit and B1 Shimming (static pTx) for the images in Figure 1 (center of poster)

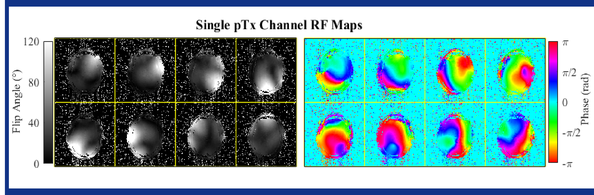


Figure 4. Individual channel RF field maps acquired from a healthy volunteer

CONCLUSIONS

- Preliminary work with B1 shimming has already shown the benefits of pTx
- Meanwhile confidence has been gained in using a technically challenging method and the added safety monitoring requirements it comes with
- Field mapping data from the cohort of healthy volunteers allows for further technical development work on dynamic pTx

University of Glasgow

ICE IMAGING CENTRE OF EXCELLENCE

NHS Greater Glasgow and Clyde

Department of Clinical Physics & Bioengineering