An Array-Compressed Parallel Transmit Network and Coil System for Dynamic RF-Shimmed Multi-slice Brain Imaging

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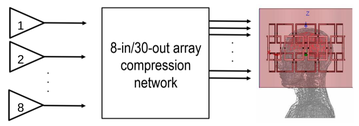
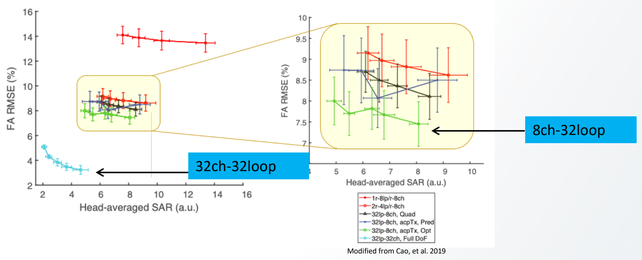
BACKGROUND & MOTIVATION

- Parallel transmission (pTx) with many transmit coils is desirable in 7 Tesla MRI to achieve uniformly high SNR while controlling SAR
- Due to cost & sitting complexity, high-field MRI scanners usually have 8 transmit channels
- Array-compressed pTx (acpTx) enables a small number of transmit channels to drive a much larger number of coils [1]



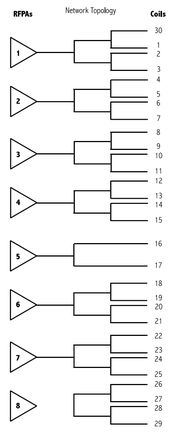
- Transmit RF field uniformity improves by 3x (matched SAR) when using an acpTx system driving 32-coils using 8 transmit channels compared to a conventional 8 coil system [1]

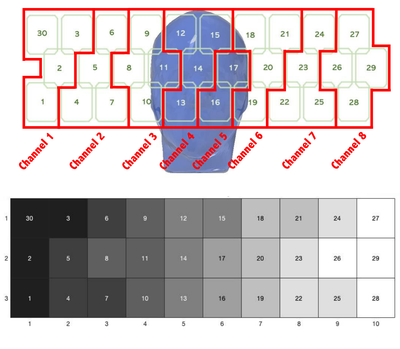


- More coils allows for more control over excitation patterns (e.g. multishot shuttered EPI) [2,3]
- This work presents an optimization strategy and results for a compression network for a 30-loop to 8-channel transmit array system.

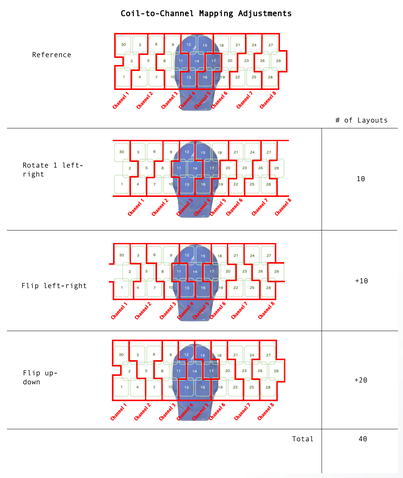
METHODS: COIL-TO-CHANNEL MAPPING SCHEME

- 8 amplifiers (channels available)
- Chose 7 groups of 4 coils and 1 group of 2 coils
- Indexed each coil within the original channels shown on the top here relative to the head
- Calculated from $B1^+$ maps and SAR from simulations of 2 head models
- Configured to eliminate cabling overlap

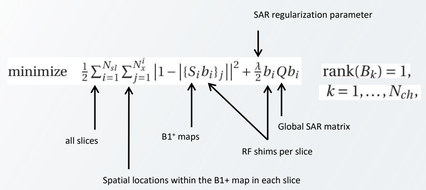




METHODS: MLS SHIM OPTIMISATION

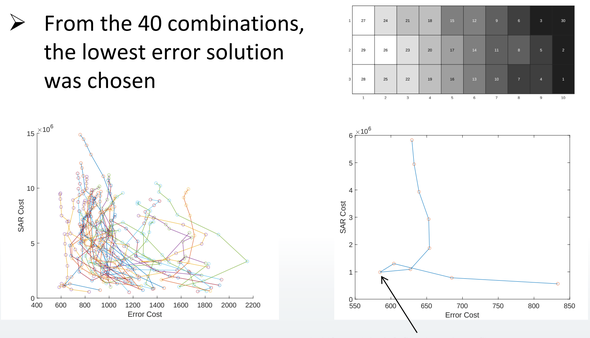


- The set of shims for each slice achieve a balance between spatial uniformity of the amplitude of their combined B_1^+ field and SAR (as tuned by λ)
- Requiring that each coil's shim is a scaled copy of the transmit channel's shim
- Complex-valued scaling that is fixed across all the slices [4,5]

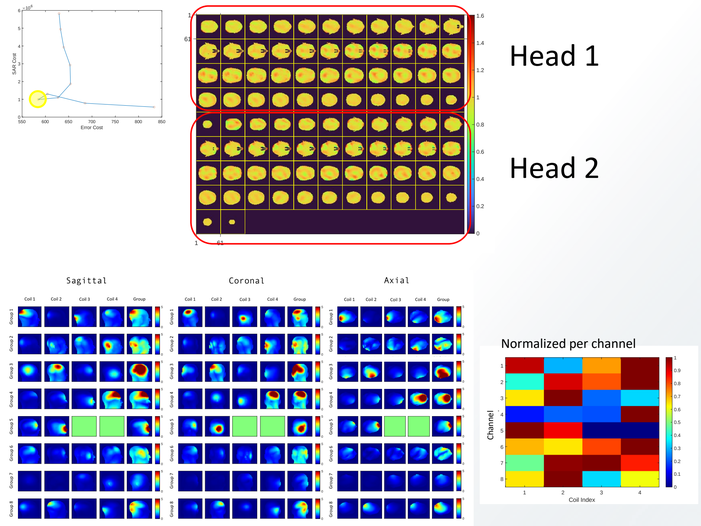


RESULTS:L-CURVES

- From the 40 combinations, the lowest error solution was chosen



RESULTS:IN-PHANTOM



DISCUSSION & FUTURE WORK

We have designed weights for a 30-element to 8-amplifier network for multi-slice RF shimming
Enables both:

- Ease of construction of the complete dense transmit array system [6,7]
- Control for excitation patterns and SAR

REFERENCES/ACKNOWLEDGEMENTS

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