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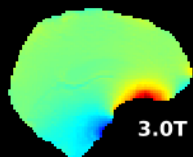
Silent slice-wise shimming with a multi-coil setup at ultrahigh-field MRI

Ali Aghaeifar¹ and Klaus Scheffler¹

¹ Max Planck Institute for Biological Cybernetics, Tübingen, Germany

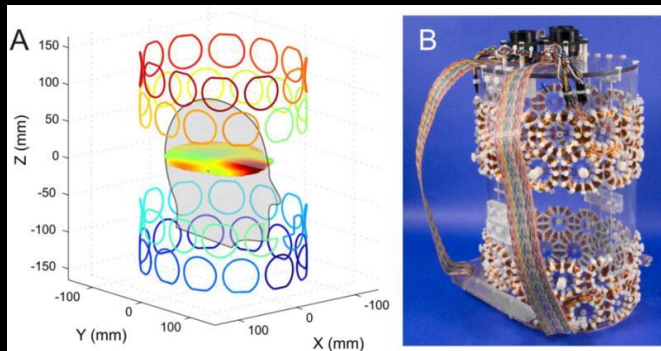
| June 2023 | ISMRM Annual Meeting & Exhibition |

Multi-Coil Shimming



3.0T

48-channel @ 7T



Juchem et al, NeuroImage 105, 462 (2015)

32-channel @ 3T



Stockmann et al, MRM 75, 441 (2016)

31-channel @ 7T



Stockmann et al, MRM 87, 1074 (2022)

16-channel @ 9.4T



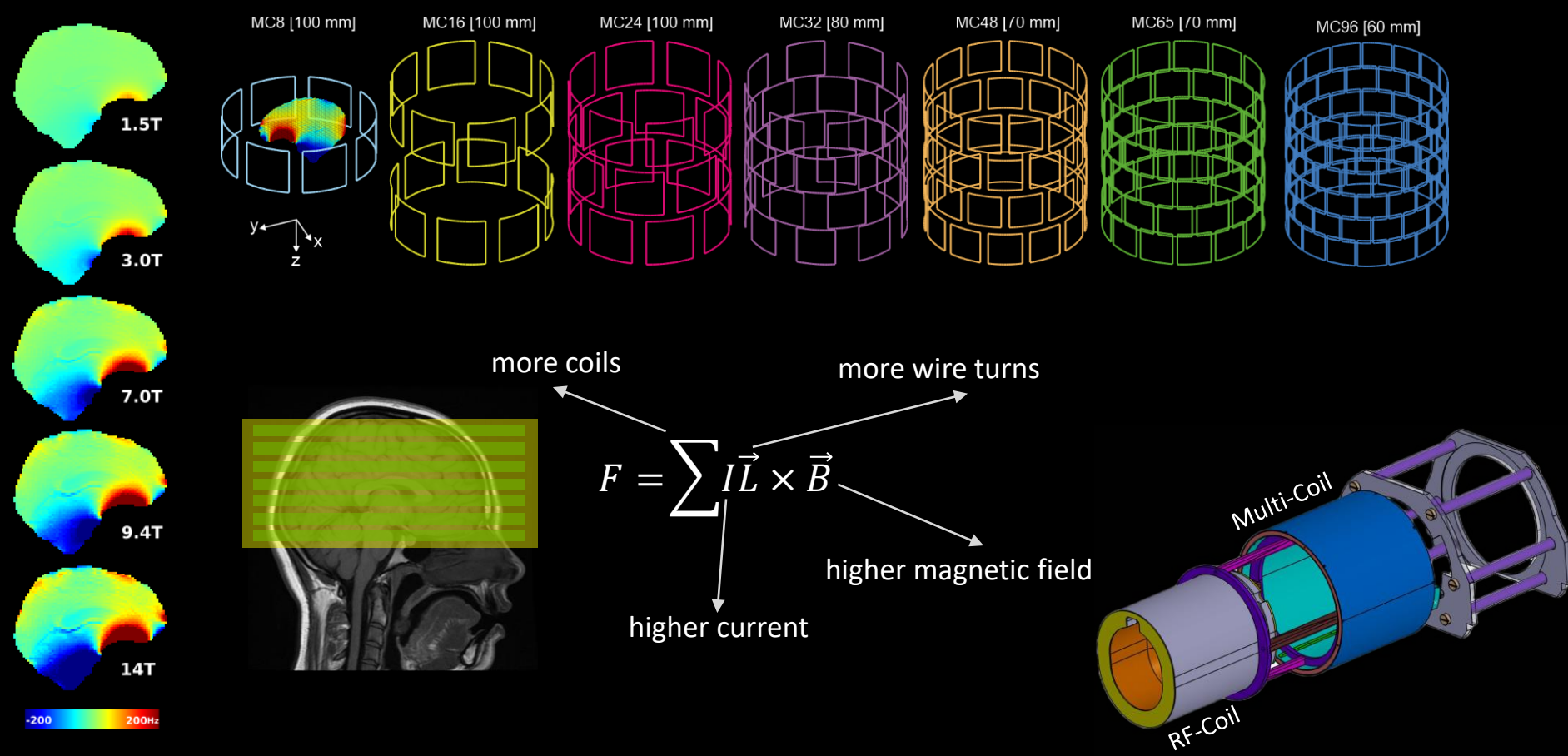
Aghaeifar et al, MRM 80, 1714 (2018)

32-channel @ 9.4T



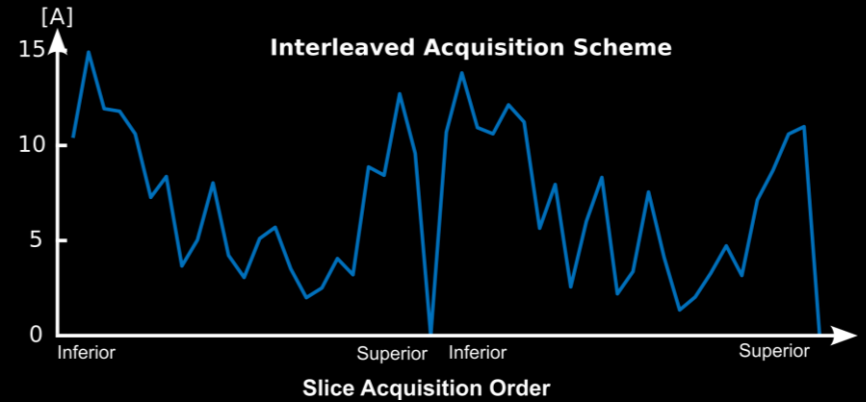
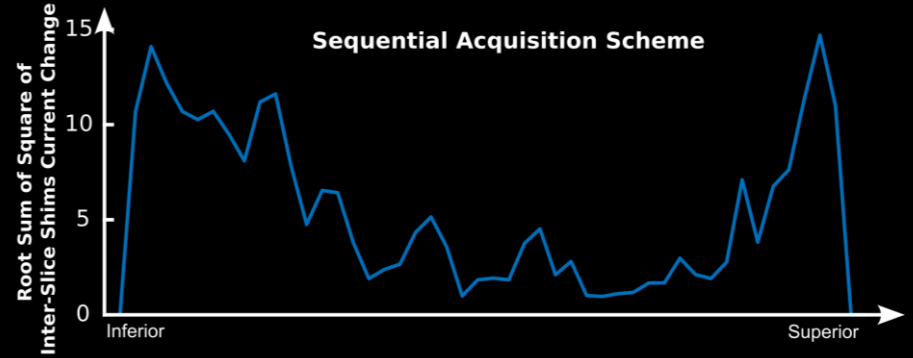
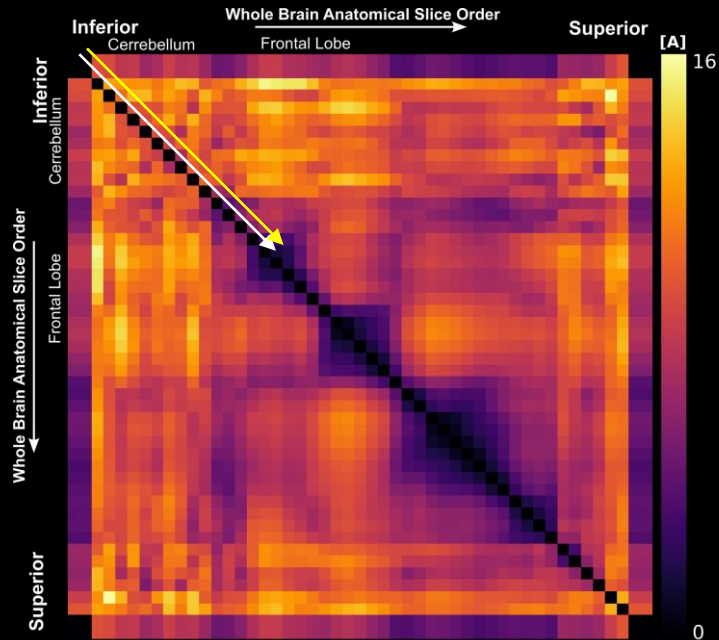
Aghaeifar et al, MRM 83, 749 (2020)

Lorentz Force

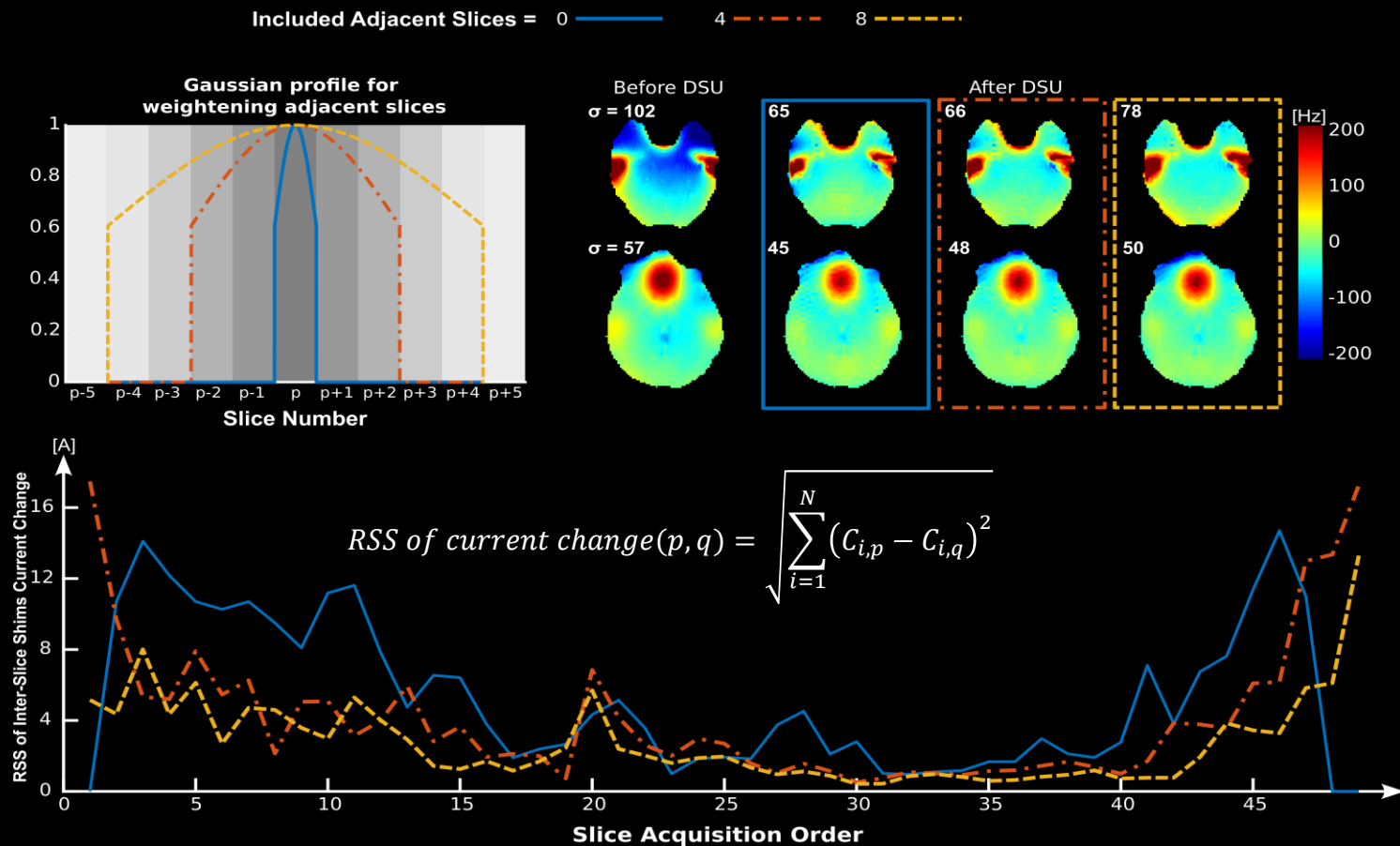


$$RSS\ of\ current\ change(p, q) = \sqrt{\sum_{i=1}^N (C_{i,p} - C_{i,q})^2}$$

q



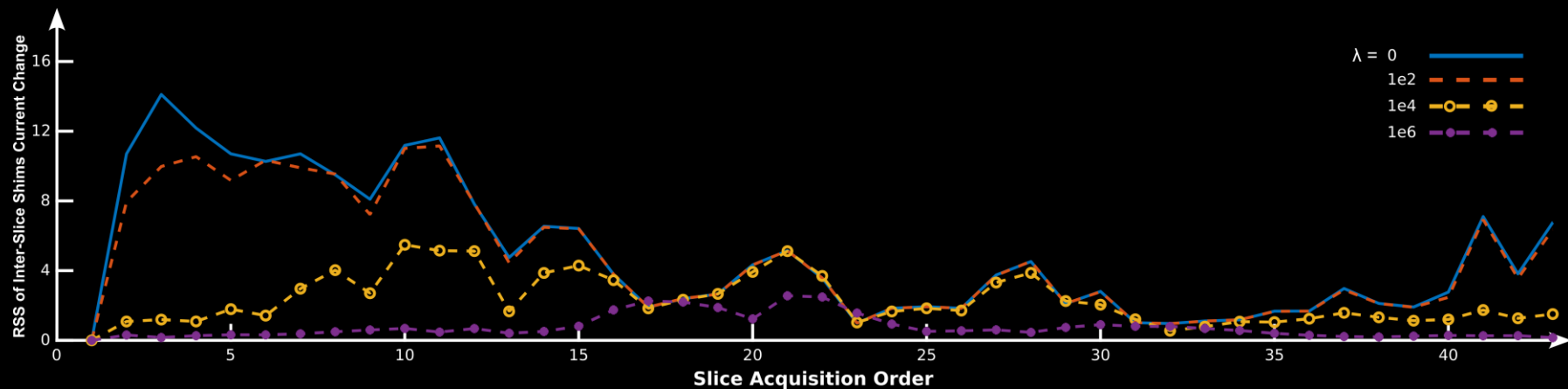
Incorporating neighboring slices



Incorporating current change into shimming problem

$$\tilde{c} = \arg \min_c \|Ac + \Delta B_0\|_2^2 + \lambda \|c - \dot{c}\|_2^2 \quad s.t. \quad lb \leq c \leq ub$$

See: Schwerter, M. *et al. MRM* **82**, 263–275 (2019).



Changing Acquisition Order

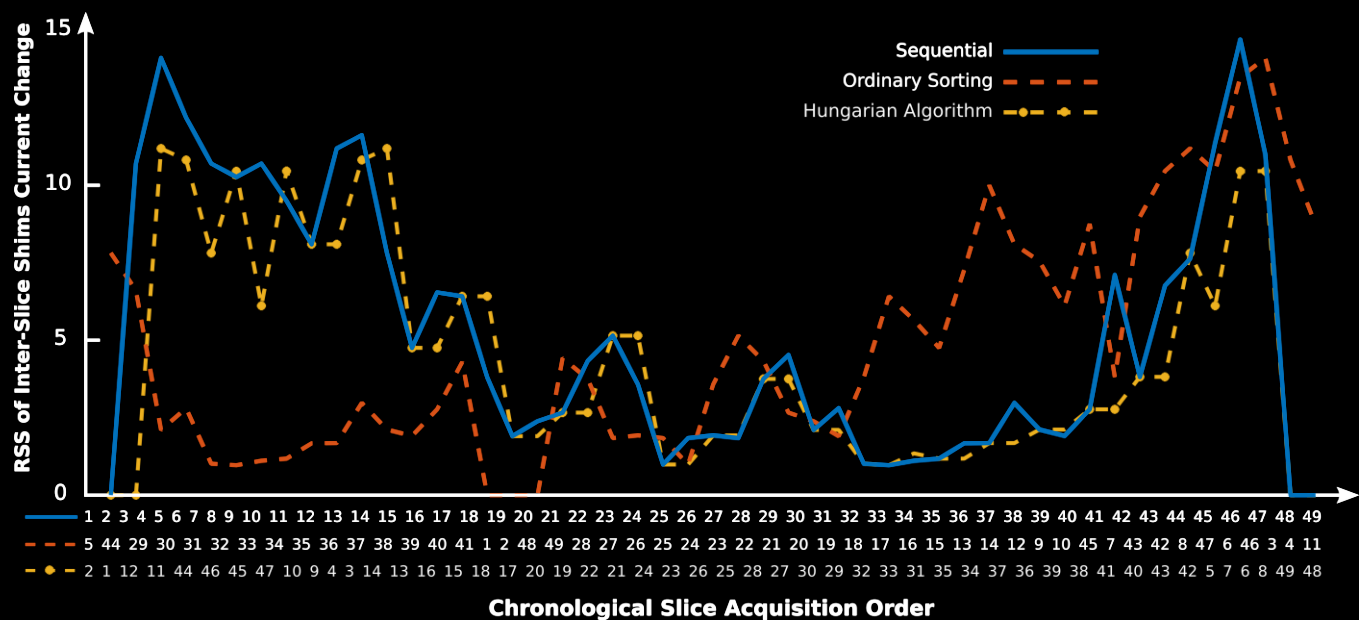
Sorting order of slice acquisition to control inter-slice shims current change.

1) Ordinary sort

- a) Choose optional slice X. If slice Y is available pick that and replace X.
- b) Find slice Y with minimum shims current change with respect to X.
- c) Remove X from slice list and go to step (a)

2) Solve a linear assignment problem

- a) Hungarian Algorithm
- b) Auction algorithm
- c) ...



Discussions

	Regular scan		Incorporating neighboring slices		Regularization for current change			Sorting slice acquisition order	
	Sequential	Interleaved	4 slices	8 slices	$\lambda = 1e2$	1e4	1e6	Ordinary	Hungarian
Whole brain SD (Hz)	35.89	35.89	37.59	41.38	35.89	35.93	37.81	35.89	35.89
Maximum change (A)	14.7	14.9	14.4	13.2	11.1	6.4	2.5	14.1	11.1
Overall change (A)	257.9	334	203.4	136.1	230.9	111	34.4	236.2	215.6



https://github.com/aghaeifar-publications/silent_shimming/