

Reducing SAR and Imaging Time at 7T Using RF Multiplexing and Transceiver Arrays at 7T

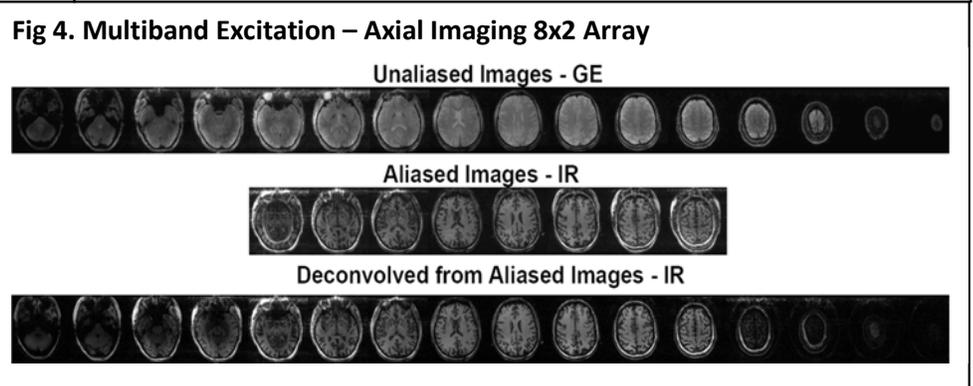
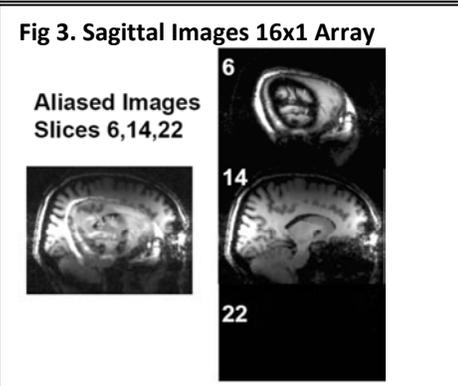
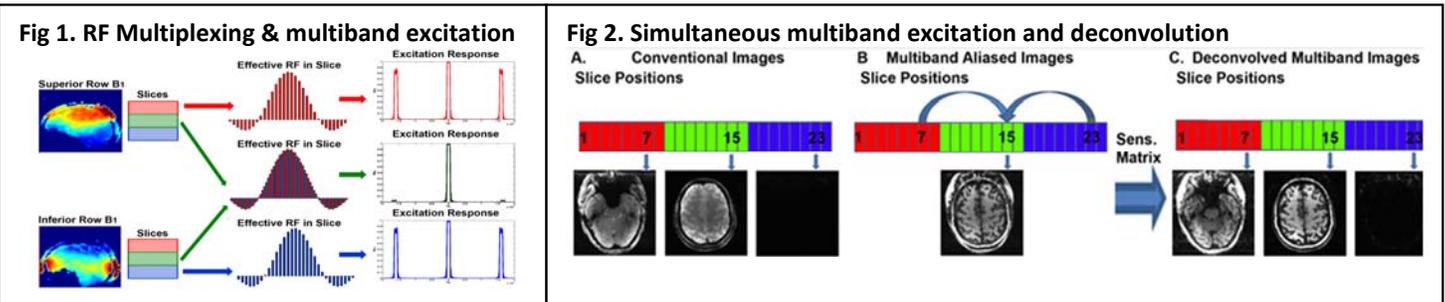
Hoby Hetherington¹, Nikolai Avdievich¹, and Jullie Pan¹

¹Neurosurgery, Yale University, New Haven, CT, United States

Introduction: At 7T, the increase in SNR affords improved spatial resolution; but decreasing T2 and T2* and increasing T1 and SAR can limit the number of slices which can be acquired within a fixed repetition (TR) period. For transceiver arrays where the number of RF coils exceeds the number independent RF channels (i.e. coil dense arrays) RF multiplexing (interdigitating at 10-50us intervals pulses to different coils – Fig. 1) enables all coils in the array to be driven independently. This improves transmit homogeneity and allowing multiple rows of relatively small coils to be used to maintain SNR. RF multiplexing generates excitation sidebands that can be used to reduce SAR by tripling the number of slices acquired with each excitation pulse.

Methods: Data was acquired at 7T using two 16 coil transceiver arrays. To demonstrate the multiband approach in the axial direction an 8x2 array (8 coils per row x 2 rows) was used. To demonstrate the multiband excitation in the sagittal and coronal planes a 16x1 array was used. RF multiplexing was achieved using a moderate power (1kW) fast (<1us) switch to route the RF from a single output channel to 2 or more coils. RF multiplexing allows the phase and amplitude of the RF delivered to be optimized for each coil in the array.

Results: Fig 1 shows B₁ maps for the superior and inferior rows of the 8x2 array. For superior brain locations (red slices) the inferior rows of the coil contribute negligible RF. At these locations the multiplexed pulse is effectively a “DANTE” pulse, where the red blocks represent RF from the superior row and the intervening delays represent the contribution (no RF) from the inferior row. This “DANTE waveform” generates a main band. Similarly, the inferior slices (blue) are excited only by the inferior row and also generate sidebands. In locations where the superior and inferior rows contribute similar amounts of RF (green slices –main band), the RF from both arrays adds constructively. Thus a single multiplexed selective slice pulse can be made to simultaneously excite three discrete slices (main band – green; sidebands – red & blue). The three simultaneously acquired slices result in aliasing (Fig 2). The aliasing is removed by deconvolving the acquired data with the sensitivity matrix of the array (Figs. 3 – sagittal images 16x1 array, 4 – axial images 8x2 array).



Conclusions: Coil dense transceiver arrays and RF multiplexing intrinsically provide multiband excitation, which reduces power deposition by decreasing the number of excitations required for multi-slice acquisitions. The reduced number of excitations can also be used to increase imaging speed and efficiency.