# First Evaluation of External Development Sequences for 7 T Parallel-Transmit MRI in a Self-Built RF Coil

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Abstract (max: 300 words, current: 300 words)

Parallel transmission (pTx) MRI is an increasingly popular tool to overcome the inhomogeneous RF transmit field at ultra-high field (UHF, ≥7 T). However, the use of pTx requires dedicated RF coils and sequences including measurement of subject-specific RF maps and optimization of pulse waveforms. These extra obligations have historically caused the benefits of pTx to be shadowed by cumbersome workflows requiring high levels of expertise.

Fortunately, the UHF community has endeavored to find solutions for “push-and-play” pTx MRI in a step towards one-day clinical integration. In this abstract, we report our experience with two such development pTx sequences. In both cases, the pTx protocols were developed for a commercially available pTx coil, and were tested with the 7T setup in Glasgow using a self-built pTx coil of similar design.

The first development sequence investigated was the pTx Direct Signal Control with Variable Excitation and Refocusing (DiSCoVER) method for 2D Turbo Spin-Echo (TSE) imaging, developed by colleagues at King’s College London and Siemens Healthcare UK and Germany. DiSCoVER uses the TSE signal model to modify relative amplitudes and phases (shims) in each transmit channel  during the TSE pulse train to generate a homogeneous signal. For T2w imaging, we compared DiSCOVER to conventional single transmission and standard volumetric shimming (fixed channel shims for all excitation and refocusing pulses) in the same volunteer.

The second development protocol used 3D MPRAGE and MP2RAGE sequences from the Package of Anatomical Sequences using parallel Transmission UniveRsal kT-point pulses (PASTeUR) developed by CEA Neurospin, Paris-Saclay, France. Figure 2 compares T1w images of a second volunteer from MPRAGE and the composite MP2RAGE UNI image using Universal Pulses (UPs) from PASTeUR.

In this initial investigation, both development pTx sequences were user-friendly and showed promising results with a few caveats. Further investigation could improve their performance with the Glasgow 7T pTx setup.

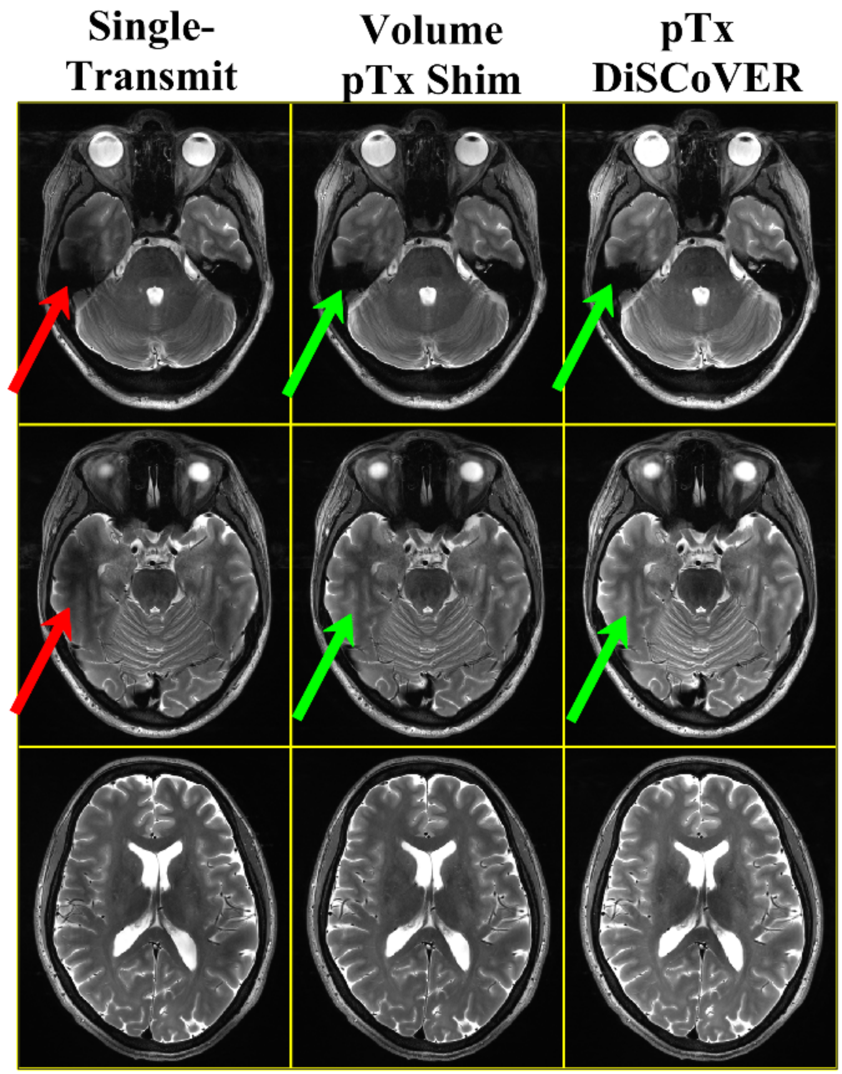


**Figure 1**. T2w Turbo Spin-Echo (TSE) images acquired with conventional single-transmit excitation (left), with vendor-provided parallel-transmit (pTx) shimming optimized over the full volume of slices (center), and with the pTx DiSCoVER sequence developed by King's College London and Siemens Healthcare (right). The green arrows highlight regions of improved RF signal homogeneity in the volumetric shimming and DiSCoVER cases, compared to nonuniformity using single transmission highlighted with red arrows. The two parallel transmission examples show greatest improvement for inferior axial slices.

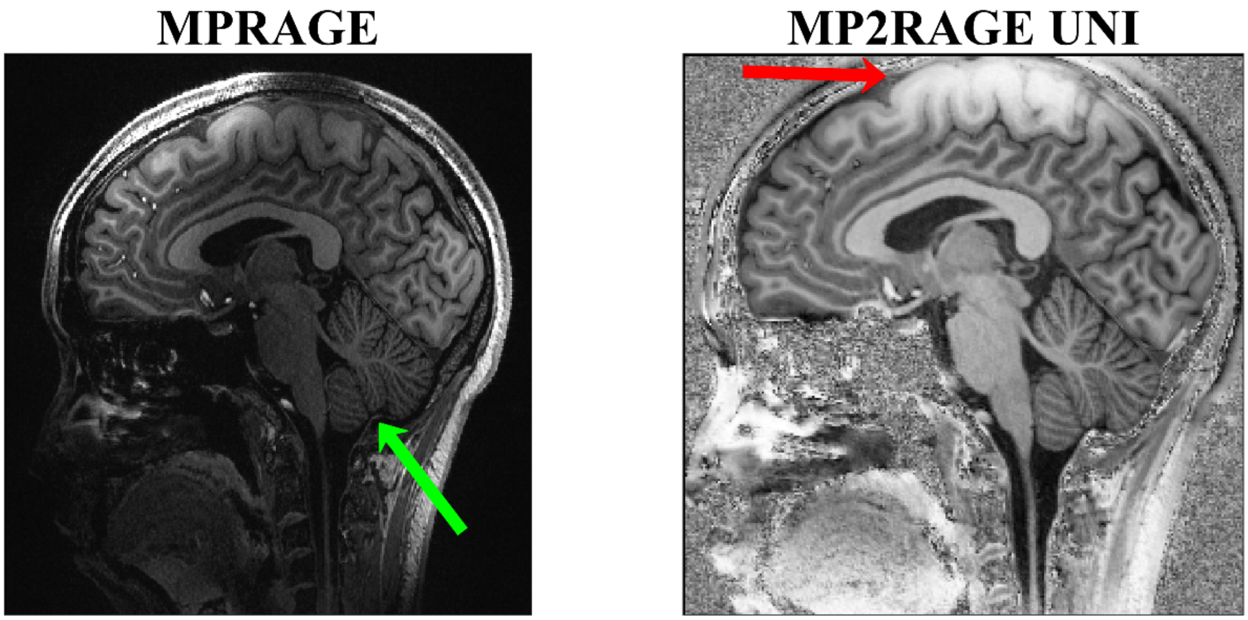


**Figure 2.** Comparison of the T1w MPRAGE and MP2RAGE pTx sequences using Universal Pulses (UPs) generated for a different RF coil than was used. TheMPRAGE pTx image (left) shows greater visualization of the cerebellum and spinal cord than would be expected using single transmission (green arrow). The MP2RAGE pTx sequence (and less dramatically, MPRAGE) suffers from erroneous excitation effects when the two inversion times are used to generate the UNI image (red arrow).