

Harmonization of MPRAGE and EPI: Data Acquisition Instruction on a non-Siemens Platform

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To extend our work from the 2023-24 ISMRM Reproducibility Team Challenge (<https://github.com/pulseseq/Pulseseq-Rocks-2023-24-ISMRM-Reproducibility-Challenge>) into a proper publication, I have updated the MPRAGE and EPI Pulseseq-based sequences to achieve improved fat suppression and correct orientation between Siemens and other platforms. Here, we would like to try to validate the data acquisition using the two sequences on a non-Siemens platform.

For cross-vendor harmonization of MPRAGE and EPI data acquisition, our goal is to configure the sequences as similarly as possible across vendors. The key sequence parameters for MPRAGE and EPI Pulseseq-based scans are outlined below. Please adapt the sequence parameters for vendor-based scans, ensuring alignment with the corresponding Pulseseq-based protocol to the greatest extent possible.

What you need to do:

- Set the vendor option properly, e.g., on GE platforms, set the vendor option: `vendor = 'ge' ;`.
- Set the B0 field of your scanner in the MPRAGE and EPI Matlab scripts. (`sys.B0 = your_B0 ;`)
- Try to run the Pulseseq-based MPRAGE and EPI sequences on your scanner.
- If the original versions of the two sequences don't run properly, adapt them to run on the scanner and back up the adapted versions of the two sequences.
- Configure the vendor-based MPRAGE and EPI sequences to closely match the Pulseseq-based parameters listed below.
- Use the Pulseseq-based and Product-based MPRAGE and EPI sequences to scan a phantom with shapes and structures so that we can check the recon images for orientation and encoding directions.
- Send phantom DICOM images of the vendor-based MPRAGE and EPI scans to us. And send the phantom raw data of the Pulseseq-based MPRAGE and EPI scans to us.
- After we confirm the data and (maybe) modify the Pulseseq-based sequences, you can scan the phantom and a healthy human brain again to acquire the DICOM images and raw data.

Note: Ensure the FOV position and the adjustment shim volume are the same for vendor-based and Pulseq-based scans.

- **MPRAGE with water excitation and two-fold GRAPPA**
(*writeMPRAGE_grappa_WE.m*)

- ❖ Orientation: Sagittal.
- ❖ Fat suppression strategy: “Water excitation”.
- ❖ Phase encoding direction: from anterior to posterior (A>>P).
- ❖ FOV = 192*240*256 mm³ ([partition, phase, readout]). In the Challenge work, it is 256*256*192 mm³.
- ❖ Matrix size = 192*240*256 ([partition, phase, readout]).
- ❖ Resolution = 1*1*1 mm³ ([partition, phase, readout]).
- ❖ TR = 2500 ms; TE = 3.64 ms; TI = 1100 ms; TA = 5:38 min.
- ❖ Flip angle = 8 degrees.
- ❖ Acceleration: integrated GRAPPA; acceleration factor PE = 2; reference lines PE = 32; acceleration factor 3D = 1.
- ❖ Asymmetric Echo = “off”; readout oversampling = 2.
- ❖ Coil combination: Sum of Squares.
- ❖ Shimming strategy: Siemens-provided automatic “**standard**” shim (if possible, please also use a similar vendor-provided automatic shim on your platform).
- ❖ Readout Bandwidth = 195 Hz/Px = 1/ADC_duration. ADC bandwidth = 100 kHz = 1/ADC_dwell_time.
- ❖ Echo spacing = 8.94 ms.
- ❖ Receiver gain: High.

Note: Please turn off all of the vendor-provided image filters and image corrections (e.g., Hamming filter, distortion correction, etc.).

- **EPI with a 3-echo navigator, fat suppression, and ramp sampling** (*writeEpiRS_label.m*)

- ❖ Number of slices = 48; Slice thickness = 3.0 mm; Slice Distance factor = 0% (no slice overlapping); Number of repetitions = 30.
- ❖ Phase Oversampling = 0%. Readout oversampling factor = 2.
- ❖ FOV Read = 220 mm; FOV Phase = 220 mm; FOV in Slice-selective direction = 3.0 * 48 mm.
- ❖ Image matrix size = 80 * 80 * 48 * 30 ([read, phase, slice, repetition]).
- ❖ Image resolution = 2.8 * 2.8 * 3.0 mm³ ([read, phase, slice]).

- ❖ **Orientation = “Transversal”**; Phase Encoding Direction = from anterior to posterior (“A>>P”).
- ❖ TR = 3656.2 ms; TE = 32.34 ms.
- ❖ Flip angle = 90 degrees (slice-selective excitation).
- ❖ **Fat-water contrast = “Fat Saturation”**.
- ❖ Acceleration Mode = “None” (no parallel imaging, no partial Fourier etc.).
- ❖ Multi-slice Mode = “Interleaved” (slice order is interleaved, e.g. 1,3,5,7,...,47, 2,4,6,8,...,48).
- ❖ Coil combination = “Sum of Squares”.
- ❖ Shimming strategy: Siemens-provided automatic “standard” shim (if possible, please also use similar vendor-provided automatic shim on your platform).
- ❖ Readout bandwidth = 1562.5 Hz/px = 1/ADC_duration. ADC bandwidth = 250 kHz = 1/ADC_dwell_time.
- ❖ Echo spacing = 0.7 ms.
- ❖ **Receiver gain: High.**

Note: Please disable all vendor-provided image filters and image corrections (e.g., Hamming filter, distortion correction, etc.).