

# Correcting B0 Distortion in EPI Using PLACE

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## 1 Introduction

EPI is prone to geometric distortions, particularly in the phase direction. One source is inhomogeneities in the off-resonance static  $B_0$  field due to differences in the magnetic properties of the sample or imperfect shimming. The PLACE [1] technique corrects  $B_0$  distortion in the phase direction using information from reference images acquired with a modified phase encoding gradient program. Distortions in other directions are not corrected by PLACE but generally they are much less pronounced.

The PLACE technique, as implemented on our scanner does not correct ghosting and actually may fail where the ghost overlaps the "real" image. In that case, using double sampling, increasing the FOV or using a saturation pulse are effective methods for reducing image ghosting in your EPI acquisition.

## 2 Acquiring the PLACE Reference Scan

### Step 1

Collect EPI data: Acquire your scan of interest using an EPI protocol in the normal way.

### Step 2

Acquire a PLACE-EPI Reference Scan: Clone your EPI scan and switch the method to "placeEPI" as indicated in figure 1.

### Step 3

Set the number of repetitions to 10 as indicated in figure 2.

#### Step 4

Set up the PLACE parameters, then start the scan. First click "Research" on the left, then click the "expand" button near "PLACE\_parameters" and set each of the circled fields as indicated in figure 3. The "Blip Strength Array" entries should be "-1" and "0".

### 3 Correcting Your Image Using PLACE

To use the PLACE correction you will need to run two macros that are installed on the 7T console, the first one on the reference scan, a second macro on the scan of interest. Be sure to back up your data before running either of these macros because your distorted image will be overwritten by the undistorted image.

#### Step 1

Back up your raw data by copying it to another location.

#### Step 2

Highlight your placeEPI reference scan data in the "Scan Control" window.

#### Step 3

Open the "Macro Manager" window by clicking the icon of the rabbit in a top hat in the "System Control" window.

#### Step 4

Run the first macro by clicking "fmriuser," then "AAAA.1PlaceRefCorrect" in the "Macro Manager" window. Push the triangle icon to run the scan. This should take less than a minute.

#### Step 5

Highlight your EPI scan to be corrected in the "Scan Control" window.

#### Step 6

Run the "AAAA.2PlaceCorrt" macro similar to the other macro above.

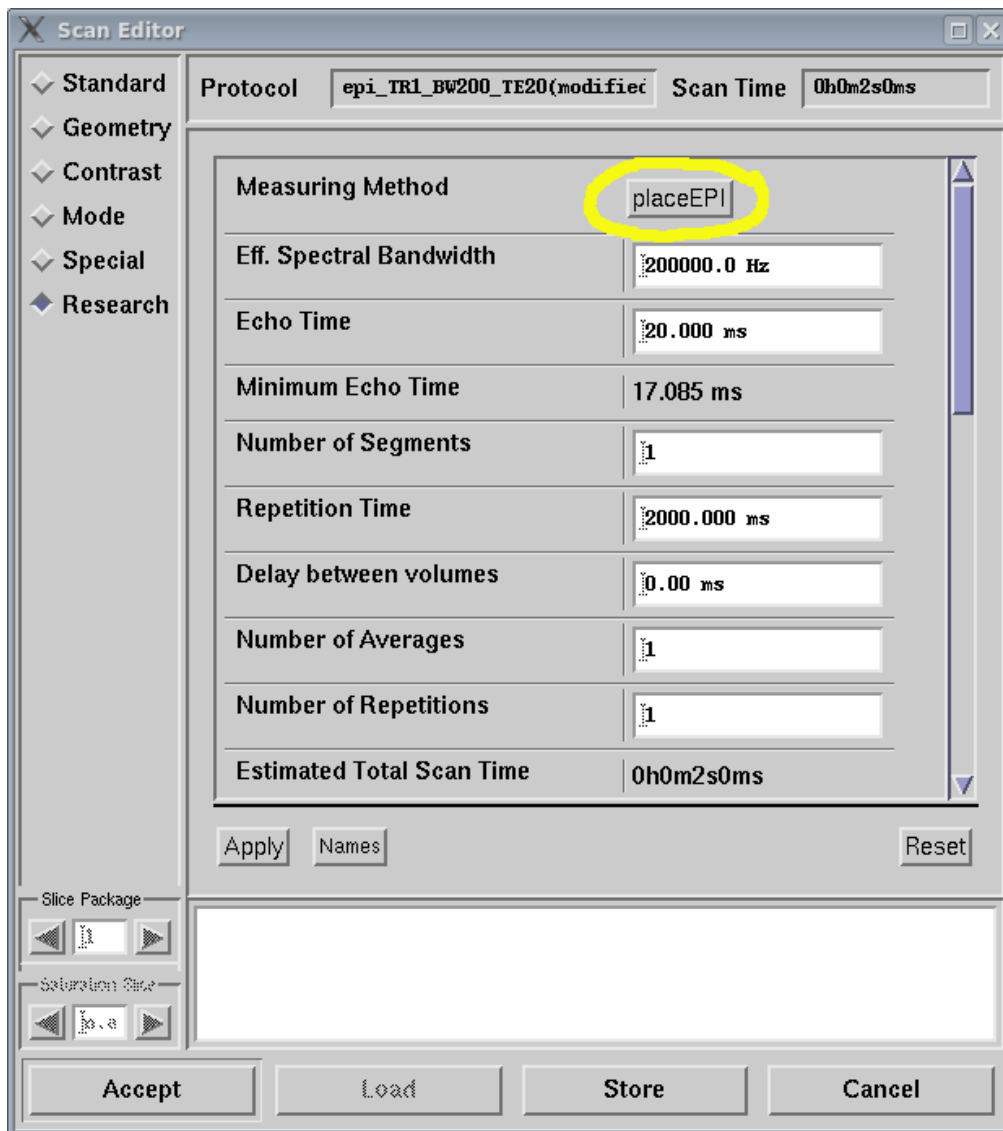


Figure 1: Change the method from EPI to PLACE, leaving your scan parameters the same.

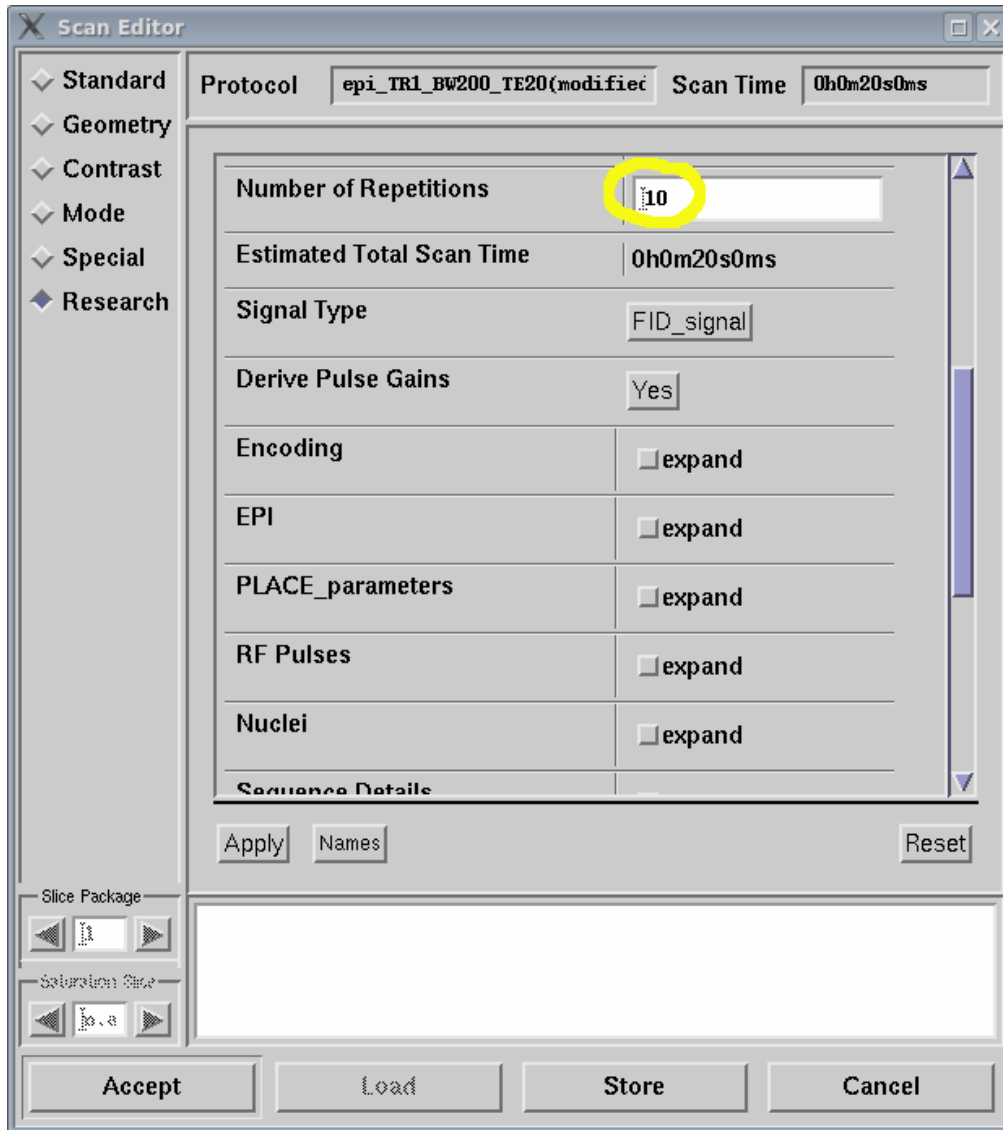


Figure 2: Set the number of repetitions to 10 in the PLACE reference scan.

PLACE_parameters	<input checked="" type="checkbox"/> expand
	Enable PLACE Blips <input type="text" value="Yes"/>
	Number of Blip Steps <input type="text" value="2"/>
	Blip Strength Array <input type="text" value="0-1"/> < 2
	<input type="text" value="-1"/> <input type="text" value="0"/>
PlaceSnapshot_parameters	<input type="checkbox"/> expand

Figure 3: Set up the PLACE\_parameters as indicated. The "Blip Strength Array" entries should be "-1" and "0".

## 4 Phase Roll

If you images were acquired off-center in the phase direction, they will no longer be centered. This is because the PLACE algorithm removes the phase roll in the phase encoding direction. At this time, no correction for this phase roll is implemented. You can use tools like afni's "3drotate" to restore the appropriate phase roll.

## References

- [1] Qing-San Xiang and Frank Q. Ye. Correction for geometric distortion and  $n/2$  ghosting in EPI by phase labeling for additional coordinate encoding (PLACE). *Magnetic Resonance in Medicine*, 57(4):731–741, April 2007.