

REGISTRATION TIME



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***DR-BUDDI* (Diffeomorphic Registration for Blip-Up blip-Down Diffusion Imaging) Method for Correcting Echo Planar Imaging Distortions**

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Abstract

We propose an echo planar imaging (EPI) distortion correction method (*DR-BUDDI*), specialized for diffusion MRI, which uses data acquired twice with reversed phase encoding directions, often referred to as blip-up blip-down acquisitions. *DR-BUDDI* can incorporate information from an undistorted structural MRI and also use diffusion-weighted images (DWI) to guide the registration, improving the quality of the registration in the presence of large deformations and in white matter regions. *DR-BUDDI* does not require the transformations for correcting blip-up and blip-down images to be the exact inverse of each other. Imposing the theoretical “blip-up blip-down distortion symmetry” may not be appropriate in the presence of common clinical scanning artifacts such as motion, ghosting, Gibbs ringing, vibrations, and low signal-to-noise. The performance of *DR-BUDDI* is evaluated with several data sets and compared to other existing

$$\xi = \int_{\Omega} CC \left(I_{up}(\phi(\mathbf{x})) \mathcal{J}(\phi), I_{down} \left(\phi^{-1}(\mathbf{x}) \right) \mathcal{J}(\phi^{-1}) \right) d\Omega$$

$$\xi_1 = \int_{\Omega} CC(I'_{up}, I'_{down}, \mathbf{x}) d\Omega$$

$$\xi_2 = \int_{\Omega} (CC(I_{up}(\phi_1(\mathbf{x}, 0.5)), \mathcal{J}) + CC(\mathcal{J}, I_{down}(\phi_2(\mathbf{x}, 0.5)))) d\Omega$$

$$\mathcal{K}(\phi_1, \phi_2) = 2 \frac{I'_{up} \cdot I'_{down}}{I'_{up} + I'_{down}}$$

$$\xi_3 = \int_{\Omega} CC(\mathcal{K}, \mathcal{J}, \mathbf{x}) d\Omega$$

$$I''_{up} = I_{up}(\phi_1(\mathbf{x}, 0.5)) \times |\mathcal{J}(\phi_1(\mathbf{x}, 0.5))|,$$

$$I''_{down} = I_{down}(\phi_2(\mathbf{x}, 0.5)) \times |\mathcal{J}(\phi_2(\mathbf{x}, 0.5))|$$

$$\xi_4 = \int_{\Omega} CC(I''_{up}, I''_{down}, \mathbf{x}) d\Omega$$

SYN EXPERIMENTS

- We tried correcting using SyN
- Looks alright but is it truly without distortion?

