OPTIMAL FAIR

Release Notes for Version 1.0

20 February 2014

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Driven to Discover[SM]

Background

Arterial spin labeling (ASL) measurements of blood flow in human hippocampus are complicated by its relatively small size and unusual shape. The diameter of the human hippocampus tapers posteriorly along its 45–50-mm curved length from a relatively wide head (8–12 mm) to a thinner body (6–8 mm) and even thinner tail (2–6 mm). The coarse spatial resolution (isotropic 3.5-mm voxels) of standard ASL imaging limited the number of voxels that could be sampled without partial volume effects where the narrow aspects of the body and tail of the hippocampus curved through the slice planes, hindering the ability to conclusively characterize and distinguish middle and posterior regions. To overcome these limitations, a standard FAIR (Flow-sensitive Alternating Inversion Recovery) pulse sequence was modified by rotating the imaging slice plane orthogonal to the oblique axial plane of the tagging inversion. With this Orthogonally Positioned Tagging Imaging Method for Arterial Labeling with FAIR (OPTIMAL FAIR) technique, oblique coronal imaging slices with high in-plane resolution can be placed perpendicular to the longitudinal axis of the hippocampus along the A–P direction (Figure 1). This reduces partial volume effects and increases resolution, allowing the detection of finer details of the A–P differences in perfusion parameters, thus enabling reliable studies of these perfusion differences in both normal and compromised or diseased hippocampus (1-3).

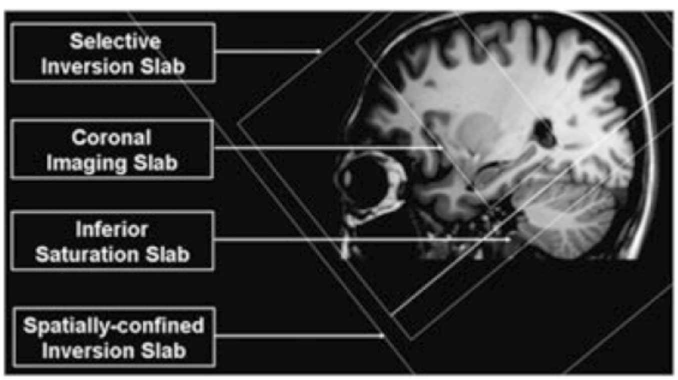

Figure 1 Spatial definitions of different slabs in Orthogonally Positioned Tagging Imaging Method for Arterial Labeling with Flow-sensitive Alternating Inversion Recovery (OPTIMAL FAIR) (1).

Technical Features

1. The OPTIMAL FAIR sequence contains a sequence module for temporal bolus width definition by using either QUIPSS II (4) or Q2TIPS (5) methods, and these two methods can also be turned off when the number of saturation pulses (via user interface (UI) parameter “QSAT.No.”) is set to zero.
2. Imaging slab pre-saturation is supported with two execution modes: a single saturation before ASL inversion RF pulses or one pre-inversion saturation combined with two post-inversion saturations. The latter can provide improved imaging slab pre-saturation and minimize the subtraction errors caused by the imperfect inversion profile (6).
3. HSN RF pulse (7) can be selected for FAIR inversions to reduce RF peak power that is usually limited at ultra high fields, e.g. 7T.
4. Both QUIPSS II (4) and Q2TIPS (5) are supported with great flexibility via multiple UI parameters: the number, duration, slab size and temporal gaps of saturation RF (please refer Figure 1 in the reference 6).
5. Up to two M_0 images can be acquired at the end of ASL series acquisition.
6. Bi-polar flow-encoding/crushing gradients are available to suppress hyperintense intravascular signals.

Installation

The zip package includes three files. XFL_extrf.dat is an external RF pulse library file. C2P_XFL_VB17A_a_ep2d_pace_SB_OPTIMAL_FAIR.dll and C2P_XFL_VB17A_a_ep2d_pace_SB_OPTIMAL_FAIR.i86 are compiled sequence library files.

The external RF library file has to be manually copied to the file directory [C:\MedCom\MriSiteData\measurement]. The two sequence library files have to be copied to the folder [C:\MedCom\MriCustomer\seq].

If a sample protocol FAIR_C2P.edx file is provided, this protocol can be imported by selecting Exam Explore=>USER=>Object=>Import=>Select FAIR_C2P.edx, and the default protocol will be as shown in Figure 2. If a sample protocol is not available, create a default protocol in Exam Explorer by selecting Insert Sequence, USER, then C2P_XFL_VB17A_a_ep2d_pace_SB_OPTIMAL_FAIR.

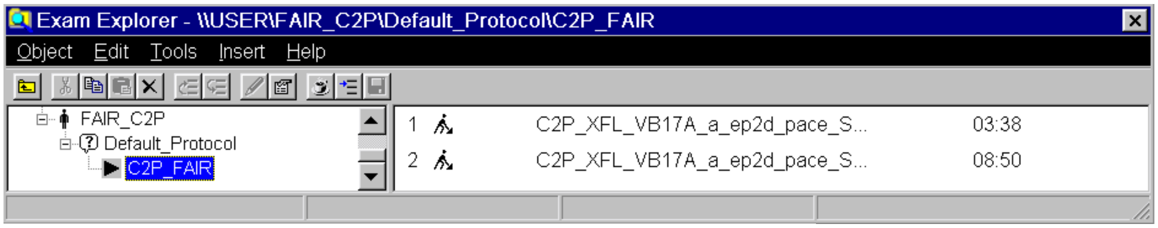

Figure 2. Imported protocol in Exam Explore.

Usage

UI parameters specific to OPTIMAL FAIR are located in the Sequence/Special card, and each UI parameter has its own tooltip (Figure 3).

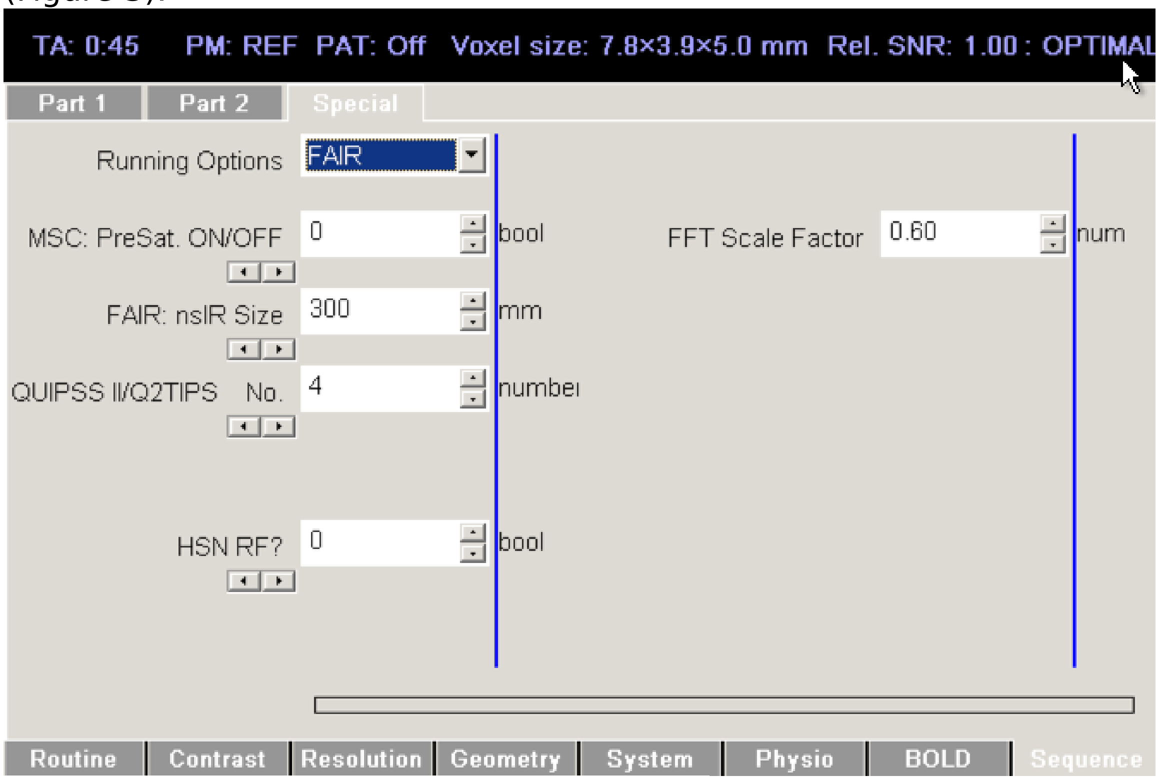

Figure 3. OPTIMAL FAIR UI parameters.

<u>Specific usage notes:</u>

1. Coronal imaging slices have to be used for OPTIMAL FAIR perfusion imaging of selected targeted regions, such as the hippocampus.
2. To minimize image distortion, advanced B_0 shimming is recommended. In addition, small field of view (e.g. 192 mm or 128 mm with 30% phase oversampling), parallel imaging and partial Fourier are also good options to help reduce the echo time of EPI and decrease image distortion.
3. The total measurements include user-prescribed number of M_0

images.

4. Imaging slice distance factor has to be 20%.

References

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2. Li X, Sarkar SN, Purdy DE, Spence JS, Haley RW, Briggs RW. Anterioposterior perfusion heterogeneity in human hippocampus measured by arterial spin labeling MRI. NMR Biomed. 2013 Jun; 26(6):613-21. doi: 10.1002/nbm.2898.
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7. Tannus, A. and M. Garwood, Adiabatic pulses. NMR Biomed, 1997. 10(8): p. 423-34.