FAIR ASST

Release Notes for Version 1.0

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Driven to Discover℠

Background

The intrinsic low signal-to-noise ratio (SNR) characteristics of arterial spin labeling (ASL) and reduced SNR in slices acquired later in the sequence due to signal losses from T_1 relaxation and label washout make whole-brain high-resolution perfusion imaging challenging. High-resolution perfusion imaging can be better achieved by using only limited number of slices sufficiently covering brain regions of interest, such as the hippocampus or the cerebellum. However, when applying the widely used pulsed arterial spin labeling (PASL) method FAIR (Flow-sensitive Alternating Inversion Recovery) for such studies of regions in the mid-brain or lower brain, the superior labeling of FAIR can introduce confounding effects for cerebral blood flow (CBF) quantification and adverse artifacts (1-2). FAIR with Active Suppression of Superior Tagging (FAIR ASST) is a variant of FAIR that resolves those issues. In FAIR ASST, the superior tagging of FAIR is suppressed by applying saturations at the labeling stage on the superior side of the imaging slab. The implementation of FAIR ASST provided in this package uses the mode 12 for superior tagging suppression (1-2).

Important Recent Features

The FAIR ASST sequence contains several important and flexible features, allowing further customizations to satisfy users' specific needs.

1. Imaging slab pre-saturation is supported with two execution modes: a single saturation before ASL inversion RF pulses or three saturations using mode 12 as for ASST (1-2). The latter can provide improved imaging slab pre-saturation and minimize the subtraction errors caused by the imperfect inversion profile (3).
2. When both pre-saturation and superior saturation are requested, a single saturation RF pulse will be applied covering both the superior tagging region and imaging slab (Figure 1).
3. HSN RF pulse (4) 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 (5) and Q2TIPS (6) are supported with great flexibility via multiple user interface (UI) parameters: the number, duration, slab size and temporal gaps of saturation RF pulses to define temporal bolus width (please refer Figure 1 in the reference 2).

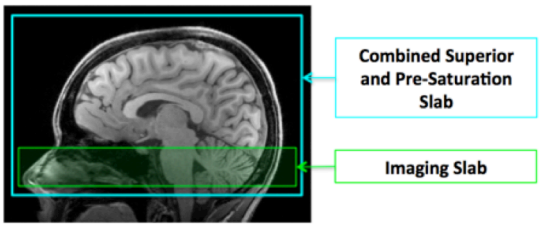

Figure 1. A single large saturation slab (cyan) is used when both superior and pre- saturation are required.

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_FAIR_ASST.dll and C2P_XFL_VB17A_a_ep2d_pace_SB_FAIR_ASST.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_FAIR_ASST.

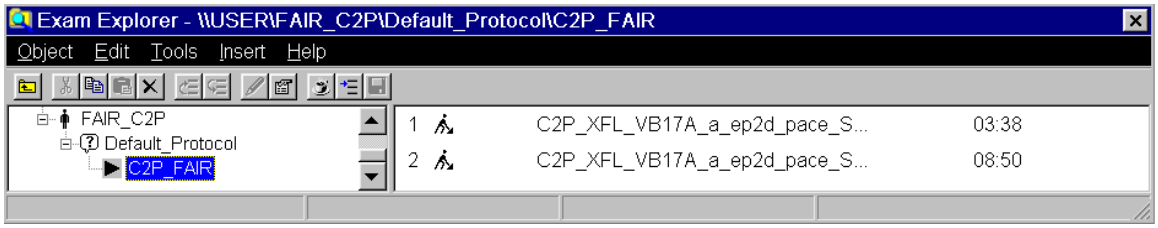

Figure 2. Imported protocol in Exam Explore.

Usage

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

Specific usage notes:

1. Perfusion imaging using FAIR ASST without applying QUIPSS II or Q2TIPS can be achieved by making “QSAT.No.” equal to zero.
2. The total measurements include user-prescribed number of M_0 images.
3. Imaging slice distance factor has to be 20%.

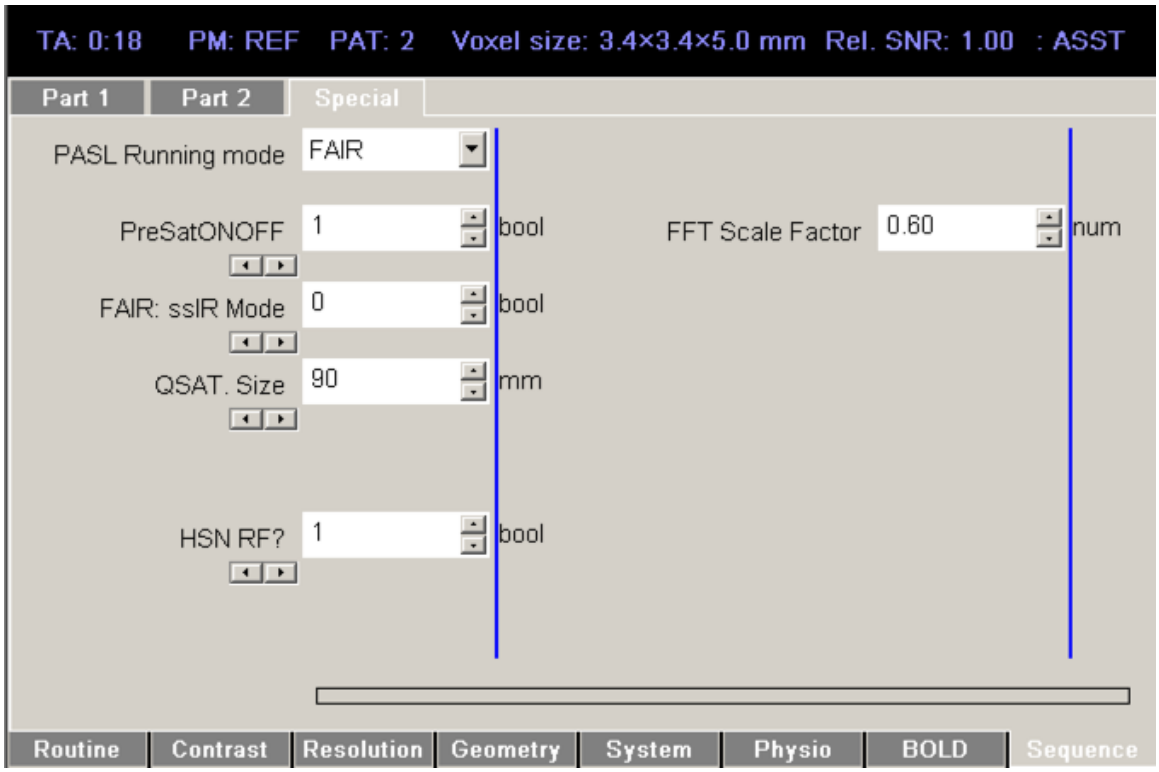

Figure 3. FAIR ASST UI parameters.

Patent

1. Li X, Gopinath K, Sarkar SN, Briggs RW; System and Methods for Active Suppression of Superior Tagging in Flow-Sensitive Alternating Inversion Recovery. United States patent 8,143,892. March 27th, 2012.

References

1. Li X, Sarkar SN, Purdy DE, Haley RW, Briggs RW. Asymmetric FAIR - FAIR with Active Suppression of Superior Tagging (FAIR ASST). In: Proceedings of the 18th Annual Meeting of ISMRM, Stockholm, Sweden 2010:Abstract 1737.
2. Li X, Sarkar SN, Purdy DE, Haley RW, Briggs RW. Improved quantification of brain perfusion using FAIR with active suppression of superior tagging (FAIR ASST). J Magn Reson Imaging. 2011;34(5):1037-1044; doi: 10.1002/jmri.22734.
3. Li X, Metzger G. Feasibility of Measuring Prostate Perfusion with Arterial Spin Labeling. NMR Biomed. 2013 Jan; 26(1):51-7. doi: 10.1002/nbm.2818.
4. Tannus, A. and M. Garwood, Adiabatic pulses. NMR Biomed, 1997. 10(8): p. 423-34.
5. Wong, E.C., R.B. Buxton, and L.R. Frank, Quantitative imaging of perfusion using a single subtraction (QUIPSS and QUIPSS II). Magn Reson Med, 1998. 39(5): p. 702-8.
6. Luh, W.M., et al., QUIPSS II with thin-slice TI1 periodic saturation: a method for improving accuracy of quantitative perfusion imaging using pulsed arterial spin labeling. Magn Reson Med, 1999. 41(6): p. 1246-54.