Novel and Efficient Multi-Phase Arterial Spin Labeling Method for MRI and fMRI

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BACKGROUND

The conventional arterial spin labeling (ASL) method measures blood perfusion by the subtraction of tag and control. The pseudo-continuous arterial spin labeling (PCASL) method offers higher SNR than pulsed ASL (PASL) by a fitting algorithm or a sinusoidal demodulation. However, PCASL method does not provide robust perfusion values in the physiological unit because the tagging efficiency of PCASL can be significantly modulated by both gradient imperfections and the presence of off-resonance fields at the tagged vessels.

TECHNOLOGY DESCRIPTION

UC San Diego researchers have developed a novel multi-phase (more than two) pseudo-continuous arterial spin labeling (MP-PCASL) method for MRI to remedy the problems encountered by the conventional ASL methods. MP-PCASL provides consistent tagging efficiency resulting in more robust and accurate blood perfusion quantification than the conventional 2-phase (2P) PCASL. The tagging efficiency is enhanced by using algorithms to derive an estimate from the MP-PCASL to correct the errors in the phase tracking. A short scan is performed first using MP-PCASL to obtain error correction estimation, followed by 2P-PCASL with phase errors corrected using the estimate. Secondly, the different phase errors across blood vessels are compensated by adding small XY shim gradient during labeling.

APPLICATIONS

- Temporal mode scanning, e.g. fMRI.
- Transient perfusion delay scanning such as, white matter perfusion measurement, perfusion deficits in brain disorders (e.g., Alzheimer's and schizophrenia), and ischemia diseases in other organs.
- The MP-PCASL is applicable to both symmetric (same gradients for control and tag) and asymmetric (different gradients for control and tag) tagging schemes.
- Symmetric PM-PCASL tagging scheme can be used for both global and territory perfusion imaging, while asymmetric PM-PCASL can only be used for the global perfusion imaging.

ADVANTAGES

The conventional 2P-PCASL can be optimized for the applications listed above because MP-PCASL provides:

- Consistent tagging efficiency. Higher SNR than 2P-PCASL.
- Higher temporal resolution than 2P-PCASL.
- No need for a special RF system, which is often required for continuous ASL method.

STATE OF DEVELOPMENT

Imaging studies of human subjects demonstrated that MP-PSCAL method provides more robust cerebral blood flow values than the conventional PCASL method and higher SNR than FAIR ASL. For fMRI, a uniform and near-optimal tagging efficiency across all tagged vessels can be achievable and comparison of the visual activation in one female subject across different ASL methods shows that the optimized MP-PCASL provides higher tSNR than PICORE ASL.

INTELLECTUAL PROPERTY INFO

Patent application filed.

RELATED MATERIALS

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OTHER INFORMATION

KEYWORDS

arterial spin labeling, ASL, multi-phase pseudo-continuous arterial spin labeling, MP-PCASL, MRI, fMRI

CATEGORIZED AS

- **Medical**
  - Diagnostics

RELATED CASES

2009-264-0

▶ Jung Y, Wong EC, and Liu TT Multi-Phase Pseudo-Continuous Arterial Spin Labeling (MP PCASL): Robust PCASL method for CBF quantification. 2009. ISMRM 17th Annual Meeting Abstract #6282.

▶ Jung Y, Rack-Gomer AL, Wong EC, Buracas GT, and Liu TT Pseudo-Continuous Arterial Spin Labeling with Optimized Tagging Efficiency for Quantitative ASL fMRI. 2009. ISMRM 17th Annual Meeting Abstract #7099.

▶ Lu K, Liu TT, Wong EC, and Jung Y. Regional White Matter Perfusion Measurement Using an Optimized Pseudo-Continuous ASL MRI 2009. ISMRM 17th Annual Meeting Abstract #4401.

PATENT STATUS

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United States Of America	Issued Patent	9,084,554	07/21/2015	2009-264

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