**Robust and Automatic Polarity Determination for Phase-Sensitive Inversion Recovery (PSIR) Imaging**

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**Target audience:** Researchers working on MR image acquisition and reconstruction

**Purpose:** Phase Sensitive Inversion Recovery (PSIR) can provide superior image contrast as compared to magnitude reconstructed IR imaging. However, ambiguity in global polarity can lead to wrong final image contrasts. Current methods for determining polarity either rely on *a priori* assumptions[1,2] or require reference data[3,4] that adds significant scan time, making them susceptible to errors under diverse clinical circumstances. Here we report an efficient, reliable and fully automatic method for determining the global polarity for PSIR imaging. The method makes no assumptions and requires practically no extra time.

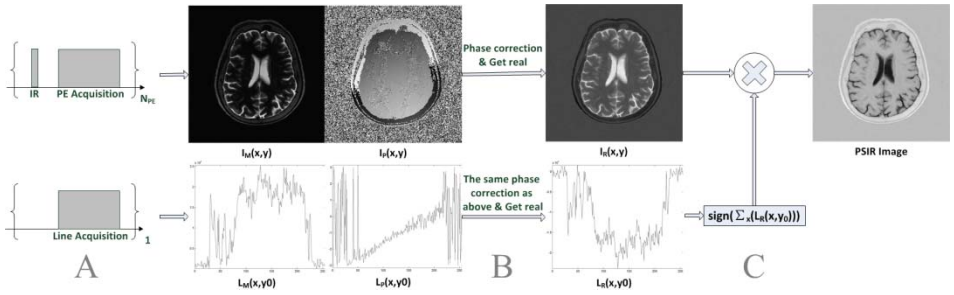


Fig. 1 Schematic depiction of the proposed method. (A) In addition to the IR image data, a line across the object is selected and acquired using the same sequence without the IR pulse; (B) Image is phase corrected to yield a real image and the same spatially corresponding phase correction is applied to the line profile to yield a real line; (C) The real line is summed and its sign is used to multiply with the real image to yield the final PSIR image.

**Methods:** The proposed method is depicted in Fig. 1. In addition to the IR imaging data, a single line is acquired using the same sequence but without IR. The line is selected by intersecting the excitation and refocusing spatial localizations. After phase-correcting the IR images[1,2,5], the same spatially corresponding phase correction is also applied to the line. Sign of the sum of real part of the line data is used to multiply the real images to finally yield the PSIR image.

The method was implemented and data were acquired on a 1.5T uMR 560 scanner of Shanghai United Imaging Healthcare (Shanghai, China). Human head PSIR data were acquired using a fast spin-echo inversion recovery sequence, with TR=7000ms, TE=71.4ms, TI=350ms, ESP=10.2ms, ETL=10, and 190 Hz/pixel bandwidth.

**Results:** Shown in Fig. 2 are exemplary PSIR head images processed using (A) "moment of inertia"[2] (MI) and (B) the proposed method. While "moment of inertia" method produced incorrect polarity, the proposed method resulted in correct image contrasts as shown in (B). Wrong polarity was also the case when using the criterion of "total magnetization in the tissue is non-negative"[1] (Non-negative). A total of 9 different cases of human head PSIR were analyzed with results summarized in Table 1.

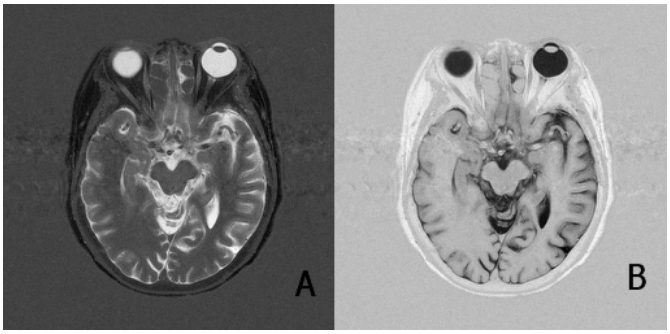


Fig. 2 Human head PSIR image processed with "moment of inertia"2 (A) and the proposed method (B)

Table 1 Correctness of global polarity for 9 cases of human head PSIR analyzed using "moment of inertia", "non-negative" and the proposed method.

| | MI | Non-negative | Proposed |
|---|---|---|---|
| Correct | 5 | 2 | 9 |
| Wrong | 4 | 7 | 0 |

**Conclusions and Discussion:** By acquiring a single line, the proposed method is able to correctly and automatically determine the global polarity without any restrictions on imaging parameters and any *a prior* knowledge of object properties. Time spent on acquisition of a single line is practically negligible. By making the process of determining global polarity fool-proof, the proposed method can be used to robustly yield PSIR images always with correct image contrasts.

**References:**

1. Xiang, Q. S. 1996. JMRI 6: 775-782
2. Jingfei Ma 2005. MRM 53:904 –910
3. Park et al. 1986. MRM 3: 15-23
4. Kellman et al. 2002. MRM 47:372–383
5. Borrello et al. 1990. MRM 14: 56-67.