Expansion of diagnostic opportunities by means of algebraic operation with MR images

Nikolay V. Anisimov, Mikhail V. Gulyaev, Svetlana S. Koretskaya, Elena V. Verkhoglazova, Ilona V. Abanshina, and Yuri A. Pirogov

Research Center for MRI and MRS, M.V.Lomonosov Moscow State University, GSP-1, Leninskie gory, Moscow, 119991, Russian Federation
E-mail: anisimovnv@mail.ru

1. Introduction

MRI data processing based on algebraic operations (subtraction, multiplication, etc.) with identical images on localization is considered. Subtraction of images is usually applied at MRI researches with injection of contrast substance, and also in fMRI. We used algebraic operations for differentiation of tissues and emulation of MR-images which cannot be received at usual scanning. Method is based on known theoretical dependence of MR-signals on parameters of used modes of scanning and influence on pixel brightness of algebraic operations over these images.

2. Materials and methods

We produced algebraic operations with the images received on MR-scanners: 0.5T Tomikon S50 (Bruker) and 3T Achieva (Philips). In the first case the firm software allowed to make both subtraction, and multiplication of images. In the second case the firm software gave the chance to do only subtraction, and for multiplication of images was used freeware ImageJ. For emulation of modes STIR or FLAIR it was fulfilled subtraction of images, accordingly: T2-FLAIR or T2-STIR. Multiplication of images from modes FLAIR, STIR and also DIR with different inversion times [1], was carried out for emulation of scanning modes with simultaneous suppression of signals from two and more normal tissues.

3. Results

Operation of subtraction T2-FLAIR gave the images similar to ones from STIR mode. It helped to revealing of dermoid cysts, formations in hypodermical fat, recognition of tissues at the skull base – Fig 1.

Operation (T2-FLAIR)xFLAIR yielded the image similar to image from DIR mode that has allowed to reveal postoperative changes in brain meninges – Fig. 2.

Operation (T2-FLAIR)xFLAIR gave image of dermoid cyst as hyperintensive formation on a dark background – Fig. 3.

Multiplication of images from DIR modes (A and B) with different inversion times TI1/TI2 (1.3/0.08s and 0.55/0.08s) emulated images from scanning mode with suppression of signals from several normal tissues, namely waters, fat, and nose mucus – Fig.4. Emulated images gave good visualization of intracranial lesions [2]. It is very useful for volume reconstruction – rendering or MIP.

4. Conclusions

Algebraic operations with MR-images give additional information in MRI research at the using of emulation of additional modes of scanning. It is especially useful at research of intracranial lesions.

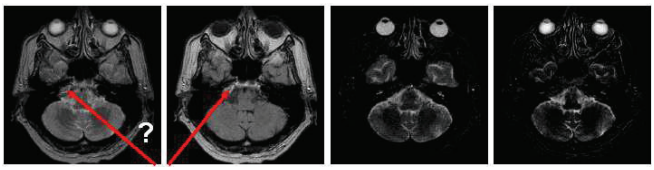

Figure 1: Left to right: T2, FLAIR, STIR, T2-FLAIR. It is suspected that asymmetric distribution of MR-contrast at the skull base is caused by an unknown pathology. But image subtraction gives image analogous to STIR. Conclusion: suspicious tissue is ordinary fat.

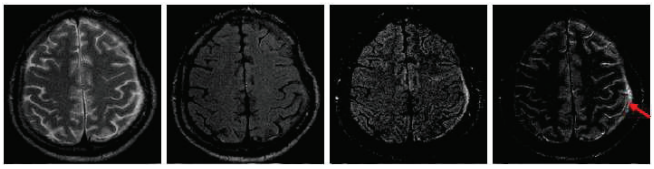

Figure 2: Left to right: T2, FLAIR, DIR, (T2-FLAIR)x(FLAIR)^2. Algebraic operations with T2 and FLAIR give image analogous DIR. Only this mode reveals enough distinctly changes in meninges after surgical operation

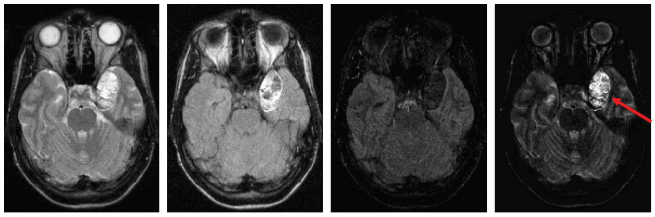

Figure 3: Left to right: T2, FLAIR, DIR, (T2-FLAIR)x(FLAIR)^2. Algebraic operations with T2 and FLAIR give very distinct visualization of dermoid cyst.

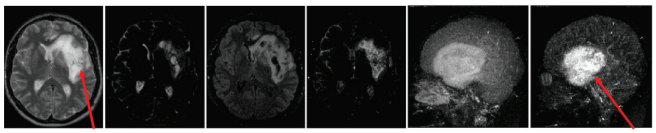

Figure 4: Left to right: T2, FLAIR, DIR(A), DIR(B), MIP-sagittal from DIR(A), MIP-sagittal from DIR(A)xDIR(B).

References

[1] T. Redpath, F. Smith Br. *J. Radiol.*, **67**, 1258–1263, 1994.

[2] N. Anisimov et al. Proceedings of *ESMRM-2005*, p.435.