An MRI denoising method using image data redundancy and local SNR estimation

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Abstract

This paper presents an LMMSE-based method for the three-dimensional (3D) denoising of MR images assuming a Rician noise model. Conventionally, the LMMSE method estimates the noise-less signal values using the observed MR data samples within local neighborhoods. This is not an efficient procedure to deal with this issue while the 3D MR data intrinsically includes many similar samples that can be used to improve the estimation results. To overcome this problem, we model MR data as random fields and establish a principled way which is capable of choosing the samples not only from a local neighborhood but also from a large portion of the given data. To follow the similar samples within the MR data, an effective similarity measure based on the local statistical moments of images is presented. The parameters of the proposed filter are automatically chosen from the estimated local signal-to-noise ratio. To further enhance the denoising performance, a recursive version of the introduced approach is also addressed. The proposed filter is compared with related state-of-the-art filters using both synthetic and real MR datasets. The experimental results demonstrate the superior performance of our proposal in removing the noise and preserving the anatomical structures of MR images.

Keywords: Denoising, Image data redundancy, Linear minimum mean square error, Magnetic resonance imaging, Rician distribution