Exploiting spatial information to estimate metabolite levels in 2D MRSI of heterogeneous brain lesions

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Magnetic Resonance Spectroscopic Imaging (MRSI) provides MR spectra from multiple adjacent voxels within a body volume represented as a 2 or 3 dimensional matrix, allowing to measure the distribution of metabolites over this volume. The spectra of these voxels are usually analyzed one by one, without exploiting their spatial context. A reasonable assumption is that signals from adjacent voxels have similar spectral parameters (frequencies, dampings). In this paper we present an improved metabolite quantification method for MRSI data, in which spatial information is included in the metabolite quantification problem using constraints on the nonlinear spectral parameters corresponding to neighboring voxels. In the proposed method we iteratively analyze each signal in the MRSI slice using nonlinear least squares in order to get good starting values for the nonlinear spectral parameters and to constrain the parameters' variability to the selected neighbors. Moreover, the nonlinear least squares problem is modified by adding a penalty term, which encourages a spatially smooth parameter map. We conclude that using spatial information significantly improves metabolite estimates when quantifying MRSI data, which can be translated into easily interpretable metabolite maps.