Accelerated T1 Mapping using Model Based Reconstruction in an iteratively TGV regularized Gauss-Newton Framework

O. Maier[1], **M. Schlögl**[1], **A. Lesch**[1], **A. Petrovic**[1], **K. Bredies**[2], and **R. Stollberger**[1,3]

[1]Institute of Medical Engineering,Technical University of Graz, 8010 Graz, Austria, oliver.maier@tugraz.at

[2]Institute for Mathematics and Scientific Computing, University of Graz, 8010 Graz, Austria

[3]Biotechmed Graz, 8010 Graz, Austria

Quantitative T_1 mapping has the potential to substantially increase diagnostic information in the clinical routine. However, it suffers from a prolonged acquisition time which limits its application. To overcome this drawback, several speed up techniques haven been applied to T_1 mapping recently. We propose a model based reconstruction algorithm combined with Total Generalized Variation(TGV) regularization in order to further enhance acceleration potential.

Based upon the steady-state signal equation for SPGR sequences (DESPOT) we derive a cost function which describes the MR Signal intensity in terms of M_0, T_1, T_R and α. This function is fitted against the measurement data in terms of a L2 norm to find the unknown values of M_0 and T_1. Furthermore, TGV regularization is added to enhance reconstruction quality at higher speed up factors. Optimization is performed within an Iterative Regularized Gauss-Newton framework using a Primal-Dual algorithm for the inner iterations. The method is evaluated with numerical phantom data and applied to in-vivo measurements.

Reconstruction from numerical data agrees well with the reference values even for high speed up factors of 10. In-vivo data also shows good accordance to fully sampled DESPOT reference reconstructions as well as to literature values for a speed up of 10. The proposed method can easily be adapted to other model based reconstruction problems and offers the possibility of increased acceleration with high image quality due to the used TGV regularization.