Adaptive Sampling Optimization for Magnetic Resonance Imaging by Bayesian Experimental Design

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Abstract

Modern nonlinear reconstruction methods could be used to cut scan time of magnetic resonance acquisitions, a hard limit for this technology. Contrary to folklore, sparse reconstruction fails for real-world medical images if measurements are drawn blindly at random, a fact which calls for sampling to be adapted to data.

The optimization of k-space sampling for nonlinear sparse MRI reconstruction is phrased as Bayesian experimental design problem. Bayesian inference is approximated by a novel convex relaxation to standard computational primitives, resulting in an efficient optimization algorithm for general trajectories. On clinical resolution brain image data from a Siemens 3T scanner, automatically optimized trajectories lead to significantly improved images, compared to standard low-pass, equispaced or variable density randomized designs. Further advantages beyond sampling optimization of Bayesian over sparse estimation methodology will be motivated.

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