Abstract

Since its discovery over the last decade, Compressed Sensing (CS) has been successfully applied to Magnetic Resonance Imaging (MRI) as a powerful way to reduce scanning time without sacrificing image quality. MR images are actually strongly compressible in a wavelet basis, the latter being largely incoherent with the k-space or spatial Fourier domain where acquisition is performed. Nevertheless, since its first application to MRI, the theoretical justification of actual k-space sampling strategies is questionable. Indeed, the vast majority of k-space sampling distributions have been heuristically designed (e.g., variable density) or driven by experimental feasibility considerations (e.g., random radial or spiral sampling to achieve smoothness k-space trajectory). In this talk, we first bring a novel answer to the CS synthesis problem, which amounts to deriving the optimal k-space sampling distribution according to a given criterion. Then, we try to reconcile very recent CS results with the MRI specificities (magnetic field gradients) by enforcing the measurements, i.e. samples of k-space, to fit smooth trajectories. To this end, we propose to follow two alternative research tracks: First, we consider random while continuous sampling based on Markov chains and we compare the reconstruction quality of this scheme to the state-of-the-art. Second, we propose to generate continuous sampling trajectories by drawing a small set of measurements independently and joining them using a traveling salesman problem solver. Our contribution lies in the theoretical derivation of the appropriate probability density of the initial drawings. Preliminary simulation results in 2D and 3D show that this strategy is as efficient as independent drawings while being implementable on real acquisition systems.

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