Clinical Applications of Compressed Sensing: Introduction: Clinical Opportunities & Barriers to Mainstream Use

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Compressed sensing potentially offers either faster MRI or higher resolution MRI. Various approaches to compressed sensing in MRI have been proposed since some of the earliest reports (1-3), and preliminary results have been promising. While compressed sensing MRI has had rapid technical development, and some studies have been performed on phantoms, animals and volunteers (e.g. 4-7), deployment in the clinic to date has been more limited. This includes work done on accuracy of dynamic contrast-enhanced pharmacokinetic parameters in breast cancer patients (8). In the pediatric setting, compressed sensing has also been deployed to obtain faster scans with initial promising results (9).

As the acceleration in compressed sensing is premised on the sparseness of the object being imaged, and phantoms tend to have much simpler image features than human anatomy, validation *in vivo* is particularly important. Additionally, because compressed sensing reconstruction methods are nonlinear and iterative, there is potential for suppressing subtle pathology in images; hence, clinical validation is also critical. Further, traditional measures of image quality, such as signal to noise ratio, are difficult to apply to these types of reconstruction methods, and therefore, outcomes such as subjective radiologist image quality preference, sensitivity, and diagnostic accuracy will play a larger role in the evaluation of compressed sensing methods.

Currently, a significant barrier to clinical use is lengthy image reconstruction time. As the algorithms are iterative, they can be quite lengthy. Though there has been recent progress on developing fast implementations of these reconstructions, early clinical applications of compressed sensing that focus on achieving otherwise unobtainable clinical information are more likely to gain adoption. Example applications include capturing fast contrast agent kinetics at high spatio-temporal resolution and imaging uncooperative patients.

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