Accelerating Chemical Exchange Saturation Transfer (CEST) Imaging using Compressed Sensing Technique

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CEST imaging is an important molecular MRI technique that can generate contrast based on the proton exchange between labile protons in solutes and bulk water protons. Notably, amide proton transfer (APT) imaging, a variant of the CEST-based molecular MRI technique, is based on the chemical exchange between free bulk water protons and the amide protons (-NH) of mobile proteins and peptides. Recent research in patients with brain tumors has shown that APT-weighted (APTw) MRI has the potential to enhance the noninvasive identification of brain tumors from peritumoral edema or normal tissue, to differentiate high-grade from low-grade tumors, or to differentiate treatment-related damage from tumor recurrence. The early clinical applications of CEST-MRI are very promising, but have been limited mainly because of the long scan time required. Further, CEST-MRI is more vulnerable to patient motion. Therefore, the development of fast CEST imaging techniques are a high priority. Herein, we demonstrated the feasibility of accelerated CEST imaging in healthy volunteers and glioma patients at 3 T. Two approaches were evaluated: 1) combined CS and SENSE techniques and 2) a blind compressed sensing technique (which models the dynamic CEST signal as a weighted linear combination of temporal basis functions from a dictionary learned from the undersampled measurement). The use of CS would significantly accelerate the translation of APTw-MRI into a clinically viable, easy-to-use, and robust approach. We expect that accelerating APTw imaging could play a critically important role in the clinical evaluation of patients with brain tumor and hyperacute stroke, particulary for pediatric patients.