Probing Disease Chemistry with Joint Spatial and Spectral Imaging

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Technology description

Magnetic resonance spectroscopy (MRS) provides a noninvasive means of discovering and quantifying chemical compounds within an area of interest like the brain. The underlying principle is that the atomic nuclei of different molecules and compounds are shielded by a unique, telltale cloud of electrons. By reading the spectral patterns that result, doctors can identify the chemical species and metabolites indicative of Alzheimer’ s disease, cancer, stroke and other pathologies.
Recent advances in hyperpolarization (HP) techniques mean that molecular agents, such as ^{13}C, can be injected and tracked through the metabolic processes of the human body. This empowers MR imaging to probe disease and disorder at the molecular level. However, imaging (HP) ^{13}C compounds is more challenging than other contrast agents because of fast polarization decay. Conventional spectroscopic imaging approaches like chemical shift imaging (CSI) and spiral CSI have proven inadequate. UW–Madison researchers have developed a method for simultaneously generating spectral and spatial images of a subject using an MRI system.
A subject receives a dose of hyperpolarized imaging compound. MR image data is acquired from the subject according to a k-space sampling trajectory that spatially oversamples to encode both spatial and spectral frequency information at the oversampled points. The MR image data then can be reconstructed into the different image types using a model-based reconstruction technique and prior knowledge of the chemical species associated with the compound.

Application area

Model-based reconstruction approach for spatially and spectrally investigating a subject
MR software for use with hyperpolarization techniques

Advantages

Single-shot approach
Faster, more efficient data acquisition

Preserves polarization while providing high spectral resolution and signal to noise

Institution

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