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(G*) Magnetic Resonance Imaging Data Acquisition Acceleration and Feature Detection with Dictionary Learning

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Magnetic Resonance Imaging (MRI) is a powerful imaging modality with excellent soft tissue contrast. Contrast agent such as iron oxide nanoparticles can be used to "tag"individual cells, distorting the magnetic field around them and allowing the imaging of single cells. Time-lapse MRI can be used to track the motion of tagged cells, providing insights in the studies of inflammatory diseases and metastasis of cancer. Current methods have a very limited temporal resolution resulting in a detection limit of 1µm/s . In addition, the manual cell counting is time consuming and difficult.
In this work, a dictionary learning based technique has been developed to accelerate the MRI data acquisition and aid in the task of locating cells. Dictionary learning is a machine learning technique, in which features of an image can be 'learned'as atoms. Images can be represented using a sparse combination of atoms. The sparsity property can be used as a constraint in non-linear image reconstruction with data sampled below the Nyquist criteria. The undersampling improved the temporal resolution of the in-vivo measurements by approximately an order of magnitude. The dictionary atom coefficients provided information on the cell locations for feature detection.

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