Accelerated 4D Flow MRI Using a Shared Subspace Constraint

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Abstract

Cardiovascular diseases are the leading cause of death in the world, more than the next three leading causes of death combined. Cardiovascular imaging techniques have allowed for the study and understanding of the function and structure of the heart as well as the detection, diagnosis, and monitoring of cardiovascular diseases in patients. One powerful technique for cardiac imaging is 4D phase contrast magnetic resonance imaging (PC-MRI) which allows measurement of blood flow velocity in the heart and vessels. However, 4D PC-MRI is difficult to perform due to low imaging speed and is therefore often carried out using accelerated imaging techniques which reconstruct images from reduced data. One approach for accelerating PC-MRI is explicit-subspace low-rank imaging; this project focuses on further accelerating explicit-subspace low-rank PC-MRI through the use of a shared temporal subspace between PC-MR images with velocity encoded in different directions. We will: a) investigate the subspace structure of the differently encoded images to verify that they indeed live in a shared subspace; b) evaluate the feasibility of estimating this shared subspace from reduced auxiliary data (which has direct implications on the frame rate of the resulting images); and c) demonstrate the utility of exploiting this subspace structure when performing image reconstruction from reduced data.