Y. Mohsin, S.G Lingala, E. DiBella, M.Jacob, Accelerated dynamic MRI Using Patch Regularization for Implicit motion CompEnsation (PRICE), MRM, 2016
Yasir Mohsin <yasir-mohsin@uiowa.edu> and Mathews Jacob <mathews-jacob@uiowa.edu>

PRICE: MATLAB CODE PACKAGE

Description of the files

- **kdata_Cart.mat**: A 4D free-breathing and prospectively ECG-gated MRI cardiac CINE dataset in undersampled kspace form. The dimensions of the dataset are phase encodes × frequency encodes × time × channels: 128 × 128 × 20 × 12. This mat file also contains b1 file which is the coil sensitivities map with dimension 128 × 128 × 12. The data is in complex double precision and is obtained at the New York University, courtesy of Dr. Ricardo Otazo.

- **A_fhp3Dmulticoil.m**: The forward Fourier sampling operator.
- **Ah_fhp3Dmulticoil.m**: The backward Fourier sampling operator.
- **computeDtD.m**: This function computes the finite difference operator of the Dirac function needed to solve the left hand side after taking the Euler-Lagrange of equation [12].
- **giveH.m**: This function computes the finite difference operator DpH specified by equation [14] of the operator hq specified by equation [13]. This output is needed to solve the right hand side after taking the Euler-Lagrange of equation [12]. Also it computes the energy function used for plotting the convergence.
- **initializeVariables.m**: Function to initilaize the parameters used by the algorithm.
- **lefthand.m**: solves the left hand side after taking the Euler-Lagrange of equation [12].
- **shrinkage_L1_sat.m**: solves the shrinkage part of the scheme specified by equations [10] and [11].
- **L1_sat.m**: solves the thresholded distance metric Phi specified by equations [6].
- **nlm_simple2.m**: This function computes Euler-Lagrange of equation [12] using CG scheme.
- **start_multicoil.m**: Main PRICE file to run the above CINE data.

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Using the codes

- Run the **start_multicoil.m.m** file to use PRICE for reconstructing the CINE data.
- The different parameters for the algorithm are defined in the **input** variable.
- The inner and outer iterations can be set for more/less iterations of the scheme.
- **input.np/ input.nwin** define the size of the patches/neighborhood.
- **input.nt** defines the number of frames used to compare the patches/neighborhoods while **input.doublesided** used to define whether a single side/both sides are used for comparison (ie the frames after and/or before the current image).
- **input.T** is the threshold parameter while **input.w** is a weight given for temporal direction.
- **input.sigmaPatch** is sigma parameter used for the Gaussian filter.
- It is important to tune the regularization parameters appropriately to get the best results. The parameters are **input.lambda** and **input.beta.** The continuation parameter **input.beta** can be initialized to low values. The idea is to start with low value and gradually increment it until convergence. This continuation strategy is crucial when using the non-convex Schatten p-norm to avoid getting stuck in local minimum solutions. In PRICE we proposed a procedure for approximating the potential function by a quadratic function. The quality of this approximation, which converges uniformly to the original function, is controlled by a parameter β, becoming exact as $\beta \to \infty$. The figures below show the original function and the desired approximation with different values of β.