# Comparison of iterative parametric and indirect deep learning based reconstruction methods in highly

# breast

**These Matlab & Python codes are used as part of the work presented in:**

Aditya Rastogi and Phaneendra K. Yalavarthy, “Comparison of iterative parametric and indirect deep learning-based reconstruction methods in highly undersampled DCE‐MR Imaging of the breast," Medical Physics, (2020), [https://doi.org/10.1002/mp.14447](https://www.google.com/url?q=https%3A%2F%2Fdoi.org%2F10.1002%2Fmp.14447&sa=D&sntz=1&usg=AFQjCNFqnfPalVE-1psb-CC2qiBaYmHTDw)

Due to the size of the code, testing data (Patient B) and trained model weights the code is uploaded on Google Drive. The link to the code is attached below:-

<https://drive.google.com/drive/folders/12Byg-207xGgg6Sq13eYl2l-VGejXD7SV?usp=sharing>

Please mail me at **adityar[at]iisc[dot]ac[dot]in** if you encounter any problem in Downloading, Executing or understanding the code.

The code has 4 folders:-

1. **Test\_Direct** :- Constructs the Ktrans map using iterative direct reconstruction techniques.This generates the following
   * Fully sampled Ktrans (ground truth)
   * Ktrans with zero padding (US)
   * Ktrans with no regularization (L2), TV+L1 regularisation, L1 regularization only and TV regularization only.
   * This code is based on work done by Yi. Guo1 in this paper "Direct Estimation of Tracer-Kinetic Parameter Maps from Highly Undersampled Brain DCE-MRI" and uses some codes and libraries from his program available at "[https://github.com/usc-mrel/DCE\_direct\_recon](https://www.google.com/url?q=https%3A%2F%2Fgithub.com%2Fusc-mrel%2FDCE_direct_recon&sa=D&sntz=1&usg=AFQjCNFPUaRGEi5ibHRadCvrCRU1ZIBoLQ)".
   * This folder has 4 main files/folder:-
     1. **main.m :-** This file executes the code and estimates Ktrans map for undersampling rate of 20X, 50X and 100X.
     2. **lam\_mat.mat** :- This .mat file contains the regularization parameter values of all methods for all undersampling rates.
     3. **Dataset** :- This folder contains the dataset of patient B.
     4. **Vol** :- This folder contains the recontructed Ktrans map of patient B for all undersampling rates (R).
2. **Test\_NN** :- This folder contains the DL based models for indirect reconstruction of Ktrans maps. This code contains three folders:-
   * **ISTA-Net\_plus** :- This folder contains the weights and testing file of ISTA-Net+[2] as mentioned in paper :- "ISTA-Net: Interpretable Optimization-Inspired Deep Network for Image Compressive Sensing". This folder contains testing model and files for 20X, 50X and 100X undersampling. **The test data of patient B and undersampling mask are present in folder of MODL.** This code is used to estimate high resolution anatomical images from undersampled K-t space Data
     1. **MODL**:- This folder contains the trained models for 20X,50X and 100X undersampling. This code is used to estimate high resolution anatomical images from undersampled K-t space Data. This method is give by Hemant Kumar Aggarwal in his paper "MoDL: Model Based Deep Learning Architecture for Inverse Problems" and the original code of the paper is available at [https://github.com/hkaggarwal/modl](https://www.google.com/url?q=https%3A%2F%2Fgithub.com%2Fhkaggarwal%2Fmodl&sa=D&sntz=1&usg=AFQjCNGSNPuiGwP2TiQVdB_PjtjVOO5YzQ) .
     2. This folder also contains a folder name **test\_datasets** which has the testing dataset of Patient B and the 20X, 50X and 100X undersampling masks.
   * **TK\_modelling**:- This folder has 4 main components:-
     1. **recon\_NN** :- This folder contains the .h5py file that is reconstructed from MODL and ISTA-Net+ .
     2. **vol** :- This folder contains the estimated Ktrans maps using the reconstructed anatomical images of MODL and ISTA-Net+ .
     3. **Vol\_ISTA\_NN\_Kt\_Vp\_SEN\_AD\_3d**.m :- This file estimates Ktrans map from reconstructed anatomical images (via ISTA-Net+ ).
        1. **Vol\_MODL\_NN\_Kt\_Vp\_SEN\_AD\_3d**.m :- This file estimates Ktrans map from reconstructed anatomical images (via MODL ).
3. **Generate Results**:- This folder contains code and data to compare the results of direct and indirect estimation techniques. This folder has 3 main files/folders:-
   * **compare.m** :- This file compares the reconstructed Ktrans map from direct reconstruction techniques and indirect reconstruction techniques using 4 metrices (PSNR, nRMSE, SSIM and Xydeas metric).
     1. **Vol\_NN** :- This folder contains the Ktrans maps reconstructed using indirect DL based techniques for all R.
     2. **Vol** :- This folder contains the recontructed Ktrans map of patient B for all undersampling rates (R).
4. Make\_plots :- This folder plots the barchart of performance of direct and indirect estimation techniques for Patient B. It has a folder:-
   * **datasets**:- This folder contains a .mat file which consists of performance results of the US, L2, TV+L1 in terms of PSNR, nRMSE, SSIM and Xydeas metric.
   * **barplot**.**py** :- Is the python execution file.