# Aditya **Rastogi**


## Ph.D. Scholar | Medical Imaging Group | Indian Institute of Science

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Room 327, Department of Computational and Data Sciences, Indian Institute of Science, Bangalore 560012, India
Born January 18, 1995 (27 years old) in Bareilly, India


My research interests are computational methods in medical imaging, parameter estimation from dynamic magnetic resonance imaging, namely DCE-MRI and ASL, multi-modal imaging, medical image reconstruction techniques, and physiological modelling of pathologies. I like working in close collaboration with clinicians and prefer a more participatory role in processes like data acquisition.

## Education

**Aug 2018 - June 2022** *(Prospectively)**M.S + Ph.D.** in Computational and Data Sciences, from **Indian Institute of Science**, Bengaluru, India
Advisor : Prof. Phaneendra K Yalavarthy **CGPA: 9.0**
Dissertation : *Towards efficient and accurate models for inverse problems in Magnetic Resonance Imaging.*

**Aug 2012 - July 2016****B.Tech** in Mechanical Engineering, from **Delhi Technological University**, New Delhi, India
Advisor : Prof. Atul Kumar Agrawal **CGPA: 8.86**
Dissertation : *Computational modelling of Composite dynamics and fabrication techniques.*

## Research Projects

### Active Tuberculosis : Develop a deep based algorithm with an interactive graphical interface to clinical deployment

Ph.D., IISc

August 2021 -

- **Objective :** To develop a deep learning algorithm and a GUI for clinicians to detect Active TB cases from pulmonary CT scans and show the region of activation.
- **Method :** Used ensamble modelling to combine the outputs of VGG19, mobileNet V2 and ResNet18 to detect signatures of active TB on individual slices of scan and then combine this information for overall prediction.

Deep Learning | Computed Tomography

### VTDCE-Net : : A spatio-temporal dimension invariant network for estimation of tracer kinetic parameters

Ph.D., IISc

Pre-submission July 2021 -

- **Objective :** To propose a spatio-temporal invariant deep learning model for direct estimation of tracer kinetic paramters.
- **Method :** Proposed a deep learning algorithm which is invariant to the number of time samples by using a 2.5 D Unet architecture.

Inverse problem | DCE MRI | Deep Learning | Quantitative MRI

### Greybox : a hybrid algorithm for direct estimation of tracer kinetic parameters

Ph.D., IISc

Pre-submission Feb 2021 -

- **Objective :** To propose a hybrid deep learning model for solving nonlinear multiparametric inverse problem of permeability estimation.
- **Method :** Implemented direct hybrid DL based algorithms for parameter estimation using linear Patlak model on multi organ DCE MRI data. The experiments shows that the network performs statistically better than iterative direct parameter estimation techniques.

Inverse problem | DCE MRI | Deep Learning | Quantitative MRI | Hybrid models | Compressive Sensing

### SpiNet : a model based DL architecture for solving inverse problems

Ph.D., IISc

Github repository Paper Feb 2020 - Feb 2021

- **Objective :** To develop a model based DL architecture for solving linear inverse problems in medical imaging.
- **Method :** Developed a Schatten p-norm regularized medical image reconstruction architecture or **SpiNet**. This architecture is first of a kind DL architecture which can enforce any $l_p$ norm on prior where $p \in [0, 2)$ and it can be trainable or fixed. Current architectures only support either 1 norm or 2 norm on prior. This work is published [2] in **Medical Physics** journal.

Inverse problem | Fast MRI | Deep Learning | Hybrid models | Compressive Sensing

### Tracer Kinetic parameter estimation from undersampled DCE MRI data

Ph.D., IISc

Github repository Paper

Aug 2019 - Aug 2020

- **Objective :** To estimate permeability parameters from undersampled Dynamic Contrast Enhanced MRI data by implementing linear and non-linear pharmacokinetic models using iterative and deep learning based techniques.
- **Method :** Implemented indirect DL based and direct iterative algorithms for parameter estimation using linear Patlak model on Breast DCE MRI data. The study showed that for higher undersampling rates, indirect DL based techniques perform sub-par compared to direct iterative techniques. This work is published [1] in **Medical Physics** journal.

Inverse problem | DCE MRI | Deep Learning | Quantitative MRI | Hybrid models | Compressive Sensing

### Reducing scan time in Arterial Spin Labelling MRI

Ph.D., IISc

Dec 2020 -

- **Objective :** Reduce the number of Control/Label pair acquisition for perfusion estimation in psuedo continuous ASL brain image scans and thereby reduce the scan duration.
- In collaboration with National Institute of Mental Health and Allied Sciences (**NIMHANS**).

Inverse problem | ASL | Quantitative MRI | Hybrid models

### Fusion of Cardiac Angiography Images

Ph.D., IISc

Jan 2019 - Aug 2019

- **Objective :** Fusion of Cardiac Angiography images of different RR phases using guided image fusion. The ECG data was used to detect the phases with less motion of right coronary artery. The objective is to reduce the number of study images required by the diagnostician for detecting stenosis in RCA or LDA.
- In collaboration with Shri Satya Sai Institute of Higher Medical Sciences, Bangalore (**SSSIHMS**).

Image Fusion | Cardiac Imaging | Guided Filtering

### Computational modelling of Composite dynamics and fabrication techniques

BTech, DTU

2015 - Aug 2016

- Bachelor's Thesis for completion of BTech in Mechanical Engineering
- **Objective :** The thesis was a part of my project of Defianz racing in which I built a MATLAB library for computing the dynamics of Carbon fibre composites and calculated their deformations under tensile, compressive, shear, thermal, moisture and curing induced stress for different layers of composites and their orientation. The library can be used to analyze the final shape of the composite after curing based on the orientation of the layers.
- **Application :** Main application was to decide the orientation of Carbon fibre layers w.r.t. each other while fabricating the aerodynamic packages of the car so that the composite takes the shape of the mould without much distortion.

Carbon fibre | FSAE | Computational modelling

## Awards

**PMRF 2020** — Link
**Prime Minister's Research Fellowship**
Awarded Prime Minister's Research Fellowship (PMRF) for research in the field of "advanced physics based DL algorithms for medical image reconstruction". **This is the most prestigious and selective grant awarded by Government of India to Ph.D. students.**

**EECS 2021** — Link
**Best research presentation award**
Awarded presentation award for **SpiNet** paper at EECS students research symposium - 2021 organised by Indian Institute of Science.

**MHRD 2018-2020** — Link
**Ph.D Grant by Ministry of Human Resource and Development**
Awarded MHRD scholarship by Government of India for Ph.D. program.

## Relevant Courses

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|---|---|
| ML/DL/Mathematics | Neural Networks and Learning Systems, Numerical Optimization, Numerical Methods, Numerical Linear Algebra, Computational Fluid Dynamics, and Quantitative Techniques. |
| Others | Medical Imaging, Digital Signal Processing, Advance Image Processing, Instrumentation and Control Systems, Compressive Sensing and Sparse Signal Processing. |

## Teaching Assistance

- **DS 288: Numerical Methods** — CDS, IISc
- **DHIM: Advance Certification in Digital Health and Medical Imaging** — CDS, IISc

› **Class - XI Biology** Kendriya Vidyalaya, IISc
Teacher volunteer for **high-school** students under Prime Minister's Research Fellowship Scheme

## Research Grant Experience

Aug 2020 - Aug 2024 **Prime Minister's Research Fellowship :** Awarded by Ministry of Human Resource Development of Government of India for research in the field of interdisciplinary sciences. The grant duration is of four years with a total grant amount of approximately INR 58,00,000 ($79,000). The grant was awarded for research in the field of **"advanced physics based DL algorithms for medical image reconstruction".**

## Industry Experience

December 2017 – July 2018 | **Assitant Manager | Engine Calibration and Emission Group, R&D Hero MotoCorp Ltd., Jaipur, India**
› ECU control strategy development for BS 6 vehicles
Engine Calibration | Emission Control | ECU optimization

July 2016 – October 2017 | **Senior Engineer | Engine Calibration and Emission Group, R&D Bajaj Auto Ltd., Pune, India**
› Powertrain Calibration and Validation aspects of gasoline engines
Engine Calibration | Emission Control | ECU optimization

## Computer Skills

› **Programming Languages** : MATLAB, C, Python, HTML
› **Libraries** : Keras, Tensorflow, Git
› **OS** : Windows, Linux, MacOS

## Reviewer Work

› IEEE Transactions of Medical Imaging

## Journal Publications

[1] 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 47(10), 4838-4861 (2020). [doi: 10.1002/mp.14447]. [**This work is the first comprehensive comparison of compressive sensing reconstruction methods with model-based deep learning methods for breast perfusion imaging and shows that deep learning methods are sub-optimal at higher undersampling rates.**] Github repository Paper

[2] Aditya Rastogi and Phaneendra K. Yalavarthy, "*SpiNet: A Deep Neural Network for Schatten p-norm Regularized Medical Image Reconstruction*,"Medical Physics 48(5), 2214-2229 (2021). [doi: 10.1002/mp.14744]. [**This work is the first-of-its-kind in proposing a generic Schatten p-norm $(0 < p \leq 2)$ regularization based deep learning network for medical image reconstruction, where $p$ is a trainable parameter (chosen automatically).**] Github repository Paper

[3] Aditya Rastogi and Phaneendra K. Yalavarthy, "*Greybox: A hybrid algorithm for direct estimation of tracer kinetic parameters from undersampled DCE MRI data*," IEEE Transactions on Medical Imaging (Under review, Manuscript ID:TMI-2022-0239). [**This work proposes a robust hybrid algorithm for solving a multiparameteric non-linear inverse problem of direct estimation of Pharmacokinetic parameters from undersampled DCE MRI data.**]

[4] Aditya Rastogi,Arindam Dutta and Phaneendra K. Yalavarthy, "*VTDCE-Net: A spatio-temporal dimension invariant network for direct estimation of tracer kinetic parameters from undersampled DCE MRI data*," Medical Physics (Conditionally accepted, Manuscript ID: 22-104). [**This is deep learning based architecture for direct estimation of permeability parameters from undersampled DCE MRI data. This network is invariant to number of time samples and spatial dimensions.**]

## Talks/Presentations

**IISc EECS Research Student Symposium** IISc
Title : "Model based deep learning architecture for generalized p-norm regularization" May 2021

**CDS Students' Research Presentation** IISc
Title : "Fast and Efficient Algorithms for Improving Magnetic Resonance Imaging" April 2021

**IPwin2021: Virtual PhD Winter School at DTU, Denmark** — DTU
Title : "Fast and Efficient Algorithms for Improving Magnetic Resonance Imaging" — Jan 2021

**CDS Students' Research Presentation (Poster presentation)** — IISc
Title : "Model based techniques for indirect Tracer Kinetic parameter estimation" — August 2019

## References


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