Aditya **Rastogi,** PhD

Post Doctoral Scholar | Dept of Neuroradiology | Universitätsklinikum Bonn

linkedin.com/in/aditya-rastogi-8167417b github.com/adityarastogi2k12
+49 15228161128 aditya.rastogi@ukbonn.de http://adityarastogi2k12.github.io
Neuroradiologie, Universitätsklinikum Bonn, Venusberg Campus 1/Gebäude 81, Bonn 53217, Germany

My research interests are computational methods in medical imaging involving deep learning, radiomics and solving inverse problems like 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 am a Postdoctoral scholar and technical group leader at Division for Computational Radiology and Clinical AI in **University Hospital Bonn, Germany** working with Prof. Dr. med. Philipp Vollmuth. I completed my M.Tech (Research) and Ph.D. from **Indian Institute of Science (IISc)** which is ranked as best university and research institute by Ministry of Education, Government of India as per NIRF Ranking of 2023 and best university in India as per QS ranking 2023.

Education

Aug 2018 - June 2022 — **M.Tech (Research) + Ph.D.** from Dept. of Computational and Data Sciences, **Indian Institute of Science (IISc)**, Bengaluru, India
Advisor : Prof. Phaneendra K Yalavarthy **CGPA: 9.0**
Dissertation : *Development of Novel Deep Learning Methods for Fast-MRI: Anatomical Image Reconstruction to Quantitative 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.*

Position

July 2024 - June 2024 — **Postdoctoral scholar | Division for Computational Radiology and Clinical AI, CCI-Bonn, University Hospital Bonn, Germany**
P.I : Prof. Dr. med. Philipp Vollmuth

- Technical group leader responsible for developing AI/ML algorithms in medical imaging and guiding PhD and Master students.
- Development of neurological vision foundational model.
- Developing deep learning models for MR scan-time reduction.
- Developing test-time adaptation strategies for Brain Metastasis tumour segmentation.

Deep Learning | Computer vision | Foundational model | MR Image Reconstruction | Radiomics

July 2022 - June 2024 — **Postdoctoral Researcher | Section of Computational Neuroimaging, Heidelberg University Hospital, Germany**
P.I : Prof. Dr. med. Philipp Vollmuth

- Developing model-based deep learning algorithm for MR image reconstruction.
- Develop strategies for robust and reproducible radiomic feature extraction.
- Deploy Federated Learning framework for tumor classification and predicting stroke outcome.

Deep Learning | Computer vision | Foundational model | Federated Learning | MR Image Reconstruction | Radiomics

Research Projects

Multi-centric study of the impact of radiomic feature normalization on glioblastoma prediction — PostDoc, UKHD

Data Collection Stage — Jan 2023 -

- **Objective :** To analyze the stability and reproducibility of various image and feature normalization techniques on glioblastoma prediction using multi-centric radiomic data.
- **Method :** The MR images are normalized using various techniques for feature extraction and the radiomic features are calculated using various bin setting to assess the stability and reproducibility towards glioblastoma prediction.

Radiomics | Tumor Prediction

Analyzing Downstream effects of Fast MRI

PostDoc, UKHD

Github repository

Aug 2022 - Dec 2023

- **Objective :** To analyze the effect of deep learning-based reconstruction of undersampled MR images on downstream tasks like Tumor segmentation, Survival Prediction etc.
- **Method :** Different sequences of MR images are reconstructed using a model-based deep learning algorithm. The results are further processed using pre-trained algorithms (on fully sampled data) and the results are compared to evaluate any drop in performance.
- Accepted in **Lancet Oncology** (In press).

Deep Learning | Inverse Problem | Tumor Segmentation

VALIDATE: Federated Learning for stroke outcome prediction

PostDoc, UKHD

Website

Aug 2022 -

- **Objective :** To develop a trustworthy AI-based prognostic tool for predicting patient outcomes in Acute Stroke.
- **Method :** Use an open-source Federated Leaning library to train a neural network which uses multi-modal imaging and clinical data.

Deep Learning | Federated Learning

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

Ph.D., IISc

Github repository Paper

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.
- Accepted in **Medical Physics** (In press).

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

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

Ph.D., IISc

Github repository Paper

July 2021 - Nov 2022

- **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. This work is published [3] in **Medical Physics** journal.

Inverse problem | DCE MRI | Deep Learning | Quantitative MRI

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

Awards

PMRF 2020 — **Prime Minister's Research Fellowship**
Link
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 — **Best research presentation award**
Link
Awarded presentation award for **SpiNet** paper at EECS students research symposium - 2021 organised by Indian Institute of Science.

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

Relevant Courses

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
- **DS 260: Medical Imaging** — 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".**

Computer Skills

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

Reviewer Work

- IEEE Transactions of Medical Imaging

Selected Journal Publications

[1] Rastogi, A., Brugnara G, Foltyn-Dumitru M, Mahmutoglu M,..., Maier-Hein KH, Radbruch A,..., Vollmuth P., "*Deep-learning-based reconstruction of undersampled MRI to reduce scan times: a multicenter retrospective cohort study.*," Lancet Oncology 2024 (in press). [The research demonstrates using comprehensive experiments that deep convolutional neural networks (dCNN) can significantly reduce MRI scan times, achieving a tenfold acceleration compared to traditional methods. This technique maintains high image quality and accurately assesses oncological treatment responses. Additionally, the dCNN showed robust generalizability on the public fastMRI benchmark dataset, indicating its wide applicability in medical imaging.] Github repository

[2] Rastogi, A. and Yalavarthy, P.K., "*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

[3] Rastogi, A. and Yalavarthy, P.K., "*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

[4] Rastogi, A., Dutta, A. and Yalavarthy, P.K., "*VTDCE-Net: A spatio-temporal dimension invariant network for direct estimation of tracer kinetic parameters from undersampled DCE MRI data*," Medical Physics 2022;1-13. [doi: 10.1002/mp.16081]. [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.] Github repository Paper

[5] Rastogi, A. and Yalavarthy, P.K., "*Greybox: A hybrid algorithm for direct estimation of tracer kinetic parameters from undersampled DCE MRI data*," Medical Physics 2024 (in press). [doi: 10.1002/mp.16935]. [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.] Github repository Paper

[6] Brugnara, G., Baumgartner, M., Scholze, E. D., Deike-Hofmann, K., Kades, K., Scherer, J., Denner, S., Meredig, H., Rastogi, A., Mahmutoglu, M. A., Ulfert, C., Neuberger, U., Schönenberger, S., Schlamp, K., Bendella, Z., Pinetz, T., Schmeel, C., Wick, W., Ringleb, P. A., Floca, R., Vollmuth, P., "*Deep-learning based detection of vessel occlusions on CT-angiography in patients with suspected acute ischemic stroke*," Nature communications, 14(1), 4938 (2023). https://doi.org/10.1038/s41467-023-40564-8

[7] Foltyn-Dumitru, M., Schell, M., Rastogi, A., Sahm, F., Kessler, T., Wick, W., Bendszus, M., Brugnara, G., & Vollmuth, P., "*Impact of signal intensity normalization of MRI on the generalizability of radiomic-based prediction of molecular glioma subtypes*," European radiology, 10.1007/s00330-023-10034-2 (2023). Advance online publication. https://doi.org/10.1007/s00330-023-10034-2

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

Prof. Dr. med. Philipp Vollmuth
Professor
Division for Computational Radiology & Clinical AI
Clinic for Neuroradiology, University Hospital Bonn
Venusberg Campus 1, Gebäude 81
Bonn, 53217, Germany
philipp.vollmuth@ukb.de

Prof. Phaneendra K Yalavarthy
Professor, PhD Advisor
Medical Imaging Group Webpage
Dept. of Computational and Data Sciences (CDS)
Indian Institute of Science
Bengaluru, KA, India, 560012
yalavarthy@iisc.ac.in
+91-80-2293 2496

Prof. Atul Kumar Agrawal
Professor, BTech Advisor
Dept of Mechanical Engineering
Delhi Technological University
Shahbad Daulatpur
New Delhi, India, 110042
atulkumaragarwal@dce.ac.in
+91-9811886443