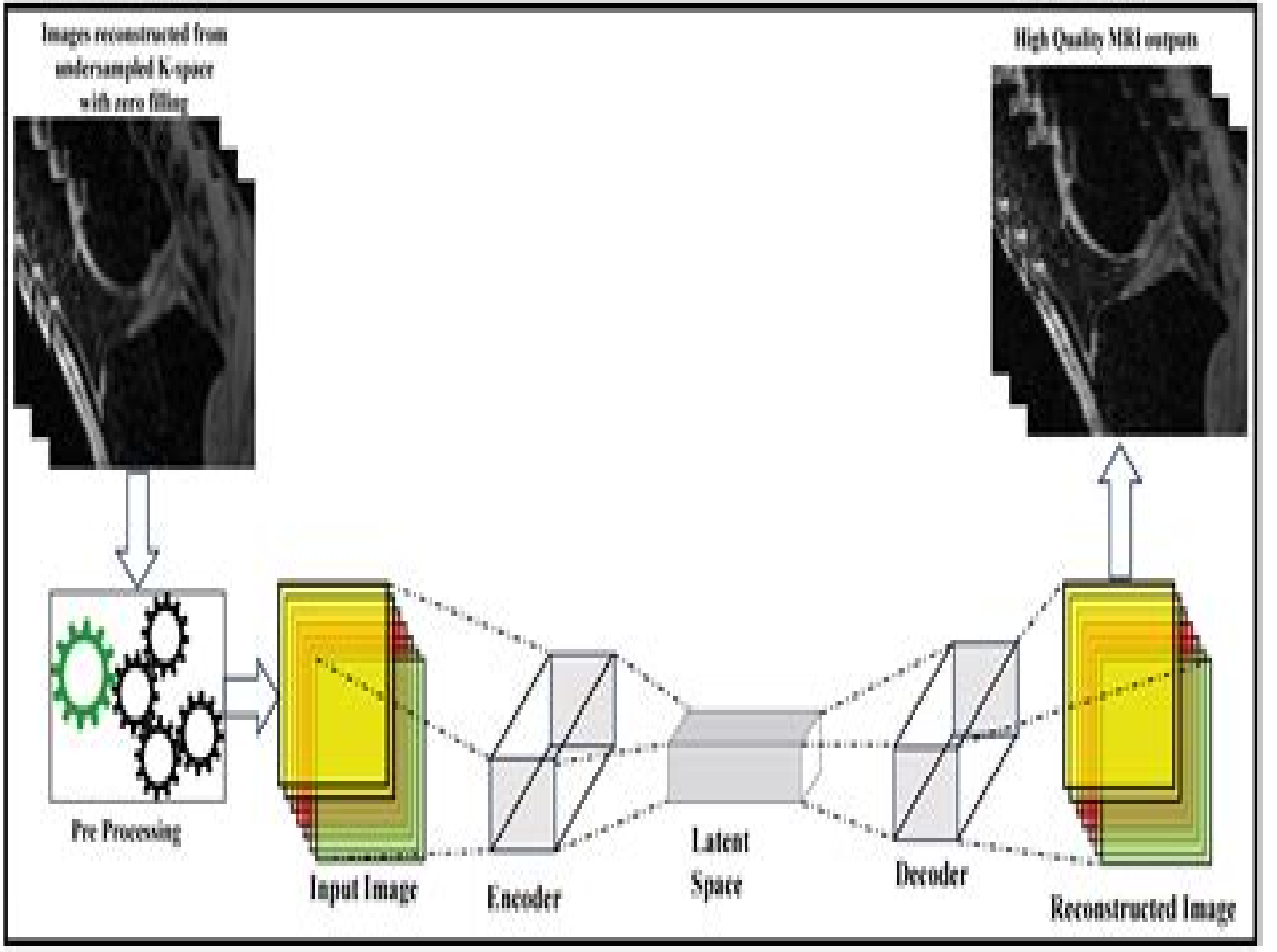

Images reconstructed from undersampled K-space with zero filling
High Quality MRI outputs
Pre Processing
Input Image
Encoder
Latent Space
Decoder
Reconstructed Image

Deep Learning For Undersampled Mri Reconstruction

Mehmet Akcakaya,Mariya Ivanova Doneva,Claudia Prieto

Deep Learning For Undersampled Mri Reconstruction:

Machine Learning in MRI Thomas Kuestner,Hao Huang,Christian F Baumgartner,Sam Payabvash,2025-12-23 Machine Learning in MRI From Methods to Clinical Translation Volume Thirteen in theAdvances in Magnetic Resonance Technology and Applications series presents state of the art machine learning methods in magnetic resonance imaging that can shape and impact the future of patient treatment and planning Common methods and strategies along the processing chain of data acquisition image reconstruction image post processing and image analysis of these imaging modalities are presented and illustrated The book focuses on applications and anatomies for which machine learning methods can bring or have already brought Ideas and concepts on how processing could be harmonized and used to provide deployable frameworks that integrate into the clinical workflows are also considered Pitfalls and current limitations are discussed in the context of how they could be overcome to cater for clinical needs making this an ideal reference for medical imaging researchers industry scientists and engineers advanced undergraduate and graduate students and clinicians By giving an interdisciplinary presentation and discussion on the obstacles and possible solutions for the clinical translation of machine learning methods this book enables the evolution of machine learning in medical imaging for the next decade Brings together applied researchers clinicians and computer scientists to give an interdisciplinary perspective on the methods of machine learning in MRI and their potential clinical translation Gives a clear presentation of the key concepts of machine learning Shows how machine learning methods can be applied to MR image acquisition MR image reconstruction MR motion correction MR image post processing and MR image analysis Includes application chapters that show how the methods can translate into medical practice *Quantitative imaging (QI) and artificial intelligence (AI) in cardiovascular diseases* Sebastian Kelle,Rene M. Botnar,Marcus R. Makowski,Daniel Rueckert,Alexander Meyer,2023-05-17 **Clinical Image-Based Procedures, Fairness of AI in Medical Imaging, and Ethical and Philosophical Issues in Medical Imaging** Stefan Wesarg,Esther Puyol Antón,John S. H. Baxter,Marius Erdt,Klaus Drechsler,Cristina Oyarzun Laura,Moti Freiman,Yufei Chen,Islem Rekik,Roy Eagleson,Aasa Feragen,Andrew P. King,Veronika Cheplygina,Melani Ganz-Benjaminsen,Enzo Ferrante,Ben Glocker,Daniel Moyer,Eikel Petersen,2023-10-09 This book constitutes the refereed proceedings of the 12th International Workshop on Clinical Image Based Procedures CLIP 2023 the First MICCAI Workshop on Fairness of AI in Medical Imaging FAIMI 2023 and the Second MICCAI Workshop on the Ethical and Philosophical Issues in Medical Imaging EPIMI 2023 held in conjunction with MICCAI 2023 in October 2023 CLIP 2023 accepted 5 full papers and 3 short papers form 8 submissions received It focuses on holistic patient models for personalized healthcare with the goal to bring basic research methods closer to the clinical practice For FAIMI 2023 19 full papers have been accepted from 20 submissions They focus on creating awareness about potential fairness issues that can emerge in the context of machine learning And for EPIMI 2023 2 papers have been accepted from 5 submissions They investigate questions that underlie medical imaging research at the most fundamental level **Artificial Intelligence in Cardiothoracic Imaging** Carlo N. De Cecco,Marly van Assen,Tim Leiner,2022-04-22 This book provides an overview of current and potential applications of artificial intelligence AI for cardiothoracic imaging Most AI systems used in medical imaging are data driven and based on supervised machine learning Clinicians and AI specialists can contribute to the development of an AI system in different ways focusing on their respective strengths Unfortunately communication between these two sides is far from fluent and from time to time they speak completely different languages Mutual understanding and collaboration are imperative because the medical system is based on physicians ability to take well informed decisions and convey their reasoning to colleagues and patients This book offers unique insights and informative chapters on the use of AI for cardiothoracic imaging from both the technical and clinical perspective It is also a single comprehensive source that provides a complete overview of the entire process of the development and use of AI in clinical practice for cardiothoracic imaging The book contains chapters focused on cardiac and thoracic applications as well more general topics on the potentials and pitfalls of AI in medical imaging Separate chapters will discuss the valorization regulations surrounding AI cost effectiveness and future perspective for different countries and continents This book is an ideal guide for clinicians radiologists cardiologists etc interested in working with AI whether in a research setting developing new AI applications or in a clinical setting using AI algorithms in clinical practice The book also provides clinical insights and overviews for AI specialists who want to develop clinically relevant AI applications *Machine Learning in Medical Imaging* Xuanang Xu,Zhiming Cui,Islem Rekik,Xi Ouyang,Kaicong Sun,2024-10-22 This book constitutes the proceedings of the 15th International Workshop on Machine Learning in Medical Imaging MLMI 2023 held in conjunction with MICCAI 2024 Marrakesh Morocco on October 6 2024 The 63 full papers presented in this volume were carefully reviewed and selected from 100 submissions They focus on major trends and challenges in the above mentioned area aiming to identify new cutting edge techniques and their uses in medical imaging using artificial intelligence AI and machine learning ML *Machine Learning in Medical Imaging* Xiaohuan Cao,Xuanang Xu,Islem Rekik,Zhiming Cui,Xi Ouyang,2023-10-14 The two volume set LNCS 14348 and 14139 constitutes the proceedings of the 14th International Workshop on Machine Learning in Medical Imaging MLMI 2023 held in conjunction with MICCAI 2023 in Vancouver Canada in October 2023 The 93 full papers presented in the proceedings were carefully reviewed and selected from 139 submissions They focus on major trends and challenges in artificial intelligence and machine learning in the medical imaging field translating medical imaging research into clinical practice Topics of interests included deep learning generative adversarial learning ensemble learning transfer learning multi task learning manifold learning reinforcement learning along with their applications to medical image analysis computer aided diagnosis multi modality fusion image reconstruction image retrieval cellular image analysis molecular imaging digital pathology etc **Intelligent Diagnosis with Adversarial Machine Learning in Multimodal Biomedical Brain Images** Yuhui Zheng,Zexuan Ji,Heye Zhang,Jonathan Wu,2021-09-23

Advances in Artificial Intelligence and Machine Learning Applications for the Imaging of Bone and Soft Tissue Tumors Brandon K. K. Fields,George R. Matcuk Jr.,Bino A. Varghese,2025-01-03 Increasing interest in the development and validation of quantitative imaging biomarkers for oncologic imaging has in recent years inspired a surge in the field of artificial intelligence and machine learning Initial results showed promise in identifying potential markers of treatment response malignant potential and prognostic predictors among others however while many of these early algorithms showed the optimistic ability to separate pathologic states on in house datasets it was often the case that these classifiers generalized poorly on external validation sets and thus were of limited utility in the clinical setting This issue was additionally compounded by the frequent use of data filtering and feature selection techniques in many studies to further bolster the machine learning results in limited case scenarios thereby biasing the overall fit and further reducing generalizability

Medical Image Computing and Computer Assisted Intervention – MICCAI 2021 Marleen de Bruijne,Philippe C. Cattin,Stéphane Cotin,Nicolas Padoy,Stefanie Speidel,Yefeng Zheng,Caroline Essert,2021-09-22 The eight volume set LNCS 12901 12902 12903 12904 12905 12906 12907 and 12908 constitutes the refereed proceedings of the 24th International Conference on Medical Image Computing and Computer Assisted Intervention MICCAI 2021 held in Strasbourg France in September October 2021 The 531 revised full papers presented were carefully reviewed and selected from 1630 submissions in a double blind review process The papers are organized in the following topical sections Part I image segmentation Part II machine learning self supervised learning machine learning semi supervised learning and machine learning weakly supervised learning Part III machine learning advances in machine learning theory machine learning attention models machine learning domain adaptation machine learning federated learning machine learning interpretability explainability and machine learning uncertainty Part IV image registration image guided interventions and surgery surgical data science surgical planning and simulation surgical skill and work flow analysis and surgical visualization and mixed augmented and virtual reality Part V computer aided diagnosis integration of imaging with non imaging biomarkers and outcome disease prediction Part VI image reconstruction clinical applications cardiac and clinical applications vascular Part VII clinical applications abdomen clinical applications breast clinical applications dermatology clinical applications fetal imaging clinical applications lung clinical applications neuroimaging brain development clinical applications neuroimaging DWI and tractography clinical applications neuroimaging functional brain networks clinical applications neuroimaging others and clinical applications oncology Part VIII clinical applications ophthalmology computational integrative pathology modalities microscopy modalities histopathology and modalities ultrasound The conference was held virtually *Deep Learning-Based Image Reconstruction in Abdominal and Cardiac Magnetic Resonance Imaging (MRI)* Chang Gao,2023 MRI plays an important role in abdominal and cardiac imaging due to its excellent soft tissue contrast and high image resolution Despite the benefit of excellent image quality MRI acquisition is intrinsically slow causing patient discomfort and slowing down the clinical workflow which hinders its broad clinical use For decades undersampling reconstruction techniques have been investigated to accelerate MRI acquisition Traditional parallel imaging and compressed sensing methods either have limited acceleration capability or require extensive computational and time resources While the recent development of deep learning achieved unprecedented performance in image reconstruction and image enhancement tasks there are challenges remaining to be solved One challenge is the potential loss of image details due to network over smooths or over regularization Another challenge is that networks may struggle to generalize well to diverse MRI data acquired under different conditions In medical imaging high quality diverse datasets are challenging to acquire especially for rare or specialized MRI applications Lastly for non Cartesian sampling the reconstruction can be challenging due to the need for time consuming interpolation of non Cartesian k space onto a Cartesian basis The overall goal of the dissertation is to contribute to the development of deep learning based accelerated image reconstruction techniques and investigate the challenges in network development as mentioned above Specifically we aim to develop deep learning networks to improve image quality and reduce artifacts and noise for the application of 1 undersampled radial MRI reconstruction in the abdomen aims 1 and 2 and 2 ferumoxytol enhanced cardiac cine MRI reconstruction aim 3 In aim 1 I developed a generative adversarial network using paired undersampled and ground truth images to reduce streaking artifacts and preserve image sharpness In aim 2 I developed a radial k space prediction framework by training an attention based transformer network on k space data By combining the acquired and predicted k space data the reconstructed images will have an improved signal to noise ratio and fewer streaking artifacts In aim 3 I developed an unrolled spatiotemporal deep learning network for ferumoxytol enhanced cardiac cine MRI reconstruction The network was trained using non contrast enhanced bSSFP cine images and can be successfully generalized to ferumoxytol enhanced images *Machine Learning for Medical Image Reconstruction* Nandinee Haq,Patricia Johnson,Andreas Maier,Tobias Würfl,Jaejun Yoo,2021-09-29 This book constitutes the refereed proceedings of the 4th International Workshop on Machine Learning for Medical Reconstruction MLMIR 2021 held in conjunction with MICCAI 2021 in October 2021 The workshop was planned to take place in Strasbourg France but was held virtually due to the COVID 19 pandemic The 13 papers presented were carefully reviewed and selected from 20 submissions The papers are organized in the following topical sections deep learning for magnetic resonance imaging and deep learning for general image reconstruction **Applying Machine Learning and Deep Learning for Improved Acquisition, Reconstruction and Quantification in MRI** Enhao Gong,2018 Magnetic Resonance Imaging MRI is a powerful imaging modality that is frequently used in both clinical and academic settings With its advantages of flexibility in signal encoding we can use MRI to non invasively visualize various soft tissue contrasts showing not only anatomical but also metabolic and functional information In addition MRI is a radiation free modality which makes it favorable in numbers of clinical applications because of the reduced radiation risk compared with other radiology modalities such as X ray Computed Tomography CT Positron

Emission Tomography PET etc Despite the advantages of MRI techniques there are still several challenges preventing MRI from becoming more efficient and accessible First the scan time for MRI is usually longer than other modalities such as X ray and CT since it requires enough measurements to resolve high quality images for diagnostic tasks In order to accelerate MRI various fast imaging techniques such as Parallel Imaging PI and Compressed Sensing CS have been proposed to speed up MRI acquisition using under sampling However it is still unclear what is the best approach to conduct the under sampling as different under sampling patterns may result in different reconstruction quality Second the reconstruction methods for under sampled MRI need further improvement The reconstruction algorithms are formed as nonlinear optimization problems using iterative optimization that can be time consuming Fixed and handcrafted penalty terms are usually used to regularize the optimization which are hard to tune There are often trade offs between the speed of the algorithm and the quality of resulting images In many cases the imperfect artifact suppression or over smoothing slows down the clinical adoption of these fast imaging techniques Third MR images are typically not quantitative Most clinical MRI protocols used nowadays are contrast weighted sequences which incorporate the tissue contrasts in qualitative ways Therefore the resulting MR images may vary a lot between different protocols and scanners which makes it very difficult for radiologists to conduct quantitative analysis or longitudinal comparison In this work we propose to resolve these remaining challenges to further improve MRI technologies We utilized state of the art Machine Learning and Deep Learning algorithms to significantly improve these three essential components in MRI faster acquisition better reconstruction and more accurate qualification Specifically we firstly propose a machine learning based method to optimize the undersampling pattern for accelerated acquisition The results validated on in vivo multi contrast brain and prostate MRI datasets demonstrate that the proposed method can generalize well for different anatomy It enables efficient 5sec 10sec and adaptive under sampling pattern optimization at per subject per scan level and achieves 30% 50% lower PI CS reconstruction error at the same acceleration factor To improve MRI acquisition with a safer protocol and lower contrast dose a deep learning model is developed to enhance the MRI The proposed Deep Learning method yielded significant N 50 p 0 001 improvements over the low dose 10% images 5dB PSNR gains and 11 0% SSIM Ratings on image quality and contrast enhancement are significantly N 20 p *Deep Learning Innovations in MRI Reconstruction and Analysis* Soumick Chatterjee,2026-02-19 High resolution magnetic resonance imaging MRI is clinically vital but inherently slow Accelerating acquisition via undersampling introduces artefacts whereas long scans risk motion blur traditional solutions such as compressed sensing often fail under such heavy corruption Consequently this thesis investigates deep learning methods to correct these artefacts It develops pipelines for the reconstruction of undersampled Cartesian and radial and motion corrupted data and for super resolution whilst exploring the integration of prior knowledge and complex valued convolutions Beyond visual diagnostics the thesis examines the impact of reconstruction on automated image processing It proposes and evaluates pipelines for classification segmentation supervised and weakly semi supervised anomaly detection and registration Validated on brain tumour and vessel tasks the study demonstrates that the proposed deep learning based reconstruction effectively supports both clinical inspection and robust automated decision making systems *Redundancy and Robustness in Deep Learning with Applications to Digital Communications and Magnetic Resonance Imaging* Marius Octavian Arvinte,2022 Compressed representations are a fundamental building block in signal processing algorithms whether the downstream applications involve data storage reconstruction from undersampled measurements or sampling from structured high dimensional distributions This dissertation proposes the use of compression in conjunction with modern deep learning tools to achieve robust downstream performance in the following applications robust compression and numerical quantization in digital communication systems robust wireless channel estimation in digital communication systems and robust magnetic resonance imaging reconstruction from undersampled measurements The choice to investigate magnetic resonance imaging MRI in the same dissertation as digital communication systems may seem arbitrary but it is not For the past two decades clinical high field MRI scanners operate using the principles of parallel imaging by acquiring undersampled electromagnetic field measurements using a set of sensitivity coils placed around the target anatomy brain knee abdomen etc This has led to the formulation of MRI image reconstruction as an inverse problems and to seminal research papers that use compressed sensing to solve it Incidentally this is also akin to a single input multiple input SIMO digital communication system leading to a large overlap of signal processing and optimization algorithms being reused between the two fields Representing information in digital communication systems using as few bits as possible is a fundamental requirement for power efficient devices that either have limited memory or communication bandwidth Storing or forwarding such compressed information is a requirement that arises in different aspects of digital communication soft bit storage is important in re transmission request protocols where the receiver wants to hold on to as much information as possible from failed transmissions while forwarding soft bits to a third party using a finite communication budget is an essential component in fronthaul and relay communications In the first part of this dissertation I introduce my work on deep learning for soft bit quantization in high dimensional communication systems The approach builds on a fundamental observation concerning the sufficient feature representation of the vector of maximum likelihood ML soft bits derived from a scalar channel use and extends this to multi carrier and arbitrary multiple input multiple output MIMO channels A closely related problem is that of soft bit estimation which has two components i developing algorithms that can efficiently approximate the ML solution and ii accurately estimating channel state information in high dimensional systems I present data driven methods to address both these problems For the first I connect soft bit compression from the previous paragraph with soft bit estimation and show that a feature learning approach can lead to efficient high fidelity estimation that is on par with supervised approaches For the second problem I propose a broader solution that uses a score based generative model to learn the distribution of wireless channels from synthetic data This model can be then used for downstream tasks such as sampling and estimation where we show robust performance under severe environment changes in synthetic scenarios with reductions of more than an order of magnitude in estimation error compared to competing deep learning approaches To address the problem of robust undersampled MRI reconstruction the final chapter of this dissertation introduces two deep learning methods The Deep J Sense approach combines iterative optimization with deep learning to learn reconstructions that are robust to measurement patterns The key insight used to achieve this is inspired by previous work that treats the coil sensitivity profiles as dynamic optimization variables In a different line of research I have contributed to the use of score based generative models for learning the distribution of MRI images and using this for robust downstream reconstruction under anatomy and measurement pattern shifts as well as introducing efficient single shot adaptation methods under these shifts Altogether these methods have tried to touch on different aspects and tasks that are present in high dimensional systems whether their role is for communication or imaging and propose solutions that increase efficiency whether related to storage budget resource overhead energy consumption or human discomfort **Deep Learning for Biomedical Image Reconstruction** Jong Chul Ye,Yonina C. Eldar,Michael Unser,2023-10-12 Discover the power of deep neural networks for image reconstruction with this state of the art review of modern theories and applications The background theory of deep learning is introduced step by step and by incorporating modeling fundamentals this book explains how to implement deep learning in a variety of modalities including X ray CT MRI and others Real world examples demonstrate an interdisciplinary approach to medical image reconstruction processes featuring numerous imaging applications Recent clinical studies and innovative research activity in generative models and mathematical theory will inspire the reader towards new frontiers This book is ideal for graduate students in Electrical or Biomedical Engineering or Medical Physics **Comparing the Training Performance of a Deep Neural Network for Accelerated MRI Reconstruction Using Synthesized and Realistic K-Space Data** Anil Kemisetti,2021 Magnetic Resonance Imaging MRI is a powerful medical imaging modality used as a diagnostic tool There is a steady rise in the imagining examination Trends from 2000 2016 showed that nearly 16 million to 21 million patients had enrolled annually in various US health care systems The number of MRIs per 1000 increased from 62 per 1000 to 139 per 1000 patients from 2000 to 2016 MR images are usually stored in Picture Archiving and Communication Systems PACS in Digital Imaging and Communication in Medicine DICOM DICOM format includes a header and imaging data MRI k space is the raw data obtained during the MR signal acquisition The file size of complex MR data is huge It is generally transformed into the anatomical imaging data and raw data is discarded and not transferred to the PACS The abundant DICOM data has the potential to be used for training neural networks Deep Neural Network models depend on the extensive training datasets DICOM images are magnitude images without the image phase It is essential to understand the effect of missing image phase information to use the DICOM data for this training task effectively My thesis attempts to compare a deep neural network s performance for accelerated MRI reconstruction using the k space to DICOM only data MR imaging offers a great deal of control to the user to acquire the data and reconstruct the clinical images All this comes at the cost of an increase in the acquisition time Typical scan times are between 30 to 40 mins Scan times go up to 60 mins if a contrast agent needs to be administered Such long acquisition times are not only expensive but a cause of inconvenience to the subject as it is impossible to stay motionless in the bore during the whole duration Two areas are of interest to reduce the scan time i accelerated acquisition and ii fast and efficient reconstruction Methods like compressed sensing and parallel imaging are used to accelerate MRI acquisition Compressed sensing achieves scan acceleration by overcoming the requirement of Nyquist sampling criteria An undersampling pattern like the Poisson Disk undersampling pattern is used to acquire an incoherent random sparse signal instead of the full k space The sigpy mri python library s Poisson API was used to simulate this undersampling This Python API generates a variable density Poisson disc sampling pattern Compressed Sensing theory mentions that image reconstruction would be possible using signals less than the number indicated by Nyquist as long as the k space undersampling is done incoherently which does not lead to structural aliasing when the anatomical image is constructed This algorithm combines the undersampling with partial Fourier imaging This API uses a fully sampled calibration region at the center of the k space in addition to the acceleration factor The acceleration factor is used for undersampling the region outside the fully sampled center region Poisson disk undersampling does random sampling while constraining the maximum and minimum distance This scheme leads to incoherent sampling and avoids structural artifacts After the image acquisition comes the reconstruction of the fully sampled k space or the anatomical image with good SNR A deep learning neural network was trained to perform the reconstruction of the retrospectively undersampled data The undersampled raw k space data s training performance is compared with that of the undersampled k space data obtained from the DICOM data Our experiments have shown that the magnitude obtained from raw k space data has consistently shown better initial training performance and faster convergence when compared to the magnitude image obtained from the DICOM image It is also observed that after training enough epochs the performance of the model trained using raw data is comparable to that of the DICOM images The significance of this finding is in the fact that the abundantly available DICOM data can be used to train a deep neural network to perform reconstruction of the undersampled k space FastMRI is a research project from Facebook AI FAIR and NYU Langone Health The dataset for this project is publicly available This dataset has two types of scans knee MRI and brain MRI For this work we have used single coil knee MRI data For performing the training 2D slices from these images are used from the training dataset s single coil knee MRI volumes The training dataset has 973 volumes and a total of 34 742 slices *Magnetic Resonance Image Reconstruction* Mehmet Akcakaya,Mariya Ivanova Doneva,Claudia Prieto,2022-11-04 Magnetic Resonance Image Reconstruction Theory Methods and Applications presents the fundamental concepts of MR image reconstruction including its formulation as an inverse problem as well as the most common models and optimization methods for reconstructing MR images The book discusses approaches for specific applications such as non Cartesian imaging under sampled reconstruction motion correction dynamic imaging and quantitative MRI This unique resource is suitable for physicists engineers technologists and clinicians with an interest in medical image reconstruction and MRI Explains the underlying principles of MRI reconstruction along with the latest research Gives example codes for some of the methods presented Includes updates on the latest developments including compressed sensing tensor based reconstruction and machine learning based reconstruction **Machine Learning for Medical Image Reconstruction** Florian Knoll,Andreas Maier,Daniel Rueckert,2018-09-11 This book constitutes the refereed proceedings of the First International Workshop on Machine Learning for Medical Reconstruction MLMIR 2018 held in conjunction with MICCAI 2018 in Granada Spain in September 2018 The 17 full papers presented were carefully reviewed and selected from 21 submissions The papers are organized in the following topical sections deep learning for magnetic resonance imaging deep learning for computed tomography and deep learning for general image reconstruction

Machine Learning for Medical Image Reconstruction Florian Knoll,Andreas Maier,Daniel Rueckert,Jong Chul Ye,2019-10-24 This book constitutes the refereed proceedings of the Second International Workshop on Machine Learning for Medical Reconstruction MLMIR 2019 held in conjunction with MICCAI 2019 in Shenzhen China in October 2019 The 24 full papers presented were carefully reviewed and selected from 32 submissions The papers are organized in the following topical sections deep learning for magnetic resonance imaging deep learning for computed tomography and deep learning for general image reconstruction *Improved Data Representations and Data-efficient Methods in Deep Learning for MRI Applications* Elizabeth Katherine Cole,2022 Magnetic resonance imaging MRI is a medical imaging modality which provides high quality non invasive soft tissue visualization The resulting images are used to assess patient health and diagnose various diseases such as coronary heart disease brain tumors and liver disease Unlike positron emission tomography and computed tomography MRI does not use harmful ionizing radiation which makes it a preferable modality in pediatric patients However MRI scans are traditionally very slow requiring patients to lie still for long periods of time to avoid motion artifacts This is especially difficult and uncomfortable for young children Therefore imaging speed remains a main limitation of MRI Scan times can be significantly reduced by collecting less measurements in the frequency domain however this leads to low quality images Image reconstruction addresses this by converting undersampled raw data to high quality images Deep learning DL methods have recently provided rapid and robust image reconstruction compared to traditional iterative methods However these DL methods still have several issues First most approaches split the complex valued MRI data into separate real and imaginary channels within some kind of convolutional neural network CNN This approach does not accurately represent the underlying complex valued structure of the data Second the vast majority of DL methods for MR image reconstruction are supervised requiring large amounts of ground truth data However ground truth data cannot be acquired for many types of MRI sequences making it impossible to train existing DL models for reconstruction In this thesis both of these issues are addressed in a series of projects First work on formulating and analyzing complex valued CNNs for supervised MR image reconstruction is shown Complex valued convolutions as opposed to real valued convolutions are shown to more accurately represent MRI data and thus perform superior reconstructions especially in terms of phase information Additionally it is shown that the superior phase recovery of these complex valued networks provides more accurate fat water separation which is important for applications such as liver fat quantification as well as more accurate blood flow estimation an important cardiovascular application Second work is presented on unsupervised MR image reconstruction A framework using generative adversarial networks is formulated to produce high quality reconstructions without ever using any ground truth images during training Our unsupervised method is compared to compressed sensing CS which being a traditional signal processing method also requires no ground truth data The reconstructions from our unsupervised method are superior compared to CS in terms of quantitative image quality metrics especially at higher accelerations This method also runs up to 7 times faster compared to CS An additional reconstruction related problem in MRI lies in the intrinsic high dimensional nature of MRI datasets In MRI using multiple radio frequency RF coil arrays can increase parallel imaging PI acceleration and improve signal to noise SNR ratio The large number of coils creates prohibitively large MRI datasets in space and infeasible computation time for reconstruction Additionally these datasets often contain redundant information across the various acquired images Coil compression algorithms are effective in mitigating this problem by compressing the datasets to convert the original set of coil images into a smaller set of virtual coil images This enables smaller datasets and faster computation time However traditional iterative coil compression methods are lossy and time consuming In this work we construct an encoder based neural network for the purposes of dimensionality reduction and apply it to the coil compression task in pursuit of higher reconstruction accuracy and faster coil compression The learned compression method achieves up to 1 5x lower NRMSE and up to 10 times runtime speed compared to traditional methods on a benchmark test dataset

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