CURRICULUM VITAE

Yoseob Han, Ph.D.

Technical Lead,

Wecover Platforms

PERSONAL INFORMATION

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RESEARCH INTEREST

Image restoration/ reconstruction, Inverse Problem, Convex/ Nonconvex/ Constrained optimization, Deep Learning methodologies, Medical Imaging, Statistical Signal Processing

EDUCATION

Ph.D. in Department of Bio and Brain Engineering [Mar 2015 – Aug 2019]
Korea Advanced Institute of Science and Technology, South Korea
Advisor: Prof. Jong Chul Ye
Thesis: Deep learning for artifact correction for CT & MR acquired from imperfect acquisition condition

M.S. in Department of Bio and Brain Engineering [Mar 2013 – Feb 2015]
Korea Advanced Institute of Science and Technology, South Korea
Advisor: Prof. Jong Chul Ye
Thesis: Multi-scale interior tomography using spectral blending in circular cone-beam trajectory

B.S. in Department of Biomedical Engineering [Mar 2006 – Feb 2013]
Kyung Hee University, South Korea
Concentration: Signal processing, computational linear algebra, computer programming

RESEARCH EXPERIENCE

Postdoctoral Scholar
(Director: Prof. Quanzheng Li, Supervisor: Prof. Kyungsang Kim) [Sep 2020 – Mar 2022]
Harvard Medical School and Massachusetts General Hospital, Department of Radiology, Boston, MA, United States

- Development of a machine learning-based diagnostic model that reduces the number of recalls after breast examination by detecting bad quality images due to breast location problems during mammography. *[Jointly supported by **GE Healthcare**]*

- Management of clinical annotators to generate training datasets by defining quantitative metrics for qualitative images.
- Development of classification and detection AI models corresponding to each bad image criterion (which are Nipple in profile, Retromammary fay, PNL within 1cm of MLO measurement, Max visualization of the posterior tissues, PML extends to or below the PNL, IM region visible, Compression, Motion Blur, etc.).
- Development of a semi-supervised learning framework to improve diagnostic performance using unlabeled datasets.
- Development of a deep-learning-based reconstruction method of interior tomography with low-dose X-ray CT system.
- Development of a federated learning framework for generating AI model that can be generalized to various datasets.

Postdoctoral Scholar
(Director: Brendt Wohlberg, Supervisor: Marc Klasky) [Nov 2019 – Sep 2020]
Los Alamos National Laboratory, Theoretical division, Applied Mathematics and Plasma Physics (T-5), Los Alamos, NM, United States

- Development of new and improved methods that will enable a fuller and more extensive use of experimental data, such as from radiographic imaging, towards better characterizing and reducing uncertainties in predictive modeling of weapons performance.
- Development of deep-learning-based de-scattering method with fast hydrodynamics simulators.

PROFESSIONAL POSITIONS

Co-founder of an AI venture company, *Wecover Platforms* [Jun 2021 – Present]
CEO: Dr. Chanyeol Choi (EE, MIT)

- Wecover Platforms (Boston, Massachusetts, USA; https://www.wecoverplatforms.com) is a company which seeks to build a hyper-automated insurance platform enabled by AI, in collaboration with ***Cigna Insurance***, ***Tufts School of Dental Medicine***, and ***Yonsei University of Dental Medicine***.
- The company is founded by AI-powered medical imaging and NLP experts comprising of PhDs from Stanford, MIT, and MGH Institute of Health Professions.
- The founders have jointly developed various Artificial Intelligence-based solutions, including image based solutions, named-entity recognition, and AI-OCR solutions.
- The project is currently supported by MIT Sandbox Innovation Fund Program, and have received pre-seed investments from renowned Korean accelerator companies (Kakao ventures, and etc.) (https://www.inews24.com/view/1460421).

Research Mentor for Science academy student, KAIST [4 Jul 2016 – 8 Jul 2016]

- Course: Introduction and practice of Artificial Intelligence (AI)
- Describe computer vision AI by analogy with Human vision systems.
- Assist students as they practice implementing computer vision AI model using pre-implemented neural network code templates prepared by mentors.
- Support and discuss students to present their AI results

Graduate Research Assistant, KAIST [Mar 2015 – Aug 2019]

Advisor: Prof. Jong Chul Ye

- Worked on newly developing AI-based methodology and applying it to medical imaging.
- Devised project ideas and prepared various grant proposals.
- Advised first and second year Ph.D. students in designing and refining their research proposals.

AWARD & SCHOLARSHIPS

- ***Doctoral Dissertation Award***, Korea Advanced Institute of Science and Technology, Aug 2020
- **3rd prize of NTIRE 2017 challenge on Single Image Super-Resolution**, Conference on Computer Vision and Pattern Recognition (CVPR), USA, Jul 2017
- **Travel Award**, Conference on Fully Three-Dimensional Image Reconstruction in Radiology and Nuclear Medicine (Fully3D), China, Jun 2017
- **KAIST Graduate Scholarship**, Korea Advanced Institute of Science and Technology, South Korea, (2015 – 2019)
- **Korea Government Graduate Scholarship**, Korea Advanced Institute of Science and Technology, South Korea, (2013 – 2015)
- ***Summa Cum Laude***, Kyung Hee University (Top 5%), South Korea, Feb 2012
- **Grand prize of the software contest**, Samsung Electronics section, Smart challenge, The World Embedded Software Contest 2011, Ministry of Trade, Industry and Energy, South Korea, Dec 2011
- **Encouragement prize of the application contest**, The Global Software Contest 2011, Ministry of Knowledge Economy, South Korea, Nov 2011
- **Excellence Award from creative idea challenge tournament**, (1st: Kyung Hee University, South Korea, Mar 2011), (2nd: Sung Kyun Kwan University, South Korea, Oct 2011), (Final: Korea Institute for Advancement of Technology, South Korea, Nov 2011)
- **Academic Excellence Award**, Department of Biomedical Engineering, Kyung Hee University, South Korea, (Feb 2009, Feb 2011)
- **Undergraduate Scholarship**, Kyung Hee University, South Korea, (2007, 2009, 2010, 2011)

INVITED TALKS

- Invited seminar at **Incheon National University**, virtual, Aug 2022
- Invited seminar at **Gangnam Severance Hospital**, virtual, Dec 2021
- **International Meeting on Fully Three-Dimensional Image Reconstruction in Radiology and Nuclear Medicine (Fully3D)** [Oral presentation], virtual, Jul 2021
- Invited seminar at **Lunit Inc., deep learning-based medical AI startup**, Seoul, South Korea, Aug 2018
- **International Meeting on Fully Three-Dimensional Image Reconstruction in Radiology and Nuclear Medicine (Fully3D)** [Oral presentation], Xi'an, China, Jun 2017
- **ISMRM Annual Meeting and Exhibition** [Oral presentation], Honolulu, HI, USA, May 2017
- **International Symposium on Biomedical Imaging (ISBI)** [Oral presentation], Prague, Czech Republic, Apr 2016

PUBLICATIONS (GOOGLE CITATION NO.=2713, H-INDEX=13, NOV 2022)

1. **"**End-to-End Deep Learning for Interior Tomography with Low-Dose X-ray CT**"**
Yoseob Han*, Dufan Wu, Kyungsang Kim, and Quanzheng Li
Physics in Medicine and Biology (Q2, IF:4.174), 2022; 67 (11), 115001.

2. **"**Deep Learning STEM-EDX Tomography for Nanocrystals**"**
Yoseob Han†, Jaeduck Jang†, Eunju Cha†, Junho Lee†, Hyungjin Chung†, Myoungho Jeong, Tae-Gon Kim, Byeong Gyu Chae, Hee Goo Kim, Shinae Jun, Sungwoo Hwang, Eunha Lee*, Jong Chul Ye*
Nature Machine Intelligence (Q1, IF:25.898), 2022; 3 (3), 267-274.

3. "Improving the reliability of pharmacokinetic parameters in dynamic contrast-enhanced MRI in gliomas: Deep learning approach"
Kyu Sung Choi, Sung-Hye You, **Yoseob Han**, Jong Chul Ye, Seung Hong Choi, Bumseok Jeong*
Neuroradiology (Q3, IF:2.995), 2020; 297 (1), 178-188

4. "Differentiated backprojection domain deep learning for conebeam artifact removal"
Yoseob Han†, Junyoung Kim†, Jong Chul Ye*
IEEE Transactions on Medical Imaging (Q1, IF:11.037), 2020; 39 (11), 3571-3582

5. "Reconstruction of multicontrast MR images through deep learning"
Won-Joon Do, Sunghun Seo, **Yoseob Han**, Jong Chul Ye, Seung Hong Choi, Sung- Hong Park*
Medical Physics (Q2, IF:4.506), 2020; 47 (3), 983-997

6. "One Network to Solve All ROIs: Deep Learning CT for Any ROI using Differentiated Backprojection"
Yoseob Han, Jong Chul Ye*
Medical Physics (Q2, IF:4.506), 2019; 46 (12), e855-e872

7. "k-Space deep learning for reference-free EPI ghost correction"
Juyoung Lee, **Yoseob Han**, Jae-Kyun Ryu, Jang-Yeon Park, Jong Chul Ye*
Magnetic Resonance in Medicine (Q2, IF:3.737), 2019; 82 (6), 2299-2313

8. "k-Space Deep Learning for Accelerated MRI"
Yoseo Han, Leonard Sunwoo, Jong Chul Ye*
IEEE Transactions on Medical Imaging (Q1, IF:11.037), 2019; 39 (2), 377-386

9. "Framing U-Net via deep convolutional framelets: Application to sparse-view CT "
Yoseob Han, Jong Chul Ye*
IEEE Transactions on Medical Imaging (Q1, IF:11.037), 2018; 37 (6), 1418-1429

10. "Deep convolutional framelets: A general deep learning framework for inverse problems"
Jong Chul Ye*, **Yoseob Han**, Eunju Cha
SIAM Journal on Imaging Sciences (Q3, IF:1.938), 2018; 11 (2), 991-1048

11. "Deep learning with domain adaptation for accelerated projection-reconstruction MR"
Yoseob Han, Jaejun Yoo, Hak Hee Kim, Hee Jung Shin, Kyunghyun Sung, Jong Chul Ye*
Magnetic Resonance in Medicine (Q2, IF:3.737), 2018; 80 (3), 1189-1205

12. "Interior Tomography Using 1D Generalized Total Variation. Part II: Multiscale Implementation"
Minji Lee, **Yoseob Han**, John Paul Ward, Michael Unser, Jong Chul Ye*
SIAM Journal on Imaging Sciences (Q3, IF:1.938), 2015; 8 (4), 2452-2486

MANUSCRIPT UNDER REVIEW/ IN PREPARATION

13. "Artificial intelligence method for high-resolution dental cone-beam computed tomography for clinical application"
Kanghyun Ryu†, Chena Lee†, Ikbeom Jang†, **Yoseob Han**, Subeen Pang, Young Hyun Kim, Chanyeol Choi, Sang-Sun Han*
Nature communications (Q1, IF:17.694), Under review

14. "Continuous emotional intensity controllable speech synthesis using semi-supervised learning"

Yoori Oh, Juheon Lee, **Yoseob Han**, Kyogu Lee*
IEEE International Conference on Acoustics, Speech, and Signal Processing (IEEE ICASSP), Under review

15. "Deep learning for sparse-view CT based on Fast Hierarchical Back Projection (FHBP)"
Yoseob Han, Kyungsang, Kim, Quanzheng Li*
Manuscript preparation

INTERNATIONAL CONFERENCES (PEER-REVIEWED)

1. "Null space image estimator using dual-domain deep learning for Region-of-Interest CT reconstruction"
   Yoseob Han*, Kyungsang Kim, Quanzheng Li
   Fully3D 2021, virtual **[oral presentation]**
2. "Cone-Angle Artifact Removal Using Differentiated Backprojection Domain Deep Learning"
   Junyoung Kim†, **Yoseob Han†**, Jong Chul Ye*
   ISBI 2020, Iowa, USA
3. "Adaptive X-ray CT Filteration method using deep CNN"
   Yoseob Han*, Junyoung Kim, Jong Chul Ye, Marc Louis Klasky, Brendt Wohlberg
   ISBI workshop on Deep Learning for Biomedical Image Reconstruction, 2020, Iowa, USA
4. "Non-Cartesian k-space deep learning for accelerated MRI"
   Yoseob Han, Jong Chul Ye*
   ISMRM 2019, Montreal, QC., Canada
5. "Non-Cartesian k-space deep learning for accelerated MRI"
   Yoseob Han, Jong Chul Ye*
   ISMRM workshop on Machine Learning, 2019, Washington, D.C., USA
6. "Reconstruction of MR images by combining k-space of multi-contrast MR data through deep learning"
   Won-Joon Do, **Yoseob Han**, Seung Hong Choi, Jong Chul Ye, Sung-Hong Park*
   ISMRM 2018, Paris, France
7. "Deep Learning Reconstruction for 9-View Dual Energy CT Baggages Scanner"
   Yoseob Han, Jong Chul Ye*
   CT MEETING 2018, Utah, USA
8. "Deep Learning Interior Tomography for Region-of-Interest Reconstruction"
   Yoseob Han†, Jawook Gu†, Jong Chul Ye*
   CT MEETING 2018, Utah, USA
9. "Deep Residual Learning Approach for Sparse-view CT Reconstruction"
   Yoseob Han, Jong Chul Ye*
   Fully3D 2017, Xi'an, China **[oral presentation]**
10. "Accelerated projection reconstruction MR imaging using deep residual learning"
    Yoseob Han, Dongwook Lee, Jaejun Yoo, Jong Chul Ye*

ISMRM 2017, Honolulu, HI, USA **[oral presentation]**

11. "Compressive dynamic aperture B- mode ultrasound imaging using annihilating filter-based low-rank interpolation"
Kyong Hwan Jin, **Yoseob Han**, Jong Chul Ye*
ISBI 2016, Prague, Czech Republic
12. "Sparse-view X-ray spectral CT reconstruction using annihilating filter-based low rank hankel matrix approach"
Yoseob Han, Kyong Hwan Jin, Kyungsang Kim, Jong Chul Ye*
ISBI 2016, Prague, Czech Republic **[oral presentation]**
13. "Multi-scale Circular Conebeam Interior Tomography using bedrosian identity: Verification with real data"
Yoseob Han, Minji Lee, John Paul Ward, Michael Unser, Seungryoung Cho, Jong Chul Ye*
CT MEETING 2016, Bambreg, Germany

PATENTS (REGISTERED, US NO.=3, KR NO.=9)

1. "METHOD FOR PROCESSING SPARSE – VIEW COMPUTED TOMOGRAPHY IMAGE USING NEURAL NETWORK AND APPARATUS THEREFOR"
Jong Chul Ye, **Yoseob Han**
US-10991132-B2, USA, 27 Apr 2021
2. "METHOD FOR PROCESSING MULTI - DIRECTIONAL X - RAY COMPUTED TOMOGRAPHY IMAGE USING ARTIFICIAL NEURAL NET"
Jong Chul Ye, **Yoseob Han**
US-10977842-B2, USA, 13 Apr 2021
3. "METHOD FOR PROCESSING ALL INTERIOR COMPUTED TOMOGRAPHY IMAGE USING SINGLE ARTIFICIAL NEURAL NETWORK AND APPARATUS THEREFOR"
Jong Chul Ye, **Yoseob Han**
10-2225747, South Korea, 04 Mar 2021
4. "METHOD FOR PROCESSING MAGNETIC RESONANCE IMAGING USING ARTIFICIAL NEURAL NETWORK AND APPARATUS THEREFOR"
Jong Chul Ye, **Yoseob Han**
10-2215702, South Korea, 08 Feb 2021
5. "APPARATUS AND METHOD FOR RECONSTRUCTING IMAGE USING EXTENDED NEURAL NETWORK"
Jong Chul Ye, **Yoseob Han,** Eunju Cha
US-10853977-B2, USA, 01 Dec 2020
6. "METHOD FOR PROCESSING MULTI-DIRECTIONAL X-RAY COMPUTED TOMOGRAPHY IMAGE USING ARTIFICIAL NEURAL NETWORK AND APPARATUS THEREFOR"
Jong Chul Ye, **Yoseob Han**
10-2174600, South Korea, 30 Oct 2020

7. "METHOD FOR PROCESSING INTERIOR COMPUTED TOMOGRAPHY IMAGE USING ARTIFICIAL NEURAL NETWORK AND APPARATUS THEREFOR"
Jong Chul Ye, **Yoseob Han**
10-2094599, South Korea, 23 Mar 2020

8. "METHOD FOR PROCESSING SPARSE-VIEW COMPUTED TOMOGRAPHY IMAGE USING ARTIFICIAL NEURAL NETWORK AND APPARATUS THEREFOR"
Jong Chul Ye, **Yoseob Han**
10-2094598, South Korea, 23 Mar 2020

9. "METHOD AND APPARATUS FOR RECONSTRUCTING IMAGE BASED ON NEURAL NETWORK"
Jong Chul Ye, **Yoseob Han**, Eunju Cha
10-2089151, South Korea, 09 Mar 2020

10. "COMPUTED TOMOGRAPHY IMAGE RECONSTRUCTION METHOD AND APPARATUS"
Jong Chul Ye, **Yoseob Han**
10-1886228, South Korea, 01 Aug 2018

11. "X-RAY IMAGING APPARATUS AND CONTROL METHOD FOR THE SAME"
Jong Chul Ye, **Yoseob Han**
10-1710866, South Korea, 22 Feb 2017

12. "INTERIOR TOMOGRAPHY RECONSTRUCTION APPARATUS USING THE LOW RANK FOURIER INTERPOLATION AND CONTROLLING METHOD THEREOF"
Jong Chul Ye, Kyong Hwan Jin, **Yoseob Han**
10-168530, South Korea, 06 Dec 2016

REFERENCES

1. **Prof. Quanzheng Li**
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   Department of Radiology,
   Harvard Medical School
   Boston, MA, United States
   Email: li.quanzheng@mgh.harvard.edu

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   Los Alamos, NM, United States
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APPENDIX I

Personal Statement

My main major of all degree is Biomedical Engineering. In the Department of Biomedical engineering, I learned various medical imaging systems like computed tomography (CT), magnetic resonance imaging (MRI), ultrasound, etc. And it was interesting to be able to visualize structure or shape inside the body without any surgery. The more focused on understanding the medical imaging systems, the more demanding the use of various mathematical tools like linear algebra, signal processing, and numerical optimization. Therefore, I got used to using mathematical tools and became more and more attracted to the medical system. The main reason I dive into the medical imaging is that the logical thinking is strongly required when developing algorithms, and I need to provide sufficient evidence and/or clues about the results derived from the algorithms I develop. ***The sophisticated logical thinking encourages me to come up with novel and creative algorithms to solve the problem I face***.

In the field of deep learning, I have proposed various novel and creative ideas to improve the quality of corrupted images collected in various system environments. While many deep learning researchers are looking for ways to enhance the quality of already-processed images (i.e., photo from cameras, medical images from DICOM), ***our deep learning algorithms process raw measurements obtained directly from imaging devices or perform specific transformation operators to mitigate the singularity of the given data.*** Therefore, our algorithms require a mathematical modeling of the acquisition process and numerical approaches to solve the equations relating the measurement/data of the unknown object, commonly referred as “inverse problems”. Numerical optimization approaches based on the mathematically designed image priors (sparsity, low rank, smooth manifold) have demonstrated the capability of image reconstruction from ill-posed problems in imaging systems. ***There are novel deep learning-based methods for solving the inverse problem by our proposed data-driven image priors (see APPENDIX II).***

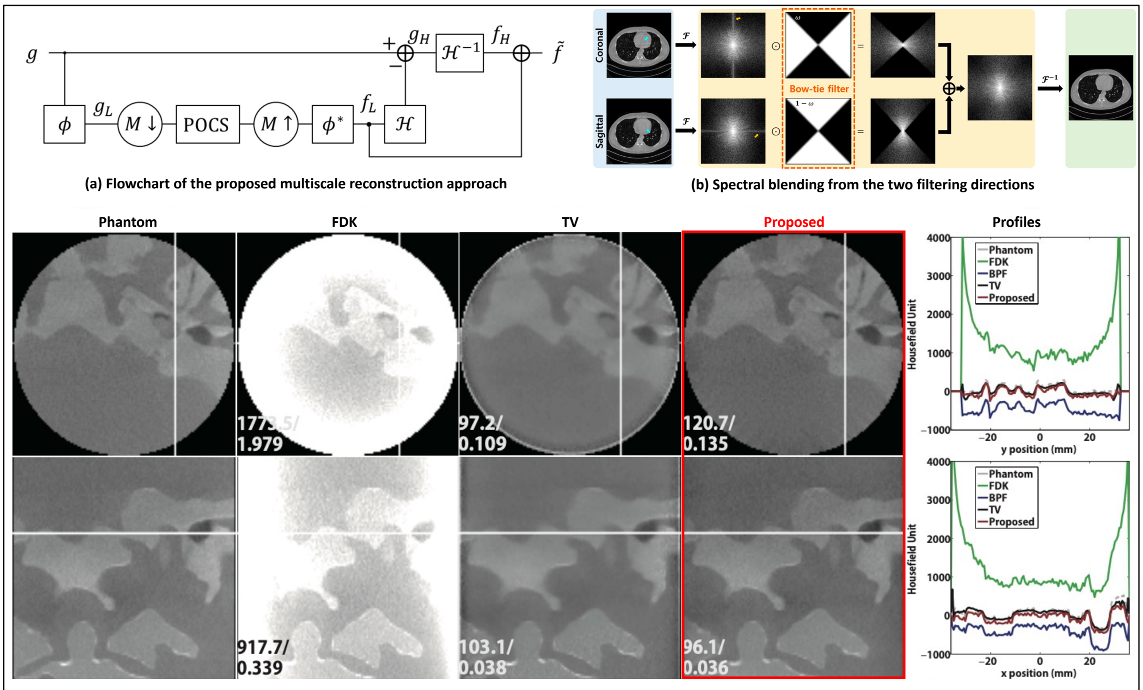
As a postdoctoral scholar in Department of Radiology at Harvard Medical School, I focused on developing artificial intelligence technologies that can be commercialized to Massachusetts General Hospital. One of the major projects jointly supported by GE Healthcare is ***the development of a machine learning-based diagnostic model that reduces the number of recalls after breast examination by detecting bad quality images due to breast location problems during mammography.*** To successfully achieve the project’s goal, I held regular meetings with clinical annotators to generate training datasets and define quantitative metrics for qualitative images. Then, using the collected datasets, I developed classification and detection deep learning models corresponding to each bad image criterion. I also built a semi-supervised learning framework using unlabeled datasets to improve diagnostic performance. Through the project, I am confident in developing technique that have clinically practical values, as well as software engineering competencies such as python, C++, linux, docker, and shell scripting, which are required to deploy algorithms for commercialization. ***As a principal investigator, this expertise will be greatly beneficial in advising graduate students and collaborating with industry and hospitals for exciting real-world applications.***

APPENDIX II

Details of Research Experiences

1. Compressed Sensing for Medical Imaging Systems

a. Region-of-Interest CT



(a) Flowchart of the proposed multiscale reconstruction approach

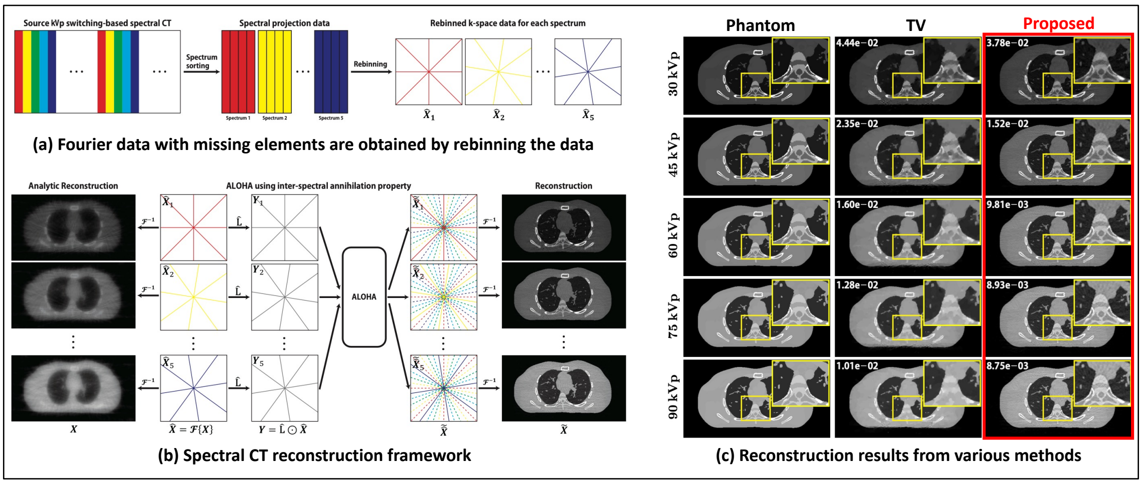
(b) Spectral blending from the two filtering directions

(c) Reconstruction results of real head phantom

[Lee et al., SIAM, 2015, Han et al., CT MEETING, 2016]

Circular trajectory is quite often used in conebeam CT (CBCT) such as C-arm CT, dental CT and so on. However, if the cone angle is wide, the FDK algorithm suffers from conebeam artifacts. Moreover, it exhibits severe truncation artifacts if the detector is truncated in transverse-ways. To mitigate these artifacts, we propose a reconstruction method that consists of two steps: ***(a) multi-scale interior tomography*** using 1D TV in both horizontal and vertical virtual chord lines, which is followed by ***(b) spectral blending*** in Fourier domain. For spectral blending, we develop a Fourier domain analysis technique to identify the missing frequency regions and design a bow tie window for weighting. ***(c) Experimental results*** with a real head phantom confirm that the proposed method significantly improves the reconstruction quality and reduces the computational time.

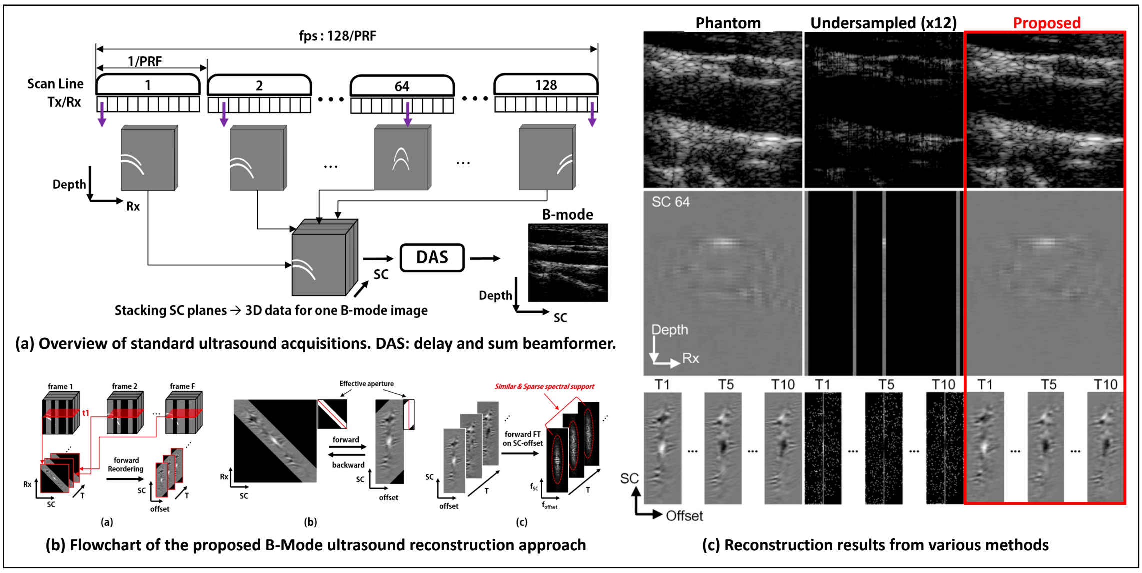
b. Sparse-view CT



[Han et al., ISBI, 2016]

In a kVp switching-based sparse view spectral CT, each spectral image cannot be reconstructed separably by an analytic reconstruction method, because ***(a) the projection views for each spectral band is too sparse***. However, the underlying structure is common between the spectral bands, so there exists inter-spectral redundancies that can be exploited by the recently proposed Annihilating filter-based LOw rank Hankel matrix Approach (ALOHA). More specifically, the sparse view projection data are first rebinned in the Fourier space, from which Hankel structured matrix with missing elements are constructed for each spectral band. Thanks to the inter-spectral correlations as well as transform domain sparsity of underlying images, ***(b) the concatenated Hankel structured matrix is low-ranked***, and the missing Fourier data for each spectral band can be simultaneously estimated using a low rank matrix completion. To reduce the computational complexity furthermore, we exploit the Hermitian symmetry of Fourier data. ***(c) Numerical experiments*** confirm that the proposed method outperforms the existing ones.

c. Ultrasound

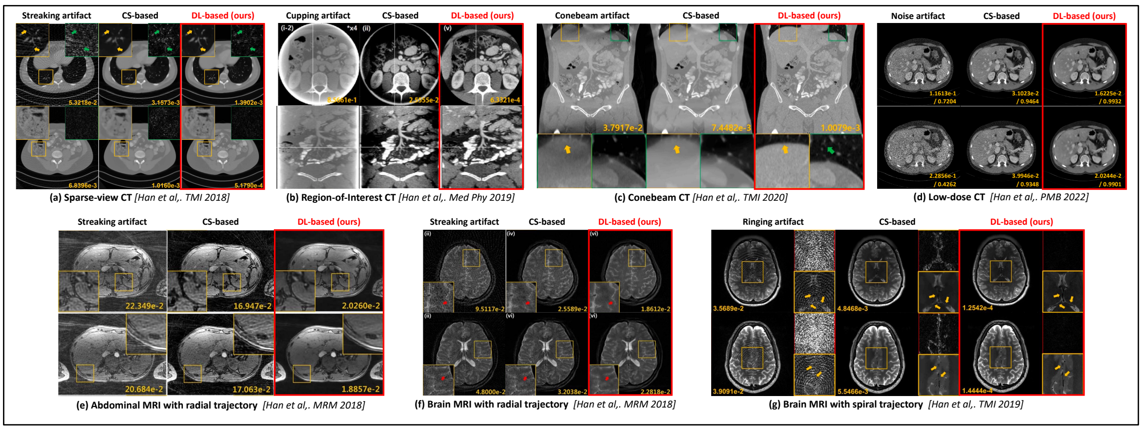


[Jin et al., ISBI, 2016]

To reduce data rate for ***(a) power-limited portable ultrasound imaging systems***, various compressed sensing approaches have been investigated. However, most of the existing approaches require either hardware changes or computationally expensive forward modeling of wave propagation. To overcome these limitations, ***(b) here we propose a novel low rank interpolation method*** that exploits the annihilation property of ultrasound measurements. ***(c) Reconstruction results*** confirmed that the proposed method can effectively reduce the data rate for ultrasound acquisition without sacrificing the image quality.

2. Deep Learning for Various Imaging Systems

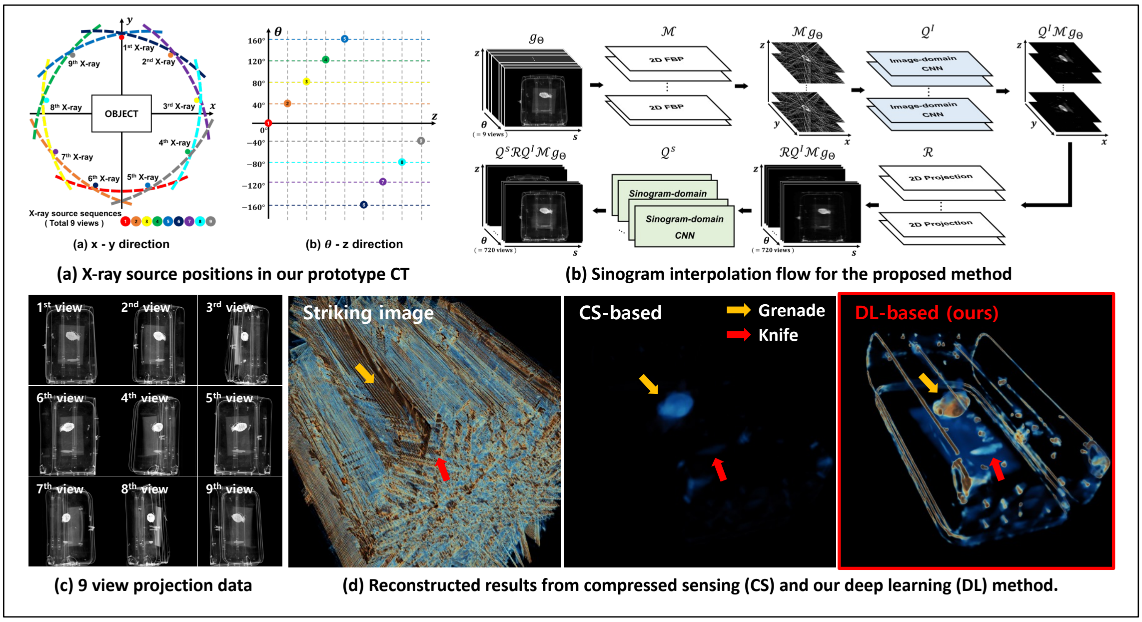
a. Medical Imaging Systems to Artifact correction



[(a) Han et al., TMI, 2018, (b) Han et al., Med Phy, 2019, (c) Han et al., TMI, 2020, (d) Han et al. PMB, 2022, (e, f) Han et at., MRM, (g) Han et al., TMI]

Unexpected artifacts occur in virtually a variety of medical imaging systems like CT, MRI, Ultrasound, etc. The unexpected artifacts usually have been caused by irregular situations such as incomplete measurements, patient motion, beam hardening, out of Field-of-view (FOV), etc. ***(a-g) The above figure shows the results of each artifact images and its results reconstructed from compressed-sensing (CS) algorithm, which is one of the conventional methods, and deep learning (DL) method developed by our group***. DL-based methods show better reconstruction results and faster computation time than CS-based methods in almost medical imaging systems. Our group have developed various DL-based algorithm to reduce each artifact; ***(a) streaking artifact of sparse-view CT, (b) cupping artifact of ROI CT, (c) conebeam artifact of conebeam CT, (d) noisy artifact of low-dose CT, (e) streaking artifact of abdominal MRI with radial trajectory, (f) and (g) brain MRI with radial and spiral trajectories, respectively.***

b. Explosive Detection System (EDX) of Baggage Scanner



(a) X-ray source positions in our prototype CT

(b) Sinogram interpolation flow for the proposed method

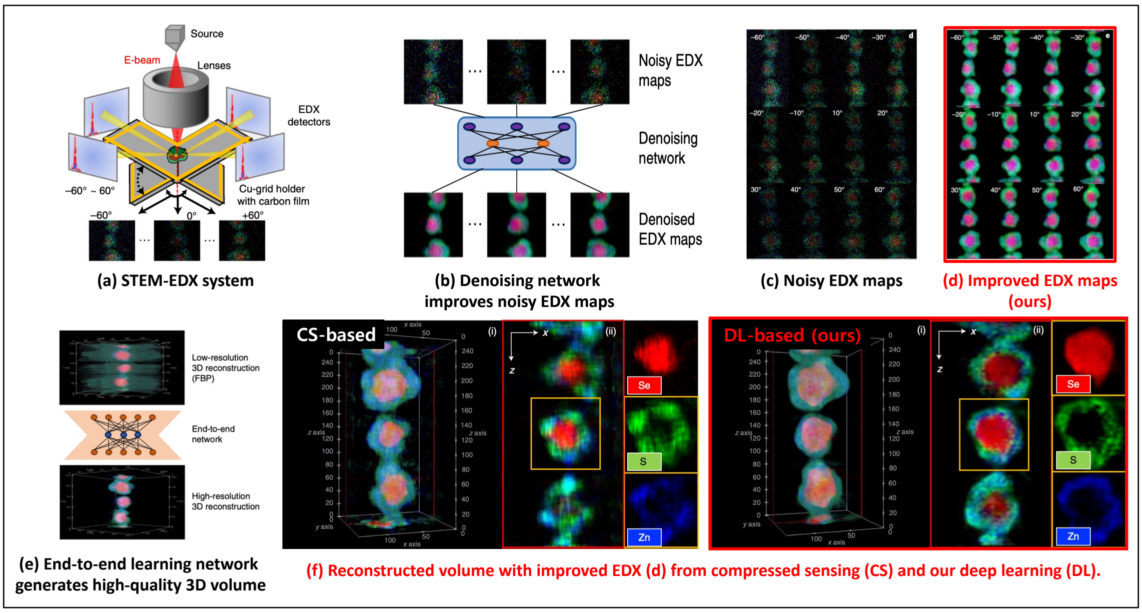
(c) 9 view projection data

(d) Reconstructed results from compressed sensing (CS) and our deep learning (DL) method.

[Han et al., CT MEETING, 2018]

For homeland and transportation security applications, 2D X-ray explosive detection system (EDS) have been widely used, but they have limitations in recognizing 3D shape of the hidden objects. Among various types of 3D computed tomography (CT) systems to address this issue, the project is interested in ***(a) a stationary CT using fixed X-ray sources and detectors***. However, due to the limited number of projection views, analytic reconstruction algorithms produce severe streaking artifacts. We propose ***(b) a novel image and sinogram domain deep learning architecture*** for 3D reconstruction from ***(c) very sparse view measurement***. The algorithm has been tested with the real data from a prototype 9-view dual energy stationary CT EDS carry-on baggage scanner, which ***(d) confirms the superior reconstruction performance over the existing approaches.***

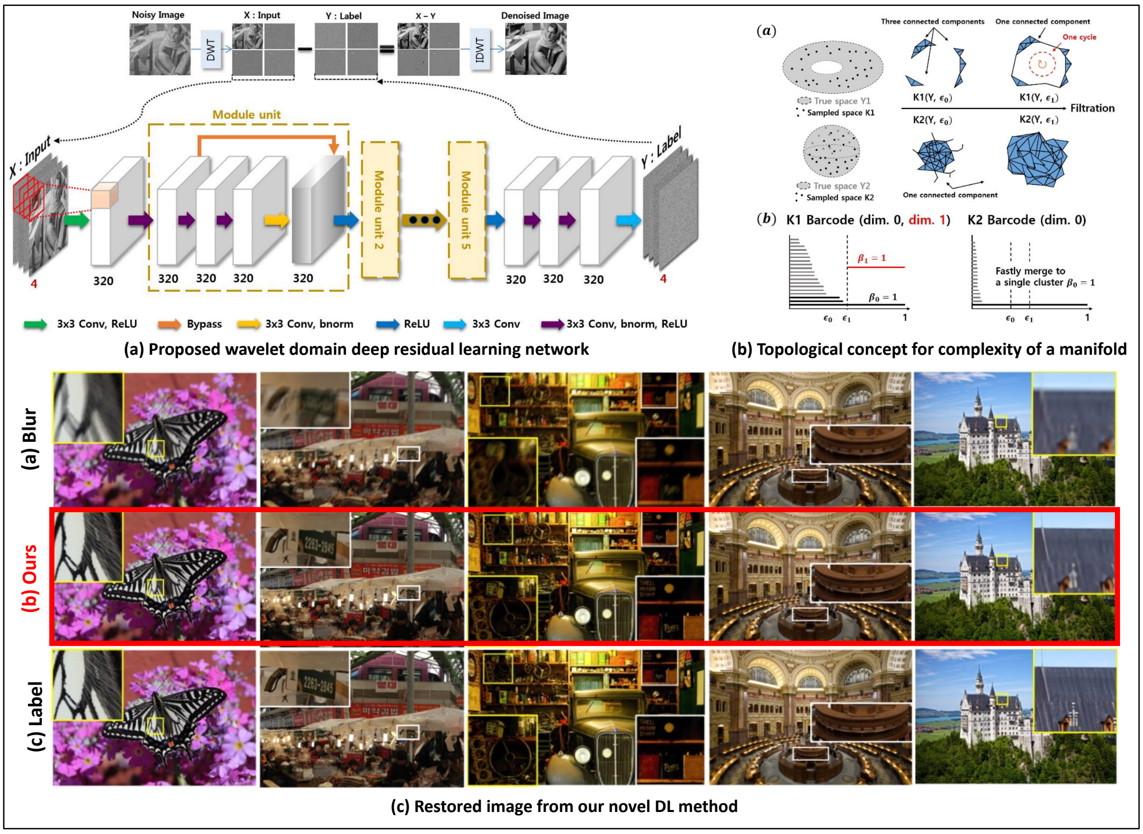
c. STEM-EDX tomography of nanocrystals



[Han et al., Nature Machine Intelligence, 2021]

Energy-dispersive X-ray spectroscopy (EDX) is often performed simultaneously with high-angle annular dark-field scanning transmission electron microscopy (STEM) for nanoscale physico-chemical analysis. However, ***(a) high-quality STEM-EDX tomographic imaging*** is still challenging due to ***(c) fundamental limitations such as sample degradation*** with prolonged scan time and the low probability of X-ray generation. To address this, we propose ***(b, e) an unsupervised deep learning method*** for high-quality 3D EDX tomography of core–shell nanocrystals, which can be usually permanently dammaged by prolonged electron beam. The proposed deep learning STEM-EDX tomography method was used to ***(d, f) accurately reconstruct*** Au nanoparticles and InP/ZnSe/ ZnS core–shell quantum dots, used in commercial display devices. Furthermore, the shape and thickness uniformity of the reconstructed ZnSe/ZnS shell closely correlates with optical properties of the quantum dots, such as quantum efficiency and chemical stability.

d. Super-resolution



(a) Proposed wavelet domain deep residual learning network

(b) Topological concept for complexity of a manifold

(c) Restored image from our novel DL method

[Timofte et al., CVPRW, 2017]

The latest deep learning approaches perform better than the state-of-the-art signal processing approaches in various image restoration tasks. However, if an image contains many patterns and structures, the performance of these CNNs is still inferior. To address this issue, ***(a) here we propose a novel feature space deep residual learning algorithm*** that outperforms the existing residual learning. The main idea is originated from the observation that ***(b) the performance of a learning algorithm can be improved if the input and/or label manifolds can be made topologically simpler by an analytic mapping to a feature space.*** Our extensive numerical studies using denoising experiments and NTIRE single-image super-resolution (SISR) competition demonstrate that ***(c) the proposed feature space residual learning outperforms the existing state-of-the-art approaches. Moreover, our algorithm was ranked third in NTIRE competition with 5-10 times faster computational time compared to the top ranked teams***.