

MING DU

Ph.D.

✉ ming.du101@gmail.com | 🌐 <http://mdw771.github.io/>

EXPERIENCE

2019 - now

Postdoctoral appointee

Argonne National Laboratory, Lemont, USA

- Developed *Adorym*, an automatic differentiation-based reconstruction framework capable of performing large-scale 2D/3D image reconstruction and parameter refinement for multiple x-ray imaging techniques.
- Developed a neural network-based method using “deep image prior” to address the crosstalk separation problems in x-ray multislice ptychography imaging.
- Developed a distributed algorithm for large 2D wavefield propagation on high performance computers (HPCs).
- Led an ASCR Leadership Computing Challenge (ALCC) project on large-scale 3D reconstruction as Principal Investigator.

2015 - 2019

Ph.D. student (Research assistant)

Northwestern University, Evanston, USA

- Developed *Tomosaic*, a Python software package for beyond-field-of-view x-ray tomography. Achieved 3D reconstruction of objects with 10^{12} voxels on supercomputers at Argonne Leadership Computing Facility.
- Developed an innovative algorithm for 3D reconstruction under complicated imaging scenarios, utilizing the automatic differentiation capability of deep learning tools.
- Conducted x-ray tomography and ptychography experiments at the Advanced Photon Source.
- Involved in the commissioning of an automated tomography processing pipeline *Automo/Ripple* at beamline 32-ID of the Advanced Photon Source.
- Built an improved theoretical model for dose estimation in the x-ray imaging of thick hydrated specimens.

2014

Student researcher

Singapore Institute of Manufacturing Technology, Singapore

- Experimentally studied the pore size dependence of anodic aluminum oxide on voltage and electrolyte temperature.
- Developed a tool for unsupervised data analysis.

EDUCATION

2015 - 2019

Doctor of Philosophy, Northwestern University, Evanston, USA

Department of Materials Science and Engineering

Advised by Prof. Chris Jacobsen

Thesis title: *To the Breadth, and to the Depth: Scalable 3D Imaging of Extended Objects with High Resolution Using X-ray Microscopy*

2011 - 2015

Bachelor of Engineering, National University of Singapore, Singapore

Department of Materials Science and Engineering

TEACHING

2018 Winter

Teaching assistant, Northwestern University

MSE 395-4: Computational Thermodynamics and Kinetics

2018 Fall

Teaching assistant, Northwestern University

MSE 401: Chemical and Statistical Thermodynamics of Materials

2018 Winter

Teaching assistant, Northwestern University

MSE 361: Crystallography and Diffraction

PUBLICATIONS

- [1] M. Du, X. Huang, C. Jacobsen, Using a modified double deep image prior for crosstalk mitigation in multislice ptychography. [Manuscript in preparation; view draft [here](#)]
- [2] M. Du, *et al.*, Adorym: A multi-platform generic x-ray image reconstruction framework based on automatic differentiation. *Arxiv*. arXiv:2012.12686 (2020).
- [3] P. Huang, M. Du, M., Hammer, A., Miceli, C. Jacobsen, Fast digital lossy compression for X-ray ptychographic data. *Journal of Synchrotron Radiation*. **28**, 292–300 (2021).
- [4] S. Ali, M. Du, M. F. Adams, B. Smith, C. Jacobsen, Comparison of distributed memory algorithms for X-ray wave propagation in inhomogeneous media. *Opt Express*. **28**, 29590 (2020).
- [5] M. Du, D. Gürsoy, C. Jacobsen, Near, far, wherever you are: simulations on the dose efficiency of holographic and ptychographic coherent imaging1. *J Appl Crystallogr*. **53**, 748–759 (2020).
- [6] M. Du, Y. S. G. Nashed, S. Kandel, D. Gürsoy, C. Jacobsen, Three dimensions, two microscopes, one code: Automatic differentiation for x-ray nanotomography beyond the depth of focus limit. *Sci Adv*. **6**, eaay3700 (2020).
- [7] J. Prasad, A. Balwani, E. Johnson, J. Miano, V., Sampathkumar, V. De Andrade, K. Fezzaa, M. Du, *et al*, A three-dimensional thalamocortical dataset for characterizing brain heterogeneity. *Scientific Data*. 358 (2020)
- [8] R. Vescovi¹, M. Du¹, *et al.*, Tomosaic: efficient acquisition and reconstruction of teravoxel tomography data using limited-size synchrotron X-ray beams. *Journal of Synchrotron Radiation*. **25** 1478–1489 (2018).
- [9] M. Du, R. Vescovi, K. Fezzaa, C. Jacobsen, D. Gürsoy, X-ray tomography of extended objects: a comparison of data acquisition approaches. *J Opt Soc Am*. **35**, 1871 (2018).
- [10] M. A. Gilles, Y. S. G. Nashed, M. Du, C. Jacobsen, S. M. Wild, 3D x-ray imaging of continuous objects beyond the depth of focus limit. *Optica*. **5**, 1078–1086 (2018).
- [11] Shahbazi, J. Kinnison, R. Vescovi, M. Du, R. Hill, M. Joesch, M. Takeno, H. Zeng, N. M. da Costa, J. Grutzendler, N. Kasthuri, W. J. Scheirer, Flexible Learning-Free Segmentation and Reconstruction of Neural Volumes. *Scientific reports*. **8**, 1448 (2018).
- [12] R. Chard, R. Vescovi, M. Du, H. Li, K. Chard, S. Tuecke, N. Kasthuri, I. Foster, (2018), *AI-Science'18: Autonomous Infrastructure for Science*, pp. 1–7.
- [13] M. Du, R. Vescovi, R. Chard, N. Kasthuri, C. Jacobsen, E. Dyer, D. Gursoy, *Biophotonics Congress: Biomedical Optics Congress 2018 (2018)*, paper BF4C.2.
- [14] M. Tondravi, W. Scullin, M. Du, R. Vescovi, V. D. Andrade, C. Jacobsen, K. P. Kording, D. Gursoy, E. Dyer, A Pipeline for Distributed Segmentation of Teravoxel Tomography Datasets. *Microscopy and Microanalysis*. **24**, 166–167 (2018).
- [15] M. Du, C. Jacobsen, Relative merits and limiting factors for x-ray and electron microscopy of thick, hydrated organic materials. *Ultramicroscopy*. **184**, 293–309 (2018).
- [16] C. J. Jacobsen, V. D. Andrade, J. Deng, M. Du, D. Gursoy, Y. S. Nashed, T. Peterka, (2016), *Digital Holography and Three-Dimensional Imaging*, p. W2A.12.
- [17] M. Du, X. Yin, C. Tang, T. J. Huang, H. Gong, Takovite-derived 2-D Ni/Al double hydroxide monolayer and graphene hybrid electrodes for electrochemical energy storage applications with high volumetric capacitance. *Electrochimica Acta*. **190**, 521–530 (2016).
- [18] X. Yin, T. J. Huang, C. Tang, M. Du, L. Sun, Z. Shen, H. Gong, Significantly different mechanical properties and interfacial structures of Cu₂ZnSn(S,Se)₄ films prepared from metallic and sulfur-contained precursors. *Solar Energy Materials and Solar Cells*. **134**, 389–394 (2015).
- [19] M. Du, X. Yin, H. Gong, Effects of triethanolamine on the morphology and phase of chemically deposited tin sulfide. *Materials Letters*. **152**, 40–44 (2015).

¹ Co-first authors with equal contributions.

CONFERENCE SPEECHES & TALKS

- [1] "Applications of automatic differentiation in image reconstruction and experimental parameter refinement for 3D microscopy, " *23rd Euro AD Workshop*, Virtual. (2020).
- [2] "Three dimensions, two microscopes, one code: Automatic differentiation for x-ray nanotomography beyond the depth of focus limit, " *ALCF Simulation, Data, and Learning Workshop*, Lemont, U.S.A. (2019).
- [3] "A Multifunctional Tool for X-Ray Ptychographic and Holographic 3D Imaging Beyond the Depth-of-Focus Limit, " *Gordon Research Seminar - X-ray Science*, Easton, U.S.A. (2019).
- [4] "Using Automatic Differentiation for Coherent Diffraction Imaging and Reconstructing Beyond Depth of Focus (co-presented with Saugat Kandel), " *Ptycho-Developer-2019*, Berkeley, U.S.A. (2019).
- [5] "3D object reconstruction beyond the depth-of- focus limit using automatic differentiation, " *Coherence 2018*, Port Jefferson, U.S.A. (2018).
- [6] "An automated pipeline for the collection, transfer, and processing of large-scale tomography data, " *Biophotonics Congress: Biomedical Optics Congress 2018*, Hollywood, U.S.A. (2018).

MEDIA COVERAGE

- [1] Andre Salles, Filling in the blanks: How supercomputing can aid high-resolution X-ray imaging. ALCF News Center (2020). [\[Link\]](#)
- [2] ALCF, ALCF supercomputers power scientific breakthroughs in 2020. ALCF News Center (2020). [\[Link\]](#)

AWARDS AND ACCOMPLISHMENTS

2020	Most active reviewers of 2019 awarded by the Optical Society of America.
2020	Team leader of an ASCR Leadership Computing Challenge (ALCC) proposal granted by Advanced Scientific Computing Research of the U.S. Department of Energy (24 projects awarded in total).
2020	Selected attendee of the Argonne Training Program on Extreme-Scale Computing (ATPESC) (~76 candidates selected internationally).
2019	Contributed to an LDRD-funded proposal (2019-0441, \$80K/year over 2 years).
2019	Contributed to a proposal of the ALCF Data Science Program (awarded 0.25 M nodes hours over 2 years).
2015	Materials Research Society (Singapore) Medal.

PROFESSIONAL ACTIVITIES

2020 - 2021	Principal Investigator of an ASCR Leadership Computing Challenge (ALCC) project titled “Distributed large wavefield propagation and 3D reconstruction beyond the depth of focus limit”.
2020	Co-organizer of workshop titled “Advances in Phase Retrieval Methods for High-resolution X-ray Imaging” in 2020 APS/CNM User Meeting.
2018 - present	Reviewer of more than 10 manuscripts submitted to <i>Optics Express</i> , <i>Applied Optics</i> , and <i>Biomedical Optics Express</i> .
2018 - present	Member , The Optical Society of America.

EXTRACURRICULAR ACTIVITIES

2018 - 2019	Member , Northwestern University Society of Physics Students
2017	Volunteer , Baxter Symposium at Northwestern University
2013 - 2015	Co-chair , Movement for Intellectually Disabled of Singapore (Fernvale branch)
2014	Chair , Movement for Intellectually Disabled of Singapore (Fernvale branch) summer camp

SKILLS

Experimental: X-ray microtomography at a synchrotron beamline; scanning electron microscopy

Programming: Python (with TensorFlow/PyTorch, MPI4py), MATLAB, Mathematica, C/C++ (with CUDA, MPI, OpenMP), R, PostgreSQL, Linux, LaTeX

Other skills: 3D computer graphics (Adobe After Effects, Blender; made a 3D animation showcasing the research outcome of our group, which was displayed at the Department of Energy’s Booth during the SC’19 conference); computer aided design (Autodesk Fusion 360)

LANGUAGES

English: Fluent

Chinese: Native

Japanese: Beginner

German: Beginner