Md Tauhidul Islam, Ph.D.

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Research Interests

Artificial intelligence, medical image analysis, imaging and cancer physics, computational genomics, big data analytics, radiation treatment planning

Awards

Pathway to Independence Award (K99/R00) 2023-2027
National Library of Medicine, National Institutes of Health
Title: High-performance deep neural networks for medical image analysis
Summary: The proposed research is directed at establishing a novel strategy of analyzing the feature space data extracted from medial images by deep neural networks (DNNs). Successful completion of the project will enable us to analyze the feature data reliably and quantify the quality of the feature space at different layers of a DNN. The study also promises to provide high-performance DNNs for medical image analysis to substantially improve the AI-based diagnosis, prognosis, and treatment of different diseases including cancer.

Research Experience

Postdoctoral Researcher June 2019 to Present
Department of Radiation Oncology,
Stanford University
Research topic: Application of deep learning in medical image and high dimensional data analysis
Supervisor: Lei Xing, Ph.D.

Graduate Research Assistant Sep 2014 to December 2018
Department of Electrical and Computer Engineering,
Texas A&M University
Research topic: Estimation of mechanopathological parameters using ultrasound poroelastography
Supervisor: Raffaella Righetti, Ph.D.

Teaching Experience

Co-organizer (with Drs. Lei Xing and Lianli Liu) Autumn Quarter 2023
BMP 254 - AI and Data Driven Methods in Biomedical Imaging and Physics
Stanford Medical School
Delivered lectures on 1) Medical image denoising using machine learning and deep learning and 2) Genomic data analytics with deep learning

Teaching Assistant Fall 2017
ECEN 410/764 - Introduction to Medical Imaging
Department of Electrical and Computer Engineering,
Texas A&M University

Education

Texas A&M University, College station, TX

Ph.D., Electrical Engineering, December, 2018

Thesis Topic: *Estimation of mechanopathological parameters using ultrasound poroelastography*
Advisor: Raffaella Righetti, Ph.D.

Bangladesh University of Engineering and Technology, Dhaka, Bangladesh

M.S., Department of Electrical and Electronic Engineering, July 2014

Thesis Topic: *Speech enhancement based on statistical modeling of teager energy operated perceptual wavelet packet coefficients and adaptive thresholding function*
Advisor: Celia Shahnaz, Ph.D.

B.S., Department of Electrical and Electronic Engineering, February 2011

Thesis Topic: *Ultrasound strain imaging in wavelet domain*
Advisor: Md. Kamrul Hasan, Ph.D.

Journal articles

1. **Islam, M.T.** and Xing, L.,"Deciphering the feature representation of deep neural networks for high performance biomedical AI", 2024, in press, *IEEE Transactions on Pattern Analysis and Machine Intelligence*.

2. **Islam, M.T.**, Zhou, Z., Zou, J., Kapp, D., Liao, J. and Xing, L., "Revealing hidden patterns in deep neural network feature space continuum via manifold learning", 2023, *Nature Communications*, 14(1), p.8506.

3. **Islam, M.T.** and Xing, L.,"Cartography of genomic interactions enables deep analysis of single-cell expression data", 2023, *Nature Communications*, 14(1), p.679.

4. **Islam, M.T.**, Wang, J., Ren, H., Li, X., Khuzani, M., Yu, L., Shen, L., Zhao, W., and Xing, L., "Leveraging data-driven self-consistency for high-fidelity gene expression recovery", 2022, *Nature Communications*, 13(1), pp.7142.

5. **Islam, M.T.** and Xing, L.,"A data-driven dimensionality-reduction algorithm for the exploration of patterns in biomedical data", 2021, *Nature Biomedical Engineering*, 5(6), pp.624-635.

6. Yan*, R., **Islam*, M.T.** and Xing, L., "Spatially semantic topography of tabular data according to feature inter-relationships enables interpretable deep pattern discovery". *co-first authors (equal contribution), 2024, in press, *Nature Biomedical Engineering*.

7. **Islam, M.T.** and Xing, L.,"Leveraging cell-cell interactions for high-performance spatial and temporal cellular mappings from gene expression data", 2023, *Patterns, Cell Press*, p.100840.

8. Wei*, Q., **Islam*, M.T.**, Zhou, Y. and Xing, L., "Self-supervised deep learning of gene-gene interactions for improved gene expression recovery". *equal contribution, 2024, *Briefings in Bioinformatics*, 25(2), p.bbae031.

9. Sang, S., Zhou, Y., **Islam, M.T.** and Xing, L.,"Small-object sensitive segmentation using across feature map attention", 2023, *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 45 (5), pp.6289-6306.

10. Liu, J., **Islam, M.T.**, Sang, S., Qiu, L., and Xing, L., "Biology-aware mutation-based deep learning for outcome prediction of cancer immunotherapy with immune checkpoint inhibitors", 2023, *npj Precision Oncology*, 7 (1), pp.117.

11. Ye, S., Shen, L., **Islam, M.T.** and Xing, L., "Super-resolution biomedical imaging via reference-free statistical implicit neural representation", 2023, *Physics in Medicine and Biology*, 68(20), p.205020.

12. Jiang, Y., Zhou, K., Sun, Z., Wang, H., Xie, J., Zhang, T., Sang, S., **Islam, M.T.**, Wang, J.Y., Chen, C. and Yuan, Q., "Non-invasive tumor microenvironment evaluation and treatment response prediction in gastric cancer using deep learning radiomics", 2023, *Cell Reports Medicine*, 4(8).

13. **Islam, M.T.** and Xing, L.,"Geometry and statistics-preserving manifold embedding for nonlinear dimensionality reduction", 2021, *Pattern Recognition Letters*, 151, pp.155-162.

14. Zhou, Z., **Islam, M.T.** and Xing, L., "Multibranch CNN with MLP-mixer-based feature exploration for high-performance disease diagnosis", 2023, *IEEE Transactions on Neural Networks and Learning Systems*.

15. Vasudevan, V., Bassenne, M., **Islam, M.T.**, and Xing, L., "Image classification using graph neural network and multiscale wavelet superpixels"', 2023, *Pattern Recognition Letters*, 166, pp. 89–96.

16. Vasudevan, V., **Islam, M.T.**, Pong, D. and Xing, L., "Implicit neural representation for radiation therapy dose distribution", 2022, *Physics in Medicine and Biology*, 67(12), p.125014.

17. Khan, M.H.R., **Islam, M.T.**, Taraballi, F. and Righetti, R., "Assessment of compression-induced solid stress, fluid pressure and mechanopathological parameters in cancers in vivo using poroelastography", 2023, *Physics in Medicine and Biology*, 68, pp.135014.

18. Majumder, S., **Islam, M.T.** and Righetti, R., "Non-invasive imaging of interstitial fluid transport parameters in solid tumors in vivo", 2023, *Scientific Reports*, 13(1), p.7132.

19. Majumder, S., **Islam, M.T.**, Righetti, R., "Estimation of mechanical and transport parameters in cancers using short time poroelastography ", 2022, *IEEE Journal of Translational Engineering in Health and Medicine*, 10, pp.1-11.

20. Liang, X., Bassenne, M., Hristov, D.H., **Islam, M.T.**, Zhao, W., Jia, M., Zhang, Z., Gensheimer, M., Beadle, B., Le, Q. and Xing, L., "Human-level comparable control volume mapping with a deep unsupervised-learning model for image-guided radiation therapy", 2022, *Computers in Biology and Medicine*, 141, p.105139.

21. **Islam, M.T.**, Tasciotti, E. and Righetti, R.,"Non-invasive assessment of the spatial and temporal distributions of interstitial fluid pressure, fluid velocity and fluid flow in cancers in vivo", 2021, *IEEE Access*, 9, pp.89222-89233.

22. Zhao, W., Shen. L., **Islam, M.T.**, Qin, W. Zhang, Z., Liang, X., Zhang, G., Xu, S., and Li, X., "Artificial intelligence in image-guided radiotherapy: a review of treatment target localization", 2021, *Quantitative Imaging in Medicine and Surgery.*

23. Li, X., Jia, M., **Islam, M.T.**, Yu, L. and Xing, L.,"Self-supervised feature learning via exploiting multi-modal data for retinal disease diagnosis", 2020, *IEEE Transactions on Medical Imaging*, 39(12), 4023-4033.

24. **Islam, M.T.**, Tang, S., Liverani, C., Saha, S., Tasciotti, E. and Righetti, R. "Non-invasive imaging of Young's modulus and Poisson's ratio in cancers in vivo", 2020, *Scientific Reports*, 10(1), pp.1-12.

25. **Islam, M.T.** and Righetti, R.,"A spline interpolation based data reconstruction technique for estimation of strain time constant in ultrasound poroelastography", 2020, *Ultrasonic Imaging*, 42(1), pp.5-14.

26. **Islam, M.T.**, Tasciotti, E. and Righetti, R. "Non-invasive imaging of normalized solid stress in cancers in vivo", 2019, *IEEE Journal of Translational Engineering in Health and Medicine*, 7, pp.1-9.

27. **Islam, M.T.** and Righetti, R. "A new poroelastography method to assess the solid stress distribution in cancers", 2019, *IEEE Access*, 7, pp.103404-103415.

28. **Islam, M.T.**, Tasciotti, E. and Righetti, R. "Estimation of vascular permeability in irregularly shaped cancers using ultrasound poroelastography", 2019, *IEEE Transactions on Biomedical Engineering*, 67(4), pp.1083-1096.

29. **Islam, M.T.** and Righetti, R.,"Estimation of mechanical parameters in cancers by empirical orthogonal function analysis of poroelastography data", 2019, *Computers in Biology and Medicine*, p.103343.

30. **Islam, M.T.** and Righetti, R.,"A novel finite element model to assess the effect of solid stress inside tumors on elastographic normal strains and fluid pressure", 2019, *ASME Journal of Engineering and Science in Medical Diagnostics and Therapy*, 2(3), p.031006.

31. **Islam, M.T.** and Righetti, R.,"An analytical poroelastic model of a spherical tumor embedded in normal tissue under creep compression", 2019, *Journal of Biomechanics*, 89, pp.48-56.

32. **Islam, M.T.**, Chaudhry, A. and Righetti, R. "A robust method to estimate the time constant of elastographic parameters", 2019, *IEEE Transactions on Medical Imaging*, 38(6), pp.1358-1370.

33. Tang S., Sabonghy E., **Islam M.T.**, Shajudeen P. S., Chaudhry, A., Tasciotti E. and Righetti, R. "Assessment of the long bone inter-fragmentary gap size in ultrasound strain elastograms" 2019, *Physics in Medicine and Biology*, 64(2), p.025014.

34. **Islam, M.T.**, Chaudhry, A. and Righetti, R. "An analysis of the error associated to single and double exponential approximations of theoretical poroelastic models", 2019, *Ultrasonic Imaging*, 41(2), pp.94-114.

35. **Islam, M.T.**, Reddy, J.N. and Righetti, R., "A model-based approach to investigate the effect of elevated interstitial fluid pressure on elastography", 2018, *Physics in Medicine and Biology*, 63(21), p.215011.

36. **Islam, M.T.** and Righetti, R.,"A novel filter for estimation of fluid pressure and fluid velocity", 2018, *Computers in Biology and Medicine*, 101, pp.90-99..

37. Tang, S., Chaudhry A., Shajudeen P. S., **Islam, M.T.**, Kim N., Cabrera F. J., Reddy J. N., Tasciotti E. and Righetti, R., "A model-based approach to investigate the effect of a long bone fracture on ultrasound strain elastography", 2018, *IEEE Transactions on Medical Imaging*, 37 (12), 2704-2717.

38. **Islam, M.T.**, Reddy, J.N. and Righetti, R. "An analytical poroelastic model of a non-homogeneous medium under creep compression for ultrasound poroelastography applications - Part I", 2018, *Journal of Biomechanical Engineering*, 141(6), p.060902.

39. **Islam, M.T.**, Reddy, J.N. and Righetti, R. "An analytical poroelastic model of a non-homogeneous medium under creep compression for ultrasound poroelastography applications - Part II", 2018, *Journal of Biomechanical Engineering*, 141(6), p.060903.

40. **Islam, M.T.**, Chaudhry, A., Unnikrishnan, G., Reddy, J.N. and Righetti, R., "An analytical model of tumors with higher permeability than surrounding tissues for ultrasound elastography imaging", 2018, *Journal of Engineering and Science in Medical Diagnostics and Therapy*, 1(3), p.031006.

41. **Islam, M.T.**, Chaudhry, A., Tang, S., Tasciotti, E. and Righetti, R., "A new method for estimating the effective Poisson's ratio in ultrasound poroelastography", 2018, *IEEE Transactions on Medical Imaging*, 37(5), pp.1178-1191.

42. **Islam, M.T.**, Chaudhry, A., Unnikrishnan, G., Reddy, J.N. and Righetti, R., "An analytical poroelastic model for ultrasound elastography imaging of tumors", 2018, *Physics in Medicine and Biology*, 63(2), p.025031.

43. **Islam, M.T.**, Shahnaz, C., Zhu, W.P. and Ahmad, M.O., "Rayleigh modeling of teager energy operated perceptual wavelet packet coefficients for enhancing noisy speech", 2017, *Speech Communication*, 86, pp.64-74.

44. **Islam, M.T.**, Shahnaz, C., Zhu, W.P. and Ahmad, M.O., "Speech enhancement based on student t modeling of teager energy operated perceptual wavelet packet coefficients and a custom thresholding function", 2015, *IEEE/ACM Transactions on Audio, Speech and Language Processing (TASLP)*, 23(11), pp.1800-1811.

JOURNAL ARTICLES UNDER REVIEW

1. Wei, Q., **Islam, M.T.**, and Xing, L., "Enhancing deep learning inference of gene regulatory networks through construction of image representation of cell-cell interactions from scRNA-seq data", 2023, under review in *Nature Communications*.

CONFERENCE PAPERS

1. **Islam, M.T.**. and Xing, L., 2023. Physics-based reconfiguration of genomic and radiomic data enables substantially improved and interpretable deep data exploration. 65th Annual Meeting & Exhibition, AAPM.

2. Ye, S., Shen, L., **Islam, M.T.**. and Xing, L., 2023. Accelerating volumetric CT and MRI imaging by reference-free deep learning transformation from low-resolution to high-resolution. International Journal of Radiation Oncology, Biology, Physics, 117(2), p.e742.

3. Liu, J., **Islam, M.T.**. and Xing, L., 2023. A self-attention-based neural network for predicting immune checkpoint inhibitors response. International Journal of Radiation Oncology, Biology, Physics, 117(2), pp.e475-e476.

4. Laurie M, Eminaga O, Shkolyar E, Jia X, Lee T, Long J, **Islam, M.T.**, Lau H, Xing L, Liao JC, 2023. Sequential modeling for cystoscopic image classification. In Advanced Photonics in Urology. Vol. 12353, pp. 48-59. SPIE.

5. Jia X, Sang S, Zhou Y, Ren H, Laurie M, **Islam, M.T.**, Eminaga O, Liao J, Xing L. 2022. Augmented colorectal cancer detection using self-attention-incorporated deep learning. In Medical Physics. Vol. 49, No. 6, pp. E442-E442.

6. Jia X, Shkolyar E, Eminaga O, Laurie MA, Zhou Z, Lee T, **Islam, M.T.**, Meng MQ, Liao JC, Xing L. 2023. Flat lesion detection of white light cystoscopy with deep learning. In Advanced Photonics in Urology. Vol. 12353, pp. 67-71. SPIE.

7. **Islam, M.T.**, Xing, L., 2022. "Discovering distinctive elements of medical image datasets for high-performance exploration". The First Workshop on Applications of Medical AI, 25th International Conference on Medical Image Computing and Computer Assisted Intervention (MICCAI), September 18-22, Singapore.

8. **Islam, M.T.**, Shaan, M.N., Easha, E.J., Minhaz, A.T., Shahnaz, C. and Fattah, S.A., 2017, November. Enhancement of noisy speech based on decision-directed Wiener approach in perceptual wavelet packet domain. In Region 10 Conference, TENCON 2017-2017 IEEE (pp. 2666-2671). IEEE.

9. **Islam, M.T.**, Shahnaz, C. and Fattah, S.A., 2014, August. Speech enhancement based on a modified spectral subtraction method. In Circuits and Systems (MWSCAS), 2014 IEEE 57th International Midwest Symposium on (pp. 1085-1088). IEEE.

10. **Islam, M.T.**, Hussain, A.B., Shahid, K.T., Saha, U. and Shahnaz, C., 2014, May. Speech enhancement based on noise compensated magnitude spectrum. In Informatics, Electronics & Vision (ICIEV), 2014 International Conference on (pp. 1-5). IEEE.

11. **Islam, M.T.** and Shahnaz, C., 2014, April. Speech enhancement based on noise-compensated phase spectrum. In Electrical Engineering and Information Communication Technology (ICEEICT), 2014 International Conference on (pp. 1-5). IEEE.

PATENT APPLICATIONS

1. Righetti, R. and Islam, M.T., "Non-invasive estimation of material parameters", US Patent App. 17/607,787, 2022.

2. Righetti, R. and Islam, M.T., "Non-invasive assessment of interstitial fluid pressure (ifp), interstitial fluid velocity (ifv) and fluid flow inside tumors", US Patent App. 17/275,261, 2021.

3. Islam, M.T., and Xing, L., "Cartography of genomic interactions enables deep analysis of single-cell expression data", US Patent App. 63/479,724, 2023.

FUNDING SUPPORTS

1. PI, "Designing high-performance deep neural networks for medical image analysis", Seed grant, Department of Radiation Oncology, Stanford University, 2021, amount: USD 12,000.

2. co-PI with Monica Nesselbush, "Optimization of non-invasive lung cancer classification using cell-free RNA", Mikitani Cancer Research Fund, Stanford Cancer Research Institute, 2022, amount: USD 30,000.

Honors	1. Top 1% of cited publications in the field of clinical medicine in 2021 and 2022, Islam, M.T. et al. "Non-invasive imaging of Young's modulus and Poisson's ratio in cancers in vivo", 2020, *Scientific Reports*, 10(1), pp.1-12. (https://engineering.tamu.edu/news/2023/03/ultrasound-and-elasticity-imaging-labs-research-in-top-1.html).
	2. International Education Fee Scholarship (IEFS) Award, summer 2016, Texas A&M University.
	3. Science Council Session Winner, "Augmented colorectal cancer detection using self-attention-incorporated deep learning" by Xiao Jia and Md Tauhidul Islam et al., American Association of Physicist and Medicine, Science Council Session, 2022.
Software Skills	Python, MATLAB, C, C++, Java, Mathematica.