SAHIL NALAWADE

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Google Scholar: https://scholar.google.com/citations?hl=en&user=NyYGcy8AAAAJ

Web of Science: https://www.webofscience.com/wos/author/record/AAO-1071-2021

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Summary

Passionate machine learning researcher dedicated to creating useful machine learning solutions to meet dynamic business and customer needs. Experienced project and team lead proficient in ML/AI solutions for improving medical workflows.

Education

Master of Science, Biomedical Engineering **May, 2017**
The University of Texas, Arlington, Texas

- 4.0 GPA
- Ranked in top 8% of class
- Tau Beta Pi Honor Member
- Completed coursework in Medical Imaging, Optical Imaging, Medical Image processing, Programming

Bachelor of Engineering, Biomedical Engineering **August, 2010**
Vidyalankar Institute of Technology, Mumbai, India

- 3.55 GPA
- Completed coursework in Signal Processing, Matlab, and Medical Imaging

Research Interests

- Deep Learning analysis of Medical Imaging Data (Image segmentation, and synthesis)
- MR Image Reconstruction and Synthesize
- Federated training and validation (Federated averaging, medical analysis, and federated statistics)
- Computer-Aided Diagnosis in Medical Imaging (Biomarker Identification, Treatment response, and survival prediction)
- MLOps for Clinical Translation - Experiment management, metadata tracking, data versioning, and model registry

Publications (Google Scholar Link - https://scholar.google.com/citations?hl=en&user=NyYGcy8AAAAJ)

- **Nalawade, S.S.**, Murugesan, G. K., Vejdani-Jahromi, M., Fisicaro, R. A., Yogananda, C. G. B., Wagner, B., ... & Maldjian, J. A. (2019). Classification of brain tumor isocitrate dehydrogenase status using MRI and deep learning. Journal of Medical Imaging, 6(4), 046003.
- **Nalawade, S. S.**, Yu, F. F., Bangalore Yogananda, C. G., Murugesan, G. K., Shah, B. R., Pinho, M. C., ... & Maldjian, J. A. (2022). Brain tumor IDH, 1p/19q, and MGMT molecular classification using MRI-based deep learning: an initial study on the effect of motion and motion correction. *Journal of Medical Imaging*, *9*(1), 016001-016001.
- **Nalawade, S. S.**, Bangalore Yogananda, C. G., Wagner, B. C., Reddy, D., Das, Y., Fang, F. Y., ... & Maldjian, J. A. (2022). Federated Learning for Brain Tumor Segmentation Using MRI and Transformers. In *International MICCAI Brainlesion Workshop* (pp. 444-454). Springer, Cham.
- Ali, O. M., **Nalawade, S. S.**, Xi, Y., Wagner, B., Mazal, A., Ahlers, S., ... & Geethakumari, P. R. (2020). A radiomic machine learning model to predict treatment response to methotrexate and survival outcomes in primary central nervous system lymphoma (pcnsl). *Blood*, *136*, 29-30.
- Murugesan, G. K., **Nalawade, S.**, Ganesh, C., Wagner, B., Yu, F. F., Fei, B., ... & Maldjian, J. A. (2020). Multidimensional and multiresolution ensemble networks for brain tumor segmentation. In *Brainlesion: Glioma, Multiple Sclerosis, Stroke and*

Traumatic Brain Injuries: 5th International Workshop, BrainLes 2019, Held in Conjunction with MICCAI 2019, Shenzhen, China, October 17, 2019, Revised Selected Papers, Part II 5 (pp. 148-157). Springer International Publishing.

- Murugesan, G. K., Ganesh, C., **Nalawade, S.**, Davenport, E. M., Wagner, B., Kim, W. H., & Maldjian, J. A. (2020). Brainnet: Inference of brain network topology using machine learning. *Brain connectivity*, *10*(8), 422-435.
- Yogananda, C. G. B., Shah, B. R., Yu, F. F., Pinho, M. C., **Nalawade, S. S.**, Murugesan, G. K., ... & Maldjian, J. A. (2020). A novel fully automated MRI-based deep-learning method for classification of 1p/19q co-deletion status in brain gliomas. Neuro-oncology advances, 2(1), vdaa066.
- Bangalore Yogananda, C. G., Das, Y., Wagner, B. C., **Nalawade, S. S**., Reddy, D., Holcomb, J., ... & Maldjian, J. A. (2022). Disparity Autoencoders for Multi-class Brain Tumor Segmentation. In *International MICCAI Brainlesion Workshop* (pp. 116-124). Springer, Cham.
- Yogananda, C. G. B., Shah, B. R., **Nalawade, S. S.**, Murugesan, G. K., Yu, F. F., Pinho, M. C., ... & Maldjian, J. A. (2021). MRI-based deep-learning method for determining glioma MGMT promoter methylation status. *American Journal of Neuroradiology*, *42*(5), 845-852.
- Yogananda, C. G. B., Shah, B. R., Vejdani-Jahromi, M., **Nalawade, S. S.**, Murugesan, G. K., Yu, F. F., ... & Maldjian, J. A. (2020). A fully automated deep learning network for brain tumor segmentation. *Tomography*, *6*(2), 186-193.
- Bangalore Yogananda, C. G., Shah, B. R., Vejdani-Jahromi, M., **Nalawade, S. S.**, Murugesan, G. K., Yu, F. F., ... & Maldjian, J. A. (2020). A novel fully automated MRI-based deep-learning method for classification of IDH mutation status in brain gliomas. *Neuro-oncology*, *22*(3), 402-411.
- Yogananda, C. G. B., Wagner, B. C., Murugesan, G. K., **Nalawade, S. S.**, Madhurantakam, A. J., & Maldjian, J. A. (2019). AUTOMATED BRAIN TISSUE SEGMENTATION USING DEEP LEARNING AND IMPERFECT LABELING. In *Proc. Intl. Soc. Mag. Reson. Med* (Vol. 27, p. 0018).
- Yogananda, C. G. B., **Nalawade, S. S.**, Murugesan, G. K., Wagner, B. C., Madhurantakam, A. J., & Maldjian, J. A. (2019). MR IMAGE RECONSTRUCTION FROM UNDERSAMPLED k-SPACE USING DEEP LEARNING. In *Proc. Intl. Soc. Mag. Reson. Med* (Vol. 27, p. 0019).
- Wang, X., Reddy, D. D., **Nalawade, S. S.**, Barrett, D., Gonzalez-Lima, F., & Liu, H. (2018, April). Mechanistic Understanding of Transcranial Photobiomodulation Stimulated by Infrared Laser on the Human Forehead. In *Optical Tomography and Spectroscopy* (pp. JW3A-55). Optica Publishing Group.
- Wang, X., Reddy, D. D., **Nalawade, S. S.**, Pal, S., Gonzalez-Lima, F., & Liu, H. (2018). Impact of heat on metabolic and hemodynamic changes in transcranial infrared laser stimulation measured by broadband near-infrared spectroscopy. *Neurophotonics*, *5*(1), 011004-011004.
- Wang, X., Tian, F., Reddy, D. D., **Nalawade, S. S.**, Barrett, D. W., Gonzalez-Lima, F., & Liu, H. (2017). Up-regulation of cerebral cytochrome-c-oxidase and hemodynamics by transcranial infrared laser stimulation: a broadband near-infrared spectroscopy study. *Journal of Cerebral Blood Flow & Metabolism*, *37*(12), 3789-3802.
- Wang, X., **Nalawade, S. S.**, Reddy, D. D., Tian, F., Gonzalez-Lima, F., & Liu, H. (2017, April). Trans-cranial infrared laser stimulation induces hemodynamic and metabolic response measured by broadband near infrared spectroscopy in vivo on human forehead (Conference Presentation). In *Optical Interactions with Tissue and Cells XXVIII* (Vol. 10062, pp. 132-132). SPIE.
- Mehta, R., Filos, A., Baid, U., Sako, C., McKinley, R., Rebsamen, M., ... **Nalawade, S. S.** …, & Arbel, T. (2022). QU-BraTS: MICCAI BraTS 2020 Challenge on QuantifyingUncertainty in Brain Tumor Segmentation-Analysis of Ranking Scores and Benchmarking Results. *Journal of Machine Learning for Biomedical Imaging*, *1*.
- Eisenmann, M., Reinke, A., Weru, V., Tizabi, M. D., Isensee, F., Adler, T. J., ..., **Nalawade, S. S.** …, & Finzel, R. (2022). Biomedical image analysis competitions: The state of current participation practice. *arXiv preprint arXiv:2212.08568*.

Awards

- Best Clinical Science e-Poster Presentation – "Classification of brain tumor IDH status using MRI and Deep Learning", Department of Radiology, UTSW Research Day, 2019
- Best Clinical Science e-Poster Presentation – "Deep Learning based ASL super resolution, using reduced number of signal averages", Department of Radiology, UTSW Research Day, 2020
- 2nd place, Poster Presentation – "Cross-Modality Super Resolution of 3D Medical Images using a Densely Connected CNN", 27Th Annual Symposium, The National center for In Vivo Metabolism & Advance Imaging Research Center, 2020
- 2nd place, Detection of Traumatic Brain Injury (TBI), ASFNR AI Challenge, ASFNR, 2019
- 2nd place, Detection of Acute Ischemic Stroke, ASFNR AI Challenge, ASFNR, 2019
- 2nd place, Detection of Detection of Acute Hemorrhage, ASFNR AI Challenge, ASFNR, 2019
- 2nd place, Detection of Characterization of Degree of Emergency, ASFNR AI Challenge, ASFNR, 2019
- 3rd place, Detection of Mass Effect, ASFNR AI Challenge, ASFNR, 2019
- 3rd place, Normal versus Abnormal Category, ASFNR AI Challenge, ASFNR, 2019

Presentations

- Brain Tumor IDH, 1p/19q, and MGMT Molecular Classification using MRI-based deep learning: Effect of motion and motion correction, Department of Radiology, 8th Annual meeting; May 11th, 2021; Dallas, TX, USA: UTSW Research Day; 2021
- MRI based Deep Learning method for determining glioma MGMT promoter methylation status, Department of Radiology, 8th Annual meeting; May 11th, 2021; Dallas, TX, USA: UTSW Research Day; 2021
- Deep Learning based ASL super resolution, using reduced number of signal averages, Department of Radiology, 7th Annual meeting; May 12th, 2020; Dallas, TX, USA: UTSW Research Day; 2020
- Motion Artifact Correction in Structural MR Images using Dense-U-Net Architecture, Department of Radiology, 7th Annual meeting; May 12th, 2020; Dallas, TX, USA: UTSW Research Day; 2020
- Improving Image Quality of ASL Images using Deep learning, American Society of Functional Neuroradiology 13th Annual meeting; November 3-5, 2019; San Francisco, CA, USA: ASFNR; 2019
- Classifying Abnormalities in CT Images using Deep learning – ASFNR AI Challenge, American Society of Functional Neuroradiology 13th Annual meeting; November 3-5, 2019; San Francisco, CA, USA: ASFNR; 2019
- Improving resolution of ASL Images using Deep learning" International society for Magnetic Resonance in Medicine Workshop on Machine Learning, Part II; October 25-28, 2018; Washington, D.C., USA: ISMRM Workshop; 2018
- Classification of brain tumor IDH status using MRI and Deep Learning, International society for Magnetic Resonance in Medicine Workshop on Machine Learning, Part II; October 25-28, 2018; Washington, D.C., USA: ISMRM Workshop; 2018
- Improving resolution of ASL Images using Deep learning, American Society of Functional Neuroradiology 12th Annual meeting; October 15-17, 2018; Coronado, CA, USA: ASFNR; 2018
- Classification of brain tumor IDH status using MRI and Deep Learning, American Society of Functional Neuroradiology 12th Annual meeting; October 15-17, 2018; Coronado, CA, USA: ASFNR; 2018
- Classification of brain tumor IDH status using MRI and Deep Learning, Department of Radiology, 6th Annual meeting; May 7th, 2019; Dallas, TX, USA: UTSW Research Day; 2019
- Super-Resolution ASL using Deep learning, Department of Radiology, 6th Annual meeting; May 7th, 2019; Dallas, TX, USA: UTSW Research Day; 2019
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Experience

Bio-informatics Team at Dana-Farber Cancer Inst. (Harvard) Boston, MA. **08/2021 to Current**

Data Scientist

- **Organ Segmentation** was performed for pancreas. Vision transformer network were used for segmenting the pancreas and surrounding organs.
- **Implemented** various vision transformer networks for the project of organ segmentation. Vision Transformer, Medical Transformer and Swin-Unetr for the semantic segmentation were implemented.
- Pipeline for detecting **Pancreatic ductal adenocarcinoma cancer** was executed with accuracy around 87% on the held-out test set. Visualizations were created for better illustrations of the results and methodology of the project.
- This approach was performed using unsupervised learning, and phenotype mapping. Phenotype mapping used (ICD, SNOMED, RXNORM, CPT and LOINC) different medical codes for unsupervised classification.
- Federated Learning pipeline was implemented using Nvidia Package (NVFlare). This was a pilot study for the deploying the framework across different clients. The pilot study was tested with different frameworks including pytorch, tensorflow, and numpy.
- Currently working on Federated learning project using Rhino Health package for executing a federated evaluation platform for testing a pre-existing pipeline across different client.
- Tested different packages for body composition analyses on the publicly available abdominal CT cases. The test pipeline was updated, maintained, and docker containers were created for ease of implementation for different clients.
- Organ radiomics pipeline was designed to extract features using segmented volumes and radiomics package. This package was tested using in-house dataset.
- Performed thorough literature review for the topics of semantic, lesion and organ segmentation task in the medical domain.
- Presented literature review on the task of Pancreas semantic segmentation, PDAC classification and self-supervised learning.

ANSIR Lab at UT Southwestern Medical Center, TX **08/2017 to 08/2021**

Research Associate

- **Semantic segmentation** for segmenting brain tumor into 3 tumor subtypes (edema, non-enhancing and enhancing tumor) using 2D and 3D segmentation algorithm (Dice Score for Whole Tumor = 90.40%)
- Rigorous model evaluation for segmentation and uncertainty scores with emphasis on different tumor types.
- Comparative study of classifying brain tumor images with molecular subtype (IDH) using different CNN architectures such as Dense-Net, Res-Net and Inception-V4 (image analysis/processing or computer vision)
- **Classification** of MR Images into different molecular subtypes such as IDH mutation status, 1p/19q co-deletion status, MGMT methylation status, and EGFR status. (Accuracy = 80.09% to 97.14%)
- Predictive 2D and 3D classification and segmentation models were used for the molecular / genomic classification task.
- **Improving resolution** (super-resolution or image reconstruction) of medical images using deep learning architectures such as GAN, 2D Dense-Net and Se-Net.
- Motion artifact correction using deep learning algorithm was designed, trained and deployed achieving greater than 99% of SSIM and 56 dB of PSNR for MR Images with 100% corruption.
- Motion correction algorithm was used to improve the spatial resolution for motion corrupted medical images, Testing was performed on both simulated and clinical dataset.
- Extensive study for effects of image artifact and artifact correction on the classification network was determined using deep learning which includes training and testing on multiple networks with varied datasets
- **Super resolution network** (SR-Net) was designed for improving the quality of low resolution ASL Images using 3D CNN, which involves patch-wise training and testing of MR Images
- Cross-Modality Net (CM-Net) was designed using 3D Dense-Net for improving the resolution of ASL, FLAIR and T1 MR Images
- Predicting survival using classical machine learning networks such as decision trees, SVM, random forest and gradient boosting for glioma and lymphoma subjects. MR images and clinical features were used for feature extraction, feature engineering, training and testing. (Accuracy=55.2% to 81.4%)

Medical Imaging Device Lab at UT Arlington, TX **09/2015 to 06/2017**

Research Assistant

- Neuro-imaging using both modalities F-NIRS and EEG for building a relationship between neuronal signals and blood flow in frontal part of the brain, worked on hardware and software design.
- Designed Image processing pipeline for MRI and F-MRI Images using algorithm such as ICA, PCA, machine learning, noise removal, segmentation, binary operations
- Developed a single wavelength based blood perfusion measuring device, using non – invasive optical technology, LabVIEW and Matlab algorithm, performed FDA and IRB approved experiments for measuring blood flow
- Performed design of experiments, data analysis, quality checks, statistical analysis using Logistic and multiple linear regression models, Anova, and t-tests.

Service Team at GE Healthcare, India **03/2011 to 08/2015**

Service Engineer

- Detecting errors in the production and pharmaceutical delivery system (process) for Medical Cyclotron. Unit cycle time saved by over 40% by cost saving & process improvements.
- Supported & improved manufacturing line by implementing engineering changes in compliance to ISO, FDA regulations

Skills

- **Primary skills**: Machine learning algorithms, Deep Learning application, Artificial Intelligence techniques, Model Deployment, Image processing, Neuroimaging data analysis, statistical and quantitative approach.
- **Programming Tools**: Python, Matlab, R, Shell, Linux
- **Architectures**: Neural Network, CNN, DNN, GAN, VAE, Auto-encoders, Inception, Res-Net, Dense-Net, SE-Net, Efficient-Net, LSTM, Vision Transformers
- **Libraries for Machine Learning**: Keras, Tensorflow, PyTorch, JAX, FLAX, Theano, Scikit-Learn (CPU, GPU or CUDA), Nvflare, Monai
- **Libraries for Image processing**: OpenCV, SimpleITK, Nibabel, NiPy, NiLearn, Scikit-Image, Scipy
- **Data visualization tools**: Matplotlib, seaborn, ggplot
- **Cluster and Cloud computing**: GCP, SLURM, HPC, AWS, Azure, Kaggle kernels
- **Troubleshooting**: GeeksforGeeks, Github, Stackoverflow, Kaggle, Leet code
- **Statistical Tool and Analysis:** R programming, Microsoft office, Regression analysis, t-test, ANOVA
- **Standard Health Codes used for projects:** CPT, LOINC, ICD-9, ICD-10, SNOMED, and RxNorm
- **Soft Skills**: Communication, critical thinking, positive attitude, teamwork, leadership, mentoring and meeting deadlines