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Salah Assana

Experience

Apr 2023–Present **Research Assistant III**, *Massachusetts General Hospital, Athinoula A. Martinos Center for Biomedical Imaging*, Boston, MA, *Advisor: Ciprian Catana*

- **MR Fingerprinting sequence design for ultra-low-field portable MRI:** Developing an automated, physics-simulation-driven approach to MR Fingerprinting pulse-sequence design—using reinforcement learning over an explicit MRI physics simulator to discover sequences, rather than relying on hand-designed flip-angle/timing schedules—targeting the ultra-low-field regime, where standard clinical-field MRF sequences and reference calibration data do not directly transfer to portable MRI systems.
- **Automatic lung parenchyma segmentation from synthetic training data:** Developing a segmentation approach trained entirely on synthetic anatomical data rather than real paired scans, targeting lung parenchyma—a structure for which reliable ground-truth annotations are largely unobtainable due to the difficulty of visually distinguishing parenchyma from adjacent pulmonary vasculature. The synthetic-data strategy sidesteps this ground-truth bottleneck directly, rather than depending on manual annotation that the anatomy itself makes impractical to produce at scale.
- **Automatic cardiac image segmentation from synthetic training data:** Developing a cardiac image segmentation approach trained exclusively on synthetic images spanning randomized contrast and resolution, addressing the substantial contrast variability characteristic of cardiac MRI protocols.

Jan 2021–Apr 2023 **Research Assistant II**, *Beth Israel Deaconess Medical Center, Cardiac MR Center*, Boston, MA, *Advisor: Reza Nezafat*

- **Accelerated cardiac T1 mapping (MyoMapNet):** Developed a physics-informed neural network for quantitative cardiac tissue mapping, reconstructing the true T1 relaxation curve from image intensities and their known inversion times rather than performing generic image-to-image mapping—cutting required acquisition time from a 17-heartbeat breath-hold to 4 heartbeats, and total scan time from 2 minutes to under 12 seconds. Validated against a 12-vial reference phantom of known T1 values and for generalization across a multi-vendor, multi-center study. Deployed inline on a clinical scanner via Siemens's OpenRecon framework in collaboration with Siemens engineers; open-sourced code, data, and trained model.
- **Real-time accelerated cine MRI (DRAPR):** Developed a 3D U-Net-based reconstruction pipeline for 12×-accelerated, real-time radial cardiac cine imaging under physiological stress; diagnosed a fundamental failure mode in image-domain-only training—where the network could not distinguish genuine cardiac motion from k-space-domain artifact and suppressed real physiology as noise—and redesigned the pipeline to enforce data consistency directly against raw, multi-coil k-space rather than the reconstructed image. Deployed on-scanner for in-vivo evaluation in patients with suspected coronary artery disease.
- **Resolution-enhancement GAN for cardiac cine (REGAIN):** Diagnosed why super-resolution networks trained on synthetically degraded images failed to generalize to real accelerated clinical acquisitions—traced to g-factor noise and parallel-imaging reconstruction artifacts introduced by the scanner's own reconstruction pipeline and absent from synthetic training pairs—and redesigned training to reconstruct through the same vendor-specific parallel-imaging pipeline used clinically, closing the resulting simulation-to-real gap and enabling a 13.6- to 16-fold effective acceleration factor relative to a fully sampled scan.

Selected open-source contributions: github.com/HMS-CardiacMR/MyoMapNet, github.com/HMS-CardiacMR/DRAPR, github.com/HMS-CardiacMR/REGAIN

Sep 2018–Aug 2020 **Research Assistant**, *MIT Media Lab, Signal Kinetics Group*, Cambridge, MA, *Co-Advisors: Fadel Adib, Rosalind Picard*

- **Contactless seismocardiography:** Developed a contactless mmWave RF sensor capable of recording a seismocardiogram (a fine-grained measurement of the heart's mechanical activity) without a contact accelerometer, using a differential filter that exploits the periodicity of cardiac motion versus the aperiodicity of body motion to isolate the target signal.
- **Real-time multi-sensor acquisition:** Built a C++/Boost-based real-time, multi-sensor data acquisition pipeline; used MATLAB to filter and analyze cardiac signal for markers of atrial fibrillation and ischemia.
- **Publication:** Published as co-first author at MobiCom 2020.

Sep 2017–Aug 2018 **Machine Learning Engineer**, *Booz Allen Hamilton*, Tysons, VA

- **Security clearance:** Held a Top Secret security clearance, sponsored by Booz Allen Hamilton.
- **Distributed data lake:** Built a scalable distributed data lake on AWS using Hadoop and Hive.
- **Text summarization:** Independently designed and built an abstractive text-summarization tool (bidirectional LSTM with attention; TensorFlow, NumPy, Pandas) after determining no existing tool met the project's requirements.

Sep 2015–May 2017 **Research Assistant**, *University of Virginia, Link Lab*, Charlottesville, VA, *Co-Advisors: Kamin Whitehouse, David Evans*

- **Privacy-preserving indoor localization:** Designed a privacy-preserving indoor localization sensor using a binocular thermal camera, reaching 99.7% travel-direction classification accuracy without transmitting identifiable image data off-device.
- **Physics-grounded synthetic data:** Built a physics-grounded synthetic-data pipeline to train the sensor's classifier, rendering realistic thermal images from physical first principles—Planckian blackbody radiance and tissue-specific emissivity—after determining that standard image augmentation did not preserve the physical fidelity needed for the classifier to generalize to real thermal captures.
- **Embedded optical flow:** Rewrote the embedded camera driver in branchless C and hand-designed a memory-constrained optical flow algorithm requiring only 33 bytes of working memory for an 8-bit ATtiny microcontroller with no debugging tools available, increasing sensor throughput $\sim$30$\times$ while cutting energy consumption by 50%.

Education

Sep 2018–May 2020 **Master of Science**, *Massachusetts Institute of Technology*, Cambridge, MA, GPA: 4.9/5.0
Thesis: *Contactless Cardiovascular Activity Monitoring Using mmWaves*

Sep 2015–May 2017 **Bachelor of Science, Computer Science**, *University of Virginia*, Charlottesville, VA, GPA: 3.87/4.0
Thesis: *Privacy-Preserving Image Processing with Binocular Thermal Cameras*

Sep 2013–May 2015 **Associate of Science, Computer Science**, *Northern Virginia Community College*, Sterling, VA, GPA: 3.84/4.0

Publications

Peer-Reviewed Publications

In press Morales M, **Assana S**, et al. "Deformation-Encoding Deep Learning Transformer (DENT) for High Frame Rate Cine Cardiac MRI." *Radiology*.

2023 Yoon S, **Assana S**, et al. "Accelerated Cardiac MR Cine Imaging Using Resolution Enhancement Generative Adversarial Inline Neural Network." *Radiology* 307(5):e222878.

2022 Morales M, **Assana S**, et al. "An Inline Deep Learning Based Free-Breathing ECG-Free Cine for Exercise Cardiovascular Magnetic Resonance." *Journal of Cardiovascular Magnetic Resonance (JCMR)* 24(1):1–14.

2022 Guo R, Chen Z, Amyar A, El-Rewaidy H, **Assana S**, et al. "Improving Accuracy of Myocardial T1 Estimation in MyoMapNet." *Magnetic Resonance in Medicine (MRM)*. doi:10.1002/mrm.29397.

2022 Amyar A, Guo R, Cai X, **Assana S**, et al. "Impact of Deep Learning Architectures on Accelerated Cardiac T1 Mapping Using MyoMapNet." *NMR in Biomedicine* 35(11):e4794.

2022 Guo R, El-Rewaidy H, **Assana S**, et al. "Accelerated Cardiac T1 Mapping in Four Heartbeats with Inline MyoMapNet: A Deep Learning-Based T1 Estimation Approach." *Journal of Cardiovascular Magnetic Resonance (JCMR)* 24(1):1–15.

2022 Fahmy A, Csecs I, Arafati A, **Assana S**, et al. "An Explainable Machine Learning Approach Reveals Prognostic Significance of Right Ventricular Dysfunction in Nonischemic Cardiomyopathy." *JACC: Cardiovascular Imaging* 15(5):766–779.

2020 Ha U[†], **Assana S**[†], Adib F. "Contactless Seismocardiography via Deep Learning Radars." *Proceedings of the 26th Annual International Conference on Mobile Computing and Networking (MobiCom)*, pp. 1–14.

2018 Griffiths E, **Assana S**, Whitehouse K. "Privacy-Preserving Image Processing with Binocular Thermal Cameras." *Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies (UbiComp/IMWUT)* 1(4):1–25.

[†] Co-first authors.

Conference Presentations

2024 **Assana S**, et al. "An Open-Source, Flexible, Plug-and-Play Inline CMR Image Segmentation Platform." International Society for Magnetic Resonance in Medicine (ISMRM).

2023 **Assana S**, et al. "Breath-Hold UTE Stack-of-Spirals Lung Water Volume Quantification at Rest and Physiological Exercise at 3T." Society for Cardiovascular Magnetic Resonance (SCMR).

2023 Ghanbari F, **Assana S**, et al. "Artificial Intelligence-Enabled Exercise-CMR for Evaluation of Cardiac Functional Reserve in Heart Failure." SCMR/AHA.

2023 Yoon S, **Assana S**, et al. "Cardiac MR Denoising Inline Neural Network (CaDIN)." ISMRM.

2022 **Assana S**, et al. "Radial Perfusion Cardiac Magnetic Resonance Imaging Using Deep Learning Image Reconstruction." ISMRM.

2022 **Assana S**, et al. "A Guide to Deploying Deep Learning Models on Scanner: A Case Study with MyoMapNet." SCMR.

Skills

Machine learning Transformers, U-Net / 3D U-Net, GANs, fully connected networks, LSTM with attention; physics-informed neural networks; self-supervised representation learning; reinforcement learning; synthetic-data training (domain randomization); deep-learning MRI reconstruction with k-space data consistency

Programming & frameworks Python, PyTorch, TensorFlow, NumPy, Pandas, C/C++, MATLAB, C#, JavaScript

MRI physics & signal modeling k-space signal modeling, Bloch/Extended Phase Graph (EPG) simulation, MR Fingerprinting, quantitative parameter mapping (T1, T2, PD), parallel-imaging reconstruction (GRAPPA/coil-combination pipelines)

Clinical deployment Siemens OpenRecon inline scanner deployment, multi-vendor/multi-center validation study design

Academic Honors

2017 **Summa Cum Laude**, University of Virginia – Highest Latin honors for academic performance.

2017 **Distinguished Majors Program, Highest Distinction**, University of Virginia – Computer Science honors thesis program; highest distinction awarded for undergraduate thesis research (privacy-preserving indoor localization, Link Lab).

2017 **Louis T. Rader Undergraduate Research Award**, University of Virginia – UVA's highest undergraduate research honor, awarded for research conducted in the Link Lab.

2017 **Phi Beta Kappa**, University of Virginia – National academic honor society; induction based on academic excellence across the liberal arts and sciences.

2015–2017 **Dean's List, all semesters**, University of Virginia – Awarded each semester for high academic standing.

2015 **Summa Cum Laude**, Northern Virginia Community College – Highest Latin honors for academic performance.

2015 **All-Virginia Academic Team**, Northern Virginia Community College – State-level honor recognizing top community college students statewide, nominated through Phi Theta Kappa.

2015 **1st Place, Northern Virginia Annual Math Competition**, Northern Virginia Community College – Regional mathematics competition open to students across Northern Virginia.

2014 **Phi Theta Kappa**, Northern Virginia Community College – International honor society for two-year college students; induction based on academic achievement.

2013–2015 **Presidential Scholar**, Northern Virginia Community College – Merit-based scholarship awarded to top incoming students.

2013–2015 **Dean's List, all semesters**, Northern Virginia Community College – Awarded each semester for high academic standing.