Timothy James Baker

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Summary

Computer scientist passionate about improving patient care and the clinical workflow by delivering data-driven solutions. Currently collaborating with radiologists to develop machine learning models that extract clinically relevant information from 3D medical images. Has expertise in Python, high performance computing, and machine learning.

Education

University of Michigan **Ann Arbor, MI**
Ph.D. Computer Science and Engineering *Sept 2017 - May 2023*

Rowan University **Glassboro, NJ**
B.Sc. Physics *Sept 2013 - May 2017*
B.Sc. Computer Science *Sept 2013 - May 2017*

Skills

- **Programming Languages:** Python, Verilog, SQL, MATLAB, C++
- **Python Deep Learning:** Pytorch, Pytorch-Lightning, MONAI, Weights and Biases
- **Python Data Analysis and Visualization:** Numpy, Pandas, Scipy, Seaborn, Matplotlib
- **Image Processing:** 3D Segmentation (U-Net), 3D Registration (Elastix), Statistical shape modeling (SSM)
- **Medical Image Formats:** Computed tomography (CT), Magnetic resonance imaging (MRI), NIFTI, DICOM
- **OS, Tools, and Platforms:** Linux, Git, High performance computing (HPC) clusters, SLURM, Jupyter Notebooks

Professional Experience

Michigan Medicine **Ann Arbor, MI**
Research Fellow *2023 - Present*

- Developed machine learning models that aid in the treatment of aortic aneurysm by accurately quantifying aortic growth using longitudinal 3D CT and MRI scans.
- Automated routine clinical research tasks by developing new software tools and ETL pipelines that allow for rapid creation of large curated clinical datasets for statistical analysis and discovery.
- Validated automated solutions, implemented algorithmic safeguards, and worked closely with clinicians to ensure that software met clinical safety standards and adequately addressed clinical challenges.

Computer Engineering Lab, University of Michigan **Ann Arbor, MI**
Graduate Student Research Assistant *2017 - 2023*

- Designed energy-efficient neural networks for devices with limited size and battery like medical devices.
- Extended PyTorch to develop Python-based hardware simulator that is used to train low-precision neural networks that have 40% smaller hardware footprint and similar classification accuracy as traditional neural networks.
- Established research agenda and scope. Demonstrated research value through persuasive statistical arguments resulting in 7 first-author research publications in leading IEEE and ACM conferences and journals.

Selected Projects

Segmenting the Aorta in Diverse 3D Medical Images *2023*

- Created robust data extraction, transform, load (ETL) pipelines to prepare 900+ 3D medical images for training deep neural networks (U-Nets) to segment the aorta and localize key anatomical landmarks in 3D images.
- Developed high-throughput U-Net training pipeline using distributed parallel GPU training on high performance SLURM computing cluster. Reduced training time and dollar cost by 100x using caching and other optimizations.
- Validated the U-Net performance with 10-fold cross validation and implemented post-processing techniques to improve reliability; U-Net is about 10+ minutes quicker per scan than manual segmentation by an expert.

Automatically Quantifying Aortic Growth Over Time *2023*

- Improved computer vision algorithm that extracts aortic diameters from 3D medical images; automated pipeline is 30 minutes quicker than the standard of care manual approaches for aortic aneurysm treatment planning.
- Enhanced registration algorithm by adding new penalty terms that encourage more physiologically realistic results.
- Registration produces a 3D model of aortic growth that allows for a clinically useful view of aneurysm progression.