Aamer Kazi

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Summary

Machine Learning and Simulation Engineer with a Ph.D. in Mechanical Engineering, 2.5 years of industry experience building and deploying large-scale ML/DL models and 5 years of academic experience in computational science spanning high-fidelity nonlinear finite element simulation and constitutive modeling. Built models serving millions of users under regulatory oversight for Align. Hands-on expertise in deep learning (Transformers, representation learning), Generative AI (Agents, VAEs), and systematic model evaluation and experimentation. Authored detailed AI model evaluation reports encompassing acceptance criteria, fairness audits across 13+ demographic slices, and V&V documentation for production deployment.

Skills

FEA & Mechanics:	ABAQUS (implicit & explicit), Drucker–Prager, Johnson–Cook, constitutive modeling, damage/fracture, V&V
ML & Optimization:	PyTorch, TensorFlow, Scikit-learn, Transformers, XGBoost, LightGBM, Bayesian Optimization (Optuna), LangGraph/LLMs
Characterization:	SEM-EDS, Surface Metrology (Alicona), Universal Testing (Instron), Hardness Testing, Profilometry, Optical Microscopy
Languages & Tools:	Python, MATLAB, NumPy, SciPy, Pandas, ClearML, Git, Docker
Statistics:	JMP, Minitab, DOE (Full Factorial), SPC, Excel

Work Experience

Align Technology — San Jose, CA

R&D Engineer III, Modeling and Simulation — Dec 2023 – Present

Deep Learning Enhanced Treatment Planning for the Invisalign System

- Developed production ML/DL models for orthodontic treatment planning, iterating from multivariable regression to a **Transformer architecture** (multi-head attention, PyTorch) that contributed to a **20% increase in clinical efficacy** for millions of patients annually
- Led **verification & validation** for all model generations under FDA regulatory oversight; performed data-slice analysis across 13+ demographic and clinical dimensions, physics-based simulation validation, and detailed AI model reporting ensuring no subpopulation degradation
- Generated surrogate training labels via **counterfactual analysis** through the production Transformer across 30,000+ cases, then framed attachment placement as a Learning-to-Rank problem (LightGBM LambdaRank); extracted interpretable clinical rules validated by domain experts and deployed to production processing 1,000+ cases/week
- Led an end-to-end **clinical study (APAC region)** assembling a cross-functional team of clinical experts, software developers, and CAD designers

LLM-Based Dental Treatment Assistant & Evaluation Framework

- Architected a **LangChain ReAct agent** integrating LLMs (Claude, Llama, Gemini) over AWS Bedrock for natural-language querying and modification of orthodontic treatment data, with a **3-category evaluation framework** (classification accuracy, calculation tolerance, LLM-as-Judge format compliance)
- Built a middleware layer with query sanitization and complexity classification for **dynamic per-request model routing**; currently being tested as a case screening tool for clinical studies

3D Shape Representation Learning for Orthodontic Attachments

- Built a **DiffusionNet-based mesh autoencoder** encoding variable-topology 3D meshes into 8–12D latent vectors at sub-millimeter fidelity; conducted systematic AE vs β-VAE comparison across multiple quantitative metrics (reconstruction fidelity, generative specificity, disentanglement, interpolation smoothness)
- Designed embeddings as drop-in geometric features for the downstream treatment planning Transformer, **replacing categorical attachment labels with continuous geometric descriptors**

Texas A&M University College Station, TX
Graduate Research Assistant Aug 2018 – Dec 2023

Finite Element Modeling of Rock Drilling Processes (U.S. DOE)

- Developed a finite element model in ABAQUS for PDC rock cutting simulation using the **Drucker–Prager yield criterion** with damage evolution to capture failure of granite under varying crack density, orientation, and confining pressure (0–100 MPa)
- Calibrated constitutive model parameters through uniaxial and diametrical compression testing; cross-referenced cutting forces predicted by the finite element simulation with experimental results for **validation**
- Built a MATLAB-based **node separation algorithm** generating random pre-existing cracks between elements based on configurable crack density parameters, enabling parametric study of crack effects on cutting forces and mechanism
- Constructed a laboratory-scale rock drilling setup on a CNC mill, demonstrating **30% reduction** in cutting and thrust forces from plasma-induced pre-cracking

Machining of Additively Manufactured Metals (Honeywell)

- Developed a 2D finite element model in ABAQUS with **Johnson–Cook plasticity and damage** criteria to simulate serrated chip formation during turning of Ti-6Al-4V; investigated the effect of fracture energy on chip morphology
- Analyzed machinability of additively manufactured Ti-6Al-4V, A205, and 17-4 SS through a **full factorial DOE** with SEM-EDS microstructural characterization

Education

Texas A&M University College Station, TX
Ph.D., Mechanical Engineering · GPA: 3.74/4.0 Aug 2018 – Sep 2023

Vellore Institute of Technology Vellore, India
B.Tech., Mechanical Engineering · GPA: 9.17/10 Aug 2014 – Jun 2018

Selected Publications · Google Scholar

[1] Kazi, A.A., et al. (2024). "Numerical Investigation of Pre-induced Cracks on Hard Rock Cutting Using FEA." *Rock Mech. Rock Eng.*, 57, 7997–8011.

[2] Kazi, A., et al. (2023). "Plasma Pre-cracking Effects on Drilling Hard Rocks." *ASME J. Manuf. Sci. Eng.*

[3] Kazi, A., Kao, Y., Tai, B.L. (2021). "Rotary vs Linear Cutting for Specific Cutting Energy of Granite." *ASME J. Manuf. Sci. Eng.*, 143(11).

[4] Raval, J., Kazi, A., et al. (2021). "Machining of Additively Manufactured Ti-6Al-4V." *JOM.*