DEEPAK KUMAR

Indian Institute of Technology Madras, Chennai, India

+91-8439373413 Deepak72855@gmail.com linkedin.com/in/deepak8439

EDUCATION

Indian Institute of Technology Madras (IIT Madras) 8.6/10.00

MS by research in Metallurgical and Materials Engineering *Year of Completion:2025*

BBDNITM - Dr. APJ Abdul Kalam Technical University (Uttar Pradesh) 8.1/10.00

Bachelor of Technology in Mechanical Engineering *Year of Completion:2017*

AREA OF INTEREST

• Characterization • AI for materials design • Lightweight and Advanced metals •Microstructure and properties

TECHNICAL SKILLS

Characterization: Scanning Electron Microscopy (**SEM**), Energy Dispersive X-Ray Spectroscopy (**EDS**), Electron Back-Scatter Diffraction (**EBSD**), X-Ray Diffraction (**XRD**), Optical Energy Spectroscopy **(OES),** Optical Microscopy, Metallography, Electropolishing, Friction Stir welding, Failure analysis, mechanical Testing

Software and Programming languages: TSL-OIM, Xpert-Highscore, OriginPro, Winwulff, ImageJ, Fusion360, AutoCAD, Abaqus, MS Office, Python, Git, GitHub.

Scripting tools and libraries: Machine Learning**,** Google Cloud Platform, Jupyter Notebook, VS code, Scikit-Learn, NumPy, Pandas, Matplotlib, TensorFlow/Keras, PyTorch, Computer Vision, Image Processing

RESEARCH PROJECTS

Nano-Porosity Detection and Analysis of Transmission Electron Microscopy (TEM) Micrograph Using Machine and Deep Learning Models

(In Collaboration with Oxford Nano Analysis (University of Oxford UK) under Profs. Sergio Lozano-Perez) *(Oct 2024- Present)*

- Automating identification and segmentation of nano-porosities in TEM micrographs of Zr- alloy cladding in nuclear reactor environment.
- Developed a data pipeline using **data augmentation technique** (Albumentations + OpenCV) to **reduce overfitting** and improved the data diversity by 70%.
- Conducted a comparative analysis of nano-porosity detection methodologies:
  - **Random Forest Classifier:** Achieved 95% training accuracy and 80% feature detection accuracy.
  - **U-Net Deep Learning Architecture:** Attained 97% training accuracy and 92% feature detection accuracy with 80% less training data.
  - **Multimodal Trans-Unet (Vision Transformer):** Fine-tuned to attain 96% training accuracy and 90% feature detection accuracy.
  - Validated model performance using **ROC-AUC, precision, recall**, and **confusion matrices**.
- **Publications:**
  - **Manuscript titled: "Microstructural Evolution and Corrosion Kinetics of X2 Zr-Nb alloy in simulated PWR and BWR Environments** " - Nama, Rajat; **Kumar, Deepak**; Liang, Xingzhong ; Frankel, Philipp; Shah, Zaheen ; Partezana, Jonna; Grovenor, Chris; Lozano-Perez, Sergio" (submitted to ASTM proceedings).
  - **Manuscript titled: "Comparative Performance of Classical and Deep Learning architectures for Nano-porosity Detection in TEM Images**" - **Kumar, Deepak**; Nama, Rajat; Grovenor, Chris; Lozano-Perez, Sergio" (Under preparation).

Friction stir welding of dissimilar Aluminium Alloy 6082 – T6 (AA6082-T6) and Dual-phase 780 steel (DP780 steel) lightweight, sustainable automotive applications: ***(MS Research Thesis)***

Guide: Prof. Ranjit Bauri, Materials Energy Manufacturing Sustainability (MEMS) Lab, MME Dept., IIT Madras *(Feb 2021- May 2025)*

- Analyzed the effect of FSW process parameters on AA6082-T6 and DP780 steel lap joints for maximum joint efficiency.
- Correlated the temperature distribution using **data acquisition tool (DAQ)**, average axial force and residual stress with process parameters.
- Investigated the material mixing to understand the interface characteristics, and the formation of intermetallic compound layers of dissimilar joints using **HR-SEM, EDS**, and **XRD** under various FSW process parameters.
- Analyzed **severe plastic deformed** weld regions using **EBSD** and mechanical testing (**UTM** and **nano-indentation**) to correlate **recrystallization**, **grain refinement**, and localized **hardness variations** of **thermomechanical processed** of AA6082-T6 and DP780 steel joints.
- Correlated the interface **failure mechanism** with the effects of intermetallic compounds at the weld interface.
- **Manuscript titled: "Investigations on microstructural evolutions and mechanical properties of Dual-Phase 780 Steel and Aluminium Alloy 6082-T6 dissimilar joints through Friction Stir Welding"- Deepak Kumar**, Ranjit Bauri, Manish N. Borse (Under Preparation).

Prediction of ultimate tensile strength (UTS) of Friction stir welded AA6082-T6 and DP780 steel using Machine learning Algorithms:

Guide: Prof. Ranjit Bauri, MEMS Lab, MME Dept., IIT Madras *(Dec 2022- June 2024)*

- Conducted **Exploratory Data Analysis (EDA)** using **Pandas, NumPy, Matplotlib**, and **Seaborn** to examine relationships between process parameters (rotation speed, traverse speed, and plunge depth) and the resulting ultimate tensile strength (UTS).
- Developed **machine learning models** in **Python** with **Scikit-Learn** to implement and evaluate **linear regression**, **decision tree**, **random forest**, **support vector machine** and assessed model performance with **MSE** and **R^2** metrics to predict UTS, supporting insights into the process-structure-property relationships in FSW.

INTERNATIONAL/ NATIONAL CONFERENCES

Guide: Prof. Ranjit Bauri, MME Dept., IIT Madras

- **Effect of process parameters on microstructural and mechanical properties of FSWed dissimilar DP780 and AA6082-T6 joint.**
  Thermec'23 international conference (University of Technology Vienna, Austria). (Certificate) *(July 2023)*
- **Analysis of microstructural and mechanical properties evolution of FSWed dissimilar joints of DP780 and AA6082-T6. Cecured 3rd place in presentation.**
  Amalgam National Symposium 1 and 2 (IIT Madras) (Certificate 1, Certificate 2) *(April 2023, March2024)*
- **Symbiosis'23 AI/ML conference and workshop** *(IIT Madras)* (Certificate) *(Jan 2023)*

RELEVANT COURSE WORK AND CERTIFICATIONS

Characterization:

- Texture in Materials
- Modern Techniques of Material Characterization
- Materials Characterization Lab
- X- ray Diffraction Techniques

Mechanical Metallurgy:

- Physical Metallurgy
- Mechanical behavior of materials

Advanced Material Science:

- Sheet metal forming
- Advanced welding Techniques
- Aluminum alloys and their composites

PROFESSIONAL EXPERIENCE

Associate Solution Leader: Machine Learning Engineer *(Feb 2024- Feb 2025)*

Brane Enterprise Pvt. Ltd., Hyderabad (India)

- Collaborated within a 50-persons team to develop and optimize deep learning models (Using TensorFlow, PyTorch) for product price optimization and segmentation, increasing sales by 15% for e-commerce clients.
- Collaborated with senior team members on analyzing large datasets to extract actionable insights, driving business decisions and strategy using Tableau and Superset, resulting in a **10% sales forecast improvement** for retail sector clients.

Technical Consultant *(Oct 2019- Dec 2020)*

OSN Consulting & Associates, Uttar Pradesh (India)

- Contributed to large-scale plant and machinery projects by conducting detailed technical and financial valuations (**INR 150-200 Cr**), providing accurate assessments that supported strategic decisions.

Assistant Engineer *(Jul 2018-Sept 2019)*

Dynamic Intra-tech Pvt. Ltd, Kota, Rajasthan (India)

- Managed a production team in steel bridge fabrication, ensuring product quality and optimizing machining parameters through data-driven analysis, which increased production rates by **9-10%.**

OTHER PROJECTS AND WORKSHOPS

B.Tech. project: *(Aug 2016- May 2017)*

Automatic Kickstand Retrieval System in Bike to Prevent Accidents:

- Designed energy-efficient mechanism and used AISI 4130 Steel and Titanium alloy grade 5 to design the kick retrieval structure.

Workshop:

- Attended a **Google Analytics** workshop at IIT Madras and **finished among the top 10% of participants**.
- Attended the SPARC International Workshop on Aluminum Alloys- IIT Madras and McMaster University.

CO-CURRICULAR EXPERIENCE

Teaching Assistant- Principles of Physical Metallurgy course (MM2010) *(Aug 2022-Nov 2023)*
Theory and practice of non-destructive testing (NOC24-MM14) *(Dec 2023- Mar 2024)*

Guide: Prof. Ranjit Bauri, MME Dept., IIT Madras

- Assisted Professor in conducting courses and examinations.
- Led weekly lab seasons to demonstrate and clarifying the experiment protocols to a batch of 70 students.

EXTRA-CURRICULAR ACTIVITIES AND ACHIEVEMENTS

- Attended a **Google Analytics workshop** at IIT Madras and **finished among the top 10% of participants**.
- **Recipient** of **GATE scholarship** with **94.2 percentile** from Govt. of India, Feb 2018.
- Regularly participated in long-distance rides securing podium finishes at IIT Madras Pedal Storm and PAN IIT events.
- Participated in 35th IMUN conference as the **delegate of country** Niger on gender equality topic by **United Nations**.

HOBBIES AND LANGUAGES

- Culinary Enthusiast, Melophile, Backpacking
- Hindi (native), English (Fluent), German (A1 level)