

# Guru Prasaath Pushparaj

R&D Engineer – Predictive Maintenance & Machine Learning

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## SUMMARY

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A Mechatronics Engineer with a Master's degree from University of Siegen, with specialization in Condition Monitoring, Reliability Engineering, Structural Health Monitoring and Machine Learning for engineering systems. Experienced in Vibration based fault detection, spectral analysis, Anomaly detection and predictive maintenance for rotating machinery. Developed deep learning surrogate models for FEM simulations, GAN based synthetic data generation for degradation modeling and end to end ML pipelines. Skilled in Python, C, C++, PyTorch, MATLAB, and Numerical modeling.

## TECHNICAL SKILLS

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**Programming Languages:** Python, C, C++, MATLAB

**Machine Learning & AI:** PyTorch, Deep Learning, GANs, CNNs, Autoencoders, Regression Models, Anomaly Detection, MLOps, Time-Series Modeling

**Predictive Maintenance & Condition Monitoring:** Vibration Analysis, Fault Diagnosis, Spectral Analysis (FFT), Degradation Modeling, Remaining Useful Life (RUL) Estimation, Modal Analysis

**IIOT & Embedded system:** STM 32, Arduino

**Signal Processing:** Time-Series Analysis, Feature Extraction, Filtering, Envelope Analysis

**Simulation & Modeling:** FEM, ANSYS, Abaqus, MATLAB/Simulink, Numerical Modeling, SolidWorks

**Data Analysis & Visualization:** NumPy, Pandas, Scikit-learn, Excel, Power BI

**Tools & Platforms:** MS Office, Linux, L<sup>A</sup>T<sub>E</sub>X, Git, Github

## EXPERIENCE

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### Research Assistant (Structural Health Monitoring)

*Chair of Structural Health Monitoring - dept – SHM – uni – siegen.de*

### Master Thesis Student - R&D

*IMS Gear SE & Co.KGaA - Advance Development Team (R&D)*

### Graduate Engineer Trainee (GET)

*TEXMO Industries - Product Development Team (R&D)*

January 2025 – Present

*Siegen, Germany*

March 2025 – August 2025

*Donaueschingen, Germany*

July 2021 – Dec 2021

*Coimbatore, India*

- Redesigned the hydraulic components for a Pressure Booster pump, improving reliability and performance.
- Developed design concepts for a Dewatering pump on functional performance.
- Troubleshooted issues in an existing 6-inch submersible pump-set.
- Created detailed 3D CAD models of various pump components for product development.

## PROJECTS

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### Development of Deep Learning Models for Predicting Load Parameters of Specific Gear Designs to Boost Finite-Element-Method (FEM) Simulation Workflows

Mar 2025 – Sep 2025

- Built DL-based surrogate models to accelerate FEM gear-meshing simulations and predict critical load parameters like root stress and contact pressure.
- Implemented and compared MLP, Deep Ensembles, Autoencoders, and CNN Autoencoders for regression performance.
- Achieved high-accuracy load parameter prediction using gradient-boosted deep ensembles for gear failure analysis.

### Synthetic Data Generation for the Extension of Degradation Index from failure Tests for missing data

May 2024 – July 2024

- Implemented GAN models to generate realistic degradation trajectories and extend missing failure data for predictive maintenance.
- Performed exploratory analysis of component degradation signals to extend degradation indices and RUL trajectories.

- Identified suitable failure thresholds and generated synthetic time-series data from component replacement to hypothetical failure.

### **Damage Detection on Bearings by Vibration-Based Condition Monitoring**

Dec 2023 – Jan 2024

- Analyzed vibration signals using multiple signal-processing techniques to identify indicators of bearing damage.
- Collected accelerometer data and prepared vibration datasets for condition monitoring analysis.
- Detected bearing fault types through spectral analysis and presented diagnostic results.

### **Robotic Arm Pick and Place Manipulator**

Oct 2023 – Dec 2023

- Programmed a robotic manipulator in MATLAB for automated pick-and-place operations.
- Developed an inverse kinematics model to compute joint configurations.
- Executed pick-and-place tasks using trajectory planning and motion control.
- Implemented and tuned a PID controller to optimize joint-level control performance.

### **Numerical Analysis of Simultaneous Heat and Mass Transfer of an Absorber in a VAR System**

July 2019 – Apr 2020

- Developed a 2D numerical model for simultaneous heat and mass transfer in a vertical plate absorber.
- Performed finite-difference numerical analysis to simulate falling-film absorption behavior.
- Implemented the model in MATLAB and incorporated Darcy's law for flow characterization.

### **CFD Analysis of Quasi One-Dimensional Flow in a Convergent-Divergent Nozzle**

Aug 2018 – Nov 2018

- Investigated thermodynamic properties (velocity, density, pressure, Mach number) of compressible flow through a convergent-divergent nozzle using analytical, numerical, and CFD approaches.
- Compared analytical solutions, finite-difference numerical results, and ANSYS Fluent CFD simulations for validation.
- Performed numerical analysis of quasi-1D nozzle flow using the MacCormack finite-difference technique.

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## **EDUCATION**

### **University of Siegen**

Siegen, Germany

*Master of Science, Mechatronics. CGPA - 1.7 (1 is the best, Master thesis - 1.3)*

2022 – Oct 2025

### **Coimbatore Institute of Technology**

Coimbatore, India

*Bachelor of Engineering, Mechanical Engineering. CGPA - 9.26/10, Silver Medalist*

2016 – 2020

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## **LANGUAGES**

### **English**

*Working Proficiency - Level B2*

### **German (Deutsch)**

*Intermediate Proficiency*

### **Tamil**

*Native and Full Proficiency*

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## **CERTIFICATIONS AND PUBLICATIONS**

### **CFD Analysis of Quasi One-Dimensional Flow in a Convergent-Divergent Nozzle**

*ISBN 978-81-930396-8-7*

### **Advanced Driver Assistance Systems (ADAS)**

*Issued Sept 2024*

### **Generative AI, from GANs to CLIP, using pytorch and python**

*Issued July 2024*

### **Machine Learning A-Z: AI, Python & R+**

*Issued Nov 2023*

### **AutoCAD Level 1 & 2**

*Issued Oct 2017 & Mar 2018*