Balakumaran Murugesan

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Education

Indian Institute of Technology Kharagpur Aug 2019 - May 2021

Masters of Technology in Aerospace Engineering (CGPA: 8.40 / 10.00) (with 10 being the highest score) *Kharagpur, India*

- Focused on Smart Structures, Composite Materials, Finite Element Methods, Structural Vibration , Aeroelasticity, and AI in Aerospace.
- All coursework and research were conducted in the **English medium**.

Anna University Aug 2015 - May 2019

Bachelor of Engineering in Aeronautical Engineering (CGPA: 7.40 / 10.00) (with 10 being the highest score) *Chennai, India*

- Focused on Engineering Mathematics, Aerodynamics, Aircraft structures, Flight Dynamics, Aircraft Propulsion, and Structural Analysis.
- All studies were completed in the **English medium**.

M.Tech Thesis

Optimization of Stacking Sequences for M21/T800S Carbon–Epoxy Composite C-Sections Using Multi Criteria Decision Making and Machine Learning | *Aug 2020 - May 2021*

- Investigated Fibre Reinforced Polymer (FRP) composite C-sections with M21/T800S pre-preg in ANSYS; designed variants with/without web cut-outs to assess strength.
- Applied Classical Laminate Theory and Generalized Reduced Gradient (GRG) optimization to determine the optimal number of plies across different orientations, then performed Finite Element Analysis (FEA) on select stacking sequences to predict attributes such as Inverse Reserve Factor (IRF), total deformation, and principal stress etc.
- Employed an Analytical Hierarchical Process (AHP)-based Multi Criteria Decision Making (MCDM) framework to combine these parameters into a single composite score by assigning weightages to key responses (failure index, buckling load, stress, and strain), and leveraged ML to extrapolate this score for any stacking sequence, which enables rapid, adaptable design optimization.

B.Tech Thesis

Comparison and Analysis of Performance Parameters of Three Different Vertical Axis Wind Turbines | *Jan 2019 - May 2019*

- Designed and analyzed three Vertical Axis Wind Turbines (VAWT) types (High/Low Aspect Ratio Savonius, High Aspect Ratio Darrieus) using CFD in ANSYS Fluent and MATLAB-based tools.
- Assessed the impact of aspect ratio, rotor solidity, and tip speed ratio on aerodynamic performance.

Selected Academic Projects & Personal Research Work

Transformer-based Structural Health Monitoring using Frequency Response Function (FRF) | *Feb 2025*

- Developed a complete pipeline for damage detection using frequency-domain vibration data (Healthy, 2.96%, 5.92%, 8.87% mass loss) and filtering key bands (10–40 Hz, 120–160 Hz, 350–450 Hz).
- Designed and trained a hybrid Convolution Neural Network (CNN)-Transformer encoder model (d_model=64, 4 heads, 2–3 layers, 0.1 dropout, batch size reduced from 8 to 2), achieving 97.86% test accuracy.
- For details, visit my blog post and Transformer-based SHM Repo.

Study of Wing Tip Vortices of wing with Bell shaped Lift Distribution | *Dec 2019*

- Study that discusses the optimization of the wingspan load, optimized to produce the smallest induced resistance at a fixed moment, thereby affecting the wake structure.
- Designed wing with the help of CFD and OpenVsp software and used Xflr 5 software to analyze the wing and compared lift and induced drag coefficient of all three wing.

Skills

English Language: Advanced Proficiency (All academic studies and research were conducted in English)
Design and FE Packages: ANSYS (FLUENT, ACP, MODAL, Design Exploration), CATIA V5, SolidWorks, Xflr5.
Programming Languages: C, C++, Python, Java, Matlab, R, MySQL.

Work Experience

SLK Software Pvt Ltd Apr 2024 – present
Research Engineer *Bangalore, India*

- Working on Intelligent Machine Error Correction (IMEC) using AI/ML for Computer Numerical Control (CNC) machining, developing predictive models for thermal expansion, geometric deviations, and tool wear monitoring.
- Created a Retrieval-Augmented Generation (RAG) system which includes graph neural network techniques for enhanced relational data analysis.

Vijna Labs Pvt Ltd Jan 2023 – Apr 2024
Product Engineer *Bangalore, India*

- Researched unsupervised representation learning using autoencoders and fine-tuned diffusion models with LORA techniques; built computer vision annotation and evaluation tools.

Pavo and Tusker Innovation Pvt Ltd Aug 2021 – Dec 2022
Associate AI Research Engineer *Chennai, India*

- Developed and deployed AI solutions for semi-supervised image classification, planogram tracking, and image processing engines using deep learning.
- Conducted research on advanced signal processing, time-series analysis, and machine learning techniques to investigate complex datasets.

Achievements

GATE — Graduate Aptitude Test in Engineering – Eligible for scholarship and postgraduate admission to the most premier research institutes in India. All India Rank – **151.**

References

Dr. Anup Ghosh
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