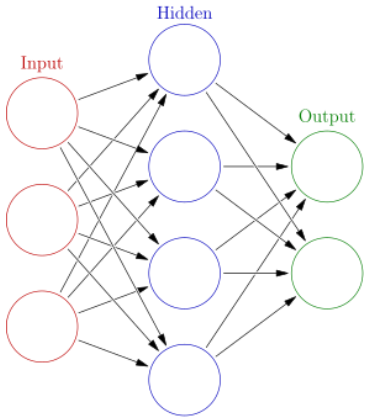
Institute for Rotorcraft and Vertical Flight
TUM School of Engineering and Design
Technical University of Munich

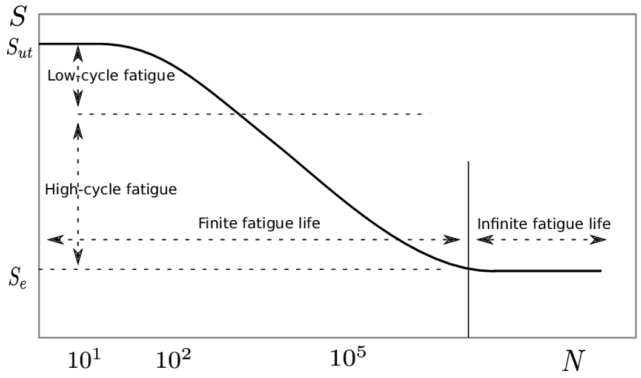
Semester / Master Thesis

Physics-informed neural networks (PINN) for predicting fatigue life of flax fiber reinforced polymers

Project Outline

Accurate fatigue modeling is essential for ensuring the safety, reliability, and lifetime prediction of aerospace materials operating under complex loading conditions. Data-driven models can identify complex patterns but often lack physical context, while classical physics-based models capture governing mechanisms but struggle with variability and real-world complexity. Physics-informed neural networks (PINNs) bridge this gap by embedding physical information directly into the learning process. With an experimental fatigue dataset of flax fiber-reinforced polymers – an emerging alternative to traditional carbon fiber composites for aerospace applications – PINN-based approaches shall be developed and evaluated to assess their ability to generalize, capture underlying degradation mechanisms, and provide robust fatigue life predictions.





Work Packages

1. Literature review
2. Data Preparation and Analysis
3. Development of Physics-Informed Neural Network Approaches
4. Training and Validation
5. Evaluation and Optimization

Recommended Background:

- Confident handling of python and common data science tools
- Experience in machine learning methods
- Experience in structural analysis and fatigue modeling

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