universität freiburg

Department of Microsystems Engineering (IMTEK)
&
Cluster of Excellence livMatS

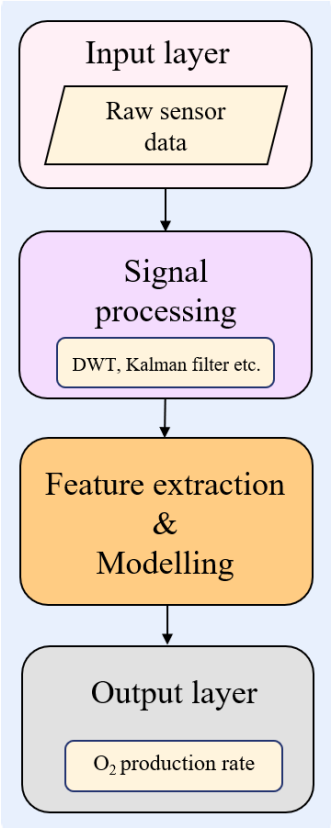

Fig: Data processing pipeline: raw sensor data to predictive modelling for O_2 release estimation.

Our profile

The Cluster of Excellence livMatS, in collaboration with the IMTEK chair at the University of Freiburg, is a leading center for research in bioinspired materials and adaptive energy systems. In our research at IMTEK, integrating microsystems engineering, machine learning, and optical sensing to develop intelligent sensing technologies for environmental monitoring, energy harvesting systems, and controlled actuation. The integration of novel materials with adaptive capabilities aligns with the livMatS vision of creating sustainable and interactive material systems for real-world applications.

Master Thesis

Predictive Modelling of O_2 Release in Varying Environmental Conditions

Background/Motivation

The controlled release of oxygen plays a crucial role in chemically triggered actuation and environmental sensing applications. Understanding and accurately predicting this oxygen release under varying conditions (pressure, absorbance, temperature) is vital for developing optimized systems. Oxygen sensing typically relies on optical absorbance and pressure measurements, but integrating these methods with machine learning (ML) models can improve accuracy, adaptability, and real-world implementation.

This Master's thesis focuses on developing a computational model to predict oxygen release dynamics, leveraging optical and pressure sensing data with ML-based predictive analytics.

Tasks & Responsibilities

During your thesis, you will work on developing a predictive framework for Ant-EPO oxygen release. You will be responsible for exploring new methodologies while working closely with sensor data and computational modelling. The project will involve:

- Apply noise reduction techniques (e.g., Wavelet denoising, Kalman filtering) and extract meaningful features.
- Develop a predictive model to estimate oxygen release dynamics from ANT-EPO molecules.
- Implement and compare ML models (e.g., XGBoost, LS-SVM, Neural Networks) to analyze experimental data.
- Validate the model and optimize performance (e.g., Bayesian hyperparameter tuning etc.) and refine the system for real-world applications.

Qualifications & Skills Required

We are looking for a motivated master's student with the following qualifications:

- Background in computer science, electrical engineering, computational science, applied physics, or a related discipline.
- Programming: proficiency in python (scikit-learn, TensorFlow/PyTorch).
- ML & data analysis (Regression models, Neural Networks, Bayesian Optimization).
- Familiar with signal processing (Wavelet Transform, PCA, Kalman Filtering for feature extraction).

This project offers a unique opportunity to gain experience in experimental design, predictive modelling, and interdisciplinary collaboration. Experience in COMSOL or ANSYS- based simulation tools is an advantage. In addition to being eager to experiment, you are independent, curious and enjoy familiarizing yourself with new topics.

Have we sparked your interest? Interested candidates should submit their resume, motivation letter, and transcript of records in a single pdf via email with the subject header: 'Masterthesis_O2sense_'.

Contact:

Abhishek Sharma
IMTEK & livMatS, University of Freiburg
abhishek.sharma@livmats.uni-freiburg.de