Lehrstuhl Steuerung,
Regelung und Systemdynamik

Master Thesis

Literature, Experimental

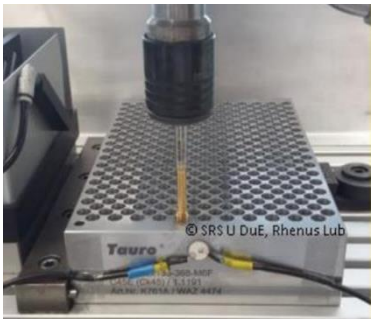
Machine Learning-Based Prediction of Thread Forming Positions

Keywords: machine learning, prediction, ultrasonic waves

Conditions:

Duration:	6 months
Submission until:	30.03.2026
Requirements:	Programming skills in MATLAB
Language:	English/German
Target group:	Master students

Contents:



Understanding the propagation behavior of ultrasonic signals in materials is a crucial aspect of structural health monitoring and non-destructive testing. When mechanical stress or damage occurs in a structure, energy is released and transformed into ultrasonic waves, whose characteristics are strongly influenced by the material properties. Analyzing these waves requires advanced signal processing techniques that can extract patterns from measurements. The propagation of ultrasonic waves is complex, processing and feature extraction are essential to link raw sensor data with physically relevant information.
The measurements were conducted during tapping torque tests investigating metal working fluids. The aim of this thesis is to predict the thread forming positions. A literature review about signal processing methods relevant to filtering, segmentation, and time–frequency analysis is to be conducted. Based on this foundation, signal transformations and filtering methods are to be explored to capture the temporal and spectral behavior of signals. The relationship between features and the response variable will then be established using suitable modeling approaches. For evaluation, the dataset is to be split into training and test sets at the level of entire measurement series, ensuring a realistic assessment of model generalization. Model performance is to be quantified using metrics such as Root Mean Square Error (RMSE) and relative error.

The goals of this work are:

- Literature review of signal processing methods
- Preprocess and segment the measurement data
- Extract meaningful features beyond simple statistical descriptors, emphasizing temporal and spectral characteristics
- Analyze the predictive relationship between feature sets and the target response variable
- Refine feature extraction and modeling strategies iteratively to improve prediction performance
- Visualize results with informative plots (e.g., error trends, feature correlations, feature importance) to support interpretation and validation
- Complete and detailed documentation/presentation of the research results

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