# Master’s Thesis Project: Vibration Signal Analysis Based Tap Changer Monitoring

## Background:

Power transformers are important and expensive equipment in an electrical power system. Therefore, the reliability and availability of the power transformers are very vital for uninterruptible power delivery. Being the only mechanically moving part of a power transformer, on load tap changers (OLTC) condition assessment and maintenance need special attention as OLTCs are historically responsible for > 25 % of major transformer failures. Thus, different on/off-line OLTC diagnostic techniques have been developed and employed to detect incipient faults, and thereby to prevent repair/replacement of tap changers and/or transformers by condition-based maintenance. Dynamic resistance, motor current, and vibroacoustic measurement are some of the popular methods practiced by the industry today, which have their own strengths and weaknesses in terms of detecting different faults and unfavorable operating conditions.

Vibroacoustic signal analysis-based OLTC monitoring has gained popularity during the last decades, however the diagnostics are not yet mature enough to be standardized. Therefore, some research is still being conducted in academia and industry to improve vibration analysis as a reliable OLTC monitoring test technique. The proposed scope of the thesis is to explore conceivable classical and modern vibration signal analysis techniques to make a positive impact on OLTC monitoring and diagnostics.

## Goals and objectives

The main goal is to extract diagnostic parameters from tap changer vibration signals in order to identify incipient faults.   
  
Detailed tasks and objectives are:

* Literature study and review – understanding current approaches that are used for vibration signal analysis
* Analyze and understand available data and identify approaches that can be effective
* Develop classical signal analysis and/or machine learning based models for parameter extraction
* Testing and Verification
* Conclusions and future work.

## Method and Delimitation

The analysis in this project will primarily employ classical signal processing techniques, contrasting with prior work on the subject, which has predominantly focused on machine learning methods.

Time Plan

**Starting date:** 2024-01-15  
**End date:** 2024-06-02

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| **Week** | **Activity** |
| 1 – 3 | **Literature Study:** Conduct an in-depth review of existing vibration signal analysis methods for OLTC monitoring, focusing on classical signal processing techniques. |
| 4 – 5 | **Data Familiarization and Preparation:** Review the available data, perform necessary cleaning and preprocessing, and identify initial analysis approaches. |
| 6 – 8 | **Initial Model Development:** Begin developing and testing basic classical signal processing methods for parameter extraction. Adjust methods based on preliminary outcomes. |
| 9 – 11 | **Model Refinement and Testing:** Refine the selected methods and perform thorough testing to assess effectiveness. Document adjustments and outcomes. |
| 12 – 14 | **Validation and Verification:** Validate the model’s performance, comparing extracted parameters against benchmarks or expected values to ensure accuracy. |
| 15 – 16 | **Result Analysis:** Analyze the results, identify strengths and limitations of the methods, and draw preliminary conclusions about their effectiveness for OLTC diagnostics. |
| 17 – 18 | **Thesis Drafting:** Begin writing the thesis, focusing on documenting methodology, findings, and analysis. |
| 19 | **Revision and Feedback:** Revise the thesis based on feedback from supervisors and make final adjustments as needed. |
| 20 | **Final Submission and Defense Preparation:** Finalize and submit the thesis by 2024-06-02 and prepare for the defense presentation. |

## Place of Work

The project will be carried out at Hitatchi Energy in Västerås and Uppsala University.

## Contact

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