

Use of vibro-acoustic measurement (VAM) for On-Load Tap-Changer (OLTC) diagnostics

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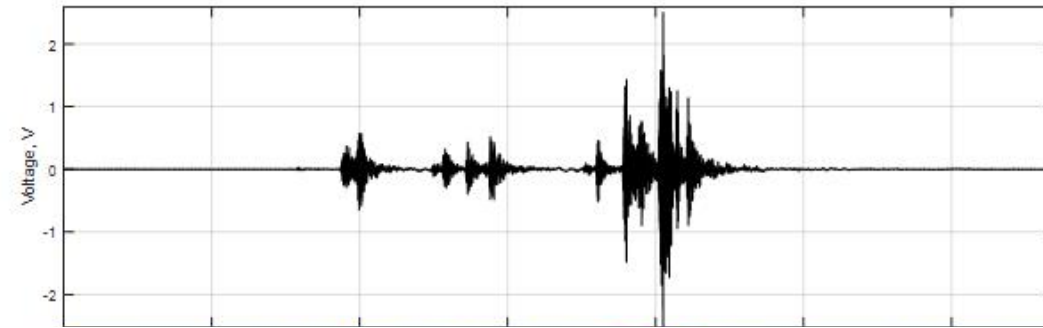
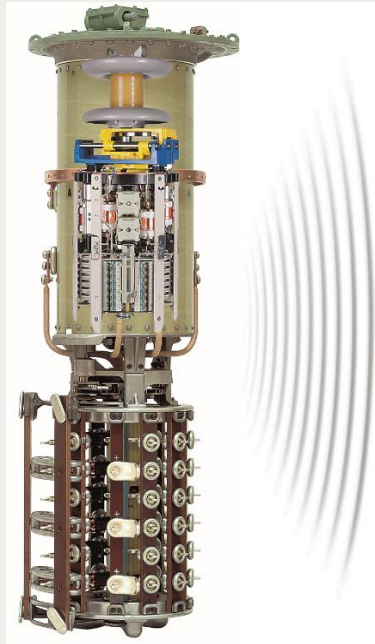
Has data sufficient quality? Do good use cases for exist?

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Vibro-Acoustic Measurement (VAM)

- Installation of an acceleration sensor nearby the OLTC
- Measurement of the vibration of the OLTC during the OLTC switching process



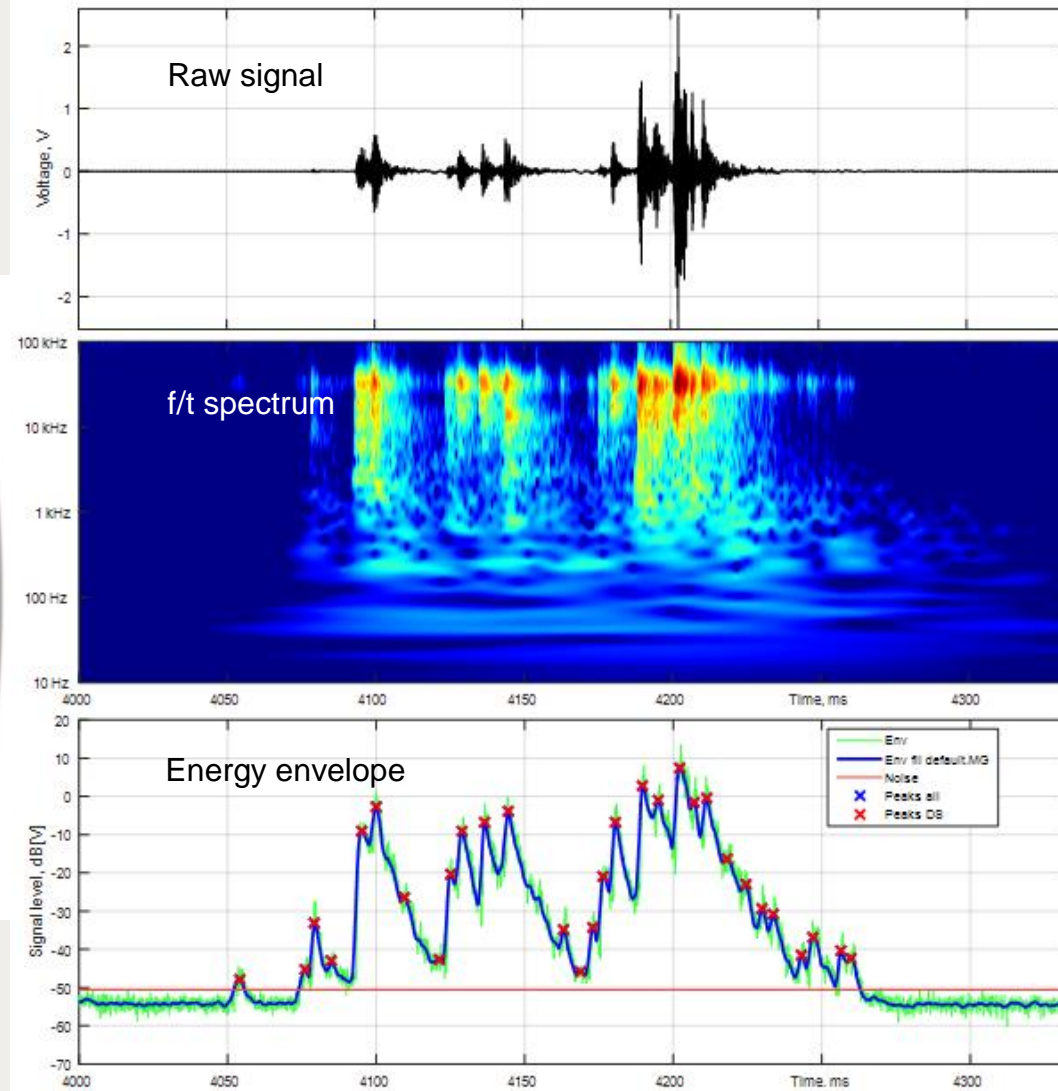
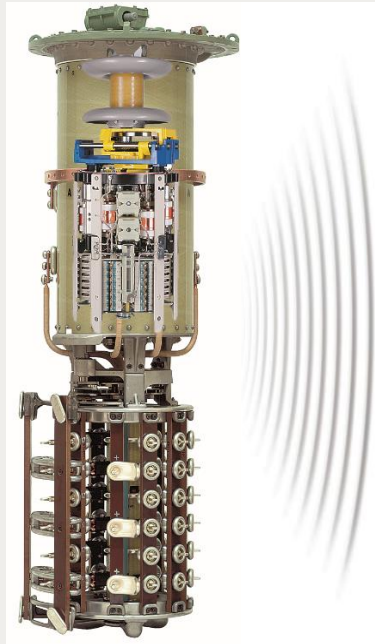
How to:



- Ensure the required data quality during the measurement (data acquisition) and repeatability
- Get a proper signal form (appropriate data processing)
- Increase the ability to interpret the results (data interpretation)

Vibro-Acoustic Measurement (VAM)

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Raw Measurement:

- Oscillating signal
- Noise from the transformer (when energized)
- Huge amount of data

Processing:

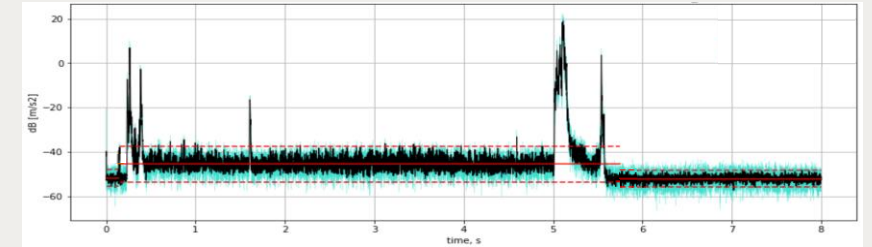
- Wavelet transform
- Hilbert transform
- Filtering

VAM Envelope:

- Noise filtered out
- Separation of useful signal
- Rectified, smooth waveform
- Reduced volume of data
- Interpretation simplified

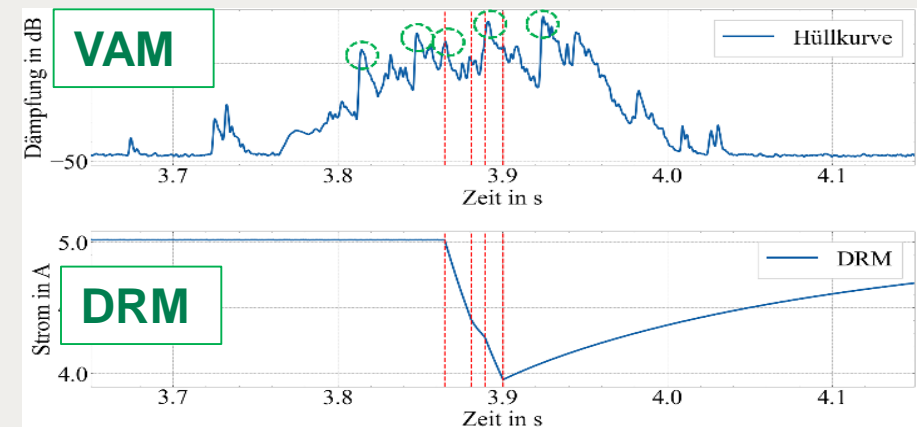
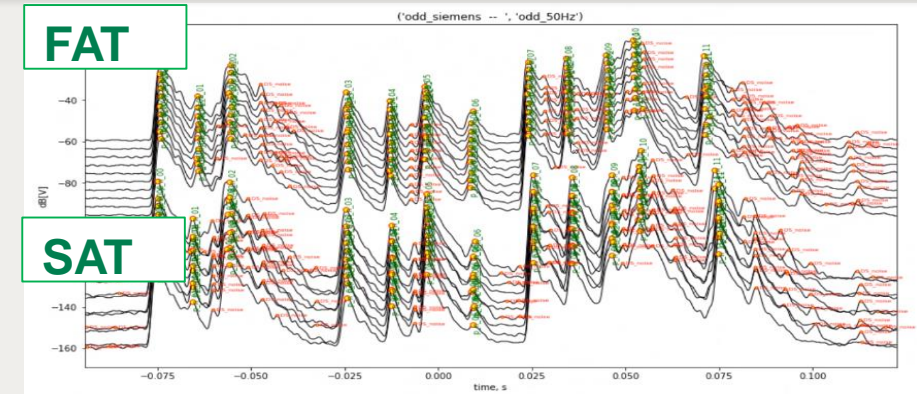
Data quality check

- VAM data can be verified with an automated quality check already in the field
- For quality assessment of the measurement different criteria can be used:
 - Time related criteria
 - Signal related criteria
- In case of not sufficient measurement results, an automated notice can be generated



Use Cases:

- Comparison of VAM measurements
 - VAM measurements on the same OLTC at transformer factory and in substation shows very good conformity in the curve (time deviation between peaks is ~1 ms, which is sufficient for a qualified interpretation)
 - Changes in envelopes helps to detect anomalies (e.g. incorrect installation, transport damages)
- Combination of VAM and Dynamic Resistance Measurement (DRM) to improve the ability of interpretation
 - VAM and DRM complement each other (as time synchronized measurement)
 - Differentiation between mechanical noise and movement of contacts
 - Simultaneous measurement with limited extra effort



Conclusion

- VAM is a useful and stable method for condition assessment of OLTCs
- Detailed design know-how of the various types is indispensable
- Sophisticated data processing is necessary to generate useful information from the available data
- Specific quality checks should be integrated already during the data acquisition
- VAM technology can be successfully used both for online and offline measurements

