

### Process large amounts of data in real time

Movares has developed an innovative evaluation method to determine the compatibility between rolling stock (RS) and LF track circuits (TC). The method is based on the electromechanical behavior of Track Relay and Track Circuit. It reflects the exact behavior of the Track Circuit and simulates the effect of continuous and transient interference currents. The method is a plug-in for the evaluation method as mentioned in the CENELEC EN 50238-2.

#### Innovative evaluation method

Movares has developed a generic real time evaluation method to determine the effect of continuous and transient interference currents on LF Track Circuits. The method is based on a generic method to model the Track Circuit as well as the corresponding Track Relay. The Track Circuit model and the Track Relay model reflect the transfer function of the line current from the train to the Track Relay. The evaluation method shows in a quantitative manner whether the measured emissions generated by the train under test will lead to electromagnetic compatibility or not.



Advanced Digital Signal Processing techniques are being used to make the method suitable to process large amounts of data in real time. The evaluation method has been implemented on a Matlab® platform. The algorithm is also suitable to be implemented in DSP architecture.

#### Features

- Generic method to model Track Circuit and Track Relay;
- Evaluates compatibility of Rolling Stock and Low Frequency Track Circuits;
- Simplifies/shortens homologation process;
- Transient evaluation based on transparent and verifiable criteria;
- Transient susceptibility limits for LF Track Circuits can be determined;
- Evaluates line current based on model with exact LF Track circuit behavior;
- RS manufacturers can cope with LF TC susceptibility limits in an early stage of the engineering and production process.

### Gaining inside knowledge

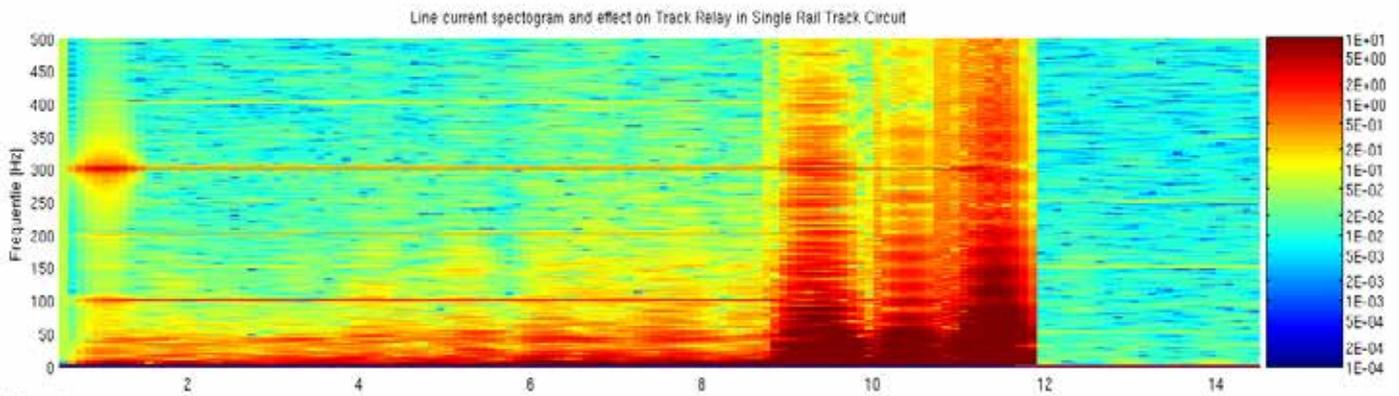
The generic model based evaluation method makes it possible to analyze the effects of interference currents on the Track Circuit. The model gives a vast amount of inside knowledge in the process on how these currents interfere with the proper functioning of the Track Circuits. The influence of typical parameters such as TC length, TC type and imbalance can be analyzed in a profound way. The model based evaluation method has been validated with measurements.

### Reference project

Movares applies the model based evaluation method in the Netherlands. Measured data of line current in Rolling Stock and/or return current in substations consisting of vast amounts of data have been analyzed in order to be able to construct an objective judgement of the effect of transients on 75 Hz Track Circuits.

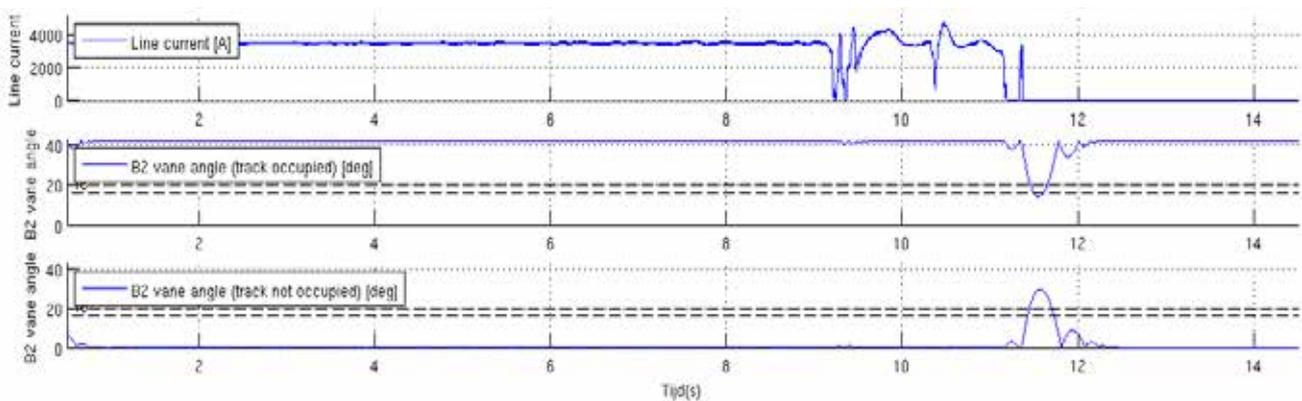
### Example Grafical Output

The figure below shows some graphical output of the evaluation method. The input signal is a transient signal due to an RS circuit breaker. At the top of the figure a FFT spectrogram of the line current signal is shown.



### The next three graphs show:

- The RS line current as function of time
- The effect of the transient on the Track Relay in an occupied track. The upper line reflects the TR vane angle (42 deg Relay up, 0 deg Relay off). The dashed lines indicate the vane angles where front/back contacts close/open.
- The effect of the transient on the Track Relay when the track is not occupied. The dashed lines indicate the opening/closing of front/back contacts.



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