IEC 61000-4-15 Flickermeter

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1   Description

The Flicker translates the visual discomfort caused by repetitive changes of brightness in lighting. It is generally caused by voltage variations due to wind turbines or certain industrial loads such as arc furnaces.

This EMTP Flickermeter is available in both 1-phase and 3 phase versions. This device implements the algorithm detailed in IEC 61000-4-15 to measure the instantaneous flicker (IFL) for 50 Hz and 60 Hz systems. Additionally, options are available to evaluate the Short-Term Flicker (PST).

2   Prerequisites

2.1 Python

Python™ is required to use the Short-term Flicker (P_{ST}) evaluation option. The following packages are required as well:
- Matplotlib
- Numpy

Refer to the documentation of the "Scripting\Python" device to learn how to install and set-up Python™ and the required packages.

3   Parameters
- **Nominal Voltage**: Used to initialize the Flickermeter at the beginning of the simulation.
- **Power Frequency**: 50Hz or 60Hz. Used to update the Flickermeter filter coefficients as per the IEC 61000-4-15 specifications.
- **T_{START} (P_{ST})**: When calculating the P_{ST}, simulation results between 0s and T_{START} are discarded. Generally used to remove the initialization of the simulations which can take a few seconds. Use 0 to evaluate the P_{ST} on the entire simulation time.
- **T_{END} (P_{ST})**: When calculating the P_{ST}, simulation results between T_{END} and the last time point are discarded. Use 1E15 to evaluate the P_{ST} on the entire simulation time.

4   Instantaneous Flicker calculation

The Flickermeter calculates the instantaneous flicker with the method described in the IEC 61000-4-15 standard. Please refer to this standard for detailed information.

The EMTP model is composed of four main blocks:
- Block 1: Input voltage adaptor and calibration checking circuit.
- Block 2: Square law demodulator.
- Block 3 and 4: Weighting filters, squaring and smoothing.

5   Short-term flicker (P$_{ST}$)

The Short-term flicker index (PST) is calculated from the instantaneous flicker calculation (time domain analysis). The following formula is evaluated:

$$P_{ST} = \sqrt{0.0314P_{0,1} + 0.0525P_1 + 0.0657P_{3s} + 0.28P_{10s} + 0.08P_{50s}}$$

Where the percentiles $P_{0,1}$, P_1, P_{3s}, P_{10} and P_{50} are the flicker levels exceeded for 0,1; 1; 3; 10 and 50 % of the time during the observation period. When this option is selected, the cumulative distribution function of the instantaneous flicker level evaluated over the observation period is displayed. IEC 61000-4-15 recommends an observation period of 10 minutes (T$_{END}$ - T$_{START}$).

Python™ is required to use the Short-term Flicker (PST) evaluation option.

6   Limitation

- **Time-step**: This Flickermeter uses high-order Butterworth filters which can become unstable when the simulation time step is small (lower than a few μs). Since the evaluation of flicker requires long simulation time (10 minutes), it was assumed that using small time-step is not practical. However, if a small time-step is required and this Flickermeter cannot be used, contact the support (support@emtp-software.com) and a solution will be provided.

- **Initialization**: The Flickermeter requires to be initialized at the beginning of the calculation. The initialization might take a few seconds and the instantaneous flicker (IFL) is not exact during the initialization period. The initialization should not be part of the P$_{ST}$ observation window.