Flicker calculator

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This document includes a short description for using the flicker calculator .m file created by Aubai Alkhatib using Matlab and FAMOS programing Software’s. Also an instruction on how to use this file is part of this document

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Inhalt

Introduction:

The Flicker Calculator is a tool used to simulate the Voltage fluctuations using the fictitious grid method defined by the IEC 61400-21 on the measured input data using Matlab Simulink environment. Afterword the dynamic results at the start of the simulation is excluded from the results of the simulation.   The cut fictitious voltage can be used afterword as an input of the flicker meter defined by IEC 61000-4-15 (This file was already available in the Internet for more information please read reference 1).

Working principle:

Working principle includes the definition of the different Flicker Calculator components. Before getting into the working principle of the m.file a list of the needed documents is defined:

Table 1 View of the needed files used when calculating the flicker values

File Name	Description
Flicker_Calculation_function.m	The governor of the other used files
flicker_Calculation_complete	Gives the final values like P_st, Ku_psyk,…… etc. according to IEC 61400-21
flicker_sim	Flickermeter according to IEC 61000-4-15
Flickermeter6140021_new_GL_Final_3ph.mdl	Matlab module file used to simulate the fictitious grid according to IEC 61400-21

The governor file (Flicker_Calculation_function.m) is used to get the user favorable input Like Alpha the impedance phase angle or the short-circuit ratio (Sk,fic /Sn) and so on. It is also used in order to direct which m.file to be executed first like in Abbildung 1

Abbildung 1 Working logic of the Governing .m file

Initial input data:

The initial input data are used in all the required files for the different m.files. Table 2 shows the list of input parameter with their description and default values.

Table 2 Input parameter used in the governing .m flie

Input parameter abbreviation	Description	Default value
input for calculation according to the norm:		
Sn	Apparent power in kW	1700 [kW]
Fn	Nominal Frequency	50 [Hz]
Un	Nominal Ph-to-Ph Voltage	400 [V]
n	The rate between Sfic/Sn	20 [pu]
Sk	Short circuit apparent power in MW	105 [MW] in Fiebing
N10	Number of switching operation within 10 min	2 [switch]
N120	Number of switching operation within 2 hours	24 [switch]
F_Sample	Sampling Time used in recording the measured data	0.00025 [S]
Alpha	Impedance phase angle (psyk) in degree	30°
differentiable user input parameter:		
endval1	Number of times a different phase angle is calculated	4 [times]
Kp	Proportional Gain factor of the PLL (used in Simulink)	50
Ki	Integral Gain factor of the PLL (Used in Simulink)	1400
Simulation_dynamic_cut_time	Is the time to be excluded from the simulation results	0.06 [s]
i	Selector: i = 1 continuous operation and i = 2 Switching operation	2
endval	Number of times of the same Row data and is different between i = 1 (then it is given using the Matlab governing .m flie) or i = 2 (in this case it is determined by the user in FAMOS- Cut.seq file after seeing the graphic of the Row data)	i = 1 (endval = 3) i = 2 (endval = 0)
Internally calculated inputs (by Matlab):		
Sk,fic	Fictitious Short cicuit apparent power grid	n*Sn = 34000 [kW]
Fs	Sampling Frequency	1/F_Sample=4000[Hz]
x_l _(endval)	Graphical input using FAMOS cursors (Only active for i = 2 Switching operation mode)	Defined by the user
x_r_(endval)	Graphical input using FAMOS cursors (Only active for i = 2 Switching operation mode)	Defined by the user
Simulation_Time = Tp	Is the difference between x_r – x_l	Defined by the user
J, jj	Counter used in ‘for’ loop	1
Simulation module .mdl inputs:		
I1,2,3_NS	Three phase currents of the measured data	[A]
U1,2,3_NS	Three phase measured voltage	[V]

Working flow:

The working flow of running the governing .m file (Flicker_Calculation_function.m) differentiates from one user to another depending on the selected input(s). The selected (i) can make difference in the work flow. The following two figures show the working flow of flicker calculation with different values of (i).

This cycle is re-done for j<=endval times in order to cover all the switching operation needed by the user.

After this loop is done 'jj' is increased and the calculation are re-done for another Alpha value defined by the user till jj<=endval1

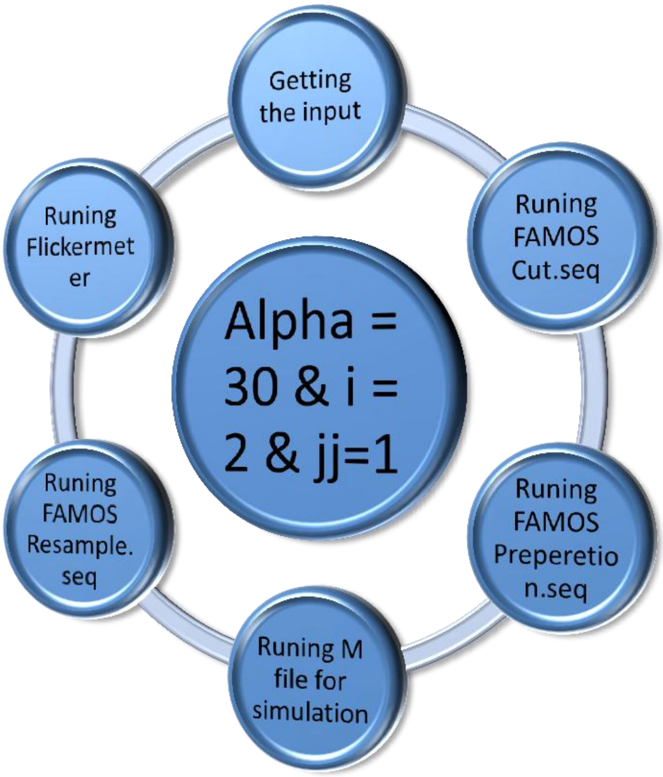

Abbildung 2 Working flow of the program when i = 2

At the beginning running the M-file the user will be asked to determine the number of switching done (normally 5 times in the IEC) and then directly on the Row Data (measured data) the different switching periods of every switching tries. So that it is automatically selected internal in the program without stopping the simulation every time to get the next measured switch.

This cycle is re-done for j<=endval times in order to cover all the switching operation defined by the user.

After this loop is done ‘jj’ is increased and the calculation are re-done for another Alpha value defined by the user till jj<=endval1

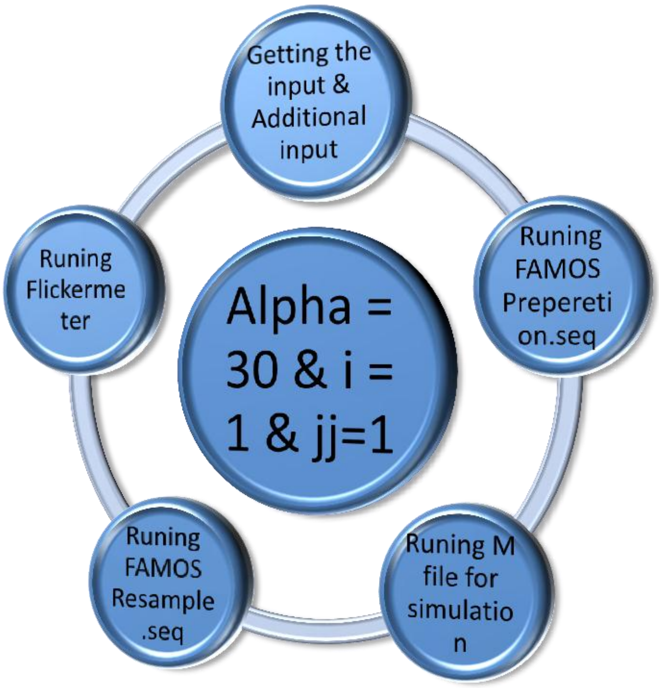

Abbildung 3 Working flow of the program when i = 1

Throughout running this file input, warning and informative massages will pop out guiding the user to get the best outcome of these calculations. As a user read the massage carefully and chose what best suit your case.

Final Output data:

The program save the needed results internal without needing to stop running the M-file. Results for the different Impendent phase angle ‘Alpha’ and different Row data is directly saved as part of the saved file name. The following table shows the different saving names with the content of the file.

File name	Saved Parameter
When i = 2	
Initial values	Includes all the input entry when i =2 (save once)
Between_values	Includes ‘j’, ‘i’, ‘Searchdir’ (saved once)
Final_results_j_Alpha	Includes all the calculated results together
When i = 1	
Initial values	Includes all the input entry when i =1 (save once)
Between_values	Includes ‘j’, ‘i’, (saved once)
Final_results_j_Alpha	Includes all the calculated results together
General output (not related to i)	
Simulation_results_j_Alpha	Ufic, U0,ku_psyk,f,U (3Ph-signals) & Time_1
Results_Complete	(Not finished) should include the average values

For more information please feel free to ask me (Aubai Alkhatib) by E-mail: Aubai.Alkhatib@enercon.de or telephone.

Appendix A

Flicker meter calculation

Introduction

The power supply network voltage varies over time due to perturbations that occur in the processes of electricity generation, transmission and distribution. Interaction of electrical loads with the network causes further deterioration of the electrical power quality.

High power loads that draw fluctuating current, such as large motor drives and arc furnaces, cause low frequency cyclic voltage variations that result in:

- Flickering of light sources which can cause significant physiological discomfort, physical and psychological tiredness, and even pathological effects for human beings,
- Problems with the stability of electrical devices and electronic circuits.

Figure 1 illustrates the way in which a small voltage change produces a noticeable effect on the luminous flux of a bulb.

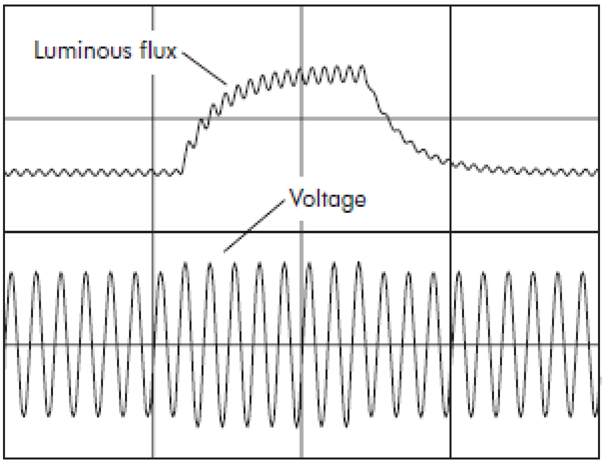

Figure 1 - Change in luminous flux resulting from a temporary voltage change [1]

Recurrent small changes of network voltage amplitude cause flickering of light sources. The effect is popularly referred to as ‘flicker’ and is a significant power quality parameter. An example of a network voltage spectrum where flicker is apparent is shown in Figure 2. The spectrum shown is typical of the voltage of a network supplying a large non-stationary electrical drive. A bulb, supplied from the same node, will flicker with frequency about 1 Hz.

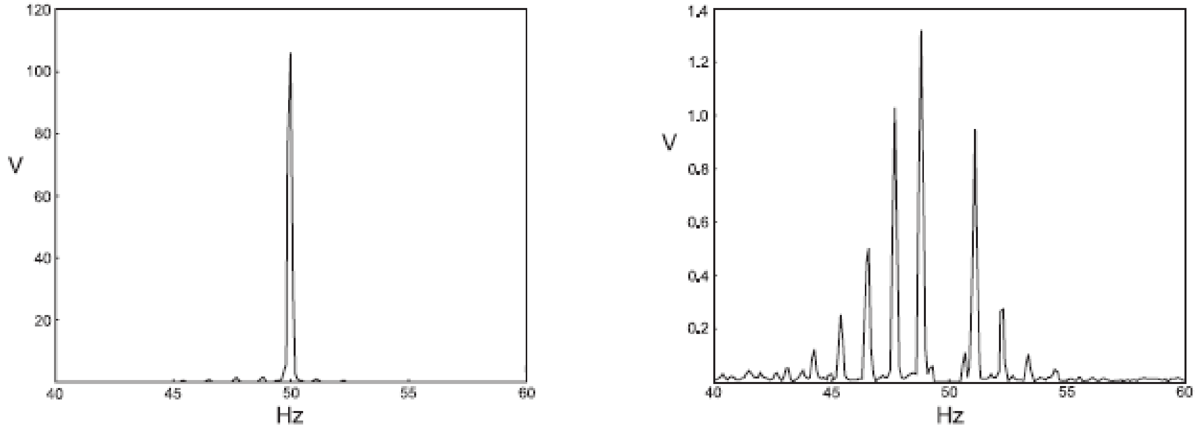

Figure 2 - Power network voltage spectrum; in the diagram on the right the 50 Hz component is omitted

Flicker is expressed in terms of two parameters: short term flicker severity PST and long term flicker severity PLT. The measurement of these parameters is discussed later in this document.

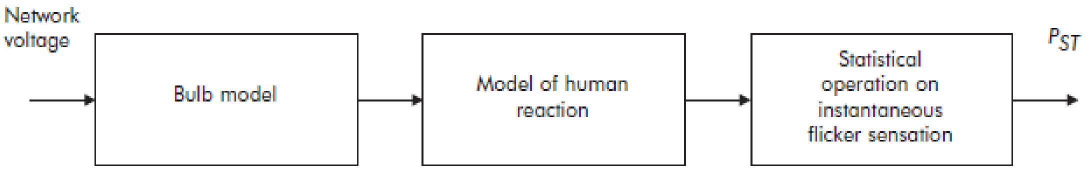

Figure 4 - The operations to determine the flicker severity P_{ST}

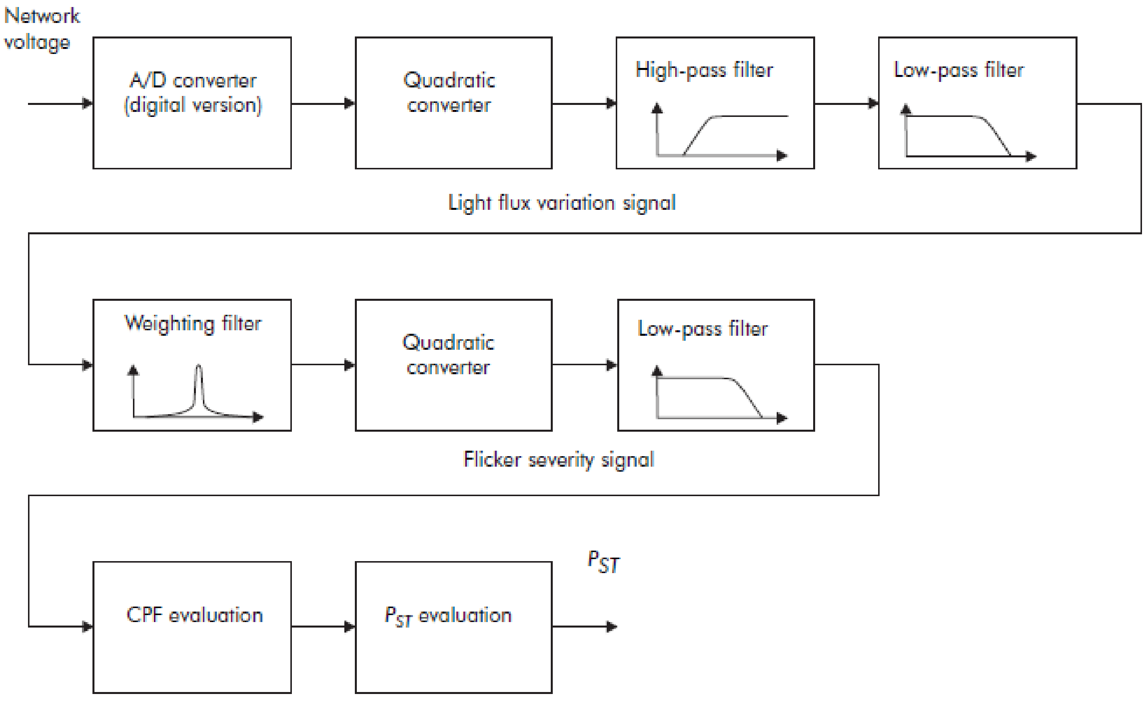

Figure 5 - The structure of the UIE flicker severity measurement instrument