

# Pulse and Transition Measurements in Dynamic Regimes of Electrical Motors

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**Abstract**— The paper deals with a modern solution to measure and analyses selected parameters of any electric motor. A virtual instrument with multiple options for selecting the analyzed parameters is described. The values of motor measurement voltages, currents and speed are read from a specified folder. With the virtual instrument presented in this paper it can be see the motor currents, voltages and speed waveforms and from the acquired data and recorded a set of parameters are computed. Boolean selector determine which signals are selected from the original seven signals (three current, three voltages and speed). It can be extract portions of data from the input signals. The extract portion is defined by begin of the offset (point of start) and the length (end the extraction). This instrument allow timing and transition measurements such as: pulse duration (pulse width), duty cycle (duty factor), preshoot (%), overshoot (%), slew rate. Also this virtual instrument allow to find the first highest (maximum) and the lowest (minimum) point in a set of values in signals of currents, voltages or motor' speed and find the time of the maximum and minimum values so determined. Knowing these values can be determined the range from the lowest point to the highest point in a set of motor's start current and voltage.

## I. INTRODUCTION

The knowledge of electrical motors operation during dynamic regimes is important for the design, operation and maintenance.

The dynamic regimes are a permanent preoccupation of researchers in the field of electric motors. For full understanding, dynamic regimes were modeled and simulated using various mathematical methods and software programs. This research is evidenced by numerous communications at scientific conferences [1], [2], [3], [4], [5].

After modeling and simulation of dynamic regimes, the results must be validated and verified practically. In the recent previous paper [6], authors describe an data acquisition system with which are measured and saved the values for three currents, three voltages and motor' speed. Measured values with the proposed acquisition system are saved in a specified file to be used later. This values has a transitory evolution along a short period of time up to 1 second, then stabilizes at specific values steady state operation.

Based on these considerations and the experience of the authors in the field of electric motors, data acquisition and LabVIEW programming, we propose to realize a virtual instrument which, using data acquired from starting a synchronous motor with variable reluctance, to make pulse and transition measurements [6], [7], [8].

## II. GENERAL ASPECTS OF TRANSITION AND PULSE MEASUREMENTS

During motor start, values of currents and voltages evolving form of short transient pulses; therefore proposed instrument is to pulse and transition measurements. The terminology and measurement definitions for virtual instrument designed comply with [10] and [13].

Study of transient regimes occurring in electric motors start assumes mainly: timing and transition measurements or pulse measurements.

### A. Timing and Transition Measurements

The virtual instrument measures the *transition duration* (*rise time* and *fall time*) of a single waveform.

Also it can be measured *slew rate* (*slope*), *undershoot* and *overshoot* for the *pre-transition* or *post-transition* region of a selected positive (rising) or negative (falling) transition in each signal.

Fig. 1 shows a typical levels for a single pulse signal. A *rising transition* is the interval between rising *low reference level* and *high reference level* crossing. A *falling transition* is the interval between falling *high reference level* and *low reference level* crossing.

State and reference levels (low and high) provide a means of accomplishing to identify the position in time of the signal feature to be measured. With this values resulted a measurement time interval that we can use as a basis for various time domain measurements.

The *high* and *low state levels* of the signal are computed with mathematic method and functions. The used methods are histogram and peak [9], [11], [13].

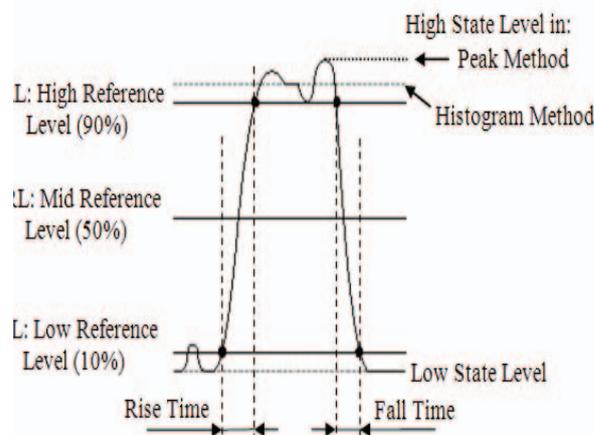


Fig. 1. Reference level and state level of a pulse signal.

The *histogram method* returns the levels of the histogram bins with the maximum number of hits above 60% and below 40% of the signal's peak-to-peak amplitude.

The *peak method* searches the entire signal for its maximum and minimum levels. The most common low, mid and high reference levels are 10, 50 and 90%.

A *pre-transition* and *post-transition region* are found in the left and right rising or falling transition. This regions contains *undershoot* and *overshoot* for the analysed pulse.

Fig. 2 shows the rising transition of a pulse signal.

To calculate the pre-transition undershoot and overshoot, Lab VIEW searches for a local minimum and maximum in the pre-transition region immediately preceding the beginning of the transition (point 1, figure 2).

The *pre-transition region* is defined as the minimum of  $3 \cdot (\text{end time} - \text{start time})$  and  $(\text{current transition start time} - \text{previous transition end time})/2$ .

If the transition to measure is the first in the waveform, the interval is defined as the minimum of  $3 \cdot (\text{end time} - \text{start time})$  and  $(\text{start time} - \text{beginning of the waveform})$  [13].

To calculate the post-transition undershoot and overshoot, Lab VIEW searches for a local minimum and maximum in the post-transition region immediately following the end of the transition (point 2, figure 2).

The *post-transition region* is defined as the minimum of  $3 \cdot (\text{end time} - \text{start time})$  and  $(\text{next transition start time} - \text{current transition end time})/2$ .

If the transition to measure is the last in the waveform, the post-transition interval will define as the minimum of  $3 \cdot (\text{end time} - \text{start time})$  and  $(\text{end of the waveform} - \text{end time})$  [13].

Fig. 3 shows the falling (negative) transition of a signal.

To calculate the *pre* or *post-transition undershoot* and *overshoot* in falling transition, proceed as in rising transition, with reference to the points 3 and 4 in the figure above.

The overshoot and undershoot for pre and post transition region of the rising and falling pulse signal are shown in Figure 2 and Figure 3.

Also in the figures it can see the portion of rising and falling transition.

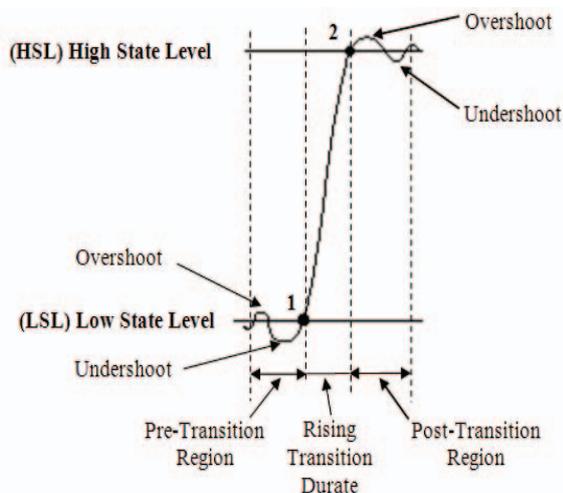


Fig. 2. Pre and post transition region with overshoot and undershoot portion for rising transition of a pulse signal.

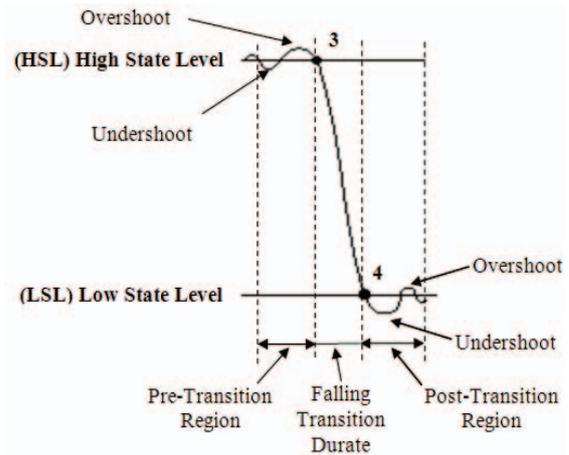


Fig. 3. Pre and post transition region with overshoot and undershoot portion for falling transition of a pulse signal.

### B. Pulse Measurements

If the waveform includes a single positive or negative pulse or a pulse train, the proposed virtual instrument can measure: *period*, *frequency*, *pulse duration* or *pulse width* and *duty cycle* or *duty factor*.

Lab VIEW uses the reference levels (low reference LRL, mid reference MRL, high reference HRL) to define the interval of one cycle measurement. Values of this reference levels are specified by the user as a percentage of state levels [13].

*Cycle average* is the mean level of a single one complete period of an analysed waveform, computed by the following formula:

$$\text{Cycle average} = \frac{1}{\text{numPoints}} \sum_{i \text{ cycle}} \text{waveform}[i] \quad (1)$$

where  $i$  indicates the waveform samples that fall in the single period and  $\text{numPoints}$  is given by the following formula:

$$\text{numPoints} = \text{int} \left( \frac{\text{period}}{dt} + 0.5 \right) \quad (2)$$

where  $dt$  is the time between two samples and  $\text{int}()$  is a function that returns the integer portion of a floating-point number.

### III. THE INPUT DATA AND VIRTUAL INSTRUMENT PRESENTATION

To check the operation of virtual instrument is used as input data the values for three currents (currents of motors phase R, S and T), three motors voltage and motor speed [6].

All of these values are found saved in a text-based measurement file (.lvm) or binary measurement file (.tdm or .tdms).

These values read out with any program like Microsoft Word, Notepad (in the first case) or LabVIEW (in the second case).

These values are obtained starting from a variable reluctance synchronous motor.

Nominal motor parameters are: rated power ( $P_N=1.5\text{kW}$ ); rated current ( $I_N=3.8\text{A}$ ); rated speed ( $n_N=1500\text{rpm}$ ).

Fig. 4 shows a capture file after input data used.

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File Edit Format View Help
|LabVIEW Measurement
Writer_Version 0.92
Reader_Version 1
Separator Tab
Multi_Headings Yes
X_Columns One
Time_Pref Absolute
Operator Esubtirelu
Date 2014/05/16
Time 12:16:32.361625
***End_of_Header***

Channels 7
Samples 1000 1000 1000 1000 1000 1000 1000
Date 2014/05/16 2014/05/16 2014/05/16 2014/05/16 2014/05/16 2014/05/16 2014/05/16
Time 12:16:39.09375 12:16:39.09375 12:16:39.09375 12:16:39.09375 12:16:39.09375 12:16:39.09375 12:16:39.09375
Y_Unit_Label Volts Volts Volts Volts Volts Volts Volts
X_Dimension Time Time Time Time Time Time Time
X0 0.000000000000000E+0 0.000000000000000E+0 0.000000000000000E+0 0.000000000000000E+0 0.000000000000000E+0 0.000000000000000E+0 0.000000000000000E+0
Delta_X 0.001000 0.001000 0.001000 0.001000 0.001000 0.001000 0.001000
***End_of_Header***
X_Value Dev1/ai0 Dev1/ai1 Dev1/ai2 Dev1/ai3 Dev1/ai4 Dev1/ai5 Dev1/ai6 Comment
0.000000 0.034458 0.041421 -0.032718 -1.573092 -2.415124 -1.467839 9.113291
0.001000 0.039918 0.014943 -0.032718 -1.836227 -1.994108 -0.415299 -17.476484
0.002000 0.025722 -0.022126 -0.025304 0.531986 -1.467839 -3.046648 -15.779264
0.003000 0.007157 0.036125 0.010706 0.689867 -2.941394 -2.783513 5.153112
0.004000 0.011525 0.038243 -0.006240 0.268851 -3.204528 -2.467751 6.284592
0.005000 0.025176 0.028711 -0.023186 -1.678346 -2.625632 0.374105 3.455892
0.006000 0.033912 -0.005181 -0.046486 -0.046910 -0.678434 -1.046823 -24.831103
0.007000 0.010979 0.009647 -0.016831 -0.467926 -1.994108 -1.520466 -7.858906
0.008000 0.021353 0.011765 -0.017890 0.058344 -1.099450 -1.573092 -8.424646
0.009000 0.024084 0.006470 -0.017890 0.321478 -2.730886 -1.152077 -6.727426
0.010000 0.014801 0.007529 0.010706 -0.836315 -2.415124 -0.678434 -8.990385
0.011000 0.027360 -0.025304 -0.028481 0.110970 -0.678434 -2.257243 -23.133883
0.012000 0.014255 0.031889 0.016002 0.479359 -3.099275 -2.573005 -13.516305
0.013000 0.018077 0.024475 -0.025304 -1.257331 -3.415036 -0.310045 2.324413

```

Fig. 4. Capture of an input data values.

Measurements have been performed in the laboratory of electric engine from Electrical Engineering Faculty of University of Craiova, using a measurement system designed specifically for dynamic regimes.

For data acquisition was used NI-USB 6210 module (16-bit resolution, 250 kS/s sampling frequency). The acquisition parameters are: timing parameters (samples per channel: 1000; rate: 1000 Hz); trigger parameters (edge: rising; pre-trigger samples: 10).

The number of samples on each channel is equal to 1000.

First row of the data files is channel names and specifies the name of DAQ device and channel: Dev1/ai0...Dev1/ai6.

First column is time data for each specified channel (X\_Value). The Delta\_X is 0.001 second.

Seven signals are assigned to seven channels as follows: ai0 = I1, ai1 = I2, ai2 = I3, ai3 = V1, ai4 = V2, ai5 = V3 and ai6 = speed of motor.

To management the process of acquisition and virtual instrument design using LabVIEW graphical programming environment, version 8.5.

As it is known, in Lab VIEW any virtual instrument consists of two main components, called: *Frontal Panel* and *Block Diagram*; this will be described in further.

#### A. The Frontal Panel of Instrument

Frontal Panel is the interface of virtual instrument with the user, containing setting and control elements, or elements for displaying the values of different quantities to be studied (buttons and displays).

The *Frontal Panel* allows viewing and studying seven graphical signals: three waveforms of currents (I1, I2 and I3), three waveforms of voltages (V1, V2, V3) and a waveform of motor's speed.

The *File Path Control* located in the upper left of Frontal Panel specifies the name of the file from which we want to read input data.

The virtual instrument finds and displays on numerical indicators the following values: *Maximum* (the highest point in a set of values in signal) and *Time of Maximum* (the time of the highest point in a set); *Minimum* (the lowest point in a set of values in signal) and *Time of Minimum* (the time of the lowest point); *Range (Maximum-Minimum)*, the value of the range from the lowest point to the highest point in a set of values in signal of current or voltage).

Fig. 5 shows the Frontal Panel of described virtual instrument.

The waveform's graph of this signals is presented in the left up-side of VI. With Boolean selector *Signals to select* we determine which signals are selected from the initial seven signals.

In the lower part of the panel there are three separate diagrams that displays currents, voltages and speed. Each of them displays portions of the input signal depending on our choice with two numerical control: *Begin Offset* (specifies the value that begin at offset) and *Length* (specifies the value that length).

All graphs are auto scaling because can automatically adjust their horizontal and vertical scales to fit the data. Also using the graph palette we can move cursors and zoom the display.

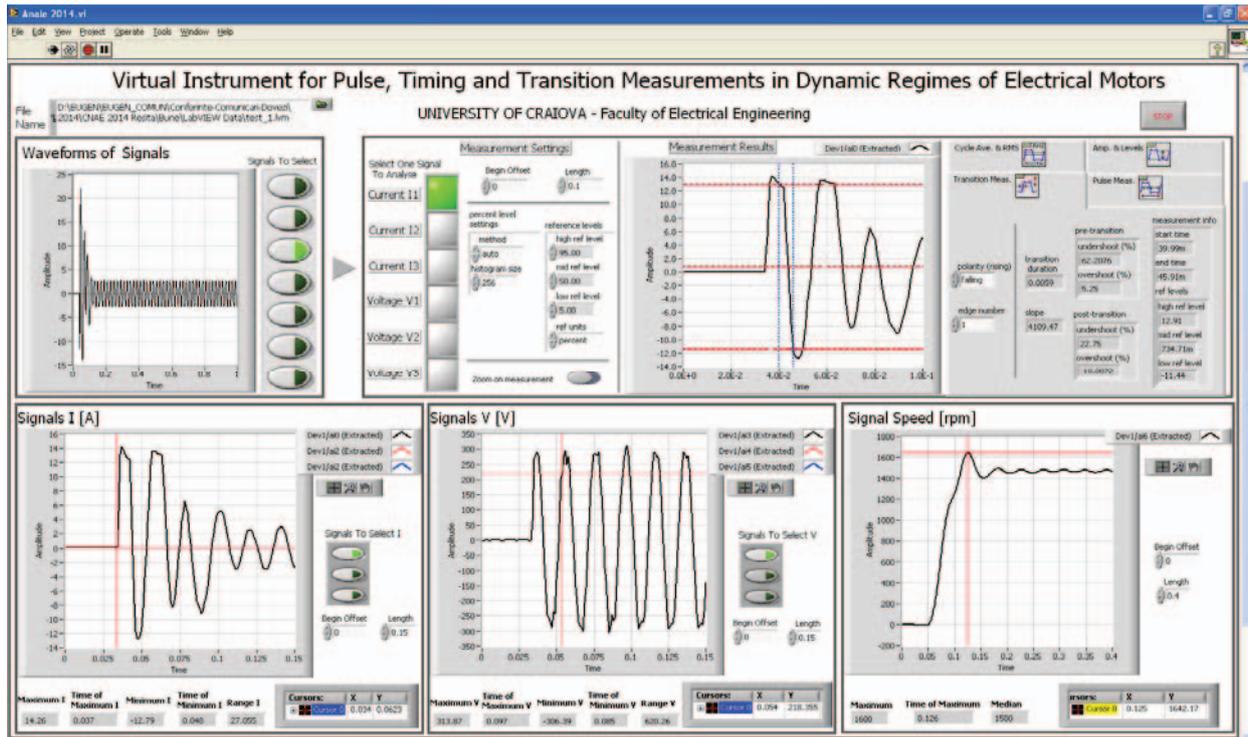


Fig. 5. Frontal Panel of the instrument

Using graph cursors we can read the exact value of a point on a current, voltage or speed waveform. The exact cursor's value displays in the cursor legend.

Virtual instrument shows in the upper part of the panel the use of the four measurements: transition measurement, pulse measurement, cycle average and root mean square (RMS), amplitude and levels of signal.

In *Measurement Settings* box, by pressing one button of the seven we select one signal to analyse of currents I1, I2, I3 or voltages V1, V2, V3. Also we can specify *Reference levels* as a percentage (%) of the state levels, with the low state and high state corresponding to 0 and 100%. *Method* specifies how the high and low state levels of the waveform are computed. Available methods are histogram and peak

*Measurements Results* displays the input waveform signal (I1...I3, V1...V3) along with the three reference levels computed for that signal. Cursors show the measurement interval for time and the measurement result for level measurements.

In the display, reference levels are shown as dashed horizontal lines, measurement results as solid lines and measurement intervals as dashed vertical lines.

The four measurements are described briefly below.

**Pulse Measurement:** *Settings* – *pulse number* specifies which pulse is measured; *polarity* defines a pulse as high or low (a high pulse consists of the interval between a rising mid-level crossing and the next falling mid-level crossing). *Results* – for a pulse number  $n$  with low polarity, the VI measures the *pulse duration* and *centre* of the  $n$ th low pulse; it measures the *period* and *duty cycle* of the period that begins with the  $n$ th low pulse.

**Transition Measurement:** *Settings* – *edge number* specifies the transition to be measured; *polarity* specifies the transition type (rising or falling); *Results* – an edge

number of  $n$  with rising polarity indicates that the VI will measure the  $n$ th rising transition it detects in the signal; for this transition the VI measures: *transition duration*, *slope*, *pre-transition* and *post-transition undershoot* and *overshoot* in (%), *start time*, *end time* and *reference levels*.

**Cycle Average and RMS:** *Settings* – *cycle number* specifies the cycle or period of the periodic signal to be measured; *Results* – for complete period of a signal, the VI will measure: *cycle average*, *cycle RMS*, *start time*, *end time*, and *reference levels*. Start (end) time specifies the time of the rising (falling) mid reference level that defines the start (end) of the interval.

**Amplitude of levels:** *Results* – *high state level* and *low state level* in absolute values; *amplitude (range)* is the difference between the high state level and the low state level.

We can select the *pulse polarity* (rising or falling) and/or the *pulse edge number* (1, 2 ...). Pulse polarity specifies if the pulse to measure is positive (High Pulse) or negative (Low Pulse) polarity. Pulse edge number specifies which edge to use for the measurement.

The *measurement info* cluster contains digital indicators which display the transition interval endpoints and the absolute reference levels used to define the transition. Thus: **start time** specifies the time of the rising or falling, low or high reference level crossing that defines the start of the transition to be measured; **end time** specifies the time that defines the end of the transition; *ref levels* displays the three our defined reference levels of the signal in absolute units. The STOP button (located in the upper right) immediately aborts the instrument execution.

## B. The Block Diagram of Instrument

Fig. 6 illustrates the Block Diagram of the virtual instrument whose Frontal Panel has been described previously.

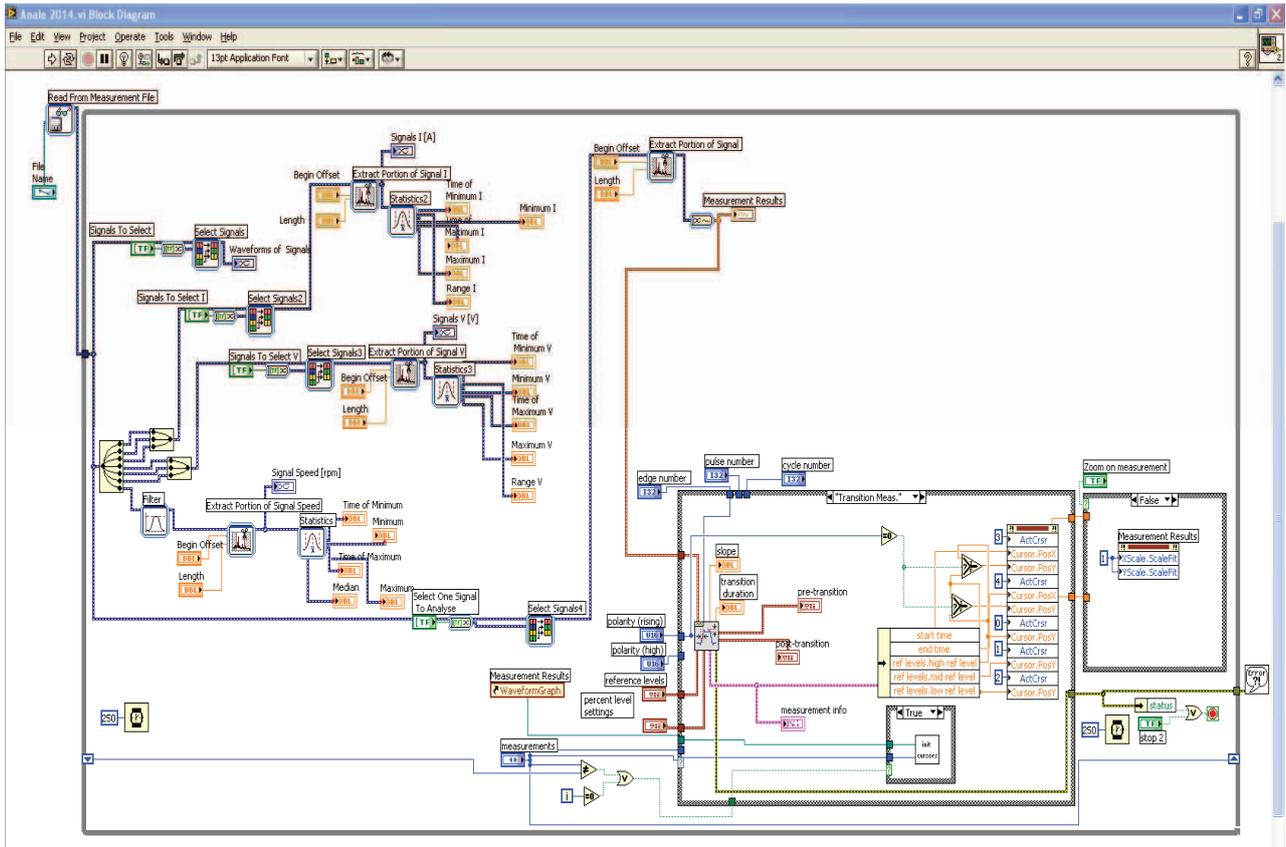


Fig. 6. Block Diagram of the instrument

*Block Diagram (BD)* contains the graphical source code (known as *G* code) for how the VI runs. Every Frontal Panel object appear as terminals on the Block Diagram.

As shown in figure, all of elements are included in a repetitive structure (type *While Loop*), which executed them till now at the finishing terminal (right-up side, the “*Stop if True*” state) arrives logical values “*True*”.

In Block Diagram we use *Express VI* which are a sub VI designed to aid in measurement and analyses tasks. We can easy configure this VI using a configuration dialog box. Some of these tools are described briefly below.

*Read from Measurement File* is an *Express sub VI* used to read data from a text based measurement file (.lvm).

*Select Signals* *Express VI* accepts multiple signals as inputs and returns only the signals selected. With this subVI we can specify which signals to include in the output and change the order of the input signals. We can choose a specific signal of the seven (three current, three voltage and speed), two, three or all signals for analysis.

With *Extract Portion of Signal* *Express VI* we can extracts portions of data from the input signals and returns the extracted data. It can be extracted a single point or a range of selected data, and it can extract data by time or index. Also we can find the time and index of the first occurrence of a value. The parameters of VI are: begin at offset (in x-axis units) or begin at sample number; duration expressed by length ((in x-axis units) or number of samples.

*Statistics* *Express VI* calculate the selected parameter of the first signal in a waveform (Maximum, Time of Maximum, Minimum, Time of Minimum, Range).

The *Case Structure* has four subdiagrams, one for each type of measurement: *Transition Measurement*, *Pulse Measurement*, *Cycle Average* and *Root Mean Square, Amplitude and Levels*.

Because the tacho signal representing speed is affected by noise, it must be software filtered. In Figure 7 is shown the configuration’s *Express Filter VI*.

This *Express VI* is configured as follows: filter type (*Lowpass*); cut-off frequency (20 Hz); *Infinite Impulse Response filter (IIR)*; topology (*Bessel*); order (3).

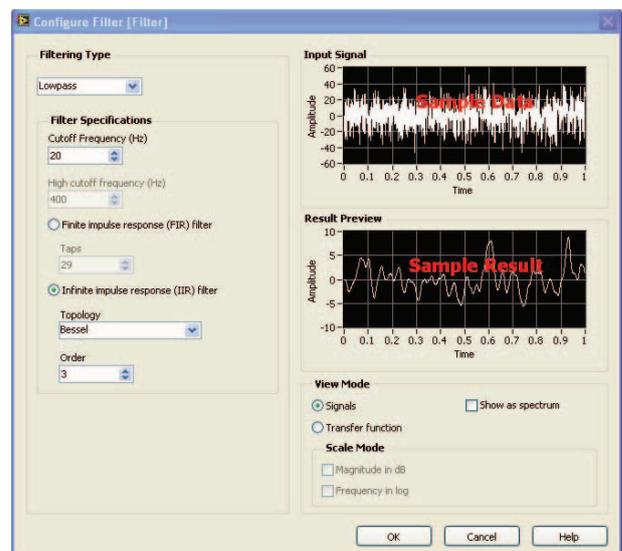


Fig. 7. Filter Express VI's configuration for motor's speed.

## IV. ANALYSIS OF RESULTS

The virtual instrument describe in this paper was used to analysis of the acquired data to start a variable reluctance synchronous motor. These acquired data (current  $I_1...I_3$ , voltage  $V_1...V_3$ , speed) have been previously saved to a file [6].

Table 1 presents the maximum and minimum motor's current, the time of these extreme values (the time of the highest point; the time of the lowest point) and the range of currents.

TABLE I.  
MINIMUM AND MAXIMUM VALUES OF PHASE CURRENTS

Currents	Value of:		
	Current [A]	Time [sec]	Range [A]
$I_1$	Maximum = 14.26	0.037	27.055
	Minimum = -12.79	0.048	
$I_2$	Maximum = 10.99	0.052	33.172
	Minimum = -22.18	0.041	
$I_3$	Maximum = 21.97	0.044	36.053
	Minimum = -14.08	0.056	

In the third column of the table are the extreme values of the *Range* (Maximum-Minimum); this is the difference between the lowest point to the highest point in a set of values in waveforms.

In Table I it is observed that the maximum (in absolute values) starting motor's current is obtained when the S-phase current drops to -22.18 A. This value is obtained at 0.041 seconds from the point of starting acquisition.

Fig. 8 shows the evolution of motor's current  $I_1$  in the time between 0 to 0.2 seconds (0 represents the starting point of data acquisition and 0.2 seconds is the value selected for Length uses). We can see maximum current value (14.26 A) at time 0.037 seconds and minimum current value (-12.79 A) at 0.048 seconds.

In order to find this extreme position (14.26 A) relative to the start time of the motor we can move a cursor on a graph to read the exact value of a point on a plot signal. This time is 0.034 seconds. In this case result:

$$\text{time of maximum } I_1 = 0.037 - 0.034 = 0.003 \text{ seconds}$$

Fig. 9 illustrates the evolution of motor's current  $I_2$  (S-phase current) in the time 0 to 0.15 seconds (Length).

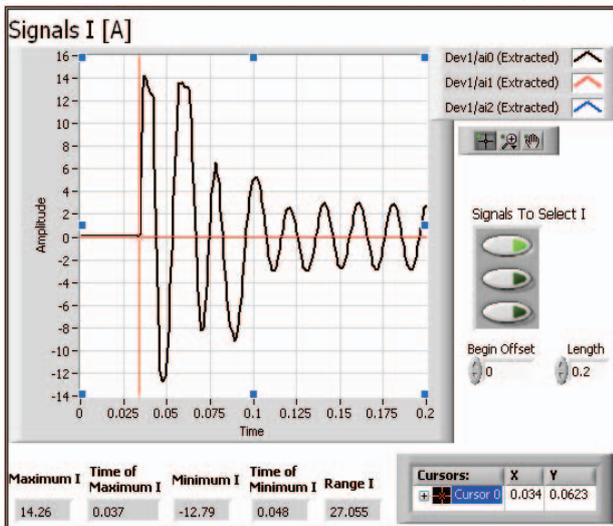


Fig. 8. The transitional regime for current R phase ( $I_1$ ).

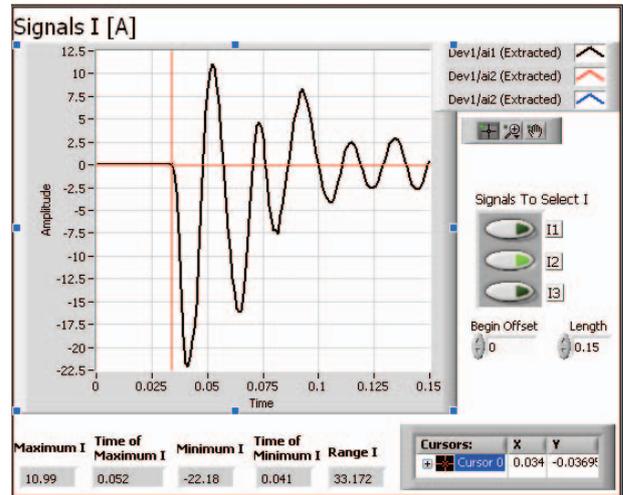


Fig. 9. The transitional regime for current S phase ( $I_2$ ).

We can see maximum current value (10.99 A) at time 0.052 seconds and minimum current value (-22.18 A) at 0.041 seconds; the Range of current  $I_2$  is 33.172 A.

In order to find the extreme position (-22.18 A) relative to the start time of the motor we can move a cursor on a graph to read the exact value of a point on a plot signal. This time is 0.034 seconds. In this case result:

$$\text{time of minimum } I_2 = 0.041 - 0.034 = 0.007 \text{ seconds}$$

$$\text{time of maximum } I_2 = 0.052 - 0.034 = 0.018 \text{ seconds}$$

Fig. 10 illustrates the evolution of motor's current  $I_3$ . We can see maximum current value (21.97 A) at time 0.044 seconds and minimum current value (-14.08 A) at 0.056 seconds.

The maximum value of current  $I_3$  (21.97 A) is reached after:

$$\text{time of maximum } I_3 = 0.044 - 0.034 = 0.01 \text{ seconds}$$

As shown in the figures, the absolute maximum value is achieved the current S phase (-22.18 A) at the motor starting 0.007 seconds.

Also it can be observed in the figures that after 0.131 seconds (from the beginning of acquisition) or 0.097 seconds (from the motors start) the transitional regime becomes stationary.

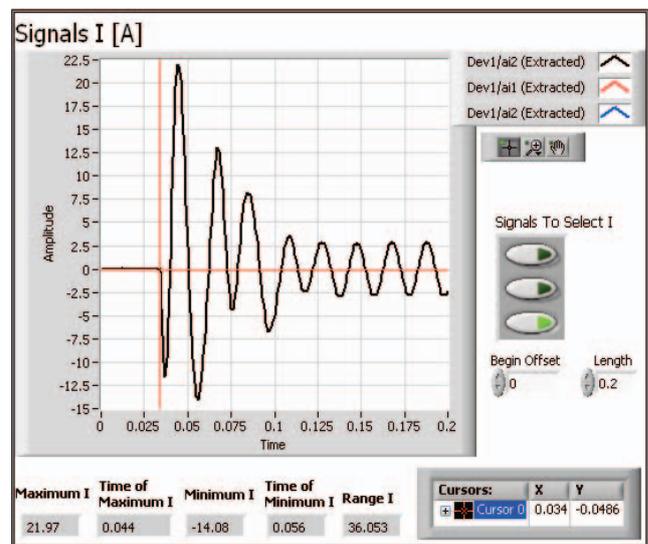


Fig. 10. The transitional regime for current T phase ( $I_3$ ).

Fig. 11 shows the capture of the measurement zone of virtual instrument for the evolution of S-phase current (selected by pressing of current I2 button) in the following conditions: begin offset = 0; length = 0.1 sec.; high ref level = 95 % (9.33 A); mid ref level = 50 % (-5.6 A); low ref level = 5 % (-20.53 A).

In this conditions, for rising polarity (between the start time = 42.33 msec. and the end time = 50.53 msec.) of the first edge number (see the figure below) the transition measurement results are: transition duration = 0.0082 sec.; slope = 3639.84 A/sec.; pre-transition undershoot = 38.3 %; pre-transition overshoot = 100.06 %; post-transition undershoot = 100.29 %; post-transition overshoot = 68.14 %.

The **Transition Measurements** option was presented in Figure 11. In the *Amplitude-Time* diagram it can be seen the red horizontal dotted line for high reference level at 9.33 A, middle reference level at -5.6 A and low reference level at -20.53 A. Also it can see the blue vertical dotted line for the start time of first rising transition at 42.33 msec. and the end time of rising transition at 50.53 msec. In this case result:

$$duration\ of\ transition = 50.53 - 42.33 = 8.2\ msec.$$

For the study of other parameters of acquired signals we can select other types of measurement, for example: Pulse Measurement or Cycle Average and Root Mean Square. Figure 12 shows the results of these measurements, in case of analysis of the transient evolution of the current I1.

With **Pulse Measurement** option we can determine for first (selected with numeric control *pulse number* from panel) low pulse (a *low pulse* consists of the interval between a falling mid-level crossing and the next rising mid-level crossing). In the *Amplitude-Time* diagram it can be seen the red horizontal dotted line for high reference level at 12.91 A, middle reference level at 734.71 mA and low reference level at -11.44 A. The first low pulse is between the first two blue vertical dotted line; it is centered at 48.58 msec. (*pulse center* specifies the time instant of the midpoint of the first low pulse). The values of pulse measurements are: period = 0.023 msec. pulse duration = 0.01 msec. and duty cycle = 0.43.

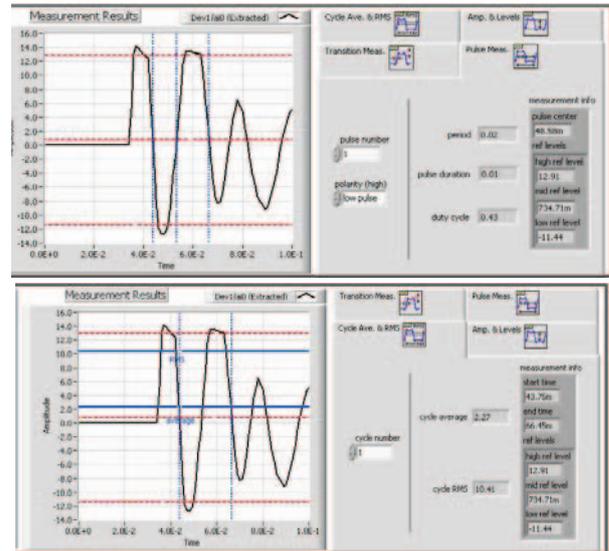


Fig. 12. Capture of: Pulse Measurement (above) and Cycle Average & RMS (below).

The **Cycle Average & RMS Measurements** option is shown at the bottom of the Figure 12. The *Amplitude-Time* diagram displays the waveform of current I1 along with the previous three reference level. Vertical cursors show the measurement interval for time measurements performed (*start time* = 43.75 msec. and *end time* = 66.45 msec.).

The measurement result for level measurements (high = 12.91 A, mid = 734.71 mA and low = -11.44 A) is: *cycle average* = 2.27 A and *cycle RMS* = 10.41 A; the horizontal blue cursors show these results.

The **Amplitude & Levels Measurements** option is shown in the Figure 13. The *Amplitude-Time* diagram displays the waveform of current I1 between 0 and 0.1 sec. (length).

Horizontal blue cursors show the high state level (14.26 A) and low state level (-12.79 A); these values are also displayed numerically, together with the amplitude or range (27.06 A) of the current.

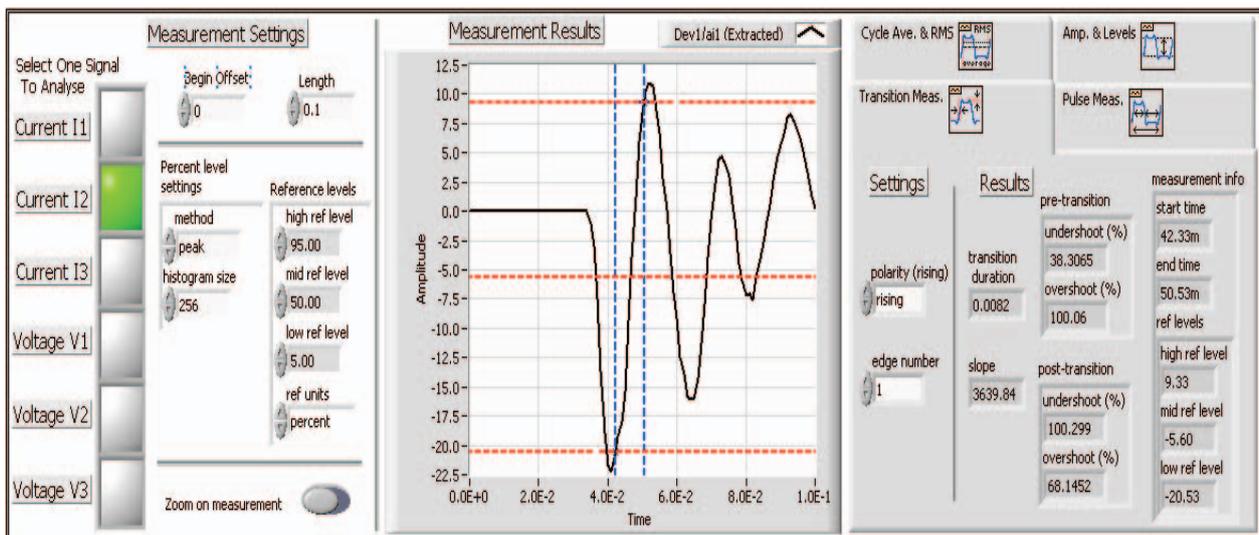


Fig. 11. Capture of measurement zone from virtual instrument with the parameters of Transition Measurement.

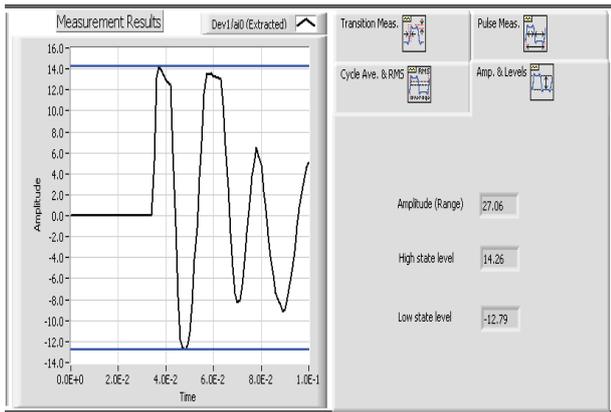


Fig. 13. Capture of measurement zone with the parameters of Amplitude & Levels Measurements.

If we want to measure different values of the instantaneous, we can use various cursors.

Fig. 14 shows the evolution in time of the motor speed in rpm. Because speed was measured by a tachometer, the signal must be software filtered with a digital low pass filter (see previous paragraph).

We observed that speed touching a maximum value of 1600 rpm at 0.126 sec. relative to the start time of acquisition. The time of maximum instantaneous speed result:

$$\text{time of maximum speed} = 0.126 - 0.05 = 0.076 \text{ sec.}$$

where 0.05 sec. is the time from start of acquisition and until the motors rotor starts rotating.

Also we observed the stabilization of motor's speed at the synchronous value of 1500 rpm. This value is reached after about 0.25 sec.

The time in which considering the evolution of motor's speed is set at length = 0.4 sec relative to the starting point of acquisition (begin offset = 0).

## V. CONCLUSIONS

The paper presents a virtual instrument for pulse and transition measurements. The instrument proposed is destined for the use in dynamic regimes of electrical motors.

Also this instrument may be used by other fields of applications where there is the need to measure transients phenomenon's.

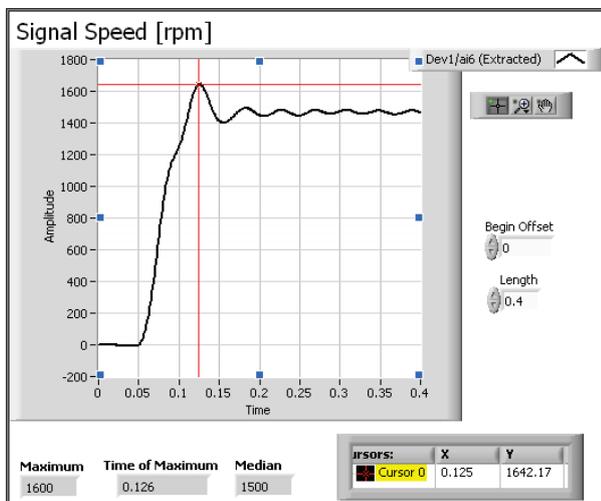


Fig. 14. Evolution in time of the motors speed in rpm.

This virtual instrument will be able to be used both in educational and in research field. Also it can be used in searching and testing laboratories of electrical machines.

With Lab VIEW customized graphic environment the authors provide an easy-to-use and interactive virtual instrument that can be integrated into the future complex measurement system.

With the flexibility and the expandability of the programming interface, in the future maybe easy increase the analysis capability and the functionality of the present virtual instrument.

## ACKNOWLEDGMENT

This work was partially supported by the grant number 30C/27.01.2014, awarded in the internal grant competition of the University of Craiova.

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