FREQUENCY ANALYZER WITH LABVIEW

FREKVENČNÍ ANALYZÁTOR POMOCÍ LABVIEW

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ANNOTATION:

In the last years the technical diagnostics has been increasingly using a computational technology in order to implement models of simple and also more complicated measuring instruments.

This contribution deals with the creation of a simple frequency analyzer model, operated by the Labview 7 Express software, and with applying this analyzer to the diagnostics of simulated vibrations.

KEY WORDS: Frequency analyzer, Labview, Vibrio
KLÍČOVÁ SLOVA: Frekvenční analyzátor, Labview , Vibrio

1   INTRODUCTION

This contribution describes some application possibilities of a computational technology in a measuring chain. If we have to deal with some more complicated signals and subsequently analyze them (e.g. a frequency analysis, interpolation by a polynomial of higher degrees, etc.), then it is suitable to integrate the computational technology into a measuring chain. With the assistance of this integration, there will be allowed an evaluation of measuring quantities in real-time. Current computational technology, with regard to its high power, and in connection with suitable software, is able to cope with more and more complicated calculations.

In our case the software Labview 7 Express was used (National Instruments Corporation) because of express functions, such as "DAQ Assistant" and "FFT analysis", which are very easy to implement in our own-created programs, which is one of our main purposes.

As an example, there was used a measuring chain that conducts measuring of vibrations and simultaneously there is the frequency analysis executed by means of computational technology.

The next part of this contribution deals with possibilities of how to utilize the computational technology for temperature measuring with thermocouples, where is necessary to eliminate two basic effects of uncertainties. The former effect is on oscillation of a comparative temperature which can be eliminated by a re-calculation to a reference temperature. The latter effect is about an elimination of the influence of a static characteristic non-linearity of sensors.

Both these negative effects can be easily eliminated on condition that we use the right type of computational technology in measuring chains.
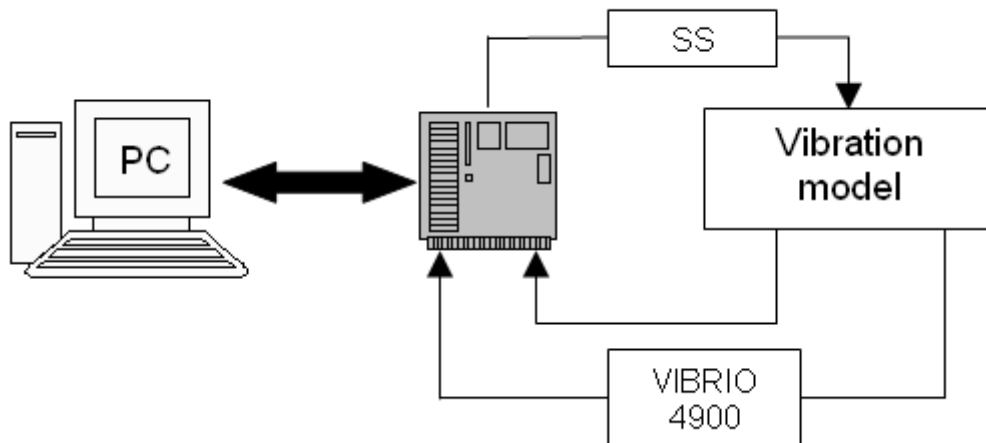
2 CONNECTION DIAGRAM

Fig. 1 - Workplace diagram

3 DESCRIPTION OF DEVICES

3.1 Vibration model

A vibration source was used for our measurement, applicable to simulating several mechanical defects which are present in a measured vibration spectrum. The diagram of this vibration source with indicated measuring points is in the picture 2. The measuring point Bx was selected for our measurement.

This is a rotating disc driven with a motor by DYNAMO – SLIVEN company which includes a speed voltage generator to measure the speed. This type of motor enables an infinitely variable speed change by altering the supply voltage U_{nap} within the range of 6-20 V.
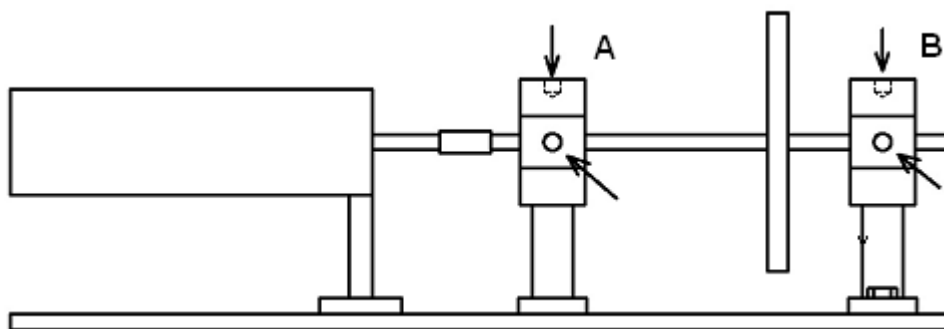

Fig. 2 – Measuring points

Our measurement is based on the simulation of the defects "Static imbalance" and "Loose base". The imbalance is simulated by bolting a bolt M4 to the rotating disc and a loose base is got when bolts of the point B base are loosened.

3.2 Vibrio 4900 II

The measurement was performed with a device for measuring vibrations Vibrio 4900 II by Adash company (Pict. 3). The VIBRIO II device measures and displays directly numeric vibration values, and both peak and calculated RMS values.

This can be done with the help of a filter (see device instructions). Further, the device is provided with a connector for measured echo vibrations and this acoustic signal was then submitted to a vibrations analysis in real time. The signal was transmitted to a DAQ card input with a reducing adaptor 3.5 mm Jack – BNC connector.

Fig.3 - Vibrio 4900

The measurement supports the theory that it is practicable to measure quantity of vibrations using an acoustic output and to perform simultaneously a real-time frequency analysis. The device is equipped with no automatic volume control, the volume is controlled manually, and therefore a reasonable value is necessary to be pre-set before the measurement starts. If the signal level is too low, then the signal is affected with some interference, and when being highly amplified, a distorted signal is found on an amplifier inbuilt in VIBRIO. This distortion has a very negative impact on the measured frequency spectrum.

3.3 SS source
A measuring card output cannot be current-overloaded; therefore a SS amplifier was needed. In our task, an adjustable SS source DC 124 C was used. The voltage value ranges between 0-25 V with a maximum voltage endurance of 4 A. The input voltage control runs by means of the input voltage of 0-5 V. The voltage of a measuring card output channel was conveyed to these terminals.

4 LABVIEW 7 PROGRAM
With the aid of Express functions available in LabView 7 Express, a frequency analyzer is easy to create. There are only two predefined modules needed in the program: DAQ Assistant for the measuring card data collection and FFT Analysis module which performs an FFT analysis. The results are plotted on a graph and a simple analyzer is finished. There is its program shown in the picture 4 – the analysis of a rectangular signal from a generator.
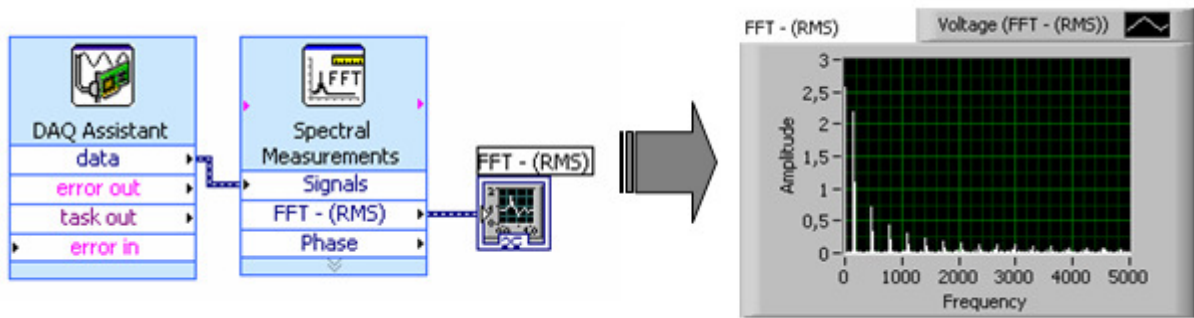
Fig. 4 – A simple analyzer program (a rectangular signal)

In order to be used also for educational purposes, an analyzer was needed which disposed of more functions, or rather enabled adjusting certain parameters when the program is running. This was the reason why a more complicated program had been created; however, this one is also based on the principle demonstrated in the figure 4.

On a front panel of the programmed analyzer (Fig. 6), there is an element "Slide" called "Napájení motoru". This element is used for regulating a current value of the SS motor voltage, and so its speed is changed. Next to it there is a device "Gauge"with the description Otáčky (1/min). This element shows the current SS motor speed value on the vibrations source, simultaneously, this value is converted into the value of the first harmonic component, in order to make orientation in the frequency analysis diagram easier. The first harmonic element value is displayed on the component "Numeric Indicator" with the title Frekvence 1. Harmonické složky. Then there are two more elements "Graphs" on the front panel. The smaller one called "Signál z přístroje VIBRIO II" shows current signal values varying with time, the other "FFT (RMS)" represents the requested frequency analysis, namely the FFT analysis.

Below this graph there are several elements for adjusting the signal. The first one, the input signal indicator, serves for an easy and quick signal volume set-up on the Vibrio device. To the left of this indicator, there you can set up parameters of the scanned sample of values, namely the number of samples and the sampling frequency. The next is the set-up of the input signal filter and the FFT spectrum window set-up. And lastly, there is the frequency with the highest amplitude.

The program itself, which was created in Labview, is described in the Figure 5. First of all, a channel of the measuring card had to be configured. An output channel for feed of vibrations source SS motor, then an input channel for a speed voltage generator output, needed for tracing the motor speed, and lastly, an input channel for Vibrio device output signal; this signal is used for the actual frequency analysis. Afterwards these channels could be applied, with the help of DAQ Assistant function, to programming. A projected packet of DAQ Assistant seemed to be not fully appropriate, so the preset DAQ Assistant was modified in order to enable changing some data collection values when the program is running and use them for further processing, this applies to a sampling frequency and a number of samples. It was also necessary to modify FFT analysis module in a similar way, to allow changing FFT set-up during a running program, specifically the Okno analysis. The

filter module was adjusted too, to make changes of parameters during a running program feasible.

As a DAQ card enables measurements up to 10 V only and an output value of a speed voltage generator is of 12 V, a resistance voltage divider with an adjustable voltage ratio placed between the speed voltage generator and the DAQ card was essential here, and subsequently, a signal correction within the program had to be made (fig. 5).
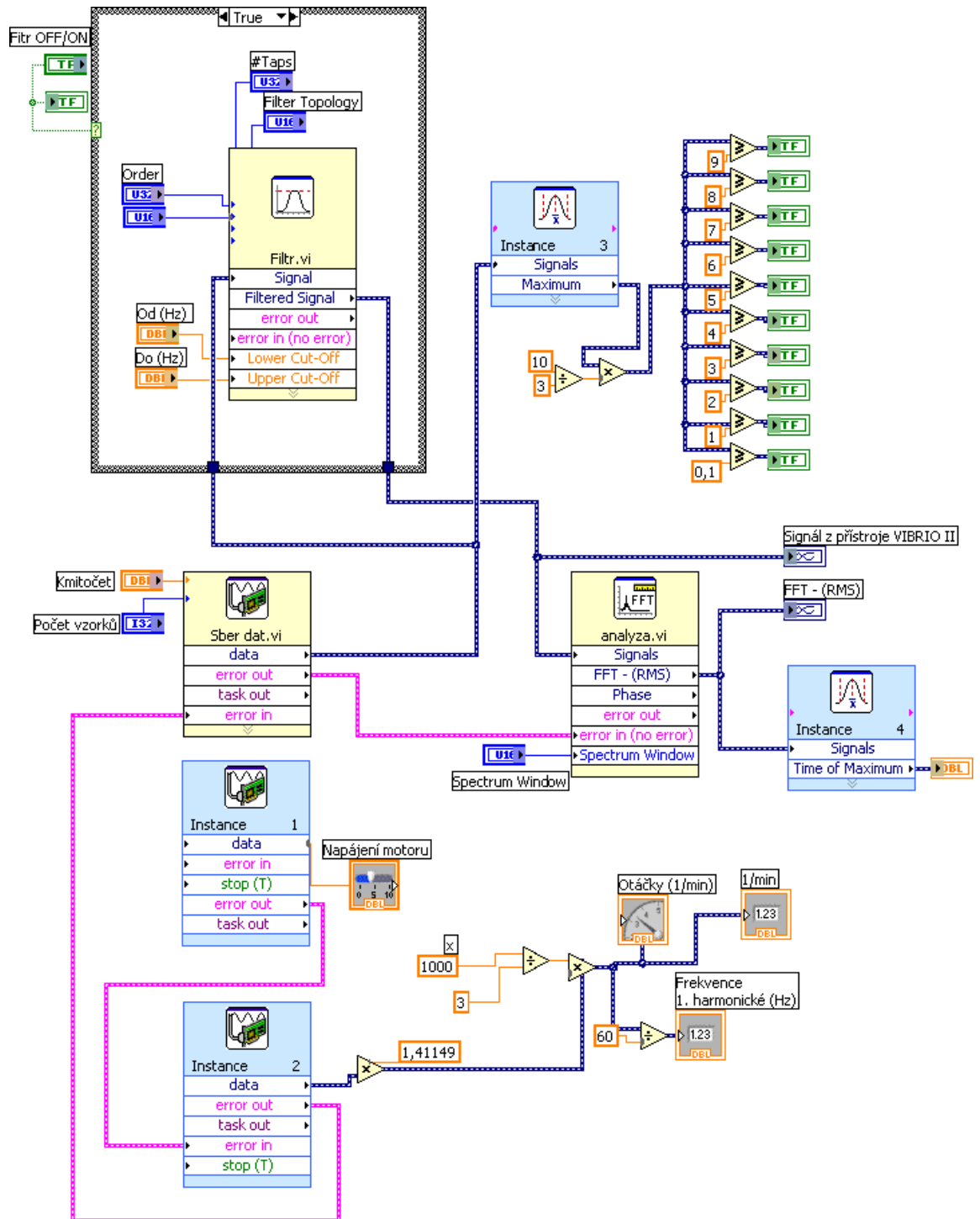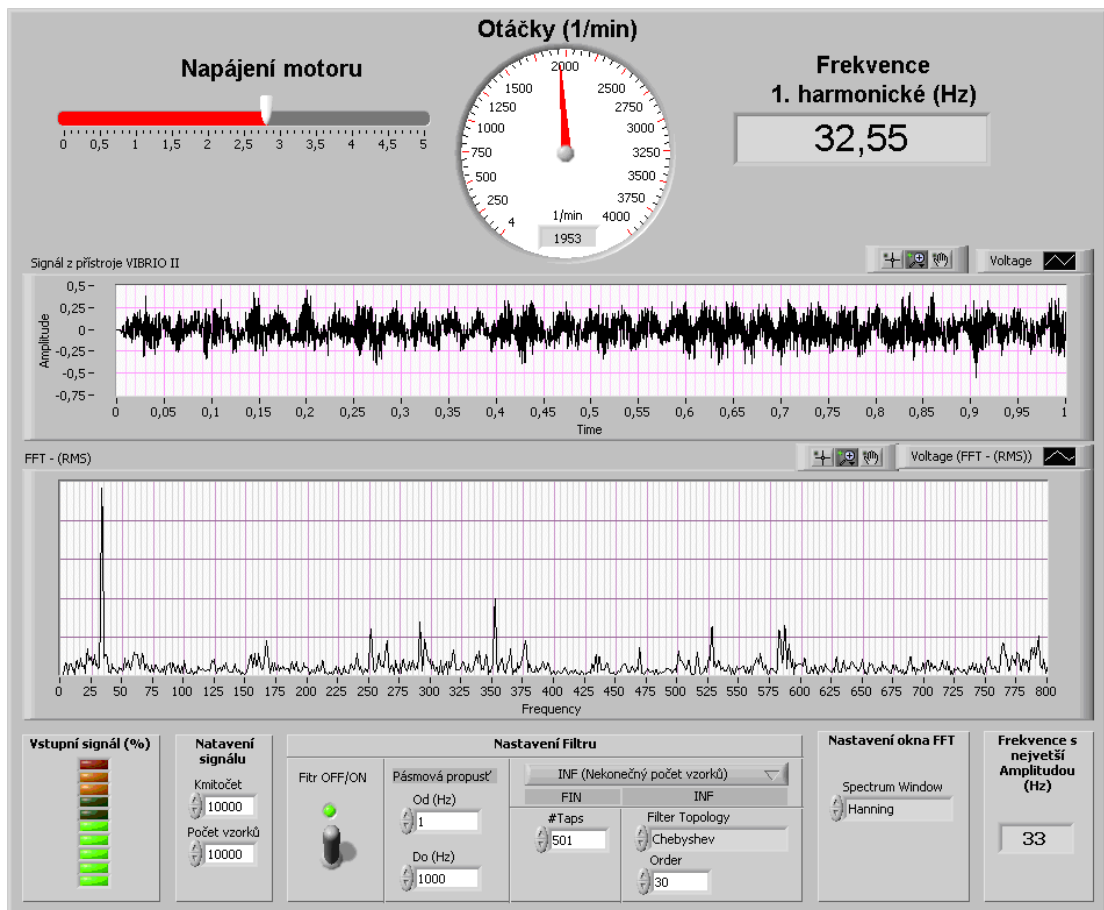
Fig. 5 - LabView 7 Express program

Fig. 6 – The front panel of the Labview program

5 DESCRIPTION OF MEASUREMENTS

Using the Slide "Napájení motoru", the vibrations model speed can be controlled. The speed is then displayed on the component Gauge (called Otáčky) and simultaneously the value is converted into the first harmonic element for more effortless orientation in the FFT graph. Then a number of samples and a sampling frequency are set. After the motor is activated, a volume on the Vibrio device is to be adjusted with an input signal level indicator. A signal level should range within 50% - 80%, to get the signal sufficiently magnified and to avoid any distortion. Finally, either filter parameters can be set, or the filter can be disabled.

The signal from Vibrio is shown in the graph "Signál z přístroje VIBRIO II" where the amplitude varies depending on time. The signal after a frequency analysis can bee seen in the graph "FFT (RMS)".

There is an apparently increased part of the first harmonic element in the measured spectrum (fig. 6), which corresponds to an anticipated spectrum of the mechanic defect "imbalance". The second harmonic element has the highest amplitude (fig. 7), and it theoretically should be so.

6 CONCLUSION

As indicated in the introduction of this article, creating a frequency analyzer with the help of PC is not too complicated and measured values show that even such a simple analyzer can provide really useful values. However, it should be pointed out that this method can be employed where there is not only PC, but especially a measuring card and suitable software available in the workplace. Considering that we have such conditions in our workplace, our analyzer can be relatively inexpensive and quick affair.

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