Virtual automated system for DC voltage calibration of a DMM

VLADISLAV SLAVOV
TASHO TASHEV
English Language Faculty of Engineering
Technical University - Sofia
Blvd. "Kliment Ohridski" 8
Bulgaria

Abstract: - This paper describes the creation of a calibrator-digital multimeter system for calibration based on LabView. The virtual approach was applied as a result of the modernization not only in the educational process but also in calibrating laboratories. The purpose of the experiment described in this paper is to show the principles and to propose algorithms for creating a DC voltage DMM automated calibration system when the developer has to create his own application using virtual instruments methods.

Key-Words: - algorithms, calibration, drivers, ELVIS II, LabVIEW, voltage

1 Introduction

The calibration of microprocessor controlled, IEEE-488 bus or RS232 communicating DMMs has been simplified by automation. The DMM itself may provide a great deal of the automated capabilities. However, external software, running in a PC, provides even more advanced calibration automation. Closed-case calibration, along with the advent of IEEE-488 bus controllers and calibration instruments controlled by the IEEE-488 bus, revolutionized the traditional DMM calibration by fully automating it. This automated process is often referred to as closed-loop calibration. Closed-loop calibration is one of the most Significant instrumentation developments in recent years. The loop is the connection between the measurement of an instrument's performance and the actual readjustment of its operating characteristics. Closed-loop calibration eliminates the need for any kind of arm in the loop[1]. The DMM that DC voltage mode performance is calibrated is FLUKE 8842A [2]. AS calibrator National Instruments’ ELVIS II station is used. The software that this system is created is LabVIEW [3]. The4 interface that FLUKE 8842A communicate with the computer and is controlled by it is IEEE 488.1[4].

Drivers has the following benefits[5]:

- Improves the consistency of instrument drivers for the benefit of end users
- Improves the quality of the drivers
- Minimizes duplicated effort.
- Improves ease of use for end users by providing a consistent methodology for using instrument drivers from a variety of sources.
- Streamline the instrument driver development process for the benefit of instrument driver developers.

Modularization, one of the main advantages of LabVIEW, was used to create a successful working automated system. The problem should be divided into

1) Controlling DC voltage outputs of the calibrator (in our case ELVIS II station)
2) Reading the measurements and controlling the range of the DMM (FLUKE 8842A)
3) Assembling the created modules in completed Plug&Play calibration driver

2 Problem Formulation

As it was said this was the simplest part of the problem to solve. Ready to use VIs was assembled in a configuration to control.

3 Problem Solution

National instruments offers ready to use virtual instrument for controlling the DC voltage outputs of ELVIS II but DMM’s driver should be created. For creating an instrument driver using IEEE 488.1 communication the developer should investigate in details the syntaxes of the commands since they are different for each instrument.

2.1 Controlling ELVIS II DC voltage outputs VI

As it was said this was the simplest part of the problem to solve. Ready to use VIs was assembled in a configuration to control.
2.2 Reading the measurements and controlling the range of the DMM VI

To read the measurements data from the DMM the following algorithm was created:

![VI driver algorithm for reading the measurements](image)

Since the maximum output voltage that ELVIS II could generated the calibration was made for two ranges of the DMM – 2V and 20V according to the algorithm on figure 3.

![VI driver algorithm for controlling automated calibration system for DC voltage of FLUKE 8842A](image)

2.3 Results

The relative and reduced errors are shown on figures 4 and 5.

![Relative error in function of the measured voltage](image)
Analyzing the errors must pay attention on the fact that the voltage source in fact is not with a high accuracy. The acceptance that ELVIS II is generating voltage with high accuracy was made only for the purposes of the experiment and to show the principles of a such automated system for DC voltage DMM calibration. It is known from the specification that the reduced error can be up to 0.8%.

From the figures can be seen that the error is different in the beginning of the range when the value of the generated voltage is increased and decreased. At the end of the range the values of the error are the same (equal).

The following conclusions can be made:
- The error at the end of the range is basically due to the voltage source;
- The error of the DMM is higher in the beginning of the range.

4 Conclusion

The experiments that were held and the achieved results lead us to the following conclusions:
- The higher values of the relative and the reduced error in all the ranges are because of the acceptance of that ELVIS II is a calibrator with ideal voltage generation (high accuracy);
- The system that was created for that experiment can be also used for solving the opposite problem, calibrating a voltage source;

Despite the acceptance the results show that this system is suitable for education purposes in the area of metrology and measurement and instrumentation subjects.

References:
[1] Calibration: Philosophy in Practice, Fluke Corporation