Efficiency of Automated Measurement Systems

[1]O. Čičáková, [2]P. Štefanička

[1]Department of Measurement, Faculty of Electrical Engineering and Information Technology,
Slovak University of Technology, Bratislava, Ilkovičova 3, 812 19, Slovak Republic
Email: olga.cicakova@stuba.sk
[2] Faculty of Electrical Engineering and Information Technology,
Slovak University of Technology, Bratislava, Ilkovičova 3, 812 19, Slovak Republic

Abstract. *Automated measurement systems may be appreciated by characteristics expressing some different qualitative and quantitative parameters, e.g. efficiency, resolution, precision etc. This contribution deals with the efficiency of automated measurement system. The efficiency can be influenced not only by faster elements but by properly selection of configuration and quantitative algorithm, too. For the programmable multimeter HP34401A controlled by PC the measurements were done through General Purpose Interface Bus. The applications that allows these measurements were generated in LabWindows/CVI and LabView environments.*

The approach was based on efficiency measurement characteristics in the term of time measurement. Duration of the measurement of given number of samples in dependence of device configurations was evaluated.

Keywords: AMS efficiency, efficiency measurement, efficiency parameters, GPIB

1. Introduction

Automated measurement system (AMS) is characterised by modular principle of technical and programming aids construction and by program that controls interconnection and function of single parts of the system. The basic structure of AMS consists of the controller and instruments that are connected and communicate through communication channels as GPIB, RS232, VXI etc. AMS can be appreciated by characteristics expressing some different qualitative and quantitative parameters, e.g. efficiency, resolution, precision [1]. This contribution deals with efficiency – from the time viewpoint it means what time the basic AMS processes last.

General Purpose Interface Bus (GPIB) is very useful interface used for programmable instruments. For programmable instruments the possibility to work in various modes by the combination of settings of parameters for corresponding functions is done. A user can make a compromise between the speed of the measurement and the accuracy. The selection of proper parameters is easier with the instrument model. In this model the instrument configuration and adequate sample (number and size of samples) correspond with input. The efficiency parameters (time and rate of measurement) correspond with output. Such a model allows the evaluation of the efficiency parameters for chosen task.

The main factors that influence on the efficiency from time viewpoint are: instrument setting time, data acquisition time, digital data transfer time, digital signal processing, human interaction time.

2. Subject and Methods

For efficiency measurements the AMS system consisted of PC as a controller and both programmable multimeter HP34401A and DC source Agilent E364xA. The communication between PC and the instruments was realised via GPIB. The program used for the communication, the measurements, data acquisition and data processing was generated in LabWindows/CVI and LabView environment. The measurement time and accuracy of DC voltage in view of configuration parameters of the programmable digital multimeter HP34401A was reviewed. Efficiency measurements with this multimeter were based on triggering. Then a large number of readings measured in short time is allowed. The application (the instrument model – see Fig.1) [3] allows configuration of the main parameters that effect efficiency measurement: integration time, automatic zero reading and autoranging. It also allows configuration of a number of readings and provides some basic information about the measurement, e.g. measurement time, time behaviour of measurement, average value and accuracy. All this information can be saved to file or loaded back from file. Errors and mazes can be computed, too.

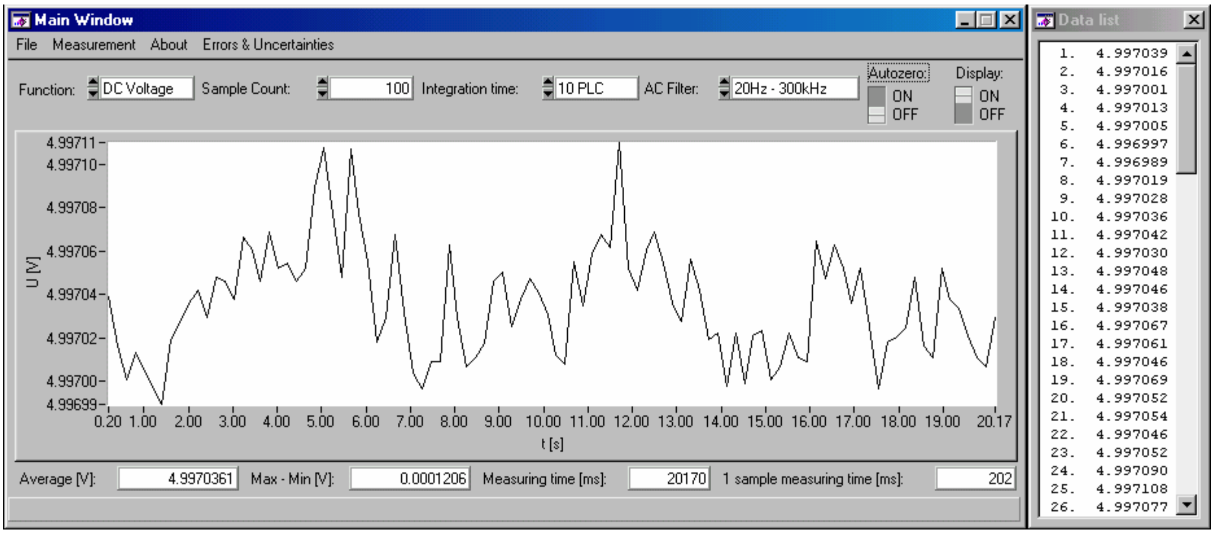

Fig.1 The instrument model

Resolution	Integration Time
Fast 4 Digit	0.02 PLC
*Slow 4 Digit	1 PLC
Fast 5 Digit	0.2 PLC
*Slow 5 Digit	10 PLC
Fast 6 Digit	10 PLC
*Slow 6 Digit	100 PLC

Table 1.*Relation between the Resolution and Integration Time*

The process of TRIGGER setting measurement consists of these settings:

- type of measurement, range and accuracy
- time between the measurements
- sample count during one trigger measurement
- immediate trigger source
- number of measurements made during triggering

After starting the measurement, the instrument is configured and the measurement is realised. The application allows reading the results and making the evaluation of the parameters value of the input signal. The errors and uncertainties are calculated, too. The measurement time as the time from starting the measurement by the multimeter till the data transfer to PC was measured both in LabView and LabWindows/CVI environments and then compared.

3. Results

In Fig.2 and 3 the results of the dependence of 1 sample measurement time on integration time and sample count in both environments on the same working place are compared. The

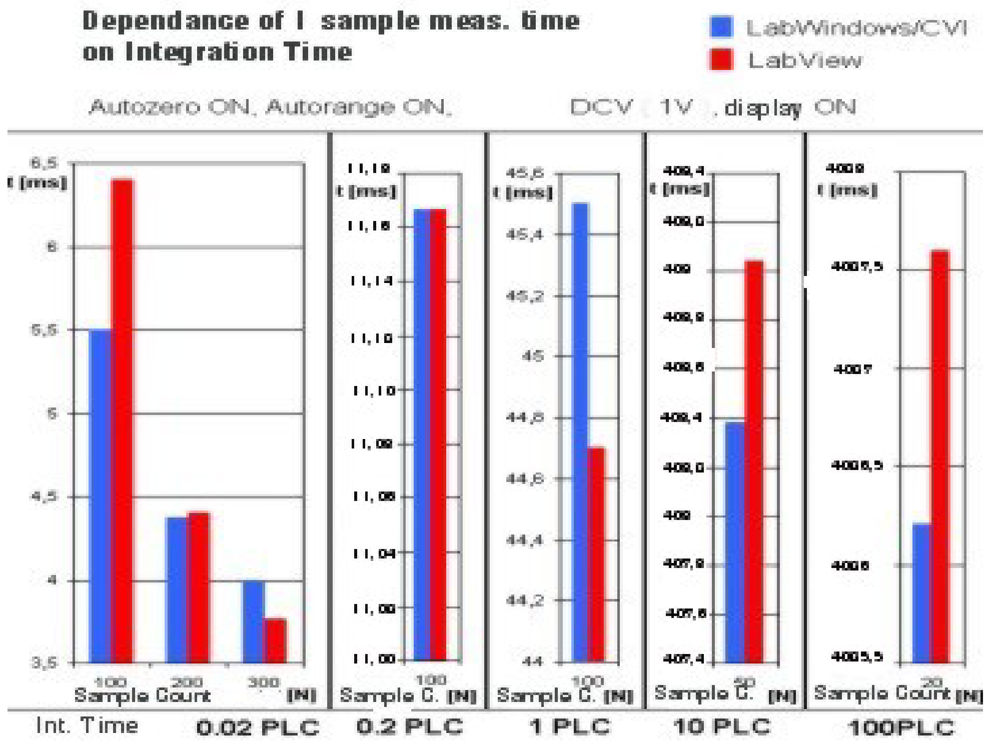

Fig.2 Dependence of 1 sample measuring time on Integration Time (Autozero ON)

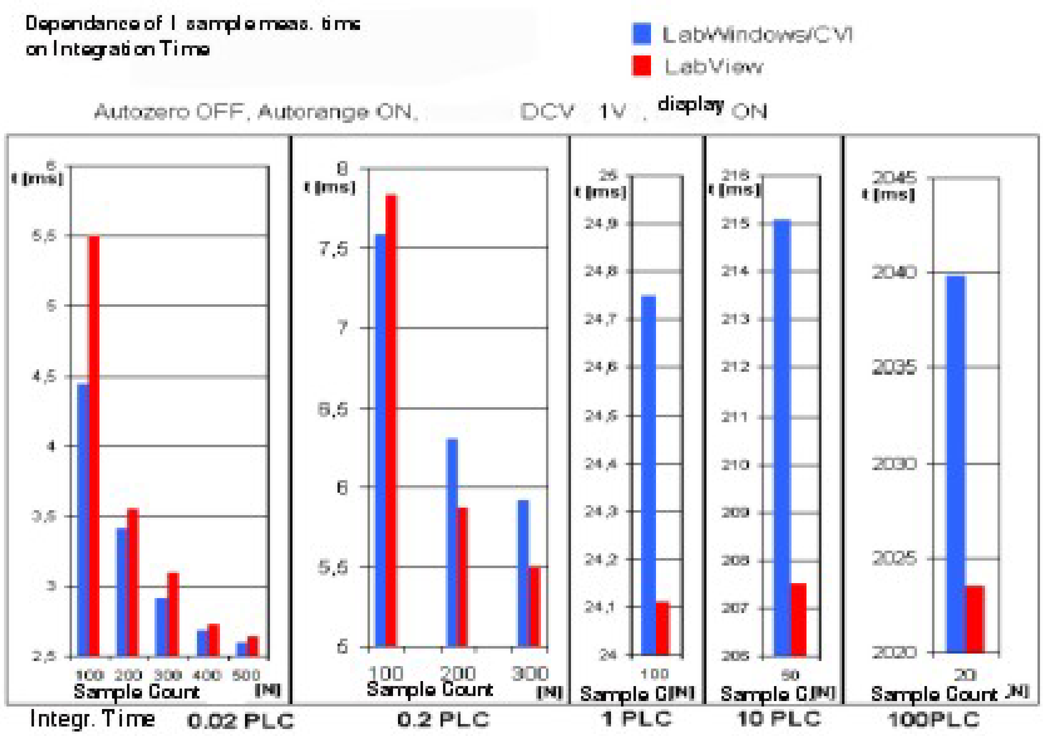

Fig.3 Dependence of 1 sample measuring time on Integration Time (Autozero OFF)

measured DC voltage was 1V, the multimeter setting was: Autorange ON, Display ON, Autozerro ON (Fig.2) or OFF (Fig.3). Comparing both these figures, it is seen, that more important time differences are for integration times 10 and 100 PLC. So if Autozero is ON it is better to do the measurements in LabWindows/CVI environment. If Autozero is OFF it is more effective to use LabView. The influence of parameter Display ON (OFF) at 100 PLC and Autozero OFF was studied. It has negligible inluence on measurement time.
The same sequency of configuration commands for the same multimeter and GPIB were used to be compared with resultes obtained in MS DOS environment in the year 1995 [2]. The amazing results were got (see Fig.4) taking in acount the parameters of PC-es (2 MHz PC in 1995) and software (MS DOS versus Windows).

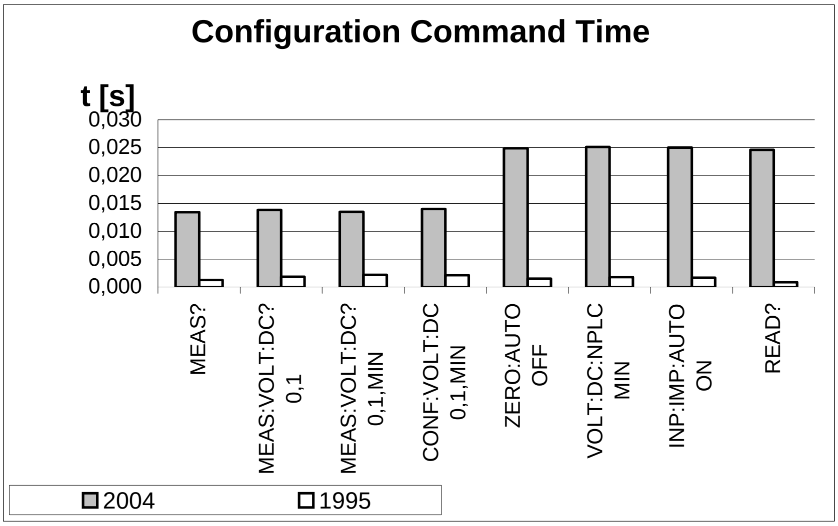

Fig.4 Configuration command time

4. Conclusions

This contribution deals with AMS efficiency parameters The approach was based on efficiency measurement characteristics in the term of time measurement. Duration of measurement of given number of samples in dependence of device configurations was evaluated.
This application is planned to be also used as a virtual instrument in distributed measurements systems. It also can be enlarged for ratio measurements, frequency response characteristics, configuration time measurement etc. and used in education.

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