TECHNICS AND INFORMATICS IN EDUCATION
6th International Conference, Faculty of Technical Sciences, Čačak, Serbia, 28–29th May 2016
TEHNIKA I INFORMATIKA U OBRAZOVANJU
6. međunarodna konferencija, Fakultet tehničkih nauka, Čačak, Srbija, 28–29. maj 2016.

UDK: 534.831:004.45 Professional review paper

Automated noise measurement technique of petrol engine

Goran Jovanov[1]
[1] International University, Faculty of Traffic Engineering - Brčko, BiH

***Abstract**: Economy, prevalence, open architecture and high computational capabilities provided by the PC led to the rapid development in the field of measurement, automation and instrumentation. Computer technology has found a variety of applications in automatic measurement of physical quantities, but all options are yet to be exhausted, so that in the future further development of this branch of the measurement techniques can be expected.*

***Keywords:** Automated measurement techniques, methods of measuring noise*

1. INTRODUCTION

Noise has been present from an early age and its importance is even more obtained in this modern age of civilization development. With the advances of techniques, the man created a new sphere that is now popularly called the techno sphere, with a number of advantages in comparison with the period when the jobs were performed manually or semi-automatically at a later time. In addition to these advantages, in the setting of techno sphere, some phenomena that are harmful to human health and the environment in general come to the surface. One of the side effects is the noise as well, which is the research problem in this paper, but it is particularly evident in the developed parts of the world, while the struggle and the striving to reduce the noise level becomes our everyday life.

There are more conceptual definitions of the term noise, but none of them is strictly specified. Noise can be treated as any unexpected or incomprehensible signal, which cannot be interpreted as a regular information. It can be defined as the murmur produced by interference or a similar phenomenon. Murmur is noise flickering which consists of a continuous range of frequencies, and therefore represents the physical size that is easily noted, measured and can be suppressed. However, the murmur is only one part of the noise, and it is necessary to access noise with a greater degree of attention to determine it on a generally acceptable level.

The term automated measurement technique signifies computer controlled measuring systems, which have due to its economy, now become an indispensable part of any system of automatic control.

The advantages of this measurement system are:

- In a short period of time it is possible to collect and process large amounts of data,
- The measurements are performed automatically,
- Calculating and documenting measurement data is accomplished using a computer,

1.1 Data acquisition systems

Data acquisition is the process by which physical phenomena in the real world are transformed into electrical signals that are measured and converted into a digital format for the purpose of processing, analyzing, and storing of the computer [2].
Figure 1 shows the general scheme of the system for data acquisition.

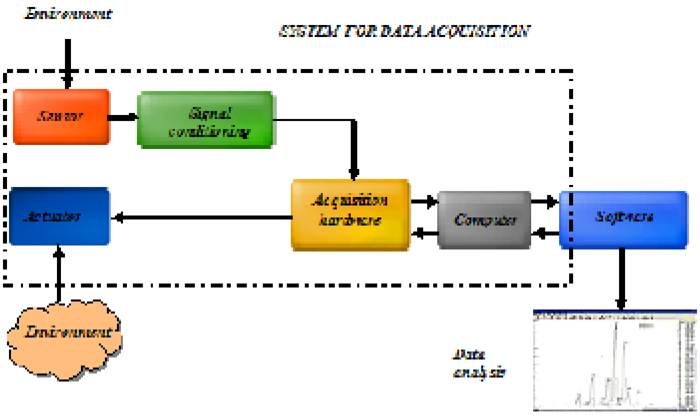

Figure 1. *General scheme of data acquisition system[1]*

Acquisition systems consist of measuring devices that accept signals from a large number of sensors and transducers, process them, transmit and remember, including the software for acquisition control, analysis and display of the data. They are known in literature as DAS (Data Acquisition System). The primary purpose of these systems is to collect data. Usually these are the data of some physical processes. After collecting it, the data is then correlated with other data, filtered, reduced, etc., in order to extract the wanted information. The data can be further analyzed, visually displayed on various types of displays, or can be used as the basis for other render diagrams. For most of the applications DAS is designed not only to collect data but also to take appropriate management actions. Therefore, the definition of DAS should include not only the aspects of obtaining data, but also the managing of the way the systems function.
The system for data acquisition and management is defined as:
Electronic instrument, or a group of interconnected electronic hardware components, intended to measure and quantization of analog signals and digital acceptance, in order to digitally analyze and process, and take feedback-control actions. [1].
The basic components of the system for data acquisition are:

- Hardware data acquisition. The main function is A/D (analog-digital) and D/A (digital-to-analog) conversion. It is installed via slots inside the computer or externally via a cable connected to a computer. It consists of subsystems, each of which performs a specific task. The subsystems include analog inputs, analog outputs, digital I/O, counter/timer.
- Sensors and actuators (Executive). Transducers are the devices that transform input energy from one form to another form of energy output. They convert the physical phenomena into signals representing hardware input for data acquisition. There are

two types of sensors based on the character of the output signal: analog and digital. Digital sensors produce an output signal that is a digital representation of the input signal and has an amplitude signal at discrete points in time. The standards of digital sensors include TTL or ECL (emitter-coupled) logic. Digital input sizes are mostly confined to the reception of voltage signal +24 VDC, analogue to the standard current signals (4-20mA) or voltage signals (0-10V), and the output relay or transistor of relatively low power. Analog input values are received directly from the measuring transducer (transducer - sensor), or from a set made from measuring sensor and an element for adjusting (conditioning) of the signal (transmitter) or from a set which prepares the signal from the transducer for direct reception by the PC via some of the standard communication links (transceiver). Return effect on the measuring and control system is realized through the executive mechanism, actuators, preceded by executive converter. As with data collection, the activation of managing mechanism is achieved through the standard current (4-20 mA) or voltage signal (0-10V, 24V). The most common actuators are: vent pipes, valves, couplings, etc. The actuator consists of a mechanical device which changes the executable size (vent pipes, switch, contactor, valve, ..) and drive (solenoid, servo-electric, pneumatic or hydraulic).

- Hardware for signal conditioning. The signals generated by the sensors are often incompatible with hardware for signal conditioning. Signal conditioning implies filtering (removing unwanted noise from the useful signal), amplification, linearization, buffering, sampling / holding (sample / hold), attenuation etc. signal from the measuring encoder.
- Computer. It includes the processor, the system clock, data bus, memory and space to store data. The computer provides the processor, system clock bus for data transfer, memory and disk space to store data. The processor controls how quickly data can be accepted from the converter. The system clock enables obtaining weather information on the data collected. Knowledge of the information gathered by the sensors is not enough. It is necessary to know when the measurements were taken. Data from the hardware are transferred to system memory via DMA (Dynamic Memory Access) or interruption. DMA is a controlled hardware and works extremely high speeds. Maximum speed of data acquisition is also designated by the computer architecture bus.
- Software. It enables the exchange of information between a computer and hardware. Typical software allows configuring the time of sampling and collecting a predefined amount of data. Receiving information from the hardware and sending information to the hardware. There are two types of software: computer hardware and application. Hardware software allows you to access and manage the hardware. [3].

2. MOTOR VEHICLE NOISE MEASUREMENT METHOD

While the vehicle is in motion, on each side of the vehicle two to three measurements are carried out and largest value obtained is taken. Test measurements are not taken into account. The technique of measuring the noise of vehicles in motion: a microphone is set at 1.2 ± 0.1 m above the surface with a distance of 7.5 ± 0.2 m from the centerline of the vehicle in comparison to normal PP to this axis (Figure 2). [4].

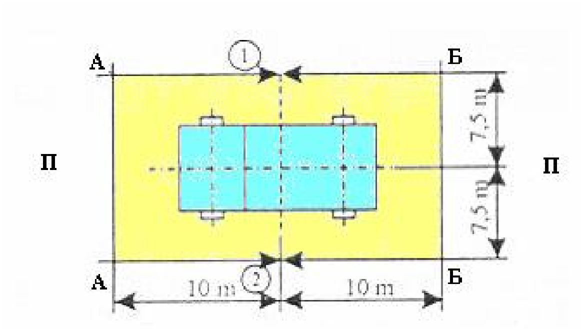

Figure 2.*Measuring points when the vehicle is in motion* [4].

Figure 2 shows that the part of the track where testing is done parallel with the PP at a distance of 10 meters, in front and behind, the two lines AA and BB are drawn. The vehicle is moving unvaryingly at a given speed, and on arrival at the position AA, where full gas is given and maintained until the rear of the vehicle passes through the line BB when gas is reduced.

2.1. The method of measuring engine noise in standby mode

For this measurement it is necessary to meet the requirements and then access the technique of measuring the noise of vehicles in standby mode.

Every open space is suitable for measuring noise emission of the vehicle while in standby mode if it is flat, made of concrete, asphalt or other hard surfaces, except trodden clay surface, where it can pull a rectangle whose sides are 3 m (Fig. 3) far from end points of the vehicle to which there are no visible obstacles. [4].

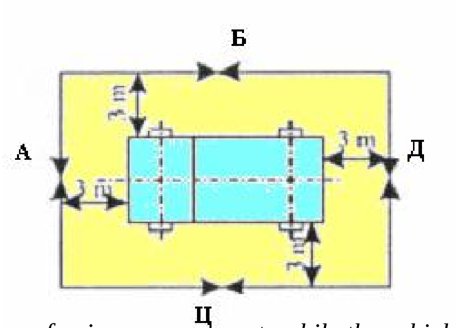

Figure 3. *Positions of noise measurements while the vehicle is stationary* [4].

Number of measurements per measuring point is a minimum of three the one that has the highest noise level is taken as the valid one. The measurement is considered valid if the difference is not greater than 2 dB (A) in between three consecutive measurements.

The vehicle should be placed on a flat surface so that the shift lever is in neutral, and the engine is running at the appropriate speed level for this operating mode. In addition, it should be noted that the vehicle must be technically correct, and to avoid measurements if the engine cooling system is on.

3. VIRTUAL INSTRUMENTATION

The basic idea of virtual instrumentation is that the personal computer, as a powerful and affordable development platform, with the help of a dedicated specialized hardware and software modules, is used in order to collect data from measuring devices for further processing and display of measured values. This represented the beginning of a new concept called virtual instrumentation.

Virtual instruments represent visualization and centralization of complex measurement systems on a standard personal computer in the form of a virtual user interface. [3]

The main advantages of this concept are the following(Figure 4). :

- The virtual instrument may have any combination of industry-standard hardware for collecting or issuing data: GPIB (IEEE 488), RS232 - devices, VXI - systems, field bus (CAN, Interbus-S, Profibus, etc.), multifunctional - connecting cards, DAQ - instruments, components for image processing and so on.
- Possibilities of analysis of measurement data and their presentation go beyond the traditional measurement techniques.
- Along with powerful software developmental environment and a set of hardware components, numerous virtual instruments can be implemented and cover a broad range of tests and applications.

Figure 4. *Traditional and virtual instrument*[3]

In centralized acquisition systems all transducers are connected on central computer interfaces, and it provides a complete digital signal processing: digital filtering, linearization, process monitoring, alarm, control, etc. For a computer to work in real time, i.e. in control of all the signals necessary for multiplexing and conversion, to end this process between the two conversions, it needs to have great processing power. However, computers with a specific construction are often used. The issue that is highly pronounced with these systems is the reliability due to failure of the central computer. Furthermore, the realization itself contains many wires leading to the central computer, and if the measuring points are spatially distant, there is also the problem of the transmission of analog signals in terms of industrial interference. The centralized system usually does not allow the separation of the control from the acquisitions. The main advantage is that the system design does not include communication between components, but all acquisition cards simply read by a direct memory access, using the existing driver instruments, as well as in case of any other virtual measurement system.

In centralized measurement systems all the devices for data collection are connected directly to the computer. The connection is realized either via the system bus (PCI, ISA, VXI, etc.) or via standard communication interface of the computer. (Figure 5). [3].
The standard interfaces include:
• Parallel port
• Serial interface RS-232
• Universal Serial Bus USB
• Firewire (IEEE-1394)
• IEEE-488 (via adapter)
Modern measurement devices have infrared, Bluetooth or WLAN interface

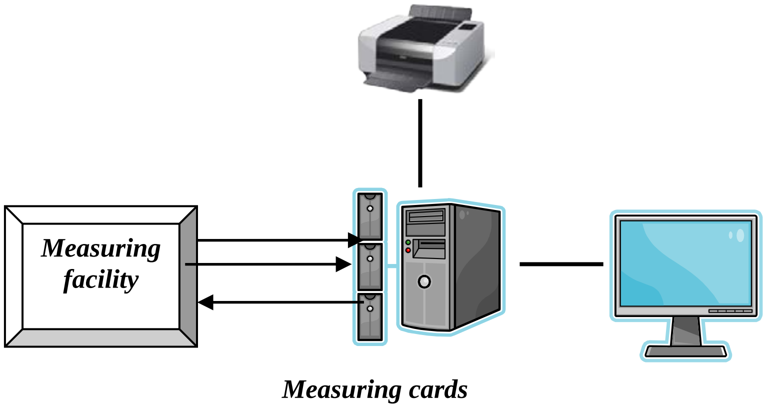

Figure 5. *Centralized measurement systems*

4. CONCLUSION

An important moment in the technology of measuring noise, whether on a motor vehicle or other technical systems, is to choose a proper methodology and comply with the applicable standards and laws of the territory in which the research is conducted. If the state does not have its own standards and regulations, some of the other national standards shall be taken as valid; in most cases here, the German standard RLS 90 for analyzing the traffic noise on the basis of which traffic noise emissions are measured and forecasted, is taken as the valid one.
In addition to this, it is necessary to use the measuring technique which also meets the prescribed requirements, so the measurements are accurate and valid. Specifically, this study was conducted using measuring equipment that meets all the standards for mapping noise pollution, such as RLS 90, RLM 2, Schall 03, ISO 9613.

REFERENCES

[1] Drndarević, V., Personalni računari u sistemima merenja i upravljanja, Akademska misao, Beograd, 2003
[2] Velagić, J., Akvizicija i prenos podataka, Elektrotehnički fakultet, Sarajevo, 2007
[3] Scher, R., Automatische Messtechnik, HTL Bulme, Graz, 2008
[4]Adamović Ž., Avramović D., Jovanov G., Dijagnostika putničkih automobila, Društvo za tehničku dijagnostiku Srbije, Smederevo, 2006. god.