EURONOISE 2006
30 May - 1 June 2006 Tampere, Finland

NEW POTENTIAL OF LONG TERM REAL TIME NOISE MONITORING SYSTEMS

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ABSTRACT

The monitoring system described in this paper transmits continuously the acoustic data measured on site to a web server and enables real time publishing on Internet of the noise data together with the acoustic map of the surroundings, periodically updated by means of the measured parameters.

The 1/3 octave spectrum of the ambient noise acquired with a time resolution of 1 s provides a detailed description of the sound events and makes possible their correlation with other parameters such as meteorological conditions and road traffic flows.

Moreover the automatic publication of data on Internet is a useful and efficient information tool for the public, as requested by the Italian Decree D.Lgs. n. 194/2005 implementing the directive 2002/49/EC.

1 INTRODUCTION

The increasing need of acoustic information more and more detailed and over long periods, together with their rapid and efficient management, leads to the realization of systems able to collect acoustic data coming from various acquisition units located in the territory and to provide the results immediately available on a web server. By this set-up the data are available in real time from any remote posting equipped with a common web browser. One of this unit has been installed at CNR-Institute of Acoustic "O.M. Corbino" (IA) in Rome together with a meteorological acquisition unit and a videocamera which enables even the audio and video streaming. The acoustic and meteorological monitoring system has been programmed for a continuous monitoring over at least one year in order to acquire the necessary data for a long period to evaluate the variability of the sound level and meteorological parameters and to study the influence of the latter on the sound propagation and on the annual value of L_{den} e L_{night}. The collected acoustic data can be available in real time on the web page at the address http://www.citynoise.net/idac/ together with the acoustic map of the monitoring site. This map is drawn and published automatically at regular time intervals on the basis of the continuous equivalent level L_{Aq} measured by the monitoring unit. The L_{Aq} level can be reasonably representative of the noise emitted by the main source present nearby the unit, namely the motorway E45/A1 located at a distance of 240 m (Fig. 1) and without any obstacles along the sound propagation path towards the monitoring system. Fig. 2 shows the web page linked to the installation at CNR-IA.

Fig.1. Aerial view of the monitoring system installed at CNR-IA and the nearby motorway.

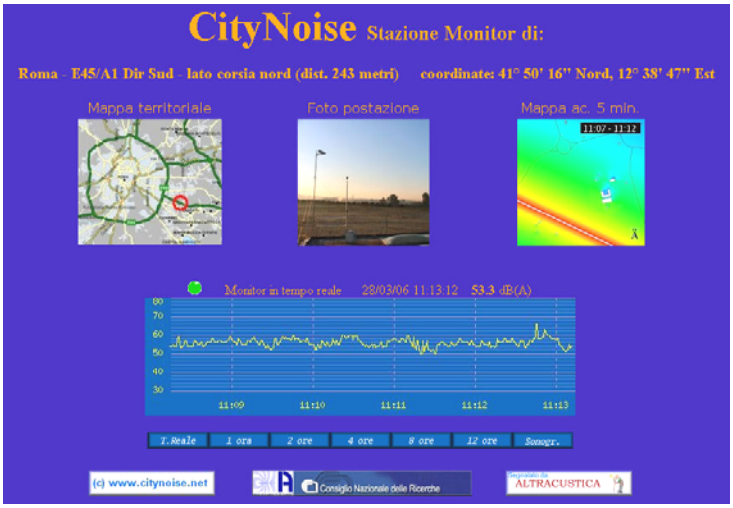


Fig. 2. Public web page ot the system with the acoustic map on top right.

2 DESCRIPTION OF THE SYSTEM

The system can be essentially divided in two main blocks: the noise monitoring unit located in the field, and the central server unit installed in the control centre. The noise monitoring unit is in charge of noise data acquisition and transmission, while the central unit is dedicated to the data collection from all the peripherals units and to publish the noise data in real time on Internet in a public or password protected web page. If real time noise mapping is required, an additional computer equipped with noise prediction software has to be linked to the central unit, in order to obtain the automatic noise map publishing, updated by means of the noise levels measured by the unit located in the field.

2.1 Noise monitoring unit

Each noise monitoring unit is equipped with a Type 1 sound level meter (SLM) connected with an outdoor microphone. The SLM is linked to a special router for its setup according to the parameters stored in the central data base. In addition the router provides the noise data transfer to the central data base by means of GPRS or DSL and Internet. Another important function of the router is to provide a suitable memory buffer in order to avoid data missing due to temporary interruption on data transmission channel. In case of GPRS data transmission and internal battery power supply, the noise monitoring unit can operate without any cable connection up to eight days continuously. If DSL and mains power supply are available, it is possible to publish real time audio and video streaming providing a videocamera installation (Fig. 3).

2.2 Central unit

The central unit consists of a Linux machine, equipped with Apache web server, PHP scripting interpreter and MySQL database. By means of this configuration it is possible to obtain automatic data publishing, report creation and SMS threshold exceeding information without any need of operator action and attendance.

Fig. 3. The monitoring unit installed at CNR-IA in Rome.

3 NOISE PARAMETER ACQUISITION

The system acquires 1/3 octave short L_{eq} spectrum (from 12.5 Hz to 20 kHz, plus overall dBA value) every 1s. The real time data transfer to the central unit eliminates any memory limitation (i.e. the limit is only the memory capacity of the central hard disk). On the published web page, visitors can display spectra, time histories with various time windows (from 1h up to 12h) of the overall dBA level and for each frequency band, as well as the sonogram over a time window of 10 minutes.

4 OFF-LINE DATA PROCESSING

All the data acquired and stored in the MySQL database are available for downloading from authorized users through a protected web page. Data downloaded from the central unit are post-processed by a dedicated software working under MS Windows®. The software provides the hourly equivalent spectrum, day-time, evening and night-time L_{Aeq} values, and the cumulative and distributive analysis of the overall levels and for each frequency band. All the data can be exported in ASCII format for further processing by other applications. The features of the data processing enables the identification of sound events produced by sources different from motorway, such as aircraft flight over and their correlation with meteorological data acquired by another monitoring system. For example Fig. 4 shows how the sonogram provided by the software highlights the flyover of an helicopter, while Fig. 5 shows the effect on sound spectrum of wind speed greater than 5 m/s. From the 24h time histories, such those reported in Fig. 6, it is clearly recognizable the time pattern of the short L_{Aeq} for a weekday (Friday) and for a Sunday; the increment of the L_{Aeq} level observed in the period 5-7 hours in the morning of Friday (Fig. 6a) is lower and shifted in time (8–9 hours) on Sunday (Fig. 6b).

The potential of the off-line data processing makes easier the recognition of the type of sources producing the sound events. This is a valid tool for the acoustic signature widely used in airport noise monitoring, in checking the compliance with the noise limits in construction sites and outdoor temporary events (concert), in motordromes, in continuous 24h industrial activities (oil plants, energy plants) and also for the validation of sound propagation numerical models. A further application is the determination of the yearly L_{den} and L_{night}

values and the annual variability of the sound emission of specific sources and of the meteorological conditions influencing the acoustic propagation. The monitoring in progress at IA is mainly focused on this specific aim.

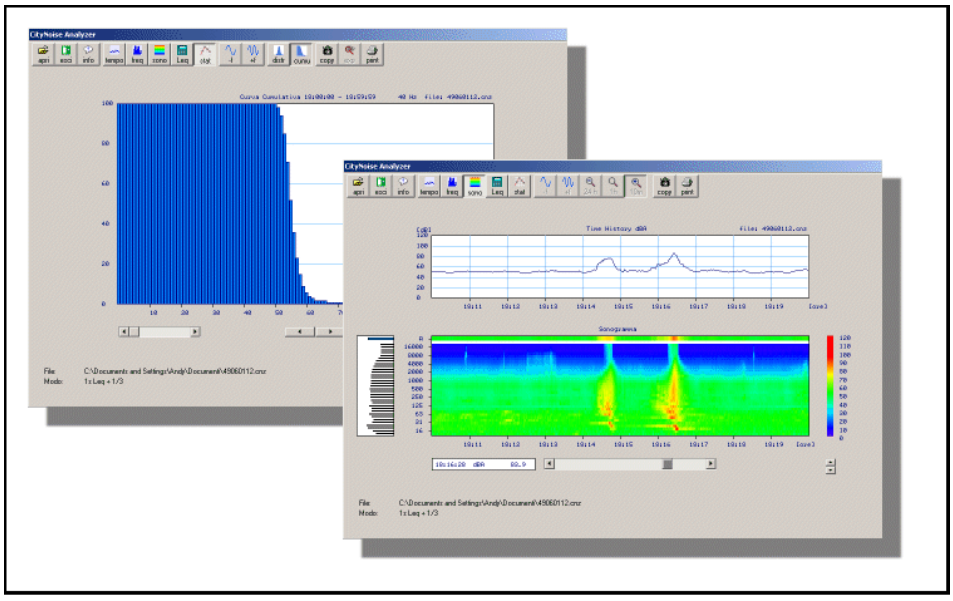


Fig. 4. Example of off-line data processing: the right bottom sonogram shows a flyover, while the cumulative distribution of the sound levels is reported on top left.

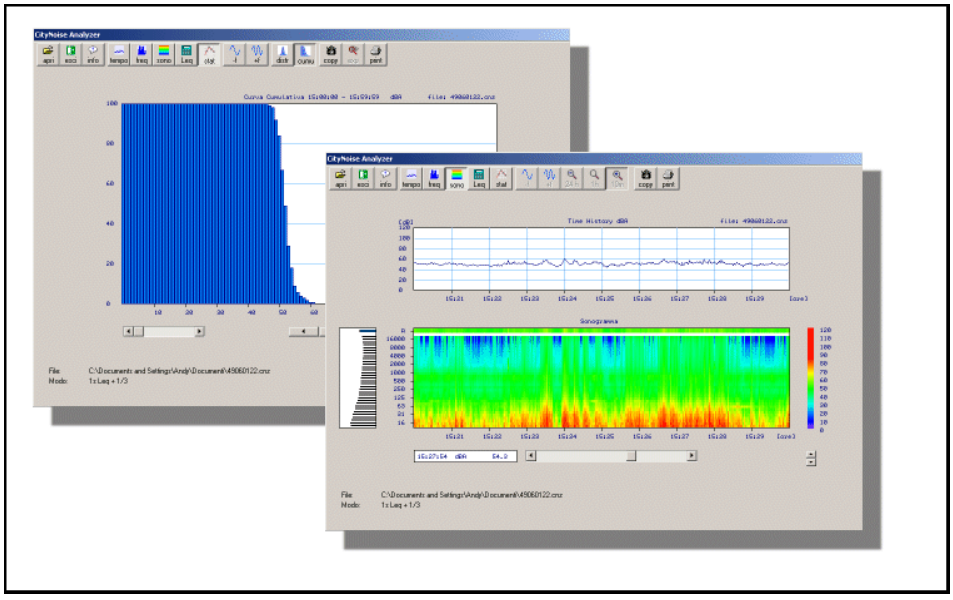
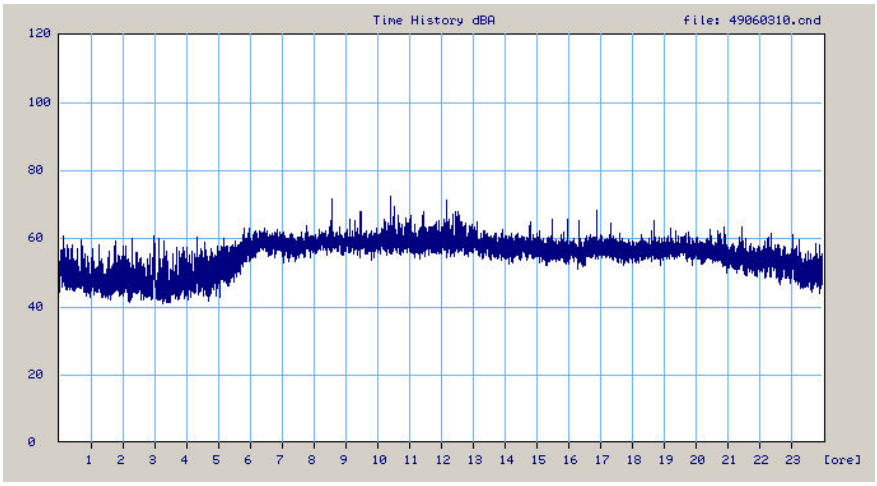
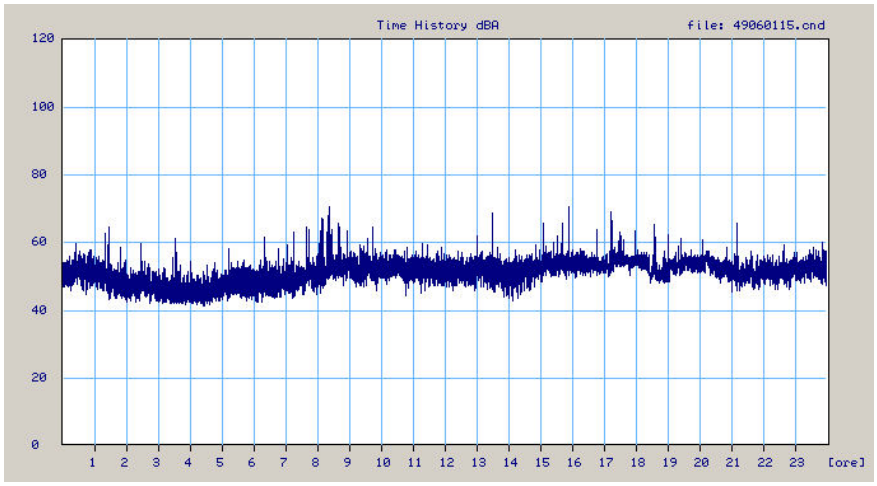


Fig. 5. Example of off-line data processing: the right bottom sonogram shows the sound levels measured with wind speed > 5m/s.



(a)



(b)

Fig. 6. Time histories over 24 hours of 1 s L_{Aeq} for a weekday (a) and Sunday (b).

5 CONCLUSIONS

A real time noise monitoring system like that described in this paper:

- enables long term measurements and acquisition of large amount of data;
- solves the problems due to the limitation of in-field memory size and periodical data download.

The main advantage consists in the immediate data availability also at large scale, such as their publication on Internet. The addition of acoustic maps, frequently updated and previously validated, is an useful and effective tool for the information to the public as required by the Italian Decree D.Lgs. n. 194/2005 implementing the directive 2002/49/EC.

A possible future implementation of a large scale network, integrated with additional data of the noise sources, will enable a deeper characterization of the sound environment and of the sources.