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A COMPREHENSIVE SYSTEM FOR ENVIRONMENTAL NOISE ANALYSIS

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INTRODUCTION

The object of this paper is to review the development of a computer program for environmental noise analysis and presentation taking data from the Larson Davis Model 870 Environmental Noise Analyser. The features of the program expand our earlier experience in the production of graphic programs for personal noise exposure monitoring, on which we have been building since 1986.

HARDWARE

Being a fully digital unit after its sound level meter stages, the Model 870 Analyser is particularly well suited to use with a fully automated computer program, and there is even an option of a completely "blind" version of the 870 which has no controls or display on the instrument itself for use on applications where the instrument is remote from the controlling computer on a permanent installation, and never needs to be touched by human hand.

Although our main objective is to review the computer program which presents the results of an enviromental noise survey, a short review of the features of the Larson Davis Model 870 will assist an understanding of how the program was developed. The instument itself is designed as a Type 0 Sound Level Meter according to IEC 651 and 804 (and their American equivalents). It has a single, unswitched dynamic range of 115dB above a noise floor of about 18dBA (with 50mV/Pa microphone), and samples the sound level 32 times per second. These samples are organised to produce a Time History of the sound level record in programmable periods (typically 1 minute, but ranging from 1/32 second through to several months), an Exceedance history (where exceedance of either of two pre-set Peak or RMS level thresholds triggers an event recorder, which can also store a history of the exceedance or trigger an analog tape recorder, if required), an overall statistical analysis, and both a Current (independently resettable) and cumulative Overall L_{eq}. Additionally, there is the Interval Mode, which can store for each coarse time block (typically 1 hour, but again ranging from seconds to hours) the L_{eq}, L_{min}, L_{max}, weighted maximum peak, unweighted maximum peak, SEL, six selected L_Ns, and the maximum, minimum and average value of three auxiliary inputs, on which exceedances of a pre-set threshold can also be counted. The auxiliary inputs might be from wind speed and direction, temperature, humidity, traffic count, gas analysers, or any relevant unit having a scaled dc output.

It was our objective to present all these data reports from within the program, so far as could possibly be done, in graphic format. With such flexibility, the 870 instrument has 162 setup

options, and it is therefore important to facilitate instrument set-up, and specific instrument configurations can be stored in the computer and transferred to the instrument as required for specific applications.

PROGRAM OBJECTIVES

Our main objective in any of our programs has always been towards graphic presentation of the data. For this reason, we decided that the Microsoft "Windows" environment is an ideal vehicle on which a graphic program can be carried. This is principally because of the very wide range of output drivers available from the environment, and there is within "Windows" the capability to output to virtually any hard copy device from the program, through the serial or parallel output of the computer.

DATA RETRIEVAL

Having collected data on a measurement site, the Analyser can be interrogated by means of a portable computer, or remotely by means of a modems (cellnet, telephone lines, or by permanently wired short-haul modems).

In the particular case of a permanently wired system, the Analysers can be linked in a continuous "Daisy Chain" from a single RS-232 port, each Analyser in the chain being allocated its individual address so that only this unit responds when called from the computer. Data is accumulated in the individual analyser, and, unsupervised, our program offers the option to call on a permanently installed, or modem linked system the individual analysers at pre-determined times to collect data into the computer and reset the analyser. Again for permanently installed systems, there is also the facility to call one or more of the instruments at any time to interrogate its current readings or to activate its electrostatic actuator for a calibration check (which is automatically done once per day as well). As the Model 870 has a very large capacity for data, download might typically take place each week, or even less frequently (our set-up routine calculates the maximum duration of the test, having read the memory capacity of the analyser and calculated memory requirements for the particular set-up configuration).

Although data transfer rates may well be limited by line lengths and modem restrictions, direct connection (to a portable computer, for example) permits data download at 19200Baud.

DATA PRESENTATION

With the data transferred to the computer, several means of presenting the data are possible. For a straightforward listing of hourly L_{eq} and L_{90} variations, a basic numerical tabulation is available (Fig 1).

A COMPREHENSIVE SYSTEM FOR ENVIRONMENTAL NOISE ANALYSIS

The best resolution of the detail variations in dBA levels is obtained from the History record (Fig 2). For screen presentation, this is automatically scaled by the program to fill the screen with a plot which combines a fast replot rate with reasonably fine resolution if the graphic resolution of the computer screen is sufficient, this can be replotted as fine as necessary from the data available. Using "Windows'" click and drag mouse technique, a section of the data can be expanded, and if required the L_{eq} and any selected L_N values can be calculated for this section of data. This is designed so that for a record spanning several days, an 18 hour L_{10} and L_{90} can be calculated for each day of the survey - a warning is given if the number of samples in the record is not sufficiently great enough to provide a statistical resolution better than 1dBA on the calculated L_N.

The Interval data gives an overall trend on a coarser time scale. It can be used to examine the variation of L_{eq}s or L_Ns and correlate either with maximum or minimum values in the corresponding time interval. Although any number of the measured parameters (up to 12 of them) can be displayed simultaneously on-screen or on a printout, the picture becomes very confused with more than 4 items displayed - worse in monochrome!

As with all "Windows" applications, the wide variety of printer and plotter drivers makes data output almost a secondary consideration. Having selected the appropriate driver (from within our program) output can be made to devices with presentation quality from a dot-matrix printer to the H-P PaintJet.

FUTURE DEVELOPMENT

A computer program is never finished. Although the present application is now commercially saleable, we continuously find means of improvement, usually through customer suggestions and requests. These are always welcome.

Model 870 Serial Number:A0173 Interval Report
From File: OFFICE2.870 Mon 12Nov1990 09:34:30
Period = 01:00 (hh:mm)

Intv	Date	Time	Duration	Leq dBA	Lmin dBA	Lmax dBA	Uwpk dB	L10 dBA	L90 dBA	RMS EXC
1	08Nov1990	15:38:43	21:16.03	57.6	46.3	76.0	115.2	59.8	47.3	0
2	08Nov1990	16:00:00	1:00:00	50.6	46.0	75.7	111.2	50.7	46.3	0
3	08Nov1990	17:00:00	1:00:00	57.7	28.6	83.0	117.0	57.1	40.7	2
4	08Nov1990	18:00:00	1:00:00	58.6	40.2	74.7	108.7	62.7	41.6	0
5	08Nov1990	19:00:00	1:00:00	55.8	23.3	79.9	113.2	55.2	28.3	0
6	08Nov1990	20:00:00	1:00:00	53.7	28.3	80.0	108.7	56.1	35.3	1
7	08Nov1990	21:00:00	1:00:00	55.2	42.6	78.4	116.7	58.1	45.3	0
8	08Nov1990	[illegible]	[illegible]	51.5	28.3	78.0	116.4	[illegible]	[illegible]	[illegible]
9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Fig. 1 Interval Report - Numeric Tabulation

A COMPREHENSIVE SYSTEM FOR ENVIRONMENTAL NOISE ANALYSIS

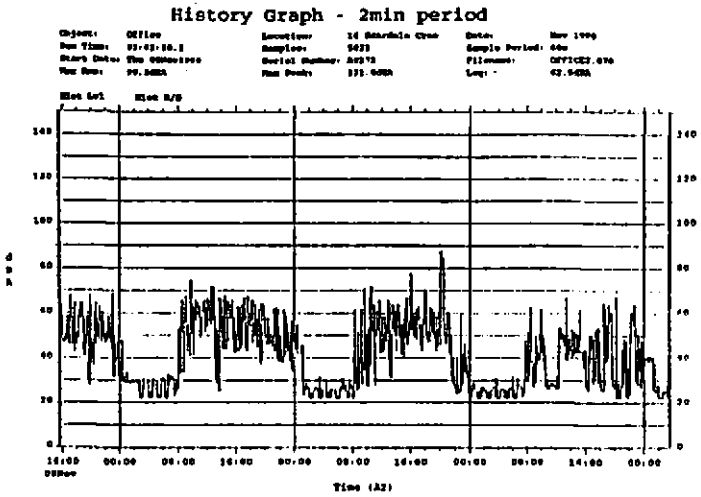

Fig. 2 History Graph

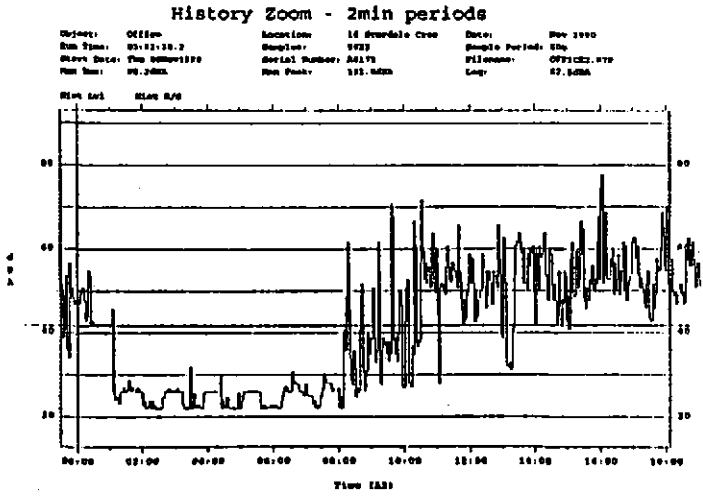

Fig. 3 History Graph with Zoom, L_{10} = 56dBA, L_{90} = 22dBA

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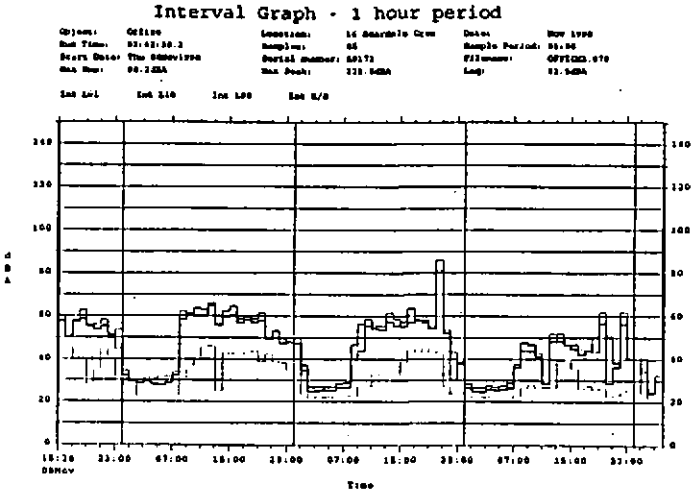
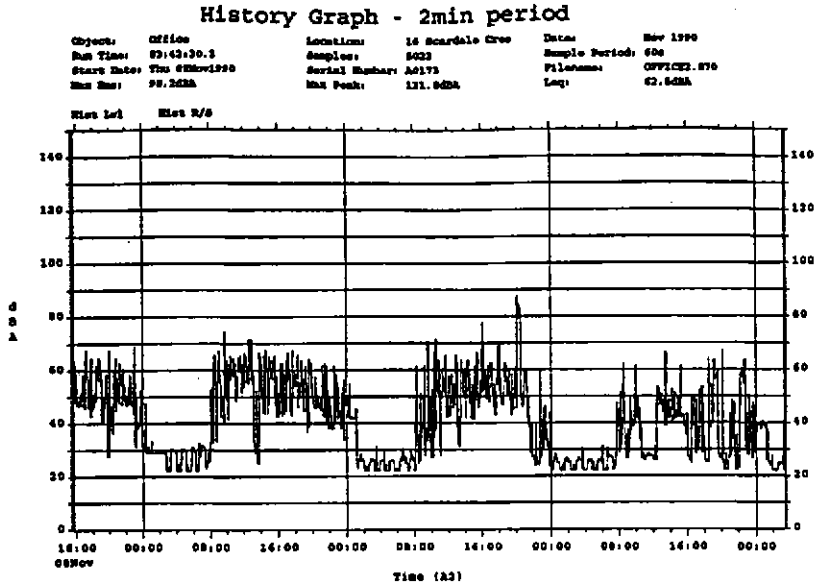
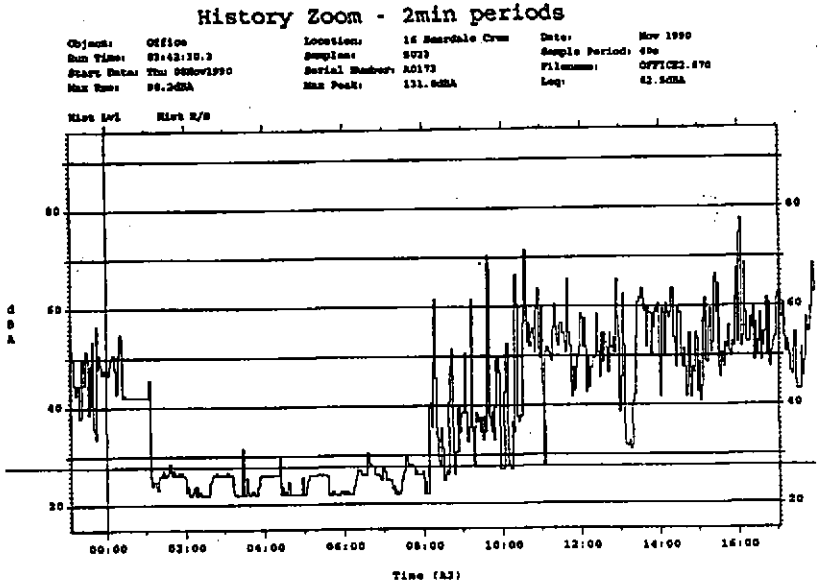
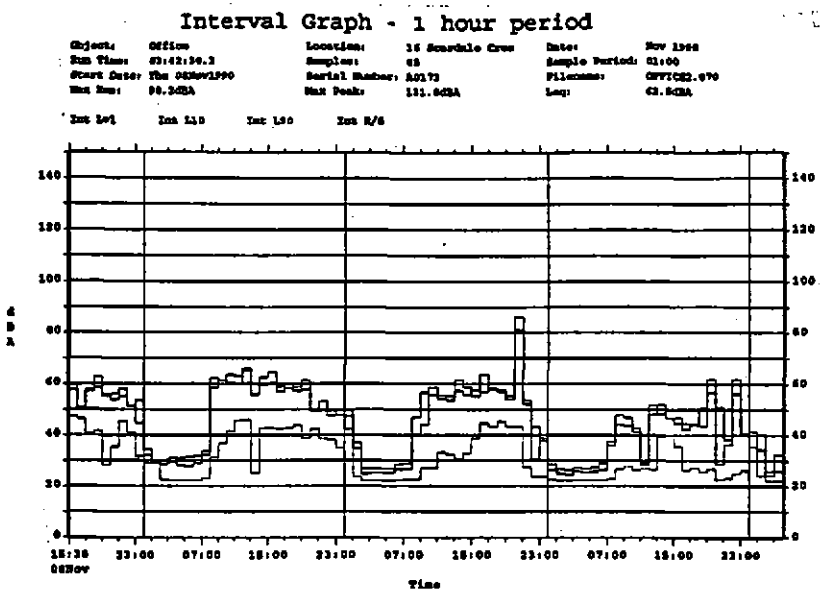


Fig. 4 Interval Graph


History Graph - 2min period
Object: Office
Run Time: 93:43:30.5
Start Date: Thu 08Nov1990
Max Max: 98.2dBA
Location: 16 Scardale Cres
Samples: 5622
Serial Number: A6175
Max Peak: 121.9dBA
Date: Nov 1990
Sample Period: 60s
Filename: OFFICE2.870
Leq: 62.6dBA
Hist Lvl
Hist R/S
dBA
140
120
100
80
60
40
20
0
16:00
08Nov
00:00
08:00
16:00
00:00
08:00
16:00
00:00
08:00
16:00
00:00
Time (A3)


History Zoom - 2min periods
Object: Office
Run Time: 07:42:30.2
Start Date: Thu 08Nov1990
Max Rms: 98.2dBA
Location: 16 Beardale Crem
Samples: 9923
Serial Number: A0173
Max Peak: 131.0dBA
Date: Nov 1990
Sample Period: 4Ms
Filename: OFFICE2.670
Leq: 62.5dBA
Hist Lvl
Hist R/S
80
60
40
20
dBA
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
Time (hr)


Interval Graph - 1 hour period
Object: Office
Run Time: 03:42:30.3
Start Date: Thu 08Nov1990
Max Rms: 98.3dBA
Location: 16 Scarsdale Crse
Samples: 48
Serial Number: A0173
Max Peak: 131.8dBA
Date: Nov 1990
Sample Period: 01:00
Filename: OFFICE2.070
Leq: 63.8dBA
Int Lv1
Int L10
Int L90
Int N/S
dBA
140
120
100
80
60
40
20
0
15:38
08Nov
23:00
07:00
15:00
23:00
07:00
15:00
23:00
07:00
15:00
23:00
Time