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Application of a Home Computer System to Acoustic Measurements

N. W. Heap, Open University, D. Oldham, Sheffield University

Introduction

With the development of large scale integrated circuits over the last few years the current trend in the design of acoustical equipment is to employ digital techniques. A number of new instruments have recently appeared using digital technology which enable many time consuming acoustical measurements to be performed automatically. Such instruments, however, tend to be expensive and of limited application hence many laboratories, although attracted by the idea of automating many standard measurements, are forced to carry on with older but still servicable equipment. This paper describes a middle route between these two extremes, namely by the use of a low cost "home" computer to control automated measurement systems employing analogue instrumentation.

An Automatic System for Measuring Transmission Loss

The capabilities of the home computer can best be explained by reference to a system in which it has been incorporated. The system selected is one intended for the measurement of the transmission loss of a partition in a transmission suite. The "traditional" semi-automatic method of measuring this parameter involves the use of a graphic level recorder to switch banks of filters and a two channel selector so that a plot of the noise spectra on either side of the partition can be obtained. This procedure is usually repeated a number of times in order that any variations in the reverberant fields on either side of the partition can be averaged out. This averaging is usually done after manually extracting the information from the recorder traces.

In order to offer a worthwhile alternative to this procedure the home computer system has to be able to do all that the level recorder can do and more. It's role can be considered under two headings: the control of the switching procedure and the processing of the data.

Control of Switching Procedures

A transmission loss measuring system based upon the Commodore PET home computer is shown in Figure 1. The PET comes complete with a video display, keyboard, 8K of memory, a Basic Compiler and cassette tape bulk storage and sells for around £550. A special feature of this machine (and one common to many microcomputers) is that all input and output together with the video display is memory mapped which avoids the need for special input/output instructions in the microprocessor instruction set. Control of the switching procedures is achieved very simply by means of a device known as the output port. It is possible to send to this port (using a POKE statement) an eight bit word. This word appears at the port as eight separate voltages which are 0V for any bits specified as zero and 5V for any bit specified as unity. These voltages can be used to operate reed relays which, with an ancillary 24 volt power supply, can be used to generate the switching

pulses used to control B and K equipment.

Since an eight bit work can be sent to the user port eight separate switching circuits, can be controlled in this way. In the system shown in Figure 1 two bits are used to control the filters and one bit to control the channel selector. Some of the spare bits can be used to make system checks that would normally be made by the operator using the level recorder method. For example the signal generator or power amplifier could be switched out in order to check that the signal to noise ratio of the measuring system was adequate. A difficulty encountered with the conventional method is that it is not possible to vary the inputs to the power amplifier once the experiment is under way. With this system a bit can be used to control the input to the power amplifier to ensure an adequate signal to noise ratio for low frequencies, when the speaker may be inefficient, or at high frequencies when the level in the receiving room may be much lower than that in the transmission room due to the transmission loss of the partition.

Data Processing

In terms of switching the various devices needed the home computer offers only slight advantages over the graphic level recorder. Its greatest benefits arise from its ability to process the data as it is collected and to present information concerning the transmission loss of a partition in either graphical or tabular form immediately at the end of an experimental run.

The first requirement is to be able to get the data into the machine. This can be done via the memory expansion bus using an analogue to digital converter and a peripheral interface adaptor. The signal from the measuring amplifier is converted to digital form and input to the computer. This is done using the memory expansion bus and special purpose integrated circuits required to ensure that it is properly buffered. The input output control routine is to be written in assembler code for speed and it is facilitated by the USR and SYS executable statements found in the PET which transfer program execution from the normal Basic to an assembler subroutine. In order that the reverberant sound field in the rooms be spatially averaged the measuring microphones should be mounted on rotating rooms and a number of values of the sound pressure level recorded at each frequency.

Data concerning the area of the transmission panel and the reverberation time of the receiving room can be stored within the machine and used with the measured level difference to calculate by means of simple programs written in Basic the transmission loss of the partition. The resultant values can be presented on the screen of the computer or printed using an accessory sold for the PET. If a graphical indication of the variation of the transmission loss with frequency is required then this can always be shown on the screen.

Conclusion

The use of a low cost home computer with analogue acoustic instrumentation can permit a variety of standard acoustic measurements to be fully automated. Although the example of transmission loss measurement to be used in the paper a similar system can be devised for the measurement of reveberation time, noise spectra, sound power level, statistical fluctuations of levels etc.

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