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AN INTERNATIONAL PERSPECTIVE ON AIRPORT NOISE MONITORING

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1.INTRODUCTION

It would seem to the unbiased observer that monitoring of aircraft noise, like aircraft themselves, would be truly international in concept and would not depend on local regulations or even local whims. After all, aircraft take off from one country and land in a second and the noise levels are likely to be the same in both countries. In addition, the International Civil Aviation Organisation, ICAO, sets noise certification standards which have to be met by the aircraft manufacturers. In reality however, the monitoring of aircraft noise makes the Atlantic divide on sound level meters standards look like a minor crack, with a huge gulf in the methods and techniques used in different countries. Since 1990, Cirrus Research have been the technology leader in the field of dedicated airport noise monitors, with units having been installed in many countries. Naturally, we do not want to take issue with users of our units, who are perfectly entitled to measure in any way they wish. However some measure of agreement eventually must prevail and the present situation with many sets of regulations should be recognised as poor acoustics and even worse economics. The current cost of an airport noise monitoring system, is more than doubled by the national differences in specification and work practises and while this might increase UK and some other countries exports, these differences should be resolved in favour of true international agreement.

2. HOW DID THIS HAPPEN?

Each country initially appoints a committee, a consulting company, or an academic, to provide a set of local regulations. They look at existing standard, the noise certification procedure and other source documents and then write the 'definitive' method for their geographical area. To demonstrate that the subject has been fully covered, existing work and current systems have often been ignored and special rules written for each situation. The results of these labours was often engraved onto tablets of stone by the local political leaders, in the form of local laws. At this point, change becomes very difficult, as no politician has ever made a mistake. This leads to the strange situation that each European country has a different metric for aircraft noise measurement; some having several different ones. There is as yet, no overriding EC Directive, so these local regulations continue. Even the crudest basis of measurement cannot be agreed, with Germany having a 4dB doubling system with most other EC countries sticking to either sound level or true L_{eq} i.e. 3dB doubling, in one form or other.
Still worse, some academics still cling to the idea that measurements in dB(D) should be used, despite the fact that this metric was intended for use with pure jets and not the current 'high bypass ratio' engines. Finally, some 'experts' even more out of touch with the practical problem, attempt to check the initial aircraft certification figures; a truly impossible task. Because of these differences, a typical tender specification document for a quite minor airport, can run to several hundred pages, requiring

a similarly lengthy reply. Because of this, in 1992 alone, Cirrus Research staff produced over 3,000 pages of replies to tender documents for airports and competitors between them must have produced at least 10,000 pages. The only person who pays for this is the eventual purchaser.

3. NOISE CERTIFICATION

The method is set out in ICOA document annex 16 and the instrumentation is described in ISO 3891. In brief, an aircraft, with a specified loading and configuration, is required to fly a special flight pattern over an airfield without reflecting objects, such as the airport buildings or other aircraft. The flying is normally done by company test pilots, well versed in all the methods of 'quiet flying'. In reality of course, this noise level will be different with the aircraft in service, usually higher, as the airline pilots have safety and comfort as their prime requirements, not the noise certification procedure. It is perhaps unfortunate that the ISO document dated 1978 is called 'noise from aircraft heard on the ground' itself mixes up the aircraft certification and airfield noise in one document. In August 1993, ISO TC43 accepted a proposal by Wallis, on behalf of New Zealand to form a new working group to write a new international standard for airfield noise and it is hoped that this will separate the two measurements.

4. THE BASIS OF AIRPORT NOISE MEASUREMENTS

As is well known, an airport monitoring system consists of individual noise monitors installed at sites round the airport, normally connected to a central 'host' computer, *Fig 1*. The noise monitors collect and store the data and transmit it to the host for processing, storage and display. Today, Short L_{eq} is used as the medium for transfer on almost all systems, as it is the most practical method of data compression and transmission without losing any of the information. *(ref 1)*. Some systems use both the temporal shape of the noise and the frequency spectrum as a means of automatically identifying the aircraft event and it is a great competitive advantage to have the most accurate algorithms for this purpose. Cirrus Research have published details of how their system operates, *(refs 2 & 3)* but even with this information many companies have not been able to get good recognition 'hit rates'.

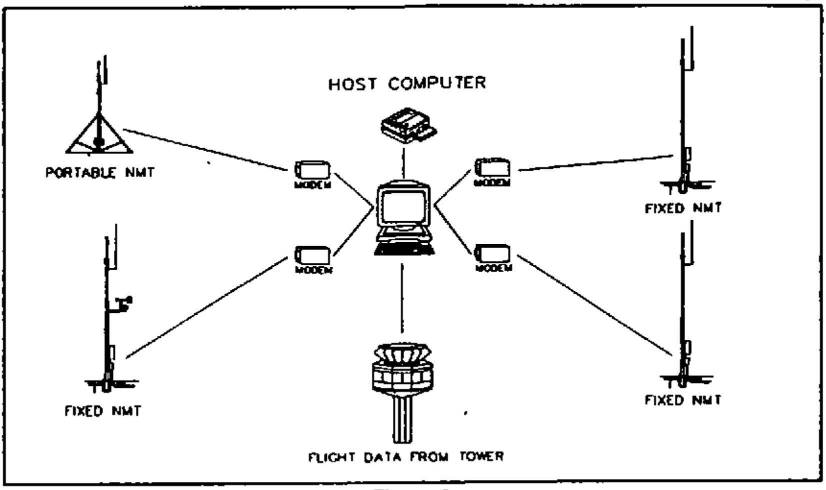

Figure 1

5. FLIGHT TRACK CORRELATION

While the noise monitor can capture the sound level and identify that an event has occurred, sound alone cannot be used to determine which aircraft was responsible for the noise. To get correlation between the noise event and a particular flight there must be some way of getting flight data into the same host computer. For the smaller sites, there is already a well accepted method, available at almost every airport - the tower flight strips. Each flight operating under ground control has a strip of card with the data for each aircraft, such as flight number, call sign, origination or destination etc. Using this data, the operator can call up a data bank of aircraft registrations and determine the details of the aircraft. However, for noise correlation, this is not very good. The main problem is that different controllers will be more or less meticulous in reporting the exact time of touch down or take-off. Thus, if the strips are to be used for noise event correlation, the algorithms used have to take account of this error, which may be random or systematic. If a systematic error occurs, software such as the Cirrus RASP suite, will detect this and correct for it. Random errors however are more difficult to correct. If the random error is greater than the spacing between flights, the correlation is eventually going to get out of sync and therefore useless.

Another method,which can produce very accurate correlation is taking the data from the local secondary radar, *Fig 2*. This is in the form of a data-stream, which gives at least the call sign, ident and heading, while newer systems give much more data than this. As all major airports have radar, this would seem to be the ideal method of event correlation, but once again, different countries have different rules. In the USA, such connection is prohibited by law, presumably because of potential security issues. In other countries, such as Germany, it is forbidden for no very good reason. It is possible if the airport is near the Canadian border in the USA to take the radar stream from the nearest Canadian radar and similarly in Germany, the Dutch or French radar can be used for the flight data. Using such data, computer companies in this field produce the most complex flight tracking systems which can replay any track and link it up to the noise levels produced, rather in the manner of a computer game, which some resemble. Most of them however, are less expert at measuring the noise correctly. While it is often the aircraft track which determines the noise level at a particular location, Mrs. Dupont, when she complains wants an answer based on noise, not on a track violation which she does not understand. A modification of this method is to passively listen to the radar echoes by installing a ground receiver, but this is not as effective as real radar pick-up. As well, the currently available system is licensed to one acoustic manufacturer and as the market is so small, an independent design is un-viable.

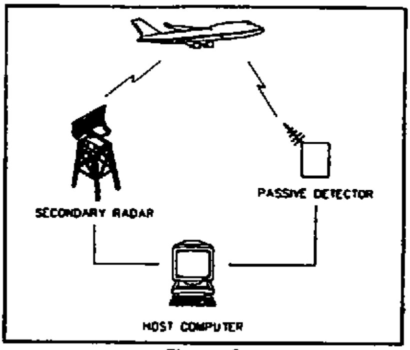

Figure 2

Other potential methods include listening to the radio stream that most aircraft produce as part of their positioning information. However, this is proprietary information and the operators are not usually willing to allow this.

6. FLIGHT DATA CORRELATION

If actual flight data is not available, other methods can be used to improve the accuracy of correlation, without plotting the track. These all depend on correcting the actual time of take-off or landing so that there can be more parameters involved in the correlation decision. Methods such as a light beam across the runway, video cameras reading the tail number and sundry other things have been tried. Reading the tail number is fine if USA or some European aircraft are involved, but some countries do not require operators to place the registration number in the normal place. A new method invented and provisionally patented by Cirrus Research, called the 'Sound gate' technology uses special noise monitors a quarter of the way down each runway and these positively identify the aircraft in time and space. These special monitors are in runway light fittings allowing the aircraft to run over them and have special filters to shape and identify the jet or prop noise. So far, no country has legislated against this method which should increase the event identification accuracy by a significant degree and, as well, be truly international.

7. OPERATING SYSTEMS

UNIX, 'the next operating system' is usually requested by airports as the operating system of choice. It is perhaps unfortunate that there are almost as many flavours of UNIX as there are computers to run it on. If a company standardizes on a particular UNIX implementation, they are locked into that make of computer. While some computers are available worldwide, many others are not, or rather they are not fully supported in some countries. This means that the supplier may have to make complicated arrangements to service and maintain these complex computers. Today, with the coming of operating systems such as Windows NT which should run on most platforms, these problems should become a thing of the past. The announcement of Windows NT has clarified the minds of the various UNIX suppliers and they now claim that they are working towards full compatibility. As a famous lady once said 'They would say that wouldn't they?'. If flight tracking is not required and only noise data is to be taken and correlated, the current Windows 3.1 is more than adequate for this purpose, even running on quite modest desk-top computers. Windows is available everywhere, in most languages and really eases the International problems with supplying a 'turnkey' system. However, some airports, typically in developing countries, think that Windows is not macho enough.

8. INSTALLATION

At least this must be truly international mustn't it? The sad fact is that this of all the areas, is the most diverse. For example, each country may insist on approving the modems, some taking up to a year to do this. Some countries like the UK will not permit you to automatically redial a number if the connection is not made, others don't care. Some refuse to allow baud rates as high as technically possible, thus limiting the through-put of the system. Each country has different regulations for the installation of the 220 or 110 volt supply. The metal box mandated in country A is forbidden in country B who require an insulated box. A European chartered engineer is able to supervise the installation in most countries, but some insist on local staff. Naturally, it is the countries with the lowest technology and poorest grasp of English who do this. In some countries, getting permission to fit the pole in a cubic meter of concrete can take up to six months, in others no significant time at all. Sometimes the standard six meter height of the mast is not allowed, so a lower mast must be provided, much to the detriment of the acoustic performance; the list of expensive and time consuming differences is endless. The result is that the installation in some countries costs almost as much as the terminals.

9. CONCLUSION

The present lack of a standard form of noise measurement and the differing local regulations result in at least a doubling of the cost of an airport noise monitoring system. Obviously, many of the problems are outside the control of the acoustic community, but many, such as differing noise metrics should be addressed at national and international level.

In addition, those involved in the preparation of monitoring specifications, for particular airports, would save their clients money and trouble if they used more 'standard' methods and parameters.

10. REFERENCES

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