ACOUSTIC IMAGING AND SOUND MAPPING OF MINING AND TRANSPORTATION NOISE SOURCES

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Résumé

À la demande de la clientèle de Soft dB, de nouvelles méthodes ont été développées pour communiquer efficacement les résultats des mesures acoustiques. Ces méthodes réduisent le temps de mesure, d'analyse, d'explication des résultats et améliore nettement la compréhension des clients, permettant ainsi des prises de décision rapide. Dans cet article, deux concepts innovants sont présentés : 1) le système I-track d'imagerie acoustique par intensimétrie utilisé pour mesurer rapidement la puissance sonore d'une source et localiser les zones les plus bruyantes de véhicules ou machines; 2) une méthode de mesures de multiples sources instationnaires, transmises en temps réel à un serveur par un réseau sans fil, ces mesures servent ensuite à générer des cartographies de bruit automatiques disponibles sur une page web en quelques secondes. Le feedback des clients est extrêmement positif à l'égard de ces nouvelles techniques. Une image vaut mille mots.

Mots clefs : Bruit, mine, véhicules, contrôle, imagerie, cartographie

Abstract

In responding to the needs of our clients, Soft dB Inc. has developed innovative techniques for communicating the results of acoustical measurements. We have found that using these techniques reduce the time required for measurement and analysis, reduce the explanations necessary during reporting, and accelerates the client's understanding and decision-making process. We present two of our most successful concepts. In the first technique, the *I-track* sound intensity imaging system is used to both measure quickly the sound power output, and precisely localise the source of noise on various vehicles and equipment. In the second technique, multiple sound levels are remotely measured next to site with varying sound sources. The measurements are transmitted in real-time to a server, which then generates a noise map for the adjacent town, viewable online within seconds by the clients. Client feedback to these new presentational techniques is extremely positive; an image can say a thousand words.

Keywords: Noise, mining, vehicles, control, imaging, sound-mapping

1 Introduction

Non-technical clients can often find large acoustical studies overwhelming, especially those reports evaluating the production of noise from multiple sound sources across mining, refining or industrial sites. At the same time, clients typically want their studies done as quickly as possible, with minimal disruption to activities on site and to the highest possible accuracy.

Soft dB has both an acoustical consultancy division and an acoustical instrument production division. Our equipment & software engineers often work together with our consultants, to continually find ways of simplifying data acquisition, processing and ultimately the presentation to clients and stakeholders.

In this paper, we present two of the new techniques we have developed and refined in Quebec that have proved particularly successful.

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2 New Techniques

2.1 *I-track* sound intensity imaging

The *I-track* sound intensity imaging system developed by *Soft dB* combines a class 1 sound intensity probe, an HD camera, and visual tracking software to create sound intensity and sound power images in real-time. A military-grade laptop and cabling permits use in the most rugged of conditions. Here, we demonstrate two such applications that facilitate efficient acoustical consultancy:

Mining equipment

In this study, a client had requested the noise evaluation of all the individual noise sources within an open-cast mine (50+ noise sources), and the noise control solutions available for each source. Creating these solutions required the identification of the main components creating the noise within each source.

Using the *I-track* system allowed for the onsite derivation of the principal individual sound sources (drill, drill shaft, fans, and engine). It also allowed for the instantaneous calculation of both the individual sound power outputs of each component, and the total sound power output of the as a whole. Because of the optical tracking of the probe, no dimensional measurements are required. Similarly, the speed of the probe movement and the scanning path are not a factor as this is automatically accounted for by the system, unlike standard sound power measurements.

As an example, an *I-track* scan output from mobile drill rig is presented in Figure 1:

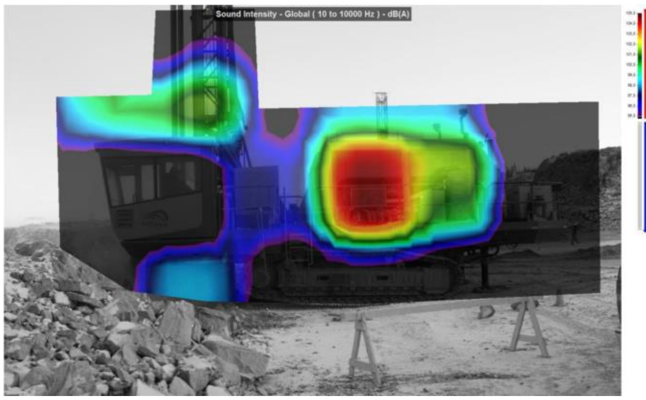

Figure 1: Sound Intensity imagery from drill rig.

In all, measuring five sides of this piece of equipment took approximately 1 hour, with the majority of the analysis work, including the sound power calculations, having been done by the system during the measurement process.

Compared to the alternative methods of investigations considered, using the I-track system accelerated both the measurement of the individual sources and significantly shortened the analysis time required. Upon receiving the images, the clients were able instantly understand the sources requiring treatment, and to what extent. Conducting the same scans after noise control treatments had been applied allowed the client to visually gauge the effectiveness of the solutions and compare the difference the solutions had made.

Transportation vehicles

The same technique has been used recently on transit buses to identify the sources of noise and routes of transmission for the sound affecting the passenger seating areas. The *I-track* system has found to be particularly useful for enclosed areas where beamforming antennas/cameras are often affected by resonant sound build-up.

During three hours of assessment driving around a test track, the *I-track* was used to scan the various structural components of the bus and quantify the sound power from each part. After creating a hierarchy of the sound sources on-site for the disturbing frequency range, the problem was localised to a vertical members at the back of the bus and the panels beneath the rear seats transmitting structure-borne noise from the engine. Recommendations were made to suitably isolate the engine, to the satisfaction of the client.

2.2 Real-time noise map creation

Noise maps are a useful tool for improving client understanding sound propagation from noise sources. However, their generation can take anywhere from a few minutes to several days. At the same time, clients are increasingly requesting the continuous monitoring of noise sources that have the potential to disturb adjacent areas. In a recent project, we developed a method to communicate more effectively the results of the continuous remote monitoring of noise sources with the automated, real-time generation of noise maps.

We placed an array of continuously monitoring sound level meters around the site under investigation. The sources on site are in fixed positions, but vary significantly in sound output throughout the day. The sound level data and meteorological conditions are wireless transmitted from the measurement stations to a central server. A CADNA-A noise map is then automatically and instantly produced.

The automated generation of the noise maps is possible because the map is actually selected from a bank of pre-existing maps that have been modelled and stored on the server for each meteorological condition and each possible sound level at each receiving position.

On a privately accessible web-page, the client can view the continually updated history of sound pressure levels for a single measurement station in the centre of the site, as well as the corresponding noise map, as shown in Figure 2:

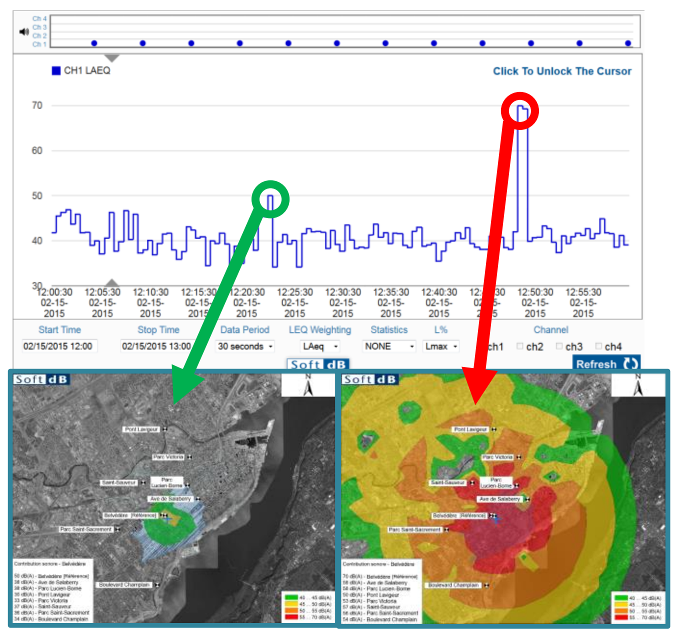

Figure 2: On-line viewing of automatically generated sound maps from remotely measured sound data (demo version available at http://www.softdb.com/noise-monitoring_beta.php).

The client can then click on any period in the time trace to view the noise map, and accompanying video and audio for that period. The satisfied client has now been using this system to monitor sound output for over two years.

3 Conclusions

By using new presentational techniques, large volumes of complex acoustical measurements can be rapidly analysed by the consultant, and be efficiently communicated to clients. Client feedback to these new presentational techniques is extremely positive; an image can say a thousand words.