

Smart Noise Monitoring – Madrid Style



Dynamic mapping helps Madrid improve the quality of life for her citizens and visitors alike.

With its 3 000 000 inhabitants and 2500 km of streets, Madrid is an excellent example of what can be done to improve human comfort related to urban noise. Since the late 60s, Madrid City Council has been working on noise problems. During this period, global environmental analysis has focused on how to evaluate and combat noise and other pollutants. A good evaluation of an existing situation is a crucial step towards optimising action plans to fulfil EU Noise Directive 2002/49/EC and improve the quality of life.

Madrid's Environmental Administration runs an urban noise-monitoring network with attended and unattended noise monitoring terminals (more than 30 stationary and 16 portable); a green patrol to ensure application of the directive, and a modern laboratory to perform pass-by tests on all types of road vehicles and sound power determination of noisy devices (generators, compressors, rubbish trucks). As a result, a large amount of data has been collected over 30 years. The latest noise map of Madrid was based on measurements performed from 4395 points by the National Acoustic Research Institute.

Small but Smart Solution

Madrid City Council is currently validating three mobile monitoring stations for the collection of fast, economical, and accurate time and space samples of noise data. Each station consists of a Mercedes Smart car fitted with a high-end Noise Monitoring Terminal, a Weatherproof Microphone on a pneumatic mast, a Global Positioning System (GPS) device to automatically locate the measurement position, and batteries for long-term use.

A driver simply positions these mobile NMTs that collect data wherever they are parked, and it is easy to park these small cars in strategic places. Noise data is stored with its GPS location. Depending on the investigation, a number of mobile stations are parked over a period of hours to days.

State-of-the-art communication ensures that data is transferred to the central server, the heart of the system which has multiple roles:

- Collect attended or unattended measured noise data and other factors
- Store raw data to ensure integrity of the system
- Manage input data for prediction, mapping and correlation between different factors
- Manage the database with all available information (raw and post-processed data)
- Manage post-processing:
 - Statistical calculations on measured data to determine algorithms for the evolution of noise functions of the period and area
 - Prediction algorithms using Lima™ and Predictor™
 - Tools for outputting results
- Outputs for reporting and communication, for example, on the web

All data is geographically referenced, and can be integrated with Geographical Information System (GIS) and GIS data.

Dynamic Noise Maps – SADMAM

A noise map represents either a stationary situation with traffic input data correlated with measured noise data from the past, or a predicted situation based on assumptions about the evolution in the future. It is not, therefore,

representative of an actual situation with traffic modifications and special events. Madrid Environmental Administration, together with Brüel & Kjær, decided to develop a new concept of data post-processing, that is, dynamic noise maps or SADMAM (Sistema Actualización Dinámica Mapa Acústico Madrid). Of course, it is not possible to install thousands of noise monitoring terminals all over the city, but if you know the areas of interest, then you can zoom in more precisely by installing mobile devices at strategic places. For this purpose, Madrid invested in a system comprising Lima Noise Calculation Software, Noise Monitoring Software, and several Noise Monitoring Terminals.

A Bright Future

With new wireless communication modes, computation speed and fast Lima calculation, it's possible to create noise maps over a large scale in real-time. Geographically referenced, measured data from the mobile NMTs is used for calibrating calculated maps locally. The key point is the interdependency between measurements and calculated values for high-quality output results in the environment. This will allow Madrid to efficiently validate and improve the quality of the strategic noise maps, which will form the basis of the action plans required by EU Noise Directive 2002/49/EC. Public confidence in the maps will be raised and unnecessary actions based on incorrect results can be avoided. In addition, the dynamic mapping will help Madrid to improve the quality of life for her citizens and visitors alike.



Real-time local calibration means that the relevant measured data is collected and safely stored by the noise monitoring software. Representative values for a particular period in a particular geographic area are then transferred to Lima in order to adjust the emission levels of user-defined sources so that the resulting map matches the actual situation. Depending on the complexity of the area to be mapped, calculation over a section of the city can be done in a few hours. Thus, for example, the daily measured levels around a local road infrastructure can be used to make maps of the daily variation of the noise contours in this area.

Predictor and Lima Fulfil EU-adapted Interim Noise Mapping Methods

Predictor Version 4.1 and Lima Version 4.2 have just been released and now include the XPS 31–133 (the adapted NMPB) and RMR/SRM II (the adapted RLM2) methods. This allows atmospheric absorption according to ISO 9613 and variable evening period length for both methods. In addition, for XPS 31–133 in both Predictor and Lima, you can now use either the current or the interim normalised spectrum, and freely define a road surface correction. Please see www.bksv.com for more information.