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NOISE MAPPING OF A MAIN ROUTE IN BRAŞOV CITY

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Abstract: *A major source of noise in an urban agglomeration is the road traffic. In order to analyze the effect of the noise on the population, the local authorities need noise maps, created depending by each major noise source. Data necessary for estimate the noise generated by the road traffic are: vehicle numbers and vehicle speed, by category, and data related to the road segment: traffic flow, road surface construction and gradient. The final result – noise map – is strongly influenced by the accuracy of input data. This paper presents a method for road noise mapping, from the beginning (data acquisition) to the end (printing). The present research paper intends to make a noise map of a main route in Braşov city: from Calea Bucureşti to the historical center of the city.*
Keywords: *noise map, road traffic, data acquisition, GIS, GPS, data processing, CAD programming*

1. INTRODUCTION

Noise is a major source of dissatisfaction in residential areas. There are many noise sources in the urban areas, but only some of them can be taken into consideration for noise mapping and noise reduction action planning. These are: road traffic, railway traffic, airports and industry – see references [3], [15]. In order to know the effect of these noise sources on the population and buildings, we have to know as much as possible about the sources and propagation. The analysis can be done using specialized software. The result is a noise map – a map representing the noise levels as surfaces or contour lines. The input data for the simulation software are a base map and specific properties of the sources (road segments, railway segments, industrial sources and others). In the figure below can see the map of the studied area from Braşov City.

Figure 1: The map of studied area from Braşov City

2. BASE MAP

The base map (GIS map) is composed by some specific layers, each of them containing noise sources or obstacles. The layers necessary for road traffic analysis are: streets (as noise source), buildings, terrain model and green areas (obstacles). Each street must be broken in segments with the same traffic data. A street segment is a linear noise source [1]. The *building* layer is composed by closed polylines (one entity for each building). The height of each building is added as *thickness*, which is also a standard property. Using the standard properties for AutoCAD entities is convenient because are easily transferred to Lima software, through DXF files. Unfortunately, some additional data cannot be transferred through the same DXF file. These are, for the *building* layer, the type of each building (industrial building, medical or educational institution, residential buildings), the number of inhabitants and dwellings in case of the residential buildings.
The metadata can be stored in the drawing using the ActiveX functions [8], and then exported to Lima using Access tables. More exactly, data associated to the AutoCAD entities are exported in text files, which are imported in Excel and saved as XLS files. The XLS files can be imported then in Ms Access, as tables. The link between the Access table and the AutoCAD objects is assured by an ID field, which is the *handle* of the entity, unique in a drawing.
The *street*s layer (Figure 2) is composed by *open polylines* according to [11]. Since each segment should contain specific data related to vehicle traffic, it was decided to use a single *line* entity for each street segment. The noise mapping software accepts both polylines and lines. Each line entity has the traffic data associated as custom properties, or metadata. There are three types of streets: main streets, connection streets and residential streets. The traffic data for residential streets are the same for all the segments, and also for the connection streets. In case of the main streets, traffic data was collected or estimated for each segment, and there are more metadata associated.

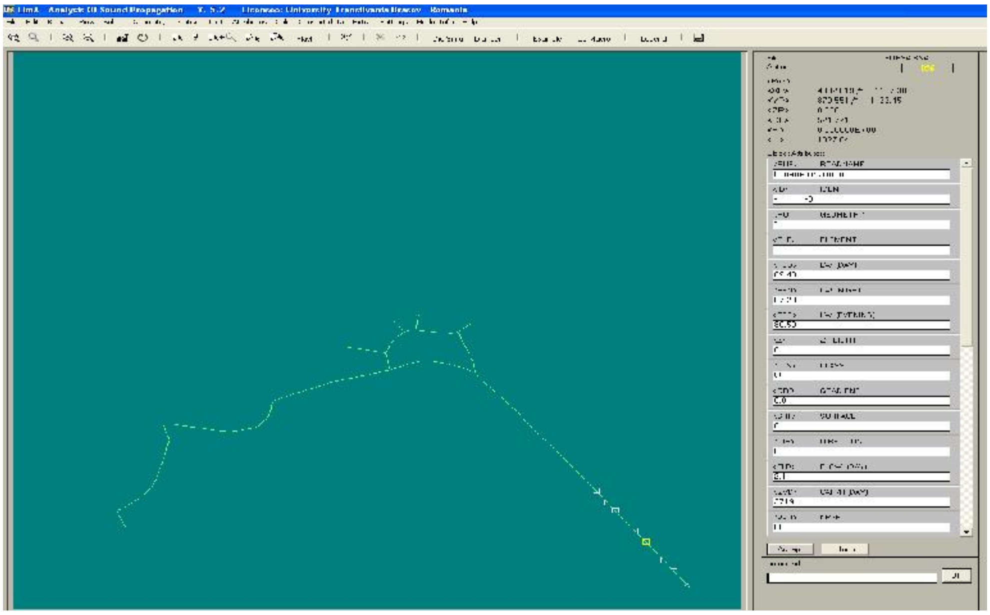

Figure 2 The *streets* layer, detail

It is important to mention that the additional information associated to the geometric entities makes the drawing larger and the regeneration process much slower. It is not easy to maintain the balance between the volume of metadata and the calculation speed.
The preprocessing phase includes the activities for preparing LimA input data: the layers of GIS map (streets, terrain model, buildings, and other obstacles) and noise sources data: traffic volumes, vehicles speed, flow type, road surface and gradient. All that data are stored in an Access database; this is imported in LimA over the base map.
The post processing phase is based on the ERT files created by LimA. These are text files and contain a line for each point of the calculation grid.
All the base map layers were drawn in AutoCAD, and the custom functions for pre- and post-processing the data was written in AutoLISP, using extended ActiveX functions available for storing metadata.

3. DATA ACQUISITION

The data related to the road traffic are the traffic volumes (number of vehicles) and vehicles speed. There are two categories of vehicles: light and heavy; the limit is at a weight of 3.5 tones [1]. On the other hand, there are three periods considered for a day: day, evening and night. The best way is to use traffic classifiers, like radars or inductive devices, but the high number of the necessary devices makes this method not affordable. Using human observers for counting vehicles is a much cheaper solution. There was established a number of points for collecting traffic volumes from the studied route.

4. CALCULATION

As mentioned before, the input data for the simulation software are stored in Access tables, which are connected to the AutoCAD drawings using the entities handle. The base map layers are imported in LimA through DXF files. For the buildings, the height information is sent as color property (the conversion between thickness and color was done previously on the AutoCAD drawing)

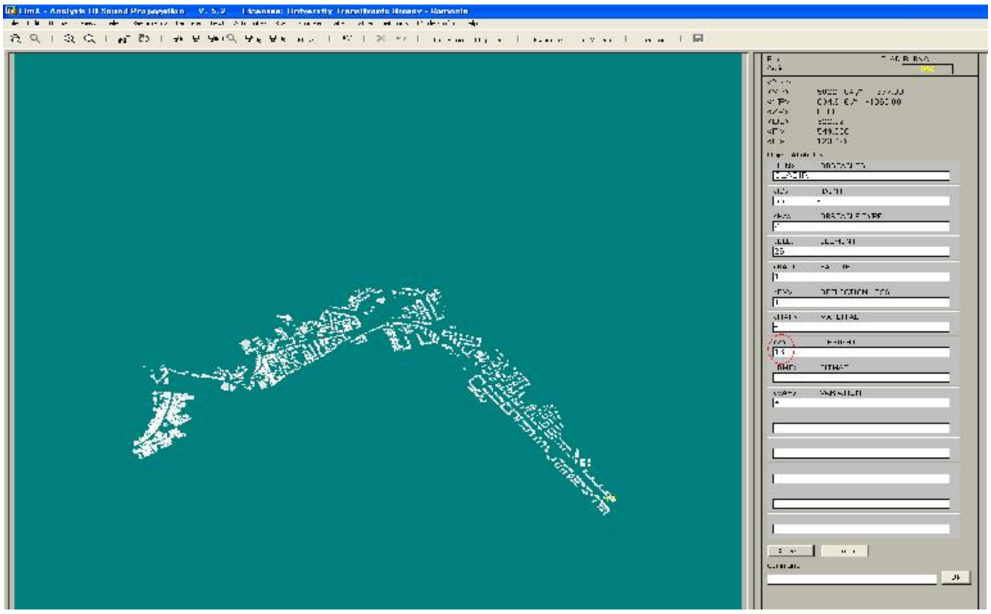

Figure 3 Buildings prepared for LimA

After importing the geometry some checks should be done in LimA: closing polygons to ensure the correct modeling, especially for buildings; recognizing and preventing multiple existences of objects; linking objects to prevent gaps in the model; smoothing polygons to reduce the number of vectors and speed up calculations [16].
After the first simulation was done and the first version of the noise map ready, the values obtained was compared with the noise values measured as you can see in the table below. The measuring points are the same or nearest the points where traffic volumes was measured.

Tabel: Validation values in different points

Simulation	Indicator	Receptor1	Receptor2	Receptor3
Route	Lden dB(A)	77,1	84,5	80,7
	Ln dB(A)	67,6	78,2	74,4

In case of differences greater than 3 dB (A) (measurement versus simulation result), the input data was corrected and the calculation process was repeated until the differences were fitted in the approved domain.

5. POST PROCESSING AND RESULTS

The output of LimA includes the ERT files, text files that can be processed with external programs. Inside the ERT file, each line corresponds to a point of the calculation grid. The information for each point is: X, Y

coordinates in km, Lday and Lngt (equivalent noise level for day and night respectively), Z (altitude), Levg (equivalent noise level for evening), Lden (equivalent noise level for the whole day). The altitude is not useful for plotting the noise map, so the z coordinate of each point can be the noise level. The color legend for points is defined in 5 dB (A) intervals [15]. Finally, each point can be representing as a square of 10x10 (10 meters is the size of calculation grid).
The final result is the plotted noise map, presenting the complex noise information in a clear and simple way. In addition, for each noise map (Lden, Ln) as you can see in de figures below.

Figure 4 The resulted road noise map – Lden

Figure 5 The resulted road noise map - Ln

6. CONCLUSION

Road noise mapping has usually three phases: preparing the input data (base map and traffic data acquisition), calculation and analysis of the effects (people exposed). Then can be defined action plans for reducing the noise in such manner that the number of the people exposed to high level of noise to be reduced significantly.
It is very difficult to propose realistic measures for reducing the noise in an urban agglomeration. Many of the possible measures are related to road traffic management and should be integrated in a more complex action

plan, not only intended for noise reduction. So the action plans is better to be based not only on the existing noise maps, but also on road traffic studies.
The whole process of noise mapping is complex and the team members should be specialists not only in acoustics, but also in road traffic and data processing.

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