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THE ACOUSTIC CHARACTERIZATION OF THE URBAN TERRITORY WITH CONTINUOUS CYCLE PRODUCING SETTLEMENTS

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Abstract

A method for the acoustic characterization of the territory with sound sources deriving from transportation infrastructures and from stable sources such as the producing settlements is being illustrated. Such a method allows for the identification of the main sound sources that act on the territory, in relation to the global present level, characterizing each source in connection with the effective acoustic "weight" of the same.

1. INTRODUCTION

The issue related to the planning of the territory while requalifying the same during verification, needs to be supported by the knowledge of some parameters that characterize the territory among which the acoustic parameter covers a role of utmost importance. Knowing the "acoustic climate" of the study area allows a planning of the transportation infrastructures, of the dislocation of the producing settlements or, in the case of pre-existence of the same, allows the identification of the reclamation interventions. The latter feature is particularly delicate, considering the economic impact that it involves. Sometimes, with more sound sources which act simultaneously (train or road infrastructures with continuous cycle industrial processes) and when the levels introduced by the single sources are comparable, it is not possible to perform an acoustic characterization of each font taken singularly next to the receptors. Similar difficulties exist when the stable disturbing source cannot be deactivated, as in the case under analysis here. In such conditions it is particularly complicated to identify the acoustic "responsibility" of each font and thus to prompt and to optimize the efficacious acoustic interventions.

The method illustrated here allows the acoustic characterization of the single sources acting simultaneously in the territory subject of the study, next to the receptors. The method has been defined within the research contract between the Technical Physics Department of the University of Rome "La Sapienza" and a service Company, related to the study on the acoustic impact in the surrounding areas on real continuous cycle producing settlements (generating station and purifier).

2. METHOD DESCRIPTION

The acoustic characterization of the territory in relation to the stationary source subject of this study, is performed by identifying, first of all, the propagation lines of the source itself to the various receptors taken in consideration. Such propagation lines are called directors of propagation. Their origin is the point next to the source and their termination are the various sensible receptors.

The proposed method is based on the time comparison of the acoustic levels simultaneously identified on various measure points, at least four, placed on the directors of propagation of the sound typical of the study area.

The above mentioned measure points have to be properly chosen both for the orographic features of the soil, and for the eventual presence, on the director, of other secondary sound fonts which vary with time, such as road and train arteries.

The first measure point has to be placed in connection with the source, so to identify the level of the spectrum which are typical of the source subject of this study. Thus, it is possible to acoustically characterize the source and establish a fixed reference for the following comparisons with the acoustic information identified in the other points placed along the various directors. The second point, along each director, has to be placed at such a distance from the source so that the sound of the latter is still the predominant one, given the lack of a source variable in time. The fourth measure point has to be placed next to the receptor; while the third one is found in an intermediate position.. At least one measure point, however, has to be put in correspondence with the secondary source so to enable the acoustic characterization.

Once all the measure points are dislocated, the performance of the A weighted global curve and of the acoustic spectra levels have to be simultaneously identified in those positions. The time superimposition of the spectra along the directors at the basis of the spectrum typical of the primary sources, allows a comparison among the various spectra in relation to the single components. Such an assessment leads to the evaluation of the acoustic weight of each source through the identification of the spectral components typical features of the primary fonts placed next to the receptors.

If the time variable acoustic source is missing, the levels and the shape of the spectra located in the various measure points are kept constant through time. The shape of the spectra in the various measure points depends directly on the primary source and on the attenuation features of the soil along the director under analysis.

If the time variable source is placed along the propagation director at an intermediate position among points 1 ad 4 and, for instance, point 2 is placed next to it on purpose, a variation of the spectrum and of the level has an impact along the director on the other measure points. The size of the perturbation along the director can be evaluated analysing the time performance of the levels of the various measure points. In particular, if we have a significant variation of the level in point 4, then it is clear that the variable source has an impact in the acoustic pollution of that point. If, on the other hand, such a variation does not take place, but there is a variation of the spectrum , then also in this case, the variable source contributed to the pollution of the point.. In order to verify further such an instance, the similarity between the instantaneous spectrum in the point next to the receptor and the instantaneous spectrum next to the secondary source should be assessed.

If in the point placed in correspondence of the receptor the level is substantially constant, but the spectrum varies its shape in time, although the shape of the other spectra in the other measure points is stable, then the presence of a source different from the main one and from the secondary one placed along the propagation director can be identified on the receptor.

In order to understand the type of source we are dealing with, the possible concurrent sources on the receptor have to be identified through a phonometric analysis of the surrounding territory. Once the new primary sources have been identified, the propagation directors have to be designed and the present method has to be applied.

4. METHOD APPLICATION

The method described above, has been defined and applied in order to evaluate, on a residential settlement, the impact of the various polluting sources existing in the surrounding areas. With reference to fig. 1, the polluting sources are two continuous producing cycle plants (a gas generating station and a purifier) called primary sources, and a railway and a high flow road acting as secondary sources (variable in time). Another secondary source has been identified in a road placed next to the residential settlement. According to the criteria shown above, the directors of propagation (A, B, C, D, E, F, G) and the related measure points have been identified (fig.1). The spectra of the minimal levels of the primary sources have been found next to the sources (points 1 of the directors C, D, E, F), and the spectra of the minimal levels in the various measure points have been compared through the simultaneous classification of the levels.

It has been noticed how the typical shape of the spectrum of the primary source is kept at the point placed next to the receptor.

By the time performance of the levels of the various spectral components it has been noticed that the presence of the secondary sources (directors G and H) have an impact on the global level only in short periods of time, that is in connection with the sporadic passage of vehicles.

In relation to director C, it has been noticed how in the measure point 2, the sound spectrum identified had already lost the spectral features as primary source due to the presence of a high flow road, while in point 3 different spectral components of the primary source can be partially found. Such components can also be found in the receptor. Furthermore, the time performance of the levels of the single spectral components shows that the secondary source has a significant influence on the shape of the spectrum of the minimal levels measured in correspondence with the passage of a set of wagons.

4. RESULTS

Next to the productive settlements subject of this analysis there are two transportation infrastructures: a railway and a high flow road; while in the three residential areas, placed at + 50 m with respect to the settlements and the transportation infrastructures there is a hill aimed at public green.

Always referring to fig. 1, the purifier and by the gas generating station act as primary sources; they are both stationary ones, since the plants are continuous cycle settlements. The railway and the high flow road act as secondary sources (those that vary in time) are made of.

In two points of a area linking road two more secondary sources have been found. It has to be noticed that, next to the receptors, there is a local low flow road that acts as a further secondary source.

As far as the gas generating station as primary source is concerned, the three directors originate from one point where the first station of measurement was placed, and end next to the receptors where we can find the fourth measure point. On each director, the second point of measure has been placed next to the secondary source, the third dislocated so to characterize the orography of the soil and the acoustic features of the local road as secondary source. In particular, being the local road placed in the proximity of the receptor, but shielded by a natural bump with respect to the primary source, the third point can be found where it can be easily seen both with respect to the primary source and the secondary one. Accordingly, the contribution of the primary source could be easily distinguished from the impact of the secondary font.

It has to be noticed that, in the fourth point of director F the primary source did not influence in a significant manner the environmental levels that had been measured. In order to identify the source responsible of the acoustic pollution on hat point, two more secondary sources were discovered: two points of a area linking road which could be easily seen with respect to the receptor. Such sources, indicated in the planimetry as control primary sources, have been considered as primary sources and thus as the origin of the respective directors of propagation (G and H) in order to evaluate their real impact on the receptor.

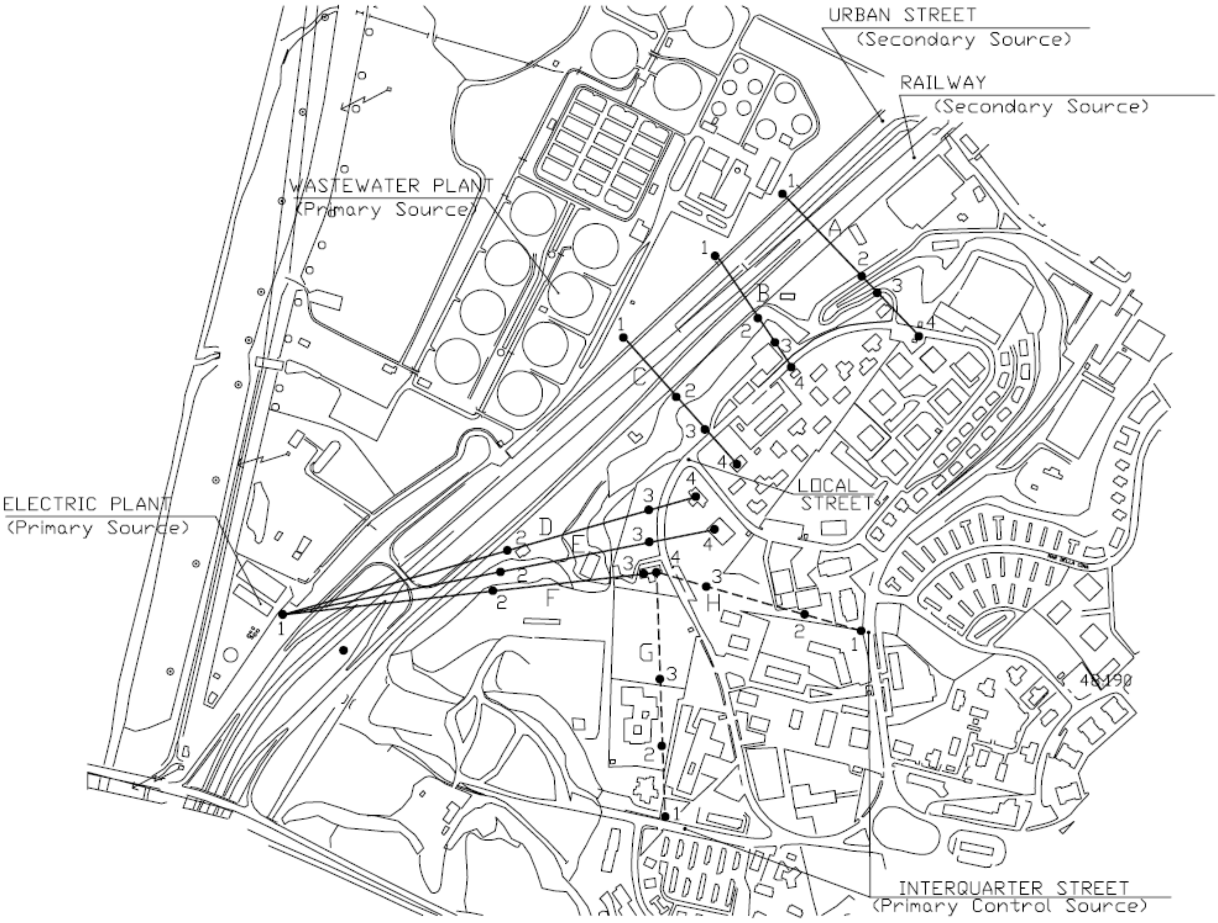

Figure 1. Planimetry of the study area with: acoustic sources; propagation directors; receptors; measure points.

As far as the purifier acting as a primary source is concerned, given that the sound sources are dislocated in the area, the directors originate from the points where the highest sound levels have been recorded. The position of the measure points has been chosen with the same criteria shown in the case of the continuous cycle generating station.

6. CONCLUSIONS

The described method has allowed the evaluation of the acoustic impact on the receptors caused by stable sources which cannot be deactivated, like the ones in analysis here, and with the presence of transportation infrastructures, when the levels introduced by the various sources are not comparable.

The results obtained are a useful basis for the optimization of the acoustic reclamation interventions.

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