Sound Source Study in Shenzhen China

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ABSTRACT

Shenzhen is a rapid developing city in Chinese urbanization. With thirty-year development, the city is derived from a rural into the fourth metropolis in China. In such a dramatic transforming, the area's ecological environment has been changed tremendously, in which its sonic environment including sound level and sound sources has been changed too. No doubtfully, many man-made sounds have penetrated into the area and original natural sounds are dying away. In order to reveal how much sound source is having been and will be changed in the Shenzhen's urbanization, the Shenzhen Environmental Monitoring Centre (SEMC) started a project of recording and monitoring sound sources and their changes with the whole city context. In this paper, works of the SEMC in investigating sound sources and their distribution around the inner Shenzhen are demonstrated. It is expected to show an ecological diverse of sound in Shenzhen. The study is also supposed to express an ecological variation of acoustic environment in terms of sound sources. Moreover, the study result will be used to effectively monitor sound changes of the Shenzhen in order to provide useful guidelines to the city planners and designers in creating more sonic pleasure open spaces for the Shenzhen's further development.

Keywords: Sound Sources, Monitoring, Shenzhen
I-INCE Classification of Subjects Number(s): 68.2

1. INTRODUCTION

With fast-speed urbanization in China, noise pollution has attracted more attentions from government sectors, while sound level has been concentrated. However, recent research has found that attenuation on sound level is insufficient to reduce noise annoyance, whereas sound sources also play an important role to influence people's noise perceptions (1-3). This is related to a soundscape study referring to a subjective sound environment with an emphasis on the way that a sound is perceived as one part of an aural space (4). In real world, sounds are realised as social elements associated with cheering or warning. Sound preference is an aesthetic response of people reacting to a soundscape (5). A study in a number of urban open spaces (4) shows that sound preference evaluation is rather complicated in terms of various types of sound sources and spatial and temporal situations they are heard (4). Therefore, an aim of this study is to present the works of the SEMC in sound source investigation of the whole Shenzhen inner city. Referring to the Chinese noise level monitoring standard "National Sound Environmental Quality Standards" GB 3096-2008 and the Guangdong Province local standards "Technical specifications automatic monitoring of environmental noise" DB44/T753-2010, sound source recording has been integrated into the automatic monitoring of environmental noise within the Shenzhen inner City. This paper is then to illustrate a method of recording sound sources and sound source analyses in terms of urban various functions based on the SEMC works. A number of sound source monitoring spots combined with noise level auto monitoring stations are developed to explore how sound source changes accompanying with an industrial evolution of a rural area into a modern city.

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2. SOUND SOURCE RECORD

2.1 Recording Method

A recording method for monitoring sound sources of the SEMC is combining sound record into auto monitoring stations of noise level. In order to monitor environmental sound level, two types of monitoring measurement spots have been set. One is for the traffic noise monitoring and the other is for the sound level monitoring of the various functional areas. For the traffic part, it is planned to set 864 measurement spots for monitoring noise level from vehicles. The noise level measurement monitoring spots for the exist road are 575, still 289 spots for the planning road need to build. As the sound source from road traffic is rather unique, no sound recording is planned to add into the road traffic's noise level monitoring spots. For the functional area's part, 130 spots are built up for monitoring sound environmental levels, while 25 of them are auto-monitoring station. According to the "National Sound Environmental Quality Standards", there are five main sound level functional zones classified, which is 0 for high-class residential recuperation area, 1 for residential & education & institute area, 2 for residential, commercial and industrial mixed area, 3 for industrial area, and 4a for along a city's main road area whereas 4b for along a city's railroad area. For the 130 functional environmental sound level measurement spots, 13 are arranged in the 1 functional zone, 62 in the 2 functional zone, 55 in the 3 functional zone, and several in the 4. There are 25 of 130 measurement spots are auto-monitoring stations. The sound source recording is then integrated into the 25 environmental sound level auto-monitoring stations.

Elevation arrangement of a sound level monitoring station is according to the highest noise level occurs. It is found that a sound level is usually higher to the upper part of a building especially to the 1-3 environmental functional area. An intensive study of sound level changes along elevation variation according to Shenzhen's urban morphology shows that a highest sound level usually occurred in the top or sub-top floor. A formula of the height that the highest sound level occurred and its distance to the middle of a road is $H = 0.7991 X + 16.91$. A correlation is 0.8173of a calculating value to a real measurement. Taking a various stories building into account, a better elevation range to set a monitoring station is around 6.4 to 48.1 meters, which is basically 3 to 10 floor. Therefore, a sound level monitoring station for a functional zone is generally set up at this height, and this is also the location to record sound sources. A monitoring station is built up as a whole auto working system as shown in Figure 1. B&K sound level meter 2238 Mediator and 2250 Mediator are used to calibrate recording accuracy. RION sound level meters are used as main recording facility. A recording plan is to record 20 seconds long once according to the web capacity ability. As limited with tremendous volume of documentation for an entire day, intermittent recording approach is adopted and a recoding triggering point is according to the sound level's value, when a sound level is over 73dB in the daytime and 63dB at night time, the sound recording facility starts. However, such a recording approach is insufficient to all kind of sound sources occur in Shenzhen. An instead improving one is to make a 20 seconds record in every hour per day.

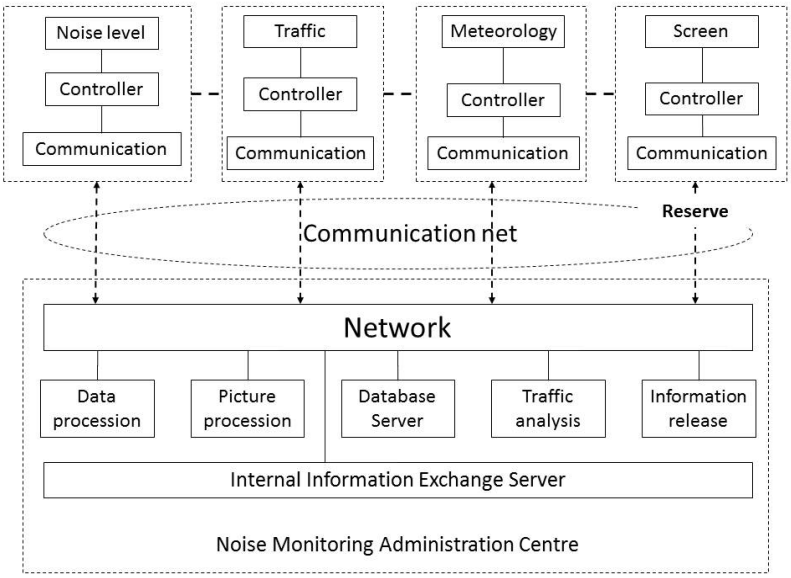

Figure 1 Working system for an auto monitoring station

2.2 Auto-monitoring Station Distribution

A distribution of 25 auto-monitoring stations in Shenzhen is shown in Figure 2. It can be seen that all 25 stations are distributed around the whole Shenzhen's six administration functional districts, namely Luo Hu, Fu Tian, Nan Shan, Yan Tian, Bao An, Long Gang, and two additional new districts, Guang Ming and Ping Di. More stations are built up in the middle part of Shenzhen that is the most important administration, financial, and commercial center. In general, there are 3 auto-monitoring stations in the Luo Hu district, 5 in the Fu Tian, 4 in the Nan Shan, 2 in the Yan Tian, 3 in the Ban An, and 3 in the Long Gang, while 2 in the new district, Guang Ming and Ping Di respectively. According to the functional classification, these 25 auto-monitoring stations cover all four functional zones. For total 25 auto-monitoring stations, 3 of them are located in the functional 1 zone, 8 are in the functional 2 zone, 6 in the functional 3 zone, and 4 in the functional 4a zone. In a word, such distributions for sound level and sound sources auto-monitoring station can best express the whole Shenzhen City's sound environmental situation. From analyzing sound sources data recorded by 25 auto-monitoring stations, how many and what kind of sounds that the Shenzhen contains can generally obtained.

Except sound level and sound source monitoring, these 25 auto-monitoring stations have been installed meteorological parameter, air quality, and traffic volumes measurements for a better understanding a sound environment features including sound level and sound sources. Using computation technique, measuring data from meteorological, air and traffic monitoring can be inputted into the sound level and sound sources database, making efficient judgment of sound monitoring data possible.

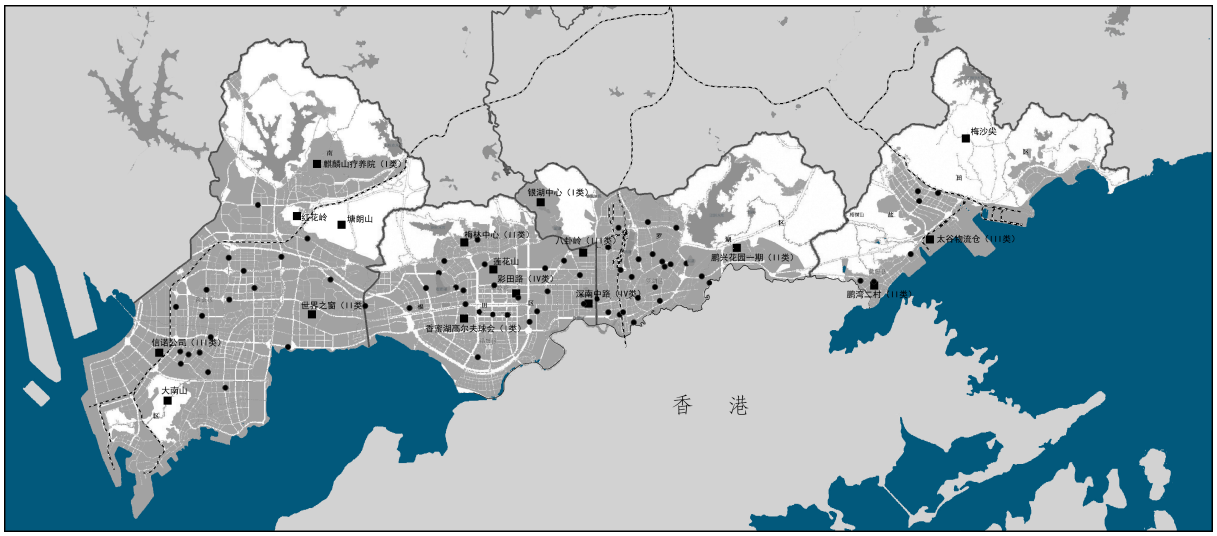

Figure 2 Distribution of Auto-monitoring stations in Shenzhen

3. ANALYSES

Based on the sound sources records from 25 auto-monitoring stations in Shenzhen, identification of various sound sources in nature or developed area has been made, and their different physical features have been analyzed in the following sections.

3.1 Sound Sources in Nature Area

Based on the monitoring station recordings, sound source classification has been made to the nature and well-developed area. It is found that there is a strong link of a nature sound source occurring with natural factors in an area. Unique green elements of trees or brushes or grass are not enough to bring natural sound source to a space. An ecological system with a diverse of botanical and zoological species should exist in a rather large space with ecological supplies. To six old and two new administration district of Shenzhen, a natural ecological space scattering in somewhere of a district usually containing bird twittering and insect singing with water sound of stream turbulence. When a district is featured with more ecological aspects, more nature sound sources can be identified from monitoring records. It is found that the Fu Tian, Nan Shan, and Yan Tian districts obtain more nature area and contain more natural sound sources compared to the Lu Hu, Bao An, Ping Di, and

Guang Ming districts. It is interesting to note that the new developing district, Ping Di and Guang Ming is decorated with a rather good green space but does not have many nature sounds due to lack of an ecological system. While the Da Peng Peninsula of the Long Gang district is not much developed and still has an original ecological aspect, a plenty of nature sound sources exist and can be heard day and night.

3.2 Sound Sources in Developed Area

Back to more than thirty-years ago, Shenzhen was an original ecological place with mountains screening in the north and seawater waving in the south. Only a few fish villages scattering in this miracle place. At that time, the whole area was full of natural sounds. However, this has been changed and nature sound source has been replaced by man-made sounds with a dramatic transforming from a small southeast town to a metropolis neighboring to the Hong Kong. A numerous industrial, residential, commercial sectors have been developed, and in nowadays-developed area of Shenzhen, nature sounds are barely heard except some ecological residential department such as the Oversea Chinese Town. In the developed area, two kind of man-made sounds generally exist, in which one is from people's living and activities and the other is from man-made machines, such as traffic sound and construction sound. According to sound source records, traffic sounds are rather high in Shenzhen as it is decorated with high-speed roads and plenty overpasses. For well-developed old area such as the Luo Hu, traffic and living sounds are main sound sources that can be identified from the recordings, while for some developing area, such as the Bao An, Guang Ming and Ping Di, construction sounds and sounds from factories are often heard because of many new constructions and manufactories.

4. CONCLUSIONS

In this paper, sound source recording works of the SEMC has been specified. Analyses of sound source recordings to a various administration districts of Shenzhen have been made. It is found that nature sounds are usually found in an ecological area, in which an ecological system has to exist. A unique green space without biological diversity cannot create natural sounds as peoples expect.

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