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Research Article

Enza De Lauro*, Mariarosaria Falanga, and Laura Tedeschini Lalli

The soundscape of the Trevi fountain in Covid-19 silence

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Abstract: This paper is devoted to the analyses of soundscape at fontana di Trevi in Rome (Italy) with the aim to compare its characteristics during the Italian lockdown due to the (Sars-COV2) Covid-19 sanitary emergency and its characteristics before and after such time. The lockdown has represented an exceptional environment due to the silence everywhere, never occurred in centuries, offering the opportunity to recognize the "signature" of the sound emitted by the famous Fontana di Trevi and recognize how it interacts with other features. The signature is important for preservation issues and cultural heritage. The soundscape was documented in a field survey by means of hand held microphones, which acquired simultaneously the acoustic wavefield all around the fountain. We find that the spectral content depends on the microphone location, revealing a very complex wavefield, showing strong amplitudes during the lockdown well below 1kHz and a frequency band extending up to 10kHz. In a time period far from the lockdown, we evidence an additional frequency band around 700-1kHz, which not simply adds to the previous spectrum, but acts as a synchronization mechanism. The important observation is that the Covid-19 silence let emerge sounds that had been there for centuries, and afforded us the possibility to document them in order to study objectively a "soundprint". Moreover, we studied the spatialization characteristics of the soundfield.

Keywords: Fontana di Trevi, Soundscape, Cultural Heritage, Spectral Analysis, Independent Component Analysis

***Corresponding Author: Enza De Lauro:** Dipartimento di Ingegneria dell'Informazione ed Elettrica e Matematica Applicata, Università di Salerno, Via Giovanni Paolo II, 132, 84084, Fisciano (SA), Italy; Email: enzadelauro@gmail.com
Mariarosaria Falanga: Dipartimento di Ingegneria dell'Informazione ed Elettrica e Matematica Applicata, Università di Salerno, Via Giovanni Paolo II, 132, 84084, Fisciano (SA), Italy
Laura Tedeschini Lalli: Università Roma Tre Dipartimento di Architettura, via Madonna dei Monti 40 00184 Rome, Italy

1 Introduction

This paper is about the soundscape of the famous Piazza Fontana di Trevi in Rome. The piazza itself is a culturally important place, so that a study of the "sound signature" of the fountain is important for heritage studies. In this paper we address the differences that can be objectively measured in very different situations regarding background noise.

At the end of December 2019, in a market of Wuhan in the Hubei Province (China), there was a first documented case of anomalous pneumonia, thereafter denominated Covid-19 disease. On January 9, 2020, the Chinese CDC reported that this anomalous pneumonia was due to a new coronavirus that was responsible of a Severe Acute Respiratory Syndrome (SARS-CoV-2) [17]. Such syndrome is still spreading all over the world and because of its high-level contagiousness and aggressiveness, it is reaping many victims. At the end of January, the World Health Organization (WHO) declared that Covid-19 was a Public Health Emergency of International Concern (A public health emergency, 2019). Only on 11 March, WHO defined Covid-19 a pandemic disease. All nations have devised strategies and took steps to limit the spread of Covid-19 often introducing a lockdown that is still ongoing in many countries (at present mainly in US, Latin America and India). The diffusion is basically "in spots" since there are many regions with a few infections and regions highly infected. The exact mechanism of diffusion is still matter of discussion, and several studies have been performed in order to link the Covid-19 diffusion to local air pollution, specific atmospheric conditions and human interaction, etc. (see, e.g., [9]). In Italy, the first documented case happened at the end of February 2020 (26 February) in the North of Italy (Codogno-Lombardia). After that, the virus rapidly spread all over Italy forcing the Italian government to impose restrictions as the first among Western countries to adopt a complete "lockdown" for about 50 successive days (9 March-first opening on 4 May). Phase 2: Several restrictions were released on 18 May, allowing people to move within the same geographical and administrative Regions-Phase 3: a free circulation of Italian citizens among Regions was instead allowed from June 3rd. The lockdown led to the cancelation of most activities from religious and political to cultural events, together with any school of all levels from nursery to university. Businesses and shops were allowed to reopen gradually. At present (Phase 3, July 2020) schools and universities are still closed. Scholars, in any research field, take this unique opportunity to study their topics in noiseless situations from seismology [20] to atmosphere sciences [9]. In this context, we devote attention to the soundscape [21] in one of the most famous location in Rome, destination for many tourists and Roman citizens. In particular, we compare the acoustic fields around the famous Trevi [14] fountain in Rome before, during the lockdown time and after lockdown in the Phase 3. Removing the usual layer of urban noise, mainly generated by human activity and traffic, has allowed us to hear the monumental Roman fountain better and improve the knowledge of the soundscape. This exceptional environment allows recognizing the signature of the fountain and how it can interact with other nearby sources [15].

1.1 Silence, soundscape and cultural heritage

Soundscape is a realm of research about sound in space, its recognizability, its social values. We make ours the words of Brambilla about the cultural implications of these studies:

> "The knowledge of the main elements of the soundscape (keynote sounds, signals and soundmarks) is fundamental not only for its protection and conservation, but also for a transformation that does not upset its social, historical, natural and cultural identity" [3].

Soundmarks are, for Raymond Murray Schaefer [21], the "typical sounds" of a place. They are in general hard to establish as many of them are at a subliminal level. Certainly, the sound of water fountains in Rome, Italy, is one such subliminal sound. Usually in Rome, today, fountains are seen, not heard, and even less so listened to [18, 23, 24]. Decade after decade, more and more drowned by more and more mechanical anthropic sounds such as car traffic, airplanes, fans, industrial production, the sound of roman fountains seemed detectable only in the vicinity. But it was there.

The Weber-Fechner law states that the reaction to a perceptual stimulus of a source does depend [19] heavily on the background on which it is perceived. In particular, it states that for sounds, the perception depends on the ratio between the increased stimulus and the ground noise. The deep silence into which Rome has fallen on March 9th 2020, suddenly revealed the sounds that had always been there. The change was abrupt and dramatic, and most people were frightened at first: silence is an alarm signal for most animals. Then, little by little, people started recognizing those sounds which in their memory were drowned in other noises.

The duality among "hi-fi" and "lo-fi" soundscapes, introduced by R. Murray Schaffer, is today largely accepted and hi-fi soundscapes are considered usually a factor of comfort, especially in urban context. In the distinction Murray Schaffer also points explicitly to the possibility to locate the sound source by ear. We rephrase this attribute as a possibility for bodily orientation by the auditive apparatus. An urban fountain, as we will see, provides such possibility. Its sound source is largely due to repeated small time-scale phenomena, *i.e.* transients, which favor orientation [4, 5]. Moreover in the case of Fontana di Trevi we show that also its spectral characteristics show subtle differences depending on the space. In this sense we keep investigating the idea that "the ear has reasons that the reason does not know,...yet."

The Covid-19 silence also allowed an exceptional documentation of such sounds. During the lockdown, however, nobody was allowed to go around, except near home. Professional field recording was out of question. We could always be halted by police and asked documentation about the actual necessity to be there. We therefore started searching among those living near Fontana di Trevi, who could justify their presence (and they have indeed been searched each time). A professional musician agreed to record the system piazza and fontana for us. She had the same device (a hand-held Zoom) and being an expert listener she could appreciate what we were aiming at.

Piazza Fontana di Trevi is relatively small. The fountain is a "water exhibit", the monumental fountains traditionally erected at the end of a Roman aqueduct to celebrate the wealth of water flowing into town, both visually and auditively. For a history of fountains in Rome one can consult [14] and its well documented bibliography. In a previous paper we have documented, via a iconographic study of visual art available [18], that the area around piazza Fontana di Trevi, including the surrounding alleys, has been characterized by this huge unmistakable sound for many centuries. We documented the fact that along with changes, the fountain has always been an "exhibit", characterized by a wealth of water, and moreover that it has always consisted of at least three different powerful jets [14]. In fact so much so, that the international competition launched for the new fountain and resulting in today’s monumental fountain, called for three separate groups of jets. Our perceptive analysis [22] recognized such groups of jets before we were aware of such historical feature, and in fact motivated our ensuing studies [13].

The paper is organized as follows: Dataset and methods containing a brief recall of the spectral analysis and the Independent Component Analysis; the outcomes are discussed in Section Results; Discussion and Conclusion follow.

2 Dataset and methods

In this study, we characterized the acoustic field recorded at Fontana di Trevi, the largest fountain in Rome (Italy) and possibly the most famous one. We performed space covering of data acquisition; the ensuing analysis is suitably spatialized (not averaging on space variables). The field survey consists of field recordings by a set of hand-held recorders (see Table 1), *i.e.* Zoom H2next and Zoom Q3HD recorders, which acquire 2 stereo tracks at 44.1/48/96kHz and 16/24 bits. In Table 1, a schematic representation of the acquisition periods and the adopted instrumentation

Figure 1: Piazza fontana di Trevi, Rome: The map shows the location of the acquisition points: Point 1-2-3 are relative to the pre-Covid phase; Point 4-5 are used both in lockdown and in Phase 3 (Map data 2020 Google). we call these points "earpoints".

Table 1: Field survey: indication of the acquisition periods and the adopted instrumentation.

	Pre-Covid	Lockdown	Phase 3	Instrumentation
PT1	22/06/2017			Zoom H2next
PT2	22/06/2017			Zoom H2next
PT3	22/06/2017			Zoom H2next
PT4		16/04/2020	20/06/2020	Zoom Q3HD
PT5		16/04/2020	20/06/2020	Zoom Q3HD

are reported. The measurements are made in three different time periods (pre-Covid, lockdown and Phase 3) and so characterized by a significantly different soundscape. In the pre-Covid phase, the acoustic field was acquired by means of three acoustic recorders located at one meter from the border of the fountain basin (our source), and surrounding it (PT1, PT2, and PT3 in Figure 1). Because of the lockdown restrictions, the second set of measures was made at the edge of the square at about 20m from the source by a professional musician (and thus an expert listener) living nearby and, therefore, among the few people who had the right to approach to the fountain. That spatial assessment was repeated in Phase 3 (the points marked as PT4 and PT5 in Figure 1) in order to make a direct comparison.

2.1 Spectral analysis

Relevant information can be achieved by performing a spectral analysis on the acoustic data. We remind that the power spectral density (PSD), or simply power spectrum, of a scalar signal $x(t)$ is defined as the square of the Fourier amplitude in the unit time. Typically, it measures the amount of energy per unit of time, or the power, contained in the signal as a function of frequency. In the real cases, to avoid problems related to finite time series, a suitable windowing is introduced: the Fourier transform of the windowed signal is the short time Fourier transform STFT [1, 25], defined as:

$$STFT\{x(t)\} := X(\tau, \omega) = \int_{-\infty}^{\infty} x(t)\, g(t-\tau) exp[-j\omega] dt, \quad (1)$$

where $x(t)$ is the continuous time acquired signal, $g(\cdot)$ is the suitable windowing of size τ, in our case a Hamming function; ω is the angular frequency. Specifically, at first, we construct a spectrogram to follow in time the main frequency content. We remind that a spectrogram is obtained by Fast Fourier Transforming the continuous signal, portioning it into several time windows that are suitably windowed. Indeed, the magnitude squared of the STFT yields the "spectrogram" of the acquired signal. A broadband spectrum can be indicative of chaotic or stochastic components. Among frequency-dependent sound level determination we apply also 1/n-octave analysis. This latter method segments the signals in time windows by a digital filter bank in a bandwidth of 1/n-octave, before the measurement of the sound level; the bandwidth is, therefore, not constant. In order to be compliant with human perception we select 1/3-octave. We remind that, in analogy to musical lexicon, "octave" indicates a frequency interval $(f, 2f)$.

2.2 Independent component analysis

In order to identify the type of dynamical system generating the experimental sound, we apply a decomposition method in time domain, that is, the Independent Component Analysis (ICA) to the whole dataset [16]. This is an entropy-based technique, which can identify underlying components (sources) from multivariate statistical data based on their statistical independence. In studies concerning sound, this means identifying sources which are separated and independent. The independence is evaluated by using fourth-order statistical properties. The goal is to find a linear representation of non-Gaussian data so that the components are statistically independent, or as independent as possible. ICA relies upon the Central Limit Theorem, which implies that, given two independent random variables, the distribution of their sum is close to a Gaussian, more than the distribution of either of the variables [16]. ICA has been already successfully applied to a variety of experimental signals such as in the field of volcano seismology and oceanography [6–8, 10–12]. Briefly, the ICA mathematical setting [16] assumes to have m different time-series $\mathbf{x}$ that are hypothesized to be the linear superposition of n mutually independent unknown signals $\mathbf{s}$, the mixing is represented by a constant unknown matrix $\mathbf{A}$. This mixing of signals is essentially due to path, noise, instrumental transfer-functions, etc. The hypothesis is to have linear mixtures of some independent dynamical systems possibly each of them nonlinear. Formally, the mixing model is written as $\mathbf{x} = \mathbf{As}$. In addition to the signal independence request, ICA assumes that the number of available different mixtures m is at least as large as the number of independent signals n. Experimentally this amounts to having at least as many different positions to record a signal, as the number of different sources one wants to identify. Under these hypotheses, the ICA goal is to obtain a separating matrix $\mathbf{W} = \mathbf{A}^{-1}$, in such a way that the vector $\mathbf{IC} = \mathbf{Wx}$ is an estimate $\mathbf{IC} \sim \mathbf{s}$ of the original independent signals. In practice, computationally, we use the fixed-point FastICA algorithm [16]. We also perform 1/n octave analysis as frequency-dependent study on noise.

3 Results

We compare the spectral characteristics in three different time periods: a pre-Covid phase; the lockdown and the Phase 3. These time periods are representative of different soundscape in the same place: full presence of activities (anthropogenic noise, *i.e.* traffic, airplanes, tourists, human disturbance); an unprecedented natural experiment in the soundscape; a gradual reintroduction of human activity.

3.1 pre-Covid phase

The study took its starting point in the audio analysis of the Fontana di Trevi performed on signals acquired on 23/06/17, in a time period very far from Covid-19 pandemic emergency. The complexity of the soundscape is evaluated by a deep analysis on the amplitude and frequency characteristics. Figure 2 shows the time evolution 10s long of the acoustic field and its spectral content as acquired at points PTs 1-3 (near field condition) of Figure 1. The signal appears stationary (Figure 2b) with sparse spikes due to casual sources. Indeed, looking at the trace acquired at the Point 2, some spikes are evident in the waveform that we associate to swallows or swifts in the listening. These kinds of sources are independent and linearly superposed to the background signal of Fontana di Trevi as recently demonstrated by De Lauro *et al.* (2020) [13]. In addition, the acoustic field shows a dependence on the space, *i.e.* the amplitude at PT2 is higher than PT1 and PT3 in accordance with previous results achieved on the basis of a perceptive study of earpoints in Piazza Fontana di Trevi [22] and shown in Figure 3. Considering the Power Spectral Density (PSD) in Figure 2a, we observe a background noise, quite uniform in amplitude in a wide band ranging from a few Hz to 5kHz, on which a few peaks at about 100 Hz, 250 Hz, 520 Hz, 750Hz, 1026Hz, 1500 Hz emerge from the noise, especially evident in the trace recorded at PT2. See the zoom in the insets of Figure 2a relative to each acquisition point. Although preserving general common features, the spectra show a dependence on the position, indicating a very complex acoustic radiation pattern that takes into account reverberation and echoes. These results underline the situation in the context of near field and in presence of anthropogenic noise due to the presence of tourists, workers, road and airplane traffic, fans and all human connected activities.

The 1/3 -octave spectra reported in Figure 2c suggest a system with a very complex behavior made of several emergent frequency peaks (each likely related to a proper time scale), whose dynamics has to be investigated to understand the degrees of freedom associated with it. Indeed, if our signal was a pure white noise, its spectrum in 1/3 -

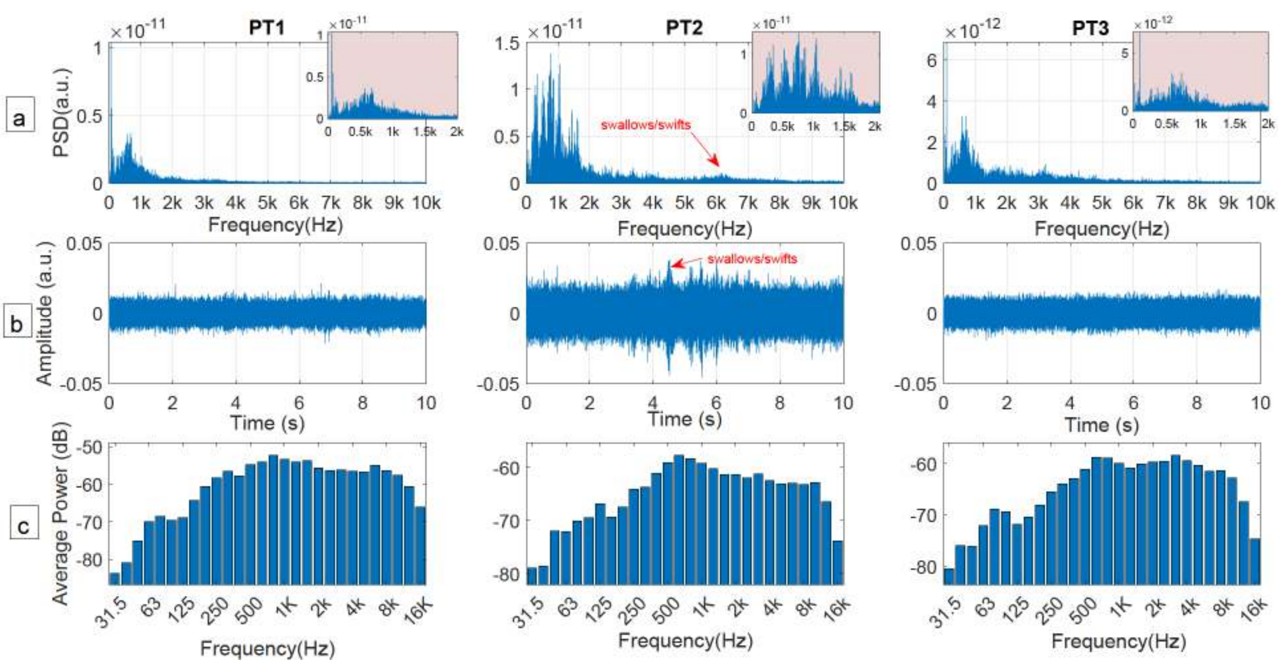

Figure 2: Spectral characteristics relative to signals acquired on 23/06/17: a) broadband spectra whose enhanced frequencies depend on the space; b) an example of time evolution evidencing differences in amplitude around the fountain; c)1/3 -octave spectra showing a complex dynamic system behaviour.

Figure 3: A perceptive survey of the sound in Piazza Fontana di Trevi after [22, 23] describing different "earpoints" and at different times. Ten people went to the square, walked the square and the adjacent streets. The entire area was divided into a grid of 3 mt mesh. Different colors (green, blue, purple) refer to the distinct recognizability of three different groups of jets, introducing an asymmetry that allows bodily orientation in the field. Intensity of color refers to the recognizability of the sound of the fountain in each spot, according to a shared method known to pediatric audiologists. On the left: survey taken in 2004, winter nighttime. On the right: survey taken in 2004, winter, daytime. On both figures we report a survey taken on April 26th 2020, 8:30 a.m., during complete lockdown. The red dot indicates where the sound of the fountain was clearly heard upon arriving. The sound invaded the streets well beyond what it achieved before lockdown, even late at night in winter).

octave should show a rising curve: the amount of energy per filter band increases towards the higher frequencies. On the other hand, in a standard spectrum (*i.e.*, FFT analysis), we should observe a flat line extending over all frequencies. At the same time, if it was a pure pink noise, it should appear flat in the spectrum in 1/3 -octave, and steep decaying in a standard spectrum. The sound of water, which is widely attributed, in terms of dynamic system, to a white noise, appears instead characterized by a more complex dynamic system (presence of characteristic emerging peaks) which takes into account various factors, such as the mechanical vibrations of the structural complex of the fountain, the roaring of the water and their solid/fluid interaction. In these terms, it means attributing a specific signature to each fountain, a peculiar soundscape. To give support to this evidence, we recorded and analyzed the acoustic field during the lockdown, when the anthropogenic noise is expected to be avoided especially for the lack of tourists, used to visit the Fontana di Trevi.

3.2 Lockdown and Phase 3

The acoustic field during the lockdown and in Phase 3 was acquired along the edge of the square at about 20m from the fountain by a musician living nearby. The acquisition points are reported in the map (PT4 and PT5 in Figure 1). The configuration of these measurements were conditioned by the lockdown restrictions, this is the reason why we were only able to perform the recordings in far field. This effect is expected to have consequence on the spectral content of the experimental traces, because high frequencies are generally attenuated as a function of the distance.

For an overall description, we perform the spectrogram for signals 60s long, shown in Figure 4. The spectrograms, both in lockdown and Phase 3 appear always contained in the range of a few Hz-5kHz with the dominant peaks confined below 1kHz. It clearly appears that, in lockdown silence, the frequencies are more spread and with lower amplitudes with respect to the Phase 3 both at PT4 and PT5. Anyway, the prevalent frequencies are always below 1kHz. In Phase 3, we observe a concentration of the frequencies below 2kHz.

Going into the details, we exploit the comparison between the normalized power spectra of the signals 1s long in the two phases and in "earpoints" PT4 and PT5, reported in Figure 5. With respect to PT4, we observe that the acoustic field in lockdown shows a broad spectrum with several peaks below 700Hz which, in Phase 3, is enriched with an additional frequency band in the range 700-1kHz. With respect to PT5, we observe that the acoustic field in lockdown is characterized by a frequency content lower than that of PT4. The frequencies, indeed, do not exceed the 400Hz that, in Phase 3, are superimposed to a packet in the range 500-800Hz. The additional packet can be observed only in Phase 3 and in both points, giving the indication that it can be ascribed to the background anthropogenic noise (thought still in absence of hordes of foreign tourists). Previous results indicate that the acoustic far field associated with the fountain is dominated by low frequencies. The signature of the Fontana di Trevi is, then, recognizable in a frequency range below 700Hz that is compatible with a waterfalls with great flow rate [2].

Once again, information about the dynamical/stochastic system underlying the acoustic field is derived from the comparison between PSD in loglog scale and 1/3 -octave spectra as already done in pre-Covid phase. In this case, we are confident that the anthropogenic noise

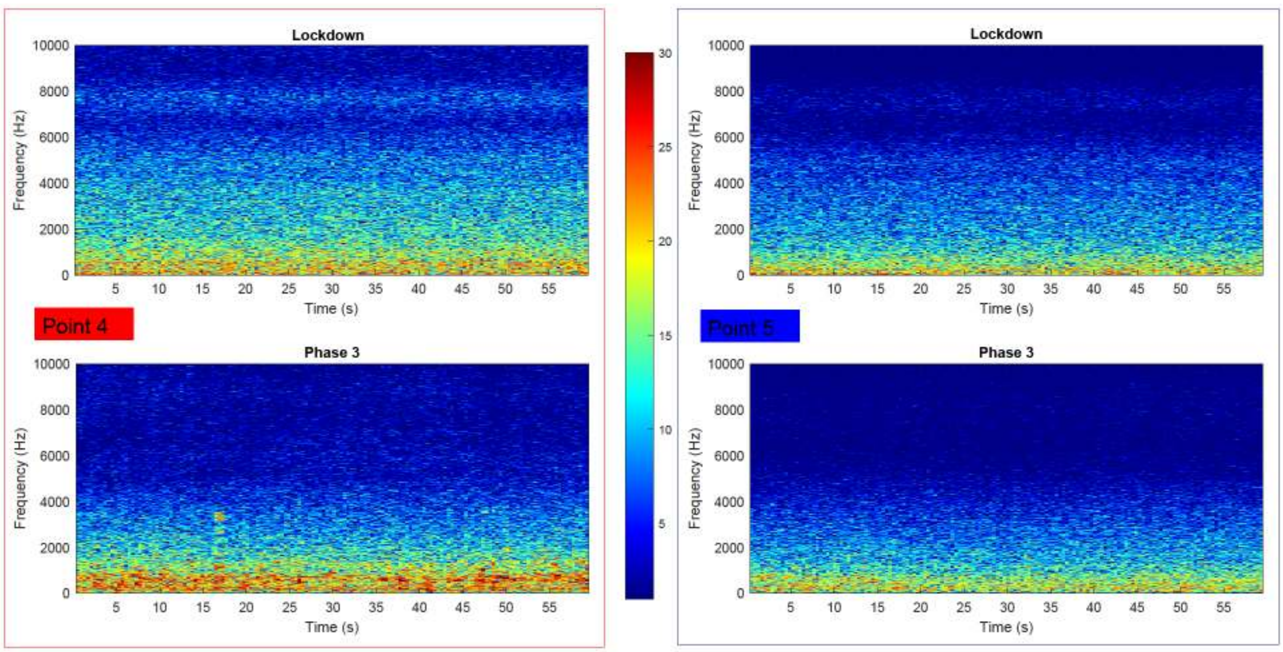

Figure 4: Spectrogram analysis relative to signals 60 s long both in lockdown and in Phase 3 acquired at PT4 and PT5 (see Figure 1 a).

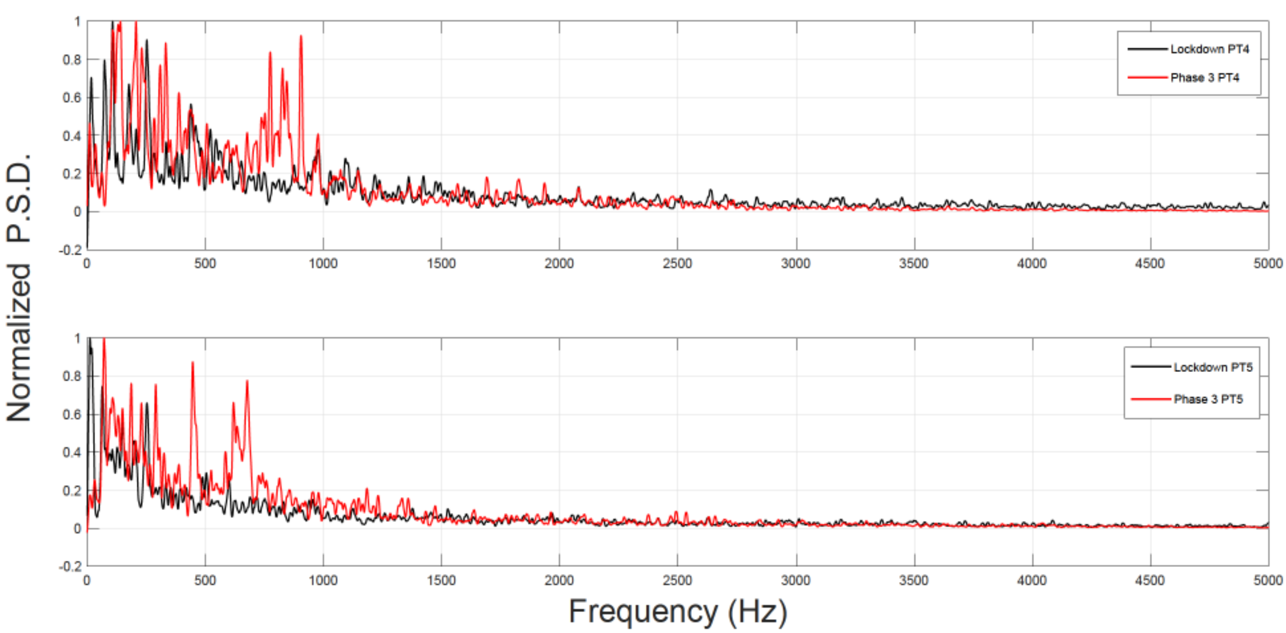

Figure 5: Normalised PSD relative to 1s long signal both in lockdown (black line) and in Phase 3 (red line) at PT4 (upper panel) and PT5 (lower panel): in Phase 3 a wavepacket in the range 700–1000Hz clearly superposes to the lower spectral content typical of lockdown

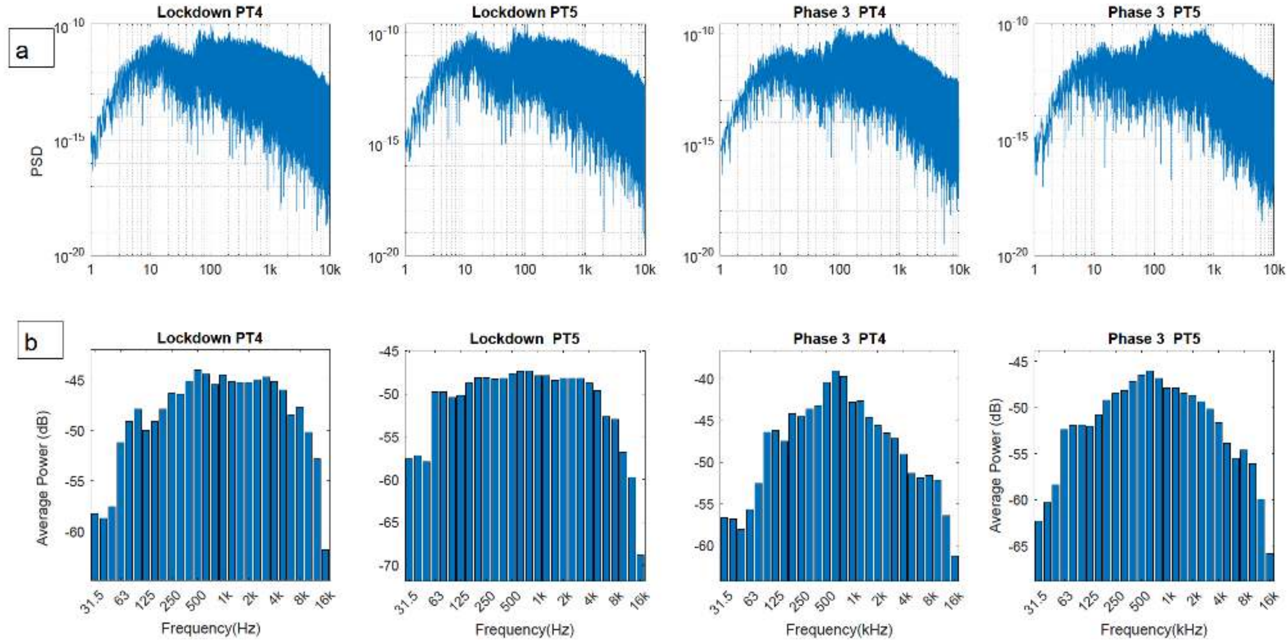

Figure 6: Spectral characteristics relative to signals acquired on 16/04/2020 and 20/06/2020: a) broadband spectra whose enhanced frequencies depend on the space; b)1/3 -octave spectra showing a complex dynamic system behaviour.

is reduced to the minimum (in lockdown) and strongly limited in Phase 3. In Figure 6, both periods indicate that also in this case we are not dealing with a pure noise, neither white nor pink, but the analyses suggest a system with a very complex behavior made of several overlapping time scales, whose dynamics has to be investigated to understand the number of degrees of freedom associated with the system.

3.3 ICA results

The aim of this analysis is to check whether a time decomposition between the contribution of the fountain and external factors (such as human voices) is possible and how the anthropogenic noise affects the sound of the fountain (linear superposition, synchronization mechanism, phase-locking mechanism). In Figure 7, we report the time evolu-

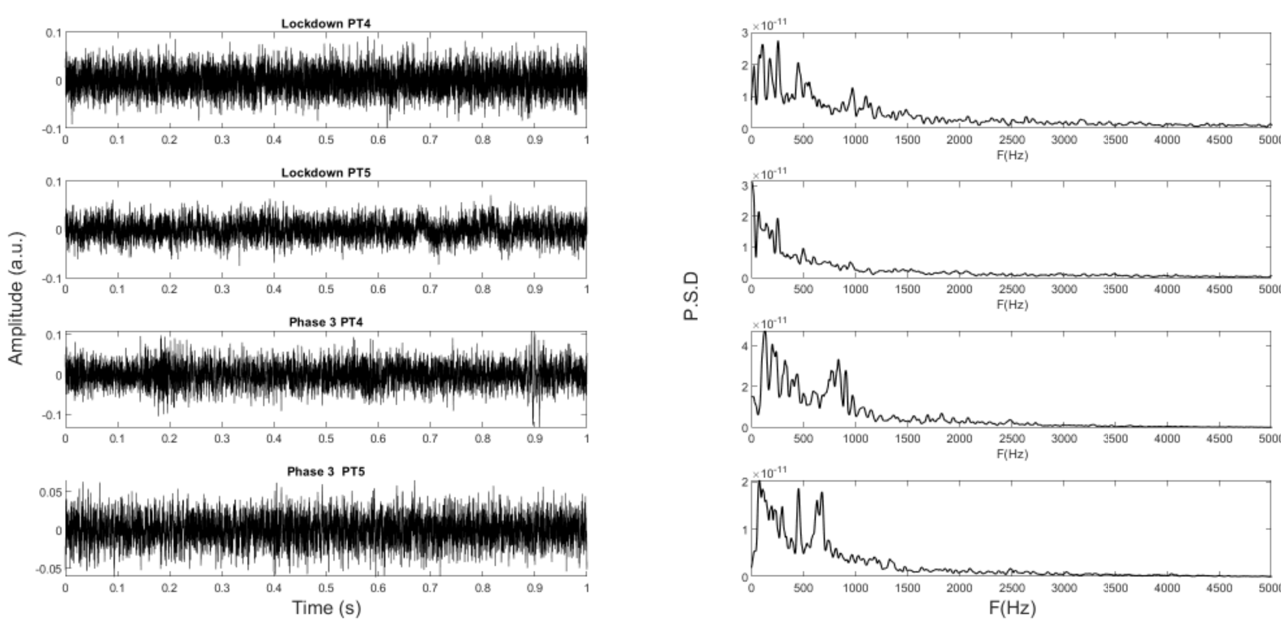

Figure 7: Time evolution of raw signals at PT4 and PT5 and relative PSDs both in lockdown and Phase 3.

tion of the raw signals 1s long acquired at PT4 and PT5 and the relative PSDs in lockdown and Phase 3. We use these signals because they were recorded by the same surveyor, using the same equipment, at the same locations. Making an assumption of ergodicity for the sound emitted by the fountain, we apply ICA to these four traces. The relative results are shown in Figure 8. No decomposition results were attained in this phase: ICA gives as output the same traces as input, indicating that no separation is possible among those signals. Looking into the details, IC1 represents Phase 3 at PT4; IC2 is similar to Phase 3 at PT5; IC3 is the equivalent in lockdown at PT5 as well as IC4 is the counterpart of lockdown at PT4.

From this analysis, we conclude that an external source (such as the chatter which is close in frequency to the signature of the fountain) does not simply add (like a linear superposition) to the fountain, but it is reasonable to think of a synchronization mechanism between fountain and human voices. This mechanism could explain the existence of urban spaces, in which the sound of flowing fountain masks the ambient noise without canceling it, but makes it less distinguishable at our ears, depending on the distance between the two sources and from the perceiver, because a synchronization occurs over the same time scales.

4 Discussion and conclusion

We have analysed the soundscape around Fontana di Trevi by comparing its characteristics among three time periods: pre-Covid, lockdown and Phase 3.
We have shown that:

- taking into account all measuring points (or "ear points"), we observe evident spatialized characteristics in the square. Specifically, moving towards its edge, we observe a degradation of the higher frequencies, as well as, in near field, strong energy at low frequency is observed both on the right and left sides with respect to the recordings acquired in the central part;
- in the pre-Covid phase, the soundscape is characterized by a background noise, quite uniform in amplitude in a wide spectral band (as deduced by PSD analysis) ranging from a few Hz to 5kHz, on which a few peaks at about 100 Hz, 250 Hz, 520 Hz, 750Hz, 1026Hz, 1500 Hz emerge from the background;
- in lockdown phase, the acoustic far field is dominated by low frequencies in a frequency range within 700Hz that is compatible with a waterfalls with great flow rate.
  In this direction, this is the signature of the fountain. In Phase 3, an additional frequency band in the range 700-1000Hz overlaps the previous one, rea-

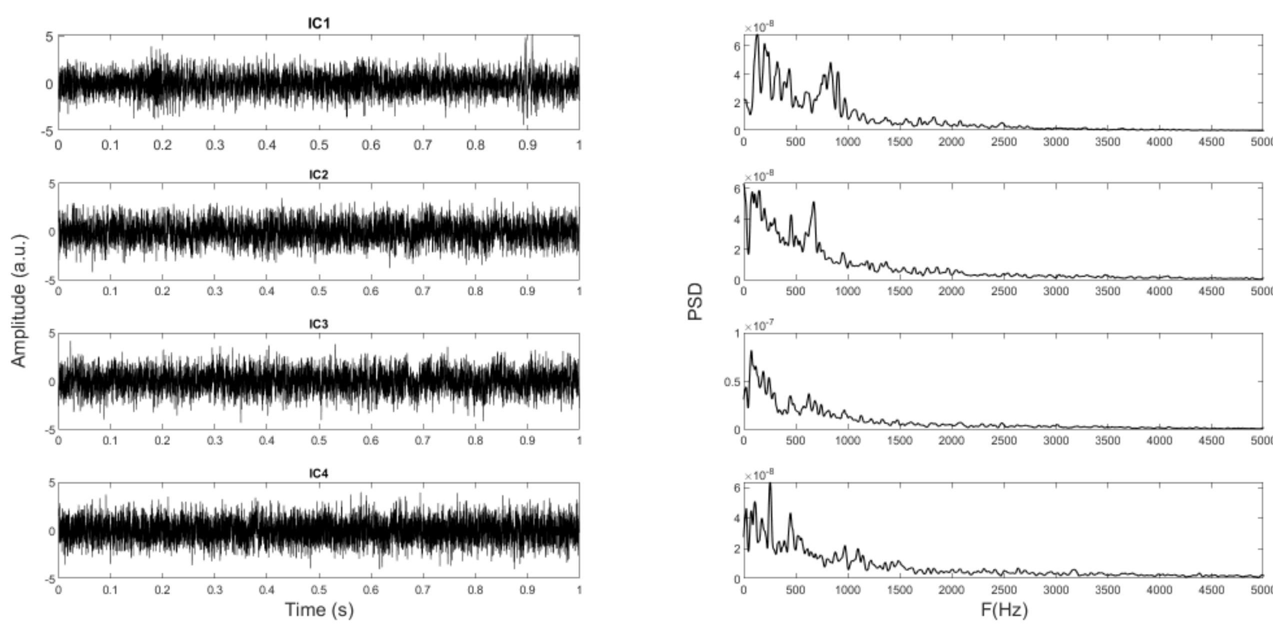

Figure 8: ICA application relative to the signals shown in Figure 6 in far field condition: the signals are not decomposed into simpler sources. In particular, the source fountain, supposed stationary, is not separated from the soundscape. This suggests that it is strongly linked to the anthropogenic noise.

sonably associated with the gradual reintroduction of the human activity in the vicinity of the Piazza and thus the anthropogenic noise;

- the 1/3 -octave spectra point to the fact that the sound is not a pure noise neither white nor pink, but instead a complex system *i.e.* one in which many different and well separated time scales enter into the dynamics;
- in Phase 3 ICA does not decompose the wavefield into simpler modes, *i.e.* ICA gives as output the same (only permutated) signals as input (with the same spectral content). This is a strong indication that the chatter in the square is not distinguishable from the fountain signature.
- We were able to validate on a spectral analyses the perceptive results obtained in [22] and also described in [23] in English. These results point to an important feature of urban fountains and the "comfort" they allow, *i.e.* their ability to orient the perceiver. In the case of the Trevi fountain this feature is even more striking, as one would expect the opposite due to the huge amount of water and loud sound in a relatively small semi-reverberant urban space. We think this is an important feature of urban fountains. We add to the perceptive analysis performed before lockdown, a perceptive observation done during the complete lockdown on April 26th 2020. The sound of the fountain in surrounding alleys in daytime (Figure 3b) reaches well beyond the point at which it was recognizable before lockdown, at night time.

Our analysis provides information on the combination of sounds, which arises from the immersive environment that represents the soundscape recorded at piazza Fontana di Trevi in Rome. In particular, from the comparison among the three selected time periods, we try to identify the sound which is unique to that square in order to preserve it. In details, we evidence the two principal sources characterizing the soundscape in piazza Fontana di Trevi: the sounds associated with the square and the fountain, including effects of the reflections and echoes of building surfaces [26] and the anthropogenic sounds both as external (*i.e.*, air and urban traffic, human activity in shops and café) and internal sources (such as tourists, swallows, pigeons). The lockdown period gave us the opportunity to define the spectral characteristics of the source square/fountain. The comparison with the pre and post lockdown periods indicates that the sounds emitted by the human activity nonlinearly superpose to source square/fountain insisting on similar frequency content. That sort of synchronization mechanism could explain why it is not possible to distinguish people talking in certain places nearby the fountain. On the contrary, recently [13] showed that the swallows represent a linearly superposed source and not intrinsically connected with the soundscape of Piazza Fontana di Trevi. These steps are crucial in the route to assess a proper soundmap, which should be unique of the area.

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