

## Sound in spaces – Sound through spaces

Critical dissertation

Vasileios Filippou, MMus – Composition

Trinity Laban conservatoire

Website: <http://vassilisph.wix.com/soundnspace>

What does a space sound like? Are sounds affected by spaces? And what happens when different types of sound and space come together? In this critical dissertation I am going to talk about those two elements (sound and space), in close relationship and also individually, through my own experimentation, documentation and analysis. It is important to distinguish what I mean by sounds *in* and *through* spaces. Sound *in* space refers to the natural sound that is surrounded by and also surrounds a space (if the space is open or the 'outside' sound has access inside it). Sound *through* space refers to both a response of the space to an external sound and also the placement of a sound through the acoustic properties of a space. For the latter I am going to elaborate on the process and techniques I used later on.

A few years ago, I was fascinated with the sound responses the room would produce when I was playing the piano. The light bulbs were singing back a certain frequency of the piano, something that made me think of the idea of 'music for prepared spaces'. What are the potentials of knowing how to prepare a certain space in order to be able to respond to certain sounds? That enquiry intrigued me from a compositional point of view and made me think of the possibilities of interaction between music or organized sound and space. This project was my opportunity to look deeper into sound and space and I view it as a very good starting point on this subject, as a foundation of a composition technique that I can use and also the basis of a bigger project to explore in the future.

There are a number of artists who influenced and highly informed my project on sound and space with their work, that I am going to touch on now, before I move on to my own approach, methodology and analysis of it. Sound artists use a particular terminology to

describe and categorize their work around sound studying, performing, composing or preserving. They not only share similar ways to talk about sound, but also have very similar ideas, enquiries, concerns and approaches when it comes to work with that medium.

*Acousmatic listening*, is a term introduced by the founder of *musique concrète* Pierre Schaeffer after radio and recording brought new ways of experiencing sound that he also called *reduced listening*.<sup>1</sup> Reduced, since the source and the place of sound were not visible. When recording environmental sounds for example, many sounds are presented to the audience who would rarely ever had the opportunity to experience the sources for most of those sounds. This is described by Francisco López, a leading electro-acoustic sound artist, as *environmental acousmatics*, something evident in his piece *La Selva* that I am going to talk about later.<sup>2</sup> Two more important terms that I would like to mention are *bioacoustics* and *acoustic ecology*. As critically described by López, bioacoustics deals with a reductive interpretation of nature recordings since the recordings of species are edited being almost separated from their background-surrounding sounds. With the same principle but following a slightly different process in the means of preserving natural sounds, *acoustic ecology* 'highlights the qualitative aspects of a soundscape'<sup>3</sup>. The term derived from the World Soundscape Project founded by R. Murray Schaffer during the late 1960s as an attempt to draw attention to the sonic environment.<sup>4</sup>

Soundscape; the sonic environment filled with sounds from any kind of species, visible and also invisible to the human eye, with sounds that seem to be inaudible to humans but what they could really be described as, is audible silence. "The sounds we (humans)

---

<sup>1</sup>Pierre Schaeffer, 'Acousmatics', in *Audio Culture: Readings in Modern Music*, Christoph Cox and Daniel Warner, (New York, London: Continuum, 2004), p.76-77

<sup>2</sup> Francisco López, 'Profound listening & Environmental sound matter', in *Audio Culture: Readings in Modern Music*, Christoph Cox and Daniel Warner, (New York, London: Continuum, 2004),p.85-86

<sup>3</sup> BBC World Services, John Levack Drever, 'Q&A with an acoustic ecologist', <[http://www.bbc.co.uk/worldservice/specialreports/2009/07/090703\\_sos\\_qawwithjohndrever.shtml](http://www.bbc.co.uk/worldservice/specialreports/2009/07/090703_sos_qawwithjohndrever.shtml)> (accessed 2 August 2015)

<sup>4</sup> Barry Truax, 'The World Soundscape Project' <<http://www.sfu.ca/~truax/wsp.html>> (accessed 2 August 2015)

create are incredibly intense for other creatures that can hear a lot of sounds that we cannot". Field recordist Jez Riley French, continued to say that 'Everything we build gives off a sound', which is an underlying cause of how human constructions can result in the abandonment of certain species from their natural environment, like for example a wire fence that naturally produces extremely intense sounds for insects living around it. A particular example is an ultrasonic recording he made at Tate Modern gallery London in 2013. These sounds that are beyond the human range of hearing can be heard by creatures, especially birds and are quite loud and dense, leaving no question why there are not so many birds in big cities.<sup>5</sup>

One important factor that all sound artists take very seriously into account is the mode of listening and also how listening is a passive activity and on the other hand, hearing is an active sound-receiving process. The term soundscape, relates precisely to an active listening of the unique features of a place. By actively listening to the sound in relationship with its space it gives a meaning that goes 'beyond walls or other physical limitations'.<sup>6</sup> Another issue is the trend of *Mp3* that seems to rule our audio culture. As noted by J. R. French, '99.9% of sounds we hear are compressed and that turns our ears stupider and stupider'<sup>7</sup> hoping that by allowing ourselves to be able and listen closely and deeply we can train our ears and improve our hearing. What we, as audience are required to do in our modern life is to cultivate a variety of 'modes of listening' and according to professor Ola Stockfelt, is the understanding of the context of sound that makes an adequate listening in relevance to the genre of music. For example, *ambient music* that accommodates many levels of listening, 'must be as ignorable as it is interesting'<sup>8</sup> to an audience.

Throughout my research on sound and space, I noticed a mutual concern from all the sound artists on noise pollution and the destruction of the (sonic) environment both from

---

<sup>5</sup> Sonic Terrain, 'Audible Silence: Jez Riley French at TEDxHull' < <http://sonic-terrain.com/2014/11/audible-silence-jez-riley-french-at-tedxhull/> > (accessed 3 August 2015)

<sup>6</sup> Raquel Castro, 'Invisible places – Sounding cities', < <http://invisibleplaces.org> > (accessed 5 August 2015)

<sup>7</sup> Sonic Terrain, < <http://sonic-terrain.com/2014/11/audible-silence-jez-riley-french-at-tedxhull/> > (accessed 12 August 2015)

<sup>8</sup> Brian Eno, 'Ambient Music', in *Audio Culture: Readings in Modern Music*, Christoph Cox and Daniel Warner, (New York, London: Continuum, 2004), p. 96-97

artists of the past, since the 1960s with the Schafer's world soundscape project as a reaction to the rapidly changing soundscape of Vancouver, but also of today with the massive technological progress that seems to slowly eliminate anything natural. Noise pollution literally but also metaphorically does not only result from man building noisy machinery but 'when man does not listen actively, understanding that noises are the sounds we have learned to ignore.'<sup>9</sup> We are all damaged by noise pollution psychologically as much as anything and we are just not aware of it'<sup>10</sup> as Chris Watson, one of the leading nature recordists of our time claimed and continued to say that 'we spend most of our time and energy shutting things out rather than listening.'<sup>11</sup>

The relationship of space with sound is very important but also the idea of the space, as the place is where sound exists and emanates from; a space like a concert hall or even our own body. 'Space itself can tell a story'<sup>12</sup>. The sense of being in a space is vibrant in sound art. A memory of a place or an imaginary one with specific details of its construction and even aesthetic properties can be communicated through a recording of a space or a sound through that space. Setting up a virtual acoustic space allows us through the loudspeaker to not only have the ability of depicting a space but also create an impossible relationship between sound and space by 'bringing together normally unrelated objects in the virtual space'.<sup>13</sup> A factor that comes with the loudspeaker is amplification that could almost have no limits in establishing the quiet presence of very small and fragile sounds and also in underlining the loudness of others. As Douglas Kahn wrote in his book *Noise, Water, Meat*, 'With enough amplification any performance space could be turned into a resonant chamber'.<sup>14</sup> The surrounding soundscape constructs a dialogue with listeners since they could select and rearrange it as they wish

---

<sup>9</sup> R. Murray Schafer, *Our sonic environment and the tuning of the world: The soundscape*, (Ralester, Vermont: Destiny Books, 1977), p. 4

<sup>10</sup> The Quietus, 'Chris Watson On Recording The Music Of The Natural World' < <http://thequietus.com/articles/11222-chris-watson-interview> > (accessed 3 August 2015)

<sup>11</sup> Ibid.

<sup>12</sup> Simon Emmerson, *Living Electronic Music*, (England, USA: Ashgate, 2007), p. 102

<sup>13</sup> Trevor Wishart, *On Sonic Art*, (Netherlands: Harwood academic publishers, 1996), p. 147

<sup>14</sup> Douglas Kahn, *Noise, Water, Meat* (Cambridge, London: The Mit Press, 1999), p. 233

and direct in a way the sound, to their willing.<sup>15</sup> In an opposite scenario with a similar relationship of space and listener, *echolocation* is the method that bats use to move in space, although in this case the space directs the creature by sending echoes back to its calling sounds and in result pointing out a direction.<sup>16</sup>

How listeners perceive a space, is part of how they interpret the sounds within that. 'We can create imaginary landscapes – the *mindscapes of expressionism*',<sup>17</sup> even eliminating those in a private acoustic space – the *headspace*, by isolating our experience through headphones, something that also offers the possibility of a portable acoustic space.<sup>18</sup> So technically as listeners we could transfer any type of space to a different one and shape our experience according to our own aesthetic. Even without headphones, this is again the case according to Alvin Lucier and Pauline Oliveros who make the point that brain waves are natural and electric sounds at the same time<sup>19</sup> and if we were able to hear the micro-world, we could probably hear the brain functioning.<sup>20</sup>

Conditions of a sounding space can have an extra element of character and substance when we, as listeners physically put ourselves in those spaces. For example *Underwater Music*, a project by composer Michel Redolfi invites the audience to listen to music underwater<sup>21</sup> and another similar project curated by Joel Cahen called *Wet Sounds* is an underwater sound installation that as he says 'exposes the audience to three sound spaces; one inside the water, one outside and one a merger of the two.'<sup>22</sup> The double dimension of a space, in this case a swimming pool within a room, results to

---

<sup>15</sup> Iain Chambers, 'The aural walk', in *Audio Culture: Readings in Modern Music*, Christoph Cox and Daniel Warner, (New York, London: Continuum, 2004), p.99-100

<sup>16</sup> Alvin Lucier, *Reflections, Interviews, scores, writings 1965-1994* (Germany: MusicTexte, 1995), p.38

<sup>17</sup> Emerson, p. 101

<sup>18</sup> R. Murray Schafer, 'The music of the environment', in *Audio Culture: Readings in Modern Music*, Christoph Cox and Daniel Warner, (New York, London: Continuum, 2004), p.34-35

<sup>19</sup> Lucier, p. 36

<sup>20</sup> Pauline Oliveros, 'Some sound observations', in *Audio Culture: Readings in Modern Music*, Christoph Cox and Daniel Warner, (New York, London: Continuum, 2004), p.106

<sup>21</sup> Michel Redolfi, 'Underwater Music', <[www.redolfi-music.com](http://www.redolfi-music.com)> (accessed 13 August 2015)

<sup>22</sup> Joel Cahen, 'Wet Sounds', <[www.wetsounds.co.uk](http://www.wetsounds.co.uk)> (accessed 11 August 2015)

a space within another one. A similar concept that I experienced recently was a 3D – model installation of a painting created by Janet Cardiff and George Bures Miller presented at the National gallery of London. They created a theatre set-like depiction of *Saint Jerome in his study* painting with a sound design in and around the model, of sounds that could exist in the painting’s scene. Remarkable was the moment when the sound of rain surrounded the painting’s model and if you went close to the designed building you could hear the raindrops sound falling on the roof.<sup>23</sup>

The idea of sound and space is also used to serve the illusion of transformative place and time. Listening to sounds being played in a particular place can trigger the memory or imagination of a listener. Also as Schafer wrote, *schizophonic* listening (when the sound originates in another place than where it is heard) can awaken the listener’s curiosity. Alteration of spaces in a performance can result to a journey through different times and places. Moreover ‘recording of a space captures time, both time in general and “a time” as a historical event’.<sup>24</sup> Those recordings as a documentation of environmental sounds can also become an organized presentation of sound recordings as a piece of art. What is the relationship of sound studies with composition and also how composers used the idea of sound and space in their practice? Is sound recording a compositional process and do sound recordists consider themselves as composers?

Composer and researcher Damian Keller notes that ‘The reproduction or description of environmental sounds fall broadly outside the field of music composition and analysis’<sup>25</sup> and he describes *soundscape composition* as an area of music research. In contrast, recordist Jonathon Storm in his own words said that ‘...I am a composer for the instrument – or orchestra of instruments called nature’<sup>26</sup> and also recordist Hildegard Westerkamp views her work as composition, using any sound that the environment offers.<sup>27</sup> There are also recordists like Marc Anderson who believe that they are

---

<sup>23</sup> National Gallery, ‘Soundscapes’, <<http://www.nationalgallery.org.uk/soundscapes>> (accessed 15 August)

<sup>24</sup> Emerson, p.102

<sup>25</sup> Damian Keller, ‘EcoModels’, <<http://www.sfu.ca/sonicstudio/srs/EcoModelsComposition/Introduction.html>> (accessed 21 July 2015)

<sup>26</sup> Jim Cummings, ‘Earth Ear’, <<http://earthear.com/aboutesa.html>> (accessed 21 July 2015)

<sup>27</sup> Ibid.

documenting and presenting a collection of pure nature soundscapes without necessarily viewing their selective process as composition. But, 'can a piece be called a soundscape composition just because it uses environmental sounds as its source material?'<sup>28</sup> A line between the two would possibly be environmental sound composition and here is how writer Jim Cummings accurately in my opinion categorizes this practice: *Documentaries*, as unimproved recordings, *Reconstructions*, as the combination of a number of field recordings in order to create a single soundscape experience. Another category is *Transformations*, as the use of recordings as the basic material for electronic processing of sound and *Musical Composition*, as the combination of human instruments of voices with the recordings of the environment.<sup>29</sup>

I chose to talk briefly about four compositions that make use of sound and space in a very effective way. *La Selva*, a sound recording that could be described as a reconstructive piece, uses the sounds of a place (reserve in Costa Rica) not to replace or represent that particular sonic environment, but rather to suggest the 'possibility of a profound, pure, 'blind' listening of sounds'.<sup>30</sup> Listening to the piece does invoke a real transformation of space and time. In a different context, using nature in a much smaller scale, La Monte Young's *Composition 1960 #5*, is at the edge of plausible audibility having a butterfly in a space believing that it can produce a sound not only with its wings but also by its body functioning sound.<sup>31</sup> Although in this case the sound source had almost no connection at all with the space, sonically. Alvin Lucier is the composer of the last two pieces I am going to mention where the performance space plays a very important role for the sound. *Music for piano with one or more snare drums* suggests the placement of musical objects in the performance space, something that immediately changes the acoustic properties of it and creating a dialogue between the sound of the piano and the membrane of the snare drum(s). Lastly, *I am sitting in a room*, is a classic example where the acoustical properties of the space transform the repeated speech by

---

<sup>28</sup> Hildegard Westerkamp, 'Writings', <<http://www.sfu.ca/~westerka/writings%20page/articles%20pages/linking.html>> (accessed 20 July 2015)

<sup>29</sup> Cummings, 'Earth Ear'

<sup>30</sup> Francisco López, 'Essays', <<http://www.franciscolopez.net/env.html>> (accessed 2 August)

<sup>31</sup> Kahn, p. 237

reinforcing the resonant frequencies of the room; a piece where sound completely relies on space.<sup>32</sup>

Some of the projects and ideas of the artists I mentioned above shaped my work in an important degree and within the next sections of my dissertation I will talk about the approach, methodology and analysis of my project. I began working on *Sound in spaces – Sound through spaces*, by making a library of recordings from places in my environment, London-UK and Ammochostos-Cyprus. What I was seeking was sound that would have a distinct interaction with space. After creating a number of recordings I decided to work with six particular spaces because of their different acoustic qualities; underwater (sea), bridge, hallway, staircase, tunnel and a playground park. My approach was not focused on the mathematical analysis of the recordings but rather as a process of listening comparison and analysis of them. Moreover, my interest lies in the juxtaposition of recordings from different places and the formation of what could be characterized as soundscape composition. My aim was to use recordings of different spaces and merge isolated characteristics of them together. With that I mean, for example the use of the sound of underwater wave recording with the reverb of the staircase. Now, the process of being able to record the reverb of each space to form an idea on how it actually sounds was by recording within the space with a sensitive microphone (Zoom H2n with high gain, surround) and also places where their sound was almost inaudible like the staircase, I would record a loud clap and then process the sound, by removing the attack and using the edited version as the impulse response to a convolution reverb that I could use as the reverb to filter any other sound.<sup>33</sup>

That was the best solution I found, in order to get an idea of a sound being heard in a space that does not have any relation to it (for example the sound of a chord played by a brass dectet in a staircase). In other words I created a 'reverberation model' for each of the six spaces. In the same way that Francisco López calls the sound of rain as the sound of plant leaves and branches,<sup>34</sup> emphasizing the objects that actually produce a

---

<sup>32</sup> Alvin Lucier, 'Album notes' <<http://www.lovely.com/albumnotes/notes1013.html>> (accessed 3 August)

<sup>33</sup> Ken Hamberg, 'Convolution reverb explained', <<http://www.bhphotovideo.com/find/newsLetter/Convolution-Reverb.jsp/>> (accessed 14 August)

<sup>34</sup> López, in in *Audio Culture: Readings in Modern Music*, p. 83



sound, I could name for example the sound of the tunnel as the sound of steps through the tunnel. After recording samples from each space I used them as the impulse responses to digitally simulate the reverberation of each space through convolution reverb. 'Only a convolution reverb can capture the ambience of a real space, or real hardware, and recreate it on a computer' explains Ableton (audio software) sound designer Christian Kleine.<sup>35</sup> The software I used to process the reverb sound of the spaces is Logic pro X where you can precisely edit the impulse response and accurately transform it to reverb.

What I did after that, was to select six excerpts from my pieces that would be quite different and 'perform' them in each space (audio examples are available on my project's website). The instrumentation of the pieces is: brass dectet, violin duo, bells and frame drum, solo flute and solo tabla. This enabled me to immediately listen to how each sound was interpreted through the sampled space having the attention on the alteration of the reverberation. My focus at this point was not to have the sound filtered completely through the space (something that I did for my composition *Paramorfosi*) but be able to differentiate the two, so I could finally compare each of the sound through the spaces clearly and accurately.

As a result of my documentation and methodology I composed two soundscape compositions using a 16-minute soundscape recording where I walk through five of the six spaces that I took samples from (excluding the underwater one). The first piece, *Peripatos* (Greek: walk) uses each of the six convolution reverb to filter the sounds recorded through the walk. There is no further editing of the final recording but the change of each space reverb is obvious especially with distinct sounds in the foreground, such as traffic or birds. The second piece, *Paramorfosi* (Greek: deformation) is using the same 16-minute recording in a completely different way, this time with the idea of cross-synthesis, a technique whereby one signal confers one or more of its characteristics to another.<sup>36</sup> In my process I kept the same elements as I used them in *Peripatos*, although this time the sounds within the recording are not

---

<sup>35</sup> Ableton 9, 'Convolution Reverb in Live 9: Space is the place', <<https://www.ableton.com/en/blog/convolution-reverb-live-9-give-your-sounds-new-space/>> (accessed 15 August)

<sup>36</sup> Indiana University - Jeffrey Haas, 'Chapter four: Synthesis' <[http://iub.edu/~emusic/etext/synthesis/chapter4\\_convolution.shtml](http://iub.edu/~emusic/etext/synthesis/chapter4_convolution.shtml)> (accessed 14 August)

obvious. Rather, attention is focused on the reverberation of both the spaces from the 16-minute walk recording and the six separate spaces. Convolution, being a method of cross-synthesis, combines two audio sources emphasizing the frequencies they share and minimizing the ones that are different.<sup>37</sup> In result, the piece flows and grows following the two audio sources, which in this case are the walk and the spaces recordings (on the project's website I give exact timings within both pieces, indicating the change of space reverb as the pieces move on).

The way that this project informs me as a musician and particularly as a composer is by providing knowledge from recording techniques to sound processing. Apart from the theoretical area of the project, the practical one gave me the opportunity to experiment with natural sounds and listen out for their detail and relation within space. Listening back to the recordings and trying to choose the right samples for either making convolutional reverbs or processing the sound of the two pieces (*Peripatos* and *Paramorfosi*), made me realize in practice the details of sound, focusing on frequencies and dynamics seeing how variation of those elements have different impacts on sound within a space. Most importantly critical listening made me seek out not only the right sound recording but also the right processing procedure and challenge myself on the creation of two pieces that although follow the same basis are very different. Working inside this project definitely shaped the way I view my own soundscape, by focusing on the sounds that I would normally ignore or considering them as a not important background noise; the same set of sounds I used to compose with. The importance of space, not only to the projection and reverberation of sound but also to the quality of the sound, is something that was obvious through the editing of the recordings.

A few limitations throughout my work shaped the project not in a new but a parallel direction. When I had the first ideas for the project I wanted to make my idea of 'music for prepared spaces' work, but I realize in the process that it was impossible to happen at this stage. Firstly, I needed professional ultrasonic devices, like the ultrasonic sound detector to be able to capture the 'full' sound of a space in its full frequency range. Secondly, the lack of knowledge on the physics of the sound within a space didn't allow my 'prepared room' idea to happen, although I repeatedly tried with different objects to achieve a 'dialogue' with instrumental sound but it wasn't stable or it would not happen

---

<sup>37</sup> Ibid.

most of the time. After I met and told my idea to a physicist, I realize how difficult and time consuming it needed to be in collaboration with him, so we left it probably for the near future. However, I had plenty of time to experiment and improve my first sound samples, I used a very good recording device and I was close to spaces I could easily have access and try out ideas.

I have decided to present my work in three ways. Firstly in a written form, in order not only to give an insight but also an explanation of how I approached my project but also to mention artists and projects that really helped and shaped my work. Secondly, as a website where my methodology is also presented sonically and it shows each step of my process and lastly, as an audio reflection of my process by the two compositions I made that are an important part of my project, since they depict my method and understanding of the relationship of sound and space in the most honest and personal way; the listening experience. I would suggest a careful listen with preferably speakers or headphones with a big frequency and dynamic range, optionally while following the time-references of the spaces that appear within the two 16-minute compositions.

In conclusion, I feel that *Sound in spaces – Sound through spaces*, has been a very exciting and at the same time highly informative project! I view it as a starting point in my exploration of sound recording and composing and I am planning on collaborating with a passionate physicist on the idea of ‘music for prepared spaces’ in the near future. As a composer it raised my awareness on hearing my surrounding sounds and conceive them as musical sounds and I came to believe what Katharine Norman pointed out: ‘...daily sound impressions play a significant role in the composition process’.<sup>38</sup> This project has been a turning point for me into more active listening and also an interest and appreciation in the natural sounds of the earth – ‘a musical planet, spinning in silence space’.<sup>39</sup>

---

<sup>38</sup> H. Westerkamp, ‘Writings’ <<http://www.sfu.ca/~westerka/writings%20page/articles%20pages/linking.html>> (accessed 16 August)

<sup>39</sup> Acoustic ecology – Gordon Hempton, ‘Writings’, <<http://www.acousticecology.org/writings/listenup.html>> (accessed 16 August)

# Bibliography

## Books:

- Campbell Murray, *The Musician's Guide to Acoustics*. New York: Oxford University Press Inc., 2001
- Cox Christoph and Warner Warner, *Audio Culture: Readings in Modern Music*. New York, London: Continuum, 2004
- Emmerson Simon, *Living Electronic Music*. England, USA: Ashgate, 2007
- Kahn Douglas, *Noise, Water, Meat*. Cambridge, London: The Mit Press, 1999
- Lucier Alvin, *Reflections, Interviews, scores, writings 1965-1994*. Germany: MusicTexte, 1995
- Schafer R. Murray, *Our sonic environment and the tuning of the world: The soundscape*. Ralester, Vermont: Destiny Books, 1977
- Wishart Trevor, *On Sonic Art*. Netherlands: Harwood academic publishers, 1996

## Online resources:

- Redolfi Michel, 'Underwater Music', <[www.redolfi-music.com](http://www.redolfi-music.com)>
- Cahen Joel, 'Wet Sounds', <[www.wetsounds.co.uk](http://www.wetsounds.co.uk)>
- National Gallery, 'Soundscapes', <<http://www.nationalgallery.org.uk/soundscapes>>
- Damian Keller, 'EcoModels', <<http://www.sfu.ca/sonicstudio/srs/EcoModelsComposition/Introduction.html>>
- Cummings Jim, 'Earth Ear', <<http://earthear.com/aboutesa.html>>
- Hildegard Westerkamp, 'Writings', <<http://www.sfu.ca/~westerka/writings%20page/articles%20pages/linking.html>>
- López Francisco, 'Essays', <<http://www.franciscolopez.net/env.html>>
- Lucier Alvin, 'Album notes' <<http://www.lovely.com/albumnotes/notes1013.html>>
- Hamberg Ken, 'Convolution reverb explained', <<http://www.bhphotovideo.com/find/newsLetter/Convolution-Reverb.jsp/>>
- Ableton 9, 'Convolution Reverb in Live 9: Space is the place', <<https://www.ableton.com/en/blog/convolution-reverb-live-9-give-your-sounds-new-space/>>

- Acoustic ecology – Gordon Hempton, ‘Writings’, <<http://www.acousticecology.org/writings/listenup.html>>
- Indiana University – Jeffrey Haas, ‘Chapter four: Synthesis’ <[http://iub.edu/~emusic/etext/synthesis/chapter4\\_convolution.shtml](http://iub.edu/~emusic/etext/synthesis/chapter4_convolution.shtml)>
- The Quietus, ‘Chris Watson On Recording The Music Of The Natural World’ <<http://thequietus.com/articles/11222-chris-watson-interview> >
- BBC World Services, John Levack Drever, ‘Q&A with an acoustic ecologist’, <[http://www.bbc.co.uk/worldservice/specialreports/2009/07/090703\\_sos\\_qawwithjohndrever.shtml](http://www.bbc.co.uk/worldservice/specialreports/2009/07/090703_sos_qawwithjohndrever.shtml)>
- Truax Barry, ‘The World Soundscape Project’ <<http://www.sfu.ca/~truax/wsp.html>>
- Sonic Terrain, ‘Audible Silence: Jez Riley French at TEDxHull’ < <http://sonic-terrain.com/2014/11/audible-silence-jez-riley-french-at-tedxhull/> >
- Castro Castro, ‘Invisible places – Sounding cities’, < <http://invisibleplaces.org> >
- Sonic Terrain, < <http://sonic-terrain.com/2014/11/audible-silence-jez-riley-french-at-tedxhull/>>