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# Telematic Immersion: Performance, Technology, and Audiovisual Work in *Virtual Studies* (2020) by Paulo C. Chagas

CÁSSIA CARRASCOZA BOMFIM<sup>1</sup>

## Abstract

This article discusses the concept of telematic immersion developed in partnership with composer Paulo C. Chagas. Focusing on Chagas's work *Virtual Studies* (2020) for flute, live electronics, and 3D video, we reflect on different aspects of artistic creativity in the telematic environment including the use of audio and video technology and the multiple connections between musicians and apparatuses. The article discusses how the parameters of chamber music in the physical environment, such as the uniqueness of the live performance, the corporality of sound, and the visual and choreographic dimension of the performance are being transformed through the virtual setting of the telematic environment. Moreover, we introduce the project *Connecting Creative Communities* as an example of how our research in telematic music has pedagogic applications. We show how the telematic paradigm involves not only the technology of interaction among human beings but also connections between humans, other intelligent systems, and affect.

## Introduction

Pauline Oliveros and her colleagues have defined telematic music as music played live and simultaneously in geographic locations via the Internet, referring to a collective musical practice that goes beyond borders of the common physical space as the musicians are in different places and communication takes place over a network.<sup>2</sup> Telematic music has been researched for decades through a variety of frameworks regarding its practical, technological, and philosophical effects (cf. Vilém Flusser, Paulo C. Chagas, Sarah Weaver, Roger Mills, and

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<sup>2</sup> Pauline Oliveros et al., "Telematic Music: Six Perspectives," *Leonardo Music Journal* 19 (2009), 95–96, <https://doi.org/10.1162/lmj.2009.19.95>.

Pauline Oliveros).<sup>3</sup> However, many musicians who had never performed online suddenly became interested in telematic music with the current scenario of the Covid-19 pandemic.

Indeed, the challenges of telematic music are manyfold. Musicians have to make themselves familiar with specific technologies developed for telematic music, get used to and search for the improvement of sound possibilities mediated by technological interfaces, work in specific performance aspects and, above all, find creative solutions for musically connecting with other musicians in the virtual environment.

Telematic music can make use of different acoustic instrument settings and also be performed with electronic music technology such as electronic instruments, synthesizers, sound processors, and computing devices. Also, telematic music does not typically involve a solo setting as it requires collaboration between many musicians.

Unshared sound space in telematic performance changes the relations of listening, visual communication, and time among musicians. The physical distance imposes a different way of being together. Traditional chamber music is a genre of collective practice that includes a small number of musicians whose performance requires them to be assemble in the same physical space to play and listen simultaneously. Moreover, it implies non-verbal communication to happen among the participants. Therefore, the collective communicates beyond the interaction of sound through other parameters of corporeality such as physical gestures, breaths, pulsations, and visual contact.<sup>4</sup>

The virtual environment, on the other hand, implies physical distance so that the paradigm of bodily communication changes due to the latency of sound and image, implying new rules to be established in this “game” of relationships between performers. Flusser gives a description of virtual chamber music in which musical communication includes improvisation and feedback between musicians; this can take place with or without an audience. He also points to the linearity of time as a fundamental difference between chamber music and telematics:

The essential difference between chamber music and telematics is therefore as follows: chamber music takes place in linear time, develops themes, and one improvisation follows another. Telematics, on the other hand, occurs in a simultaneous time and space, and all players in all places make decisions relating to themes and their variations all at once. That is the difference between pressing on a piano key and on the key of the apparatus.<sup>5</sup>

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<sup>3</sup> For more on telematic chamber music, see Vilém Flusser, *Into the Universe of Technical Images* (Minneapolis: University of Minnesota Press, 2011); Paulo C. Chagas, “Creativity with Apparatuses: From Chamber Music to Telematic Dialog,” *Flusser Studies* 17, no. 1 (2014): 1–15; Sarah Weaver, “Synchrony: Music of Sarah Weaver and Collaborations,” *Journal of Network Music and Arts* 2, no. 1 (2020): 1–45, <https://commons.library.stonybrook.edu/jonma/vol2/iss1/6>; and Roger Mills, *Tele-Improvisation: Intercultural Interaction in the Online Global Music Jam Session* (Cham: Springer, 2019).

<sup>4</sup> Paulo C. Chagas, “A Música de Câmara Telemática: A Metáfora de Flusser e o Universo da Música Eletroacústica [Telematic Chamber Music: Flusser’s Metaphor and the Universe of Electroacoustic Music],” *Revista Ghrebh* 1, no. 11 (2008): 26–49, [https://www.cisc.org.br/portal/jdownloads/Ghrebh/Ghrebh-%2011/05\\_chagas.pdf](https://www.cisc.org.br/portal/jdownloads/Ghrebh/Ghrebh-%2011/05_chagas.pdf); Danilo Rossetti, and Cássia C. Bomfim, “Live Electronics, Audiovisual Compositions, and Telematic Performance: Collaborations During the Pandemic,” *Journal of Network Music and Arts* 3, no. 1 (2021): 1–28, <https://commons.library.stonybrook.edu/jonma/vol3/iss1/3/>.

<sup>5</sup> Flusser, *Into the Universe of Technical Images*, 163.

The polyphony that emerges from the improvisational and gamified characteristic of the network situation creates a sense of linear time shared among the participants. However, due to the latency that occurs in the network situation, the participants develop a different sense of synchronization as when they play in the same physical location. Musical connections turn into an interactive, complex interplay of constant changes and transformations. As Roy Ascott has stated:

In a telematic art, meaning is not something created by the artist, distributed through the network, and received by the observer. Meaning is the product of interaction between the observer and the system, the content of which is in a state of flux, of endless change and transformation.<sup>6</sup>

## Telematic Immersion

In the following section, I will present a case study of my own experience working on telematic music during the last two years as a performer, teacher, and composer, focused on the idea of telematic immersion in *Virtual Studies*, a 2020 work by Paulo C. Chagas.

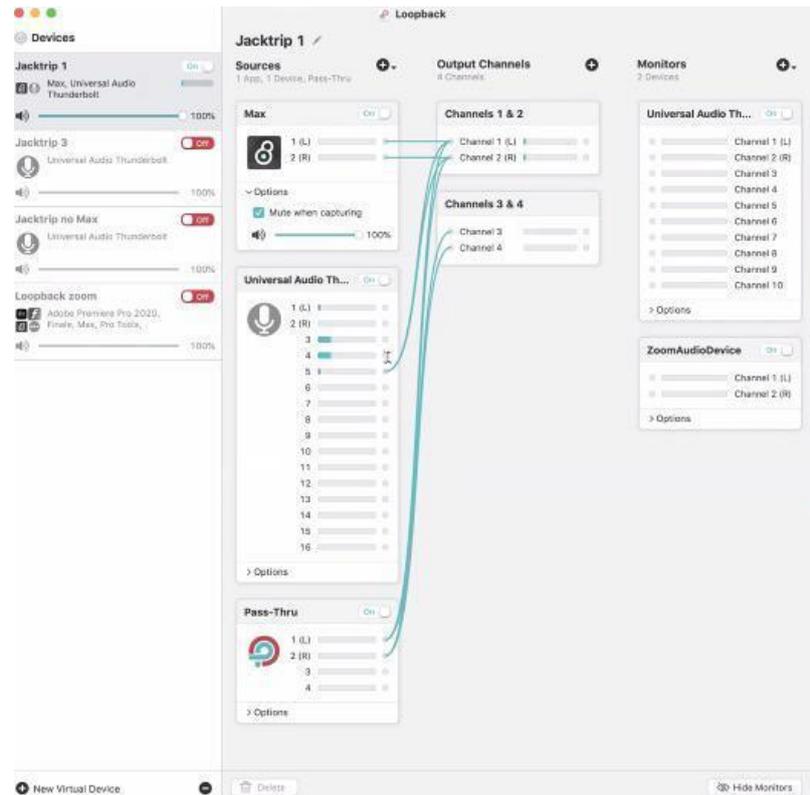
At the end of 2019, we started a collaboration based on Chagas's *Sound Imaginations*, a research project which aims to investigate different cultures and categories of listening throughout a global context.<sup>7</sup> Since March 2020, we have been exploring new concepts of telematic performance working on Chagas's compositions for flute, electronics, and video, all of which unfold through an aesthetics of audiovisual immersion.

The support we received from the JackTrip community was crucial for developing our work. After attending the NowNet Arts Conference in November 2020, I joined the NowNet Arts Lab Ensemble under the leadership of Sarah Weaver. In early 2020, two members of the ensemble, Jane Wang and Gloria Damijan, prepared a tutorial and taught the ensemble musicians how to set up a cloud server. This tool allowed me to connect with several musicians including Chagas. Then Chagas and I were assisted by the sound engineer Mike O'Connor who built an audio system for routing the audio signals from the JackTrip software to the real-time processing program Max via the Rogue Amoeba's Loopback software. The resulting audio was routed directly from Max to Zoom and made available to the audience (fig. 1).

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<sup>6</sup> Roy Ascott, "Is There Love in the Telematic Embrace?" *Art Journal* 49, no. 3 (Fall 1990): 241, <https://doi.org/10.1080/00043249.1990.10792697>.

<sup>7</sup> For more on *Sound Imaginations*, see <https://artsblock.ucr.edu/Exhibition/sound-imaginations>.



**Figure 1:** Loopback routing system for *Virtual Studies*. All figures by the author.

*Mojave*, a work for flute, electronics, and video, was the collaboration between us. The virtual telematic performance unfolds through an aesthetics of audiovisual immersion.<sup>8</sup> It was developed on the basis of 3D video and ambisonics audio recordings made in the desert of Mojave, California in January 2019. I created a performance for this specific site, physically interacting with the landscape and improvising with sounds exploring extended techniques for flute and bass flute. Chagas composed a score for flute and live electronics exploring algorithms of delay and feedback that created an extended timeframe for the perception of pulse and rhythm. This conception of time establishes a dialectic of periodicity/non-periodicity that structurally unifies the acoustic and electroacoustic layers of the composition. Different versions of the work have been created for live performance, telematic performance, and audiovisual media.

One characteristic of audio systems for telematic music is the absence of sound spatialization and reverberation in virtual space. Since there is no shared physical space, neither the performer nor the listeners have the same sonic experience as when they perform in the same room and the sound is projected into the acoustic space. Chagas has explained the importance of connecting these elements as a practical maneuver:

<sup>8</sup> Paulo C. Chagas, *Mojave*, score (2020). The work is 8:53 in length.

The acoustic properties of the performance hall play an important role in determining how the listener perceives the music. Reverberation, for example, can significantly impact both the performance and the listening experiences. It affects the clarity and liveness of the sound and the localization of the sound source.<sup>9</sup>

*Mojave's* musical concept explores the idea of repetition. The delay in the live, electronic sound processing has the function of multiplying repetition, which further creates a multiplicity of temporalities. In figure 2 we see the beginning of the piece with repeated notes.

The image shows a musical score for a Flute part in 4/4 time, with a tempo of 96. The score is divided into four systems. The first system starts with a box labeled 'A' above the first measure. The music consists of repeated eighth notes with accents and dynamic markings of *sfzpp*. The second system has a 3/8 time signature change. The third and fourth systems continue the repeated eighth notes with accents and *sfzpp* markings.

**Figure 2:** In *Mojave*, the beginning is based on repetition of the pitches A and E.

The initial idea behind the work was to establish a harmonic field generated by the alternation of pitches A and E played in different octaves and for this harmonic field to resonate through the delay and feedback algorithm (fig. 2). The live electronics expands the rhythmic and harmonic fabric of the composition. Later, the work turns into a rhythmic complexity with ruptures, chromatic structures, and different temporal layers.

The Max patch created by Chagas has the function of emphasizing and expanding the idea of repetition that structurally shapes *Mojave*. The algorithm of delay and feedback takes a mono signal as input and converts it into a stereo signal that creates two different sound layers. On each channel the delay time is activated periodically and independently so that the sound unfolds independent layers on the left and right channels.

<sup>9</sup> Paulo C. Chagas, *Unsayable Music: Six Reflections on Musical Semiotics, Electroacoustics, and Digital Music* (Leuven: Leuven University Press, 2014), 229.

In figure 3, we observe the sonogram of the Max patch preset of *Mojave*. Tacking an impulse as input, the sound-processing delay works as follows: in the first channel (*left side*), the repetition occurs in every fifth sixteenth note; in the second one (*right side*), every eighth sixteenth notes. We can see that the two channels meet at every 40 sixteenth notes. This builds up a large amount of periodicity into this musical movement; although the listener may not necessarily perceive this meeting, it contributes to establish the dialectics of periodicity/non-periodicity that structures the composition.

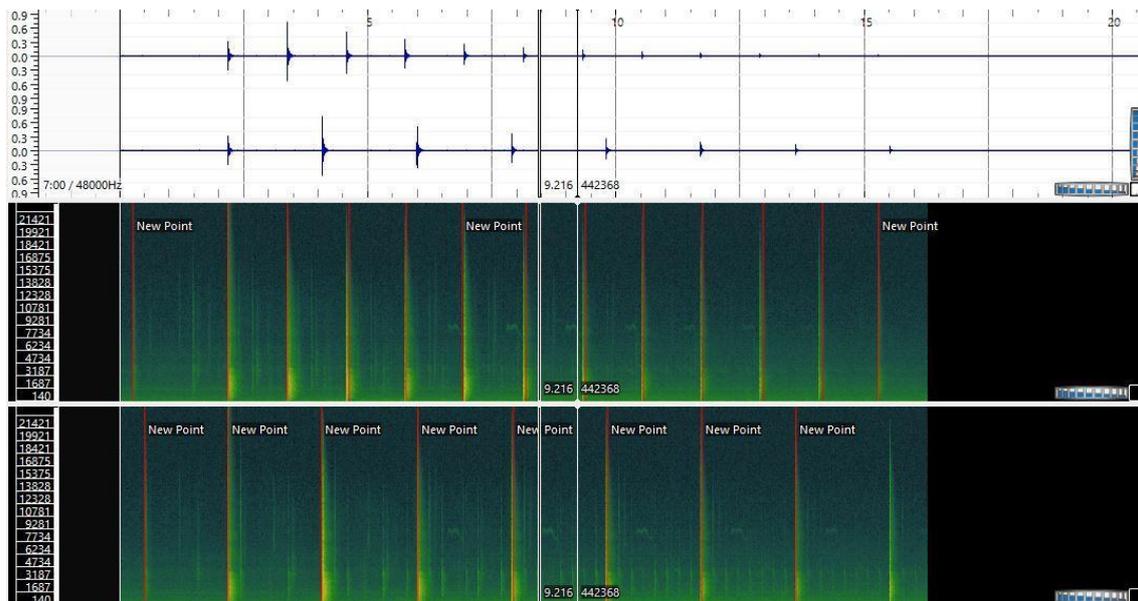


Figure 3: Sonogram from *Mojave* preset 5 x 8

## Virtual Studies

*Virtual Studies* consists of five studies for flute or flute ensemble, electronics, and video. This cycle was conceived upon the principles of encouraging the performers' creative freedom and advancing the use of audiovisual technology within the performance.<sup>10</sup> The composition promotes flexibility through conjugated actions. Each study can be performed independently or in sequence by a single instrumentalist or by an ensemble of flutes or other instruments. The work has variable duration; it can be performed on the stage or in a telematic environment in an acoustic or electroacoustic version.

*Virtual Studies* requires performers to use different technological tools and in such a way that it expands the field of musical performance through interaction with virtual media and audiovisual immersion. The composer extends ideas about polyphonic music to the concept of "audiovisual polyphony," as Chagas explains in the performance notes:

The use of electronic music significantly extends the universe of musical possibilities, from the sounds that extend the timbre possibilities of the flute to the question of temporality

<sup>10</sup> Paulo C. Chagas, *Virtual Studies*, score (2020), 5. The performance of *Virtual Studies* varies in length from 6 to 45 minutes.

that is affected by the extensive use of delay. In other words, electronic music enhances the synchrony and non-synchrony relations in the construction of the work. Video and audio editing are a creative process of audiovisual composition, which can be performed by the performer or in collaboration with engineers and artists. It is very important to develop a global audiovisual conception of the work exploring the possibilities of composition with sounds and images.<sup>11</sup>

Chagas developed an aesthetic concept of a non-synchronous, canonic polyphony that can explore the harmonic and timbral potential of melodies, the alternation of sounds and silences, and online latency, among other matters. This concept results in a texture of sound spaces created by the performers' individual interventions without the need for a concomitance of musical events, such as in traditional chamber music. Furthermore, the performers have the possibility of creating improvisations based on elements proposed by the score. Chagas explains how he elaborated the digital system for execution with electronic music:

The melodic lines can be played and recorded in an acoustic or electroacoustic version. An application is provided (built from a Max patch) to play and record the parts with electronic music. Electronic music exploits a delay and digital feedback algorithm to process the sound of the flute. The performer can experiment with different possibilities of the algorithm and create different electronic versions of the melodic lines.<sup>12</sup>

In the following section, I will discuss aspects of the different creative processes pertaining to the performance and technological improvements of *Virtual Studies* that took place between April and November 2021. Each change in process resulted in different versions of the piece. The resources used in these processes included the JackTrip software for audio networking communication, Zoom video conferencing platform, and Max program for sound processing. The works to be discussed are, as follows:

- 1) *Virtual Study 5*: solo flute with electronics and still background, presented in a virtual event on April 24, 2021, at the “Festival Música Estranha,” São Paulo, Brazil.
- 2) *Virtual Studies*: ensemble with electronics, conducting, and still backgrounds. Part of the project *Transnational Telematic Chamber Music: Connecting Creative Communities*, which consisted of two concerts at the University of California, Riverside (UCR). The first concert was held at the *¡Que Viva Mexico!* conference on May 16, 2021. The second was part of the concert program of the UCR Concert Band on June 2, 2021.
- 3) *Virtual Studies*: flute and bass flute with electronics and video, presented on November 6, 2021, at the NowNet Arts Conference 2021.

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<sup>11</sup> Paulo C. Chagas, “Notes,” in *Virtual Studies*, 5.

<sup>12</sup> Chagas, “Notes,” 5.

- 4) *Virtual Studies*: flute and bass flute with electronics and video, presented on December 2, 2021. Concert held at the 3rd International Cycle of Sound Convergences [*Ciclo Internacional de Convergências Sonoras*], Remote Connections: Musical and Emotional Dialogues on Virtual Stage.

As we improved the performance process, Chagas created different versions of the Max patch for the telematic execution and recording of *Virtual Studies*. Figure 4 shows the most recent Max patch. One can observe the different possibilities of processing the instruments by means of delay through 16 presets, feedback and reverb, and the pre-recorded sounds added for the live performance. The patch design carefully controls the levels of the different sound sources, i.e., the sound of the performers, the processed sound, and the pre-recorded sounds, in order to achieve a detailed balance in the overall result.

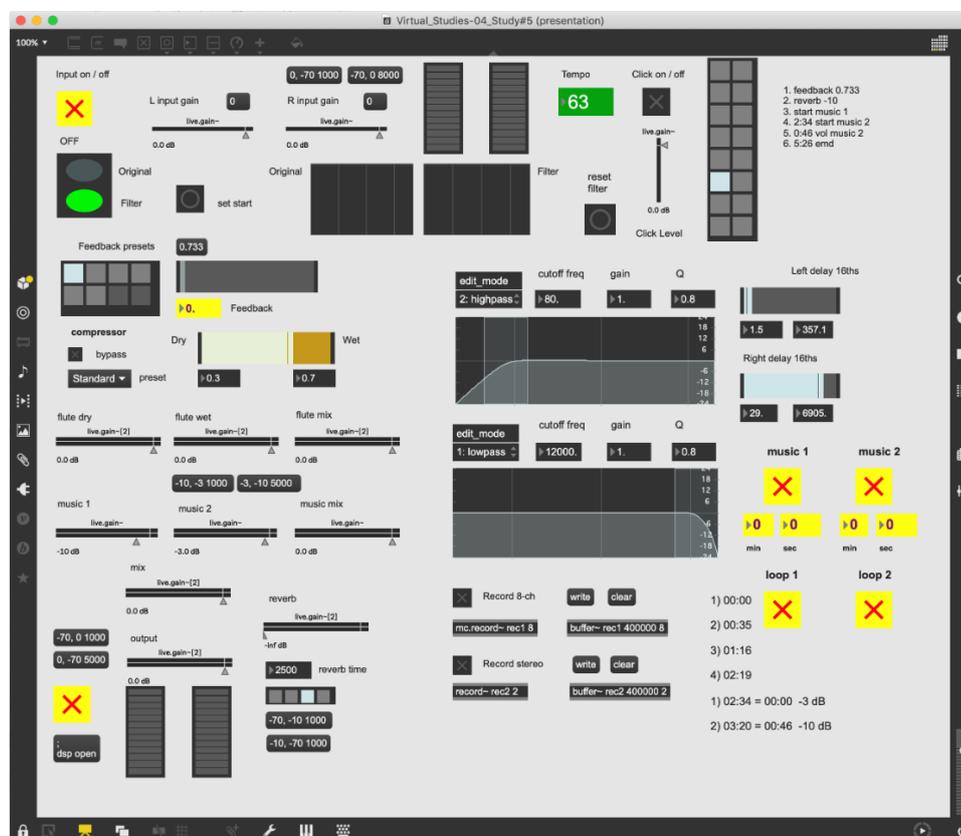


Figure 4: Patch for *Virtual Studies* (2020) by Paulo C. Chagas

### *Virtual Study 5: Solo Flute with Electronics and Still Background*

*Virtual Study 5* functions as fixed media inside the Max patch for sustaining the live processing of the flute. There were two different performances of this study. The premiere took place on April 24, 2021, at the *Festival Música Estranha* in São Paulo; the second performance also took place in São Paulo and was held on May 22, 2021, as part of the International Encounter Hespérides. Both were telematic performances where I played flute and bass flute while Chagas performed with live electronics.

For the performance of *Virtual Study 5*, I generated a series of material consisting of eight different versions of the melody—four with flute and four with bass flute—which I recorded with electronics using the Max patch. For each version I varied the playing using different presets and expanded techniques for the flute. Chagas created two sound files by mixing six versions of this material; these files were included in the patch and played back in combination with the real-time processing of the flutes. The mixed sound files contributed to the emotional atmosphere of the performance.

The first mixed sound file (length 4:36) consisted of four sound files: two recordings with flute and two with bass flute (fig. 5). The composer alternated the different flutes to create a kind of four-voice canon. The file begins with flute one, then bass flute one starts at the 35-second mark, flute two at 1:16, and bass flute two at 2:19.

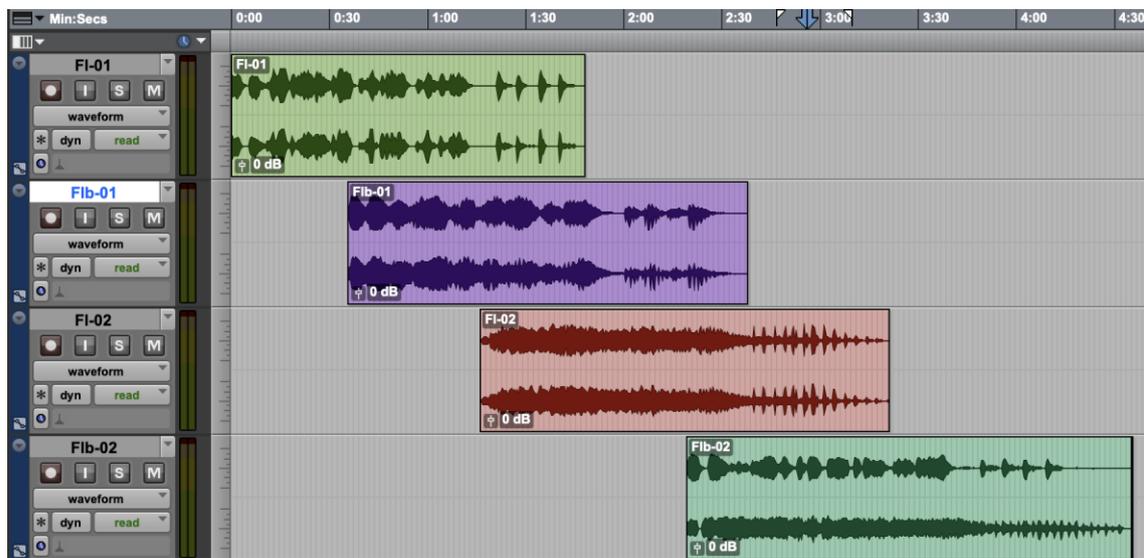


Figure 5: First mixed sound file for *Virtual Study 5* by Paulo C. Chagas

In the following sonograms we visualized the combination of delay and periodicity of each preset. Flute one was recorded with preset 10 ( $1.5 \times .75$ ) where 1.5 refers to how, in the left channel, the repetition occurs after one-and-a-half (1.5) sixteenth notes and how, on the right channel, this occurs after every three-quarters (.75) of a sixteenth note. In so doing, the two channels establish a period length of 1.75 sixteenth notes (fig. 6).

Bass flute one was recorded with preset one ( $5 \times 8$ ) where, in the left channel, the repetition occurs every fifth sixteenth note, and on the right channel, every eighth sixteenth note. Thus, the two channels meet up at every fortieth sixteen note (fig. 7).

Flute two was recorded with preset 14 ( $21 \times 20.75$ ) such that the repetition occurred every twenty-first sixteenth note, as seen in the left channel, and on the right channel, every 20.75 notes. Thus, the two channels meet every 1,743rd sixteenth note (fig. 8).

The bass flute two was recorded with preset 11 ( $1.5 \times 29$ ) such that in the left channel, the repetition occurs after 1.5 sixteenth notes and on the right channel every 29, so the two channels meet after 87 sixteenth notes (fig. 9).

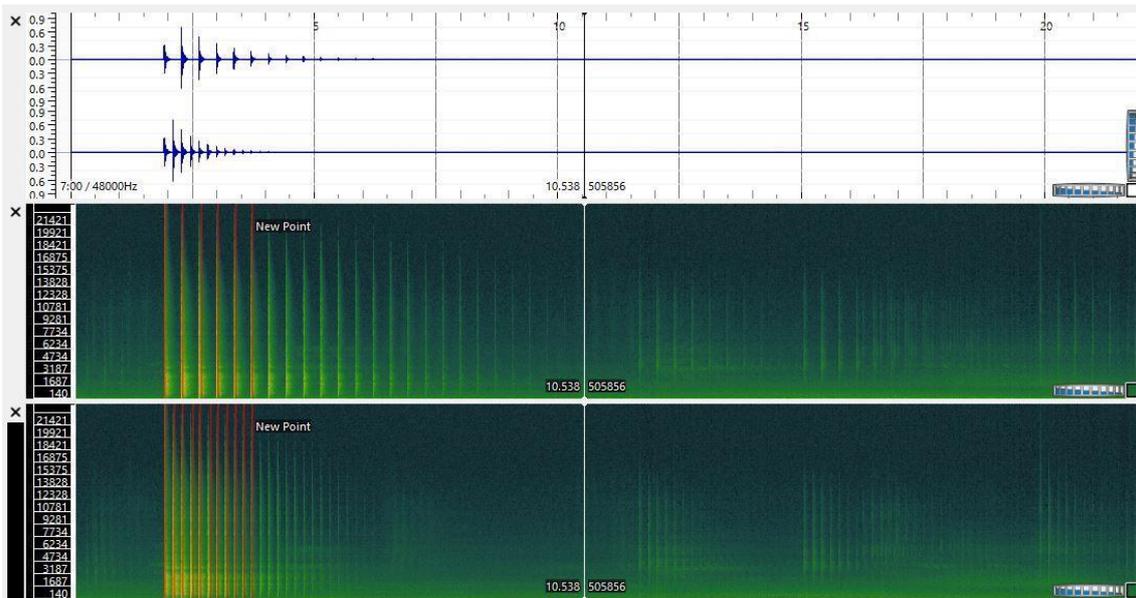


Figure 6: Flute one, preset ten (1.5 x .75)

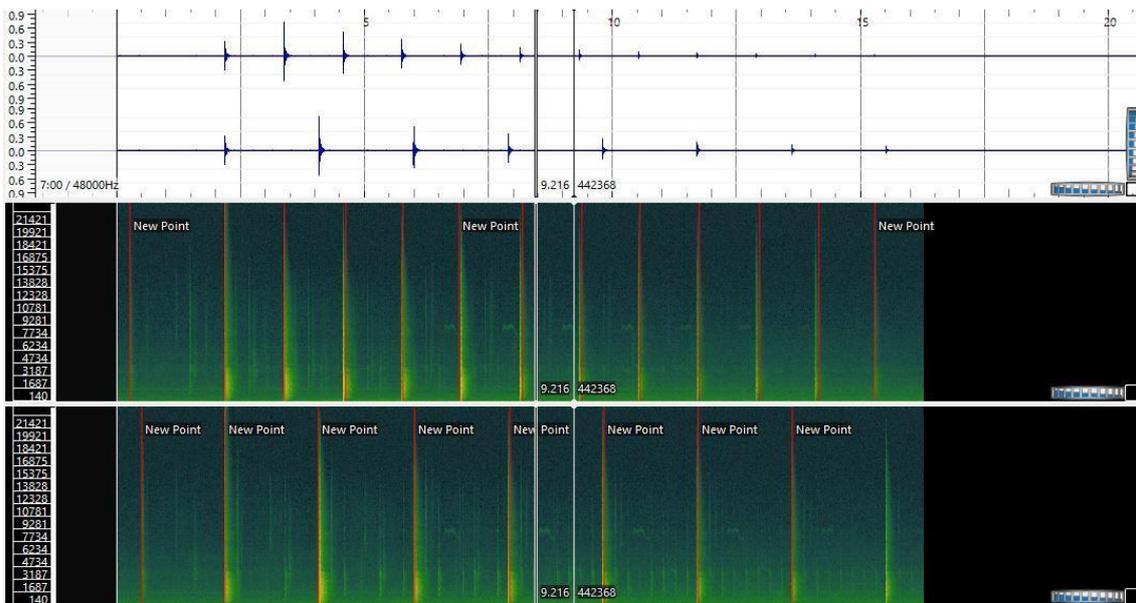


Figure 7: Bass flute one, preset one (5 x 8)

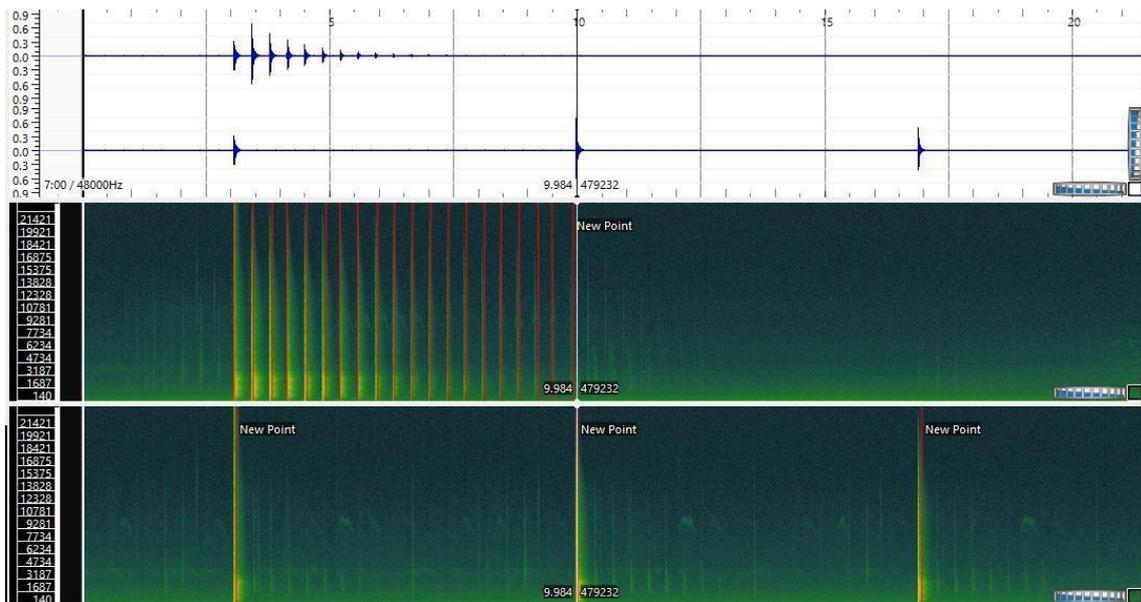


Figure 8: Flute two, preset fourteen (21 x 20.75)

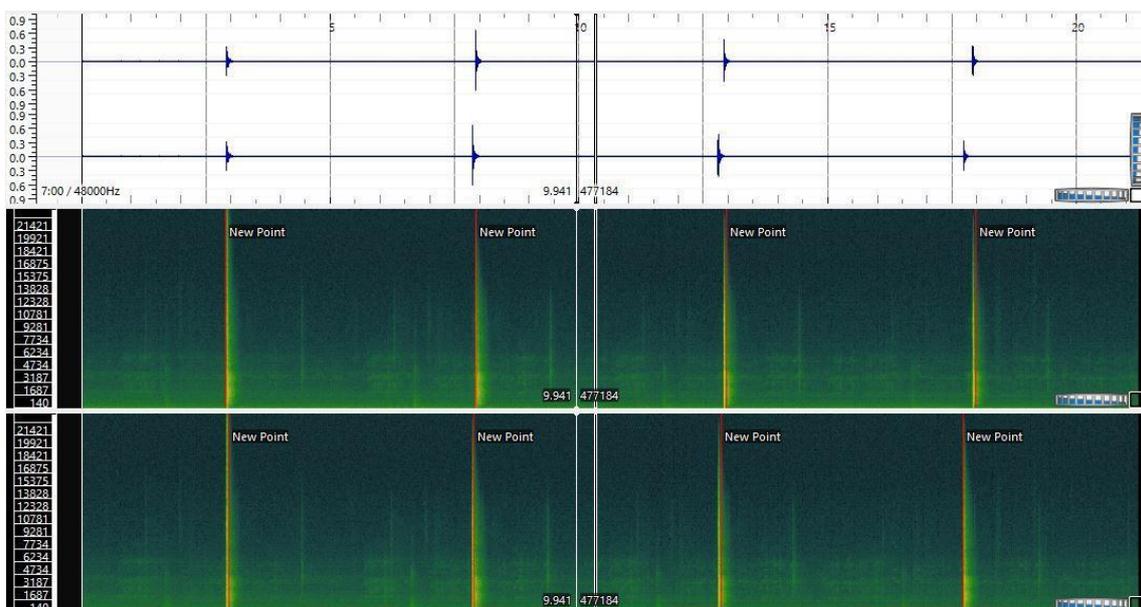


Figure 9: Bass flute two, preset eleven (1.5 x 29)

These sonograms help demonstrate how repetition functions as a structuring element of the composition and how periodicity creates different temporalities. The second mixed sound files used two original recordings of flute with a length of 2:51. In the live performance, it starts to play at 2:34 from the beginning of the piece.

For the live performance of *Virtual Study 5*, I played in a very free manner in relation to the score. I started playing after the first mixed sound file and I used breathing as an expressive element. I chose the breath as an emotional component because of its dialogue with Covid-19 due to how the virus effects the lungs and makes breathing difficult.

The process of generating sonic material for the performance of *Virtual Study 5* served as a model for the development of the complete version of the work consisting of five studies. The complete version was presented on November 6, 2021, at the NowNet Arts Conference.

## Building the Virtual Studio for Telematic Performance

The trend to create intermedia projects had already been set before the pandemic period. When it comes to musical performance, the virtual environment is naturally a space of audiovisual performance.

In the universe of electronic music, there has been a growing interest in audiovisual composition with more electroacoustic works being coupled with video, and mixed works combining electroacoustic sounds, live performance, and visual projection. Audiovisual composition has the potential to bring electroacoustic music to a broader audience, as it addresses a multimodal perception and sensibility. It reveals two important components: the convergence of fields and perceptions as well as the creation of a diversity and differentiation of forms.<sup>13</sup>

Developing the idea of telematic immersion in the time of a pandemic required building a home studio in which the technical characteristics of the apparatuses impact the artistic choices and possibilities of expression. The search for technological solutions adapted to our physical space has been a constant in our work. Since the beginning of the project, we sought to improve the actual quality of the image delivered to the audience. In figure 10, we can see the equipment and setup of the home studio used for the performance of *Virtual Study 5* in April (left) and in November 2021 (right). The use of a HD camera, studio lighting, and a chromakey background significantly improved image capture.

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<sup>13</sup> Paulo C. Chagas, and Cássia C. Bomfim, "With Love: Electroacoustic, Audiovisual, and Telematic Music," in *Proceedings of the 15<sup>th</sup> International Symposium on CMMR* (November 2021), 273, [https://cmmr2021.github.io/proceedings/pdf/cmmr2021\\_31.pdf](https://cmmr2021.github.io/proceedings/pdf/cmmr2021_31.pdf).



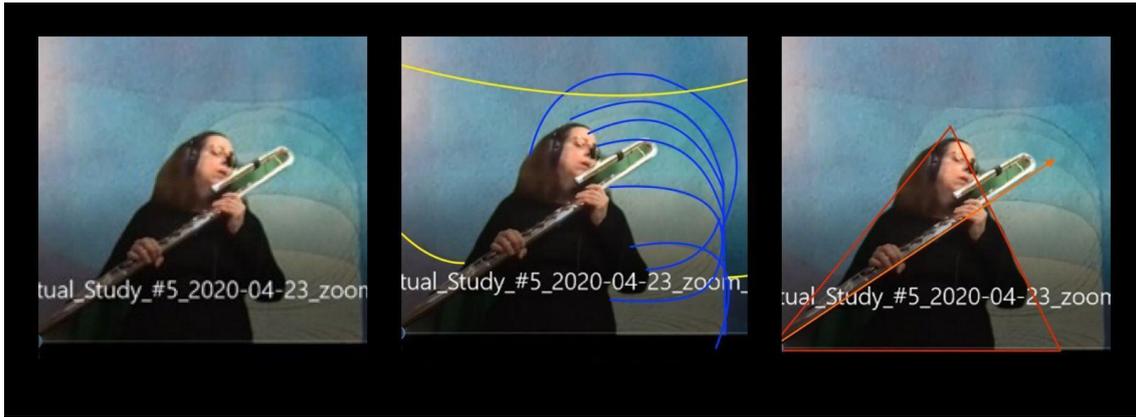
**Figure 10:** Home studio for performing *Virtual Study 5*. On the left in April and on the right in November 2021.

On the other hand, even if we have the ability to make technical improvements to sound and image quality in a virtual environment, some questions have emerged that are directly linked to performance itself. For instance: What are the parameters of corporeality in the performance of live chamber music that underwent a change in the telematic environment? How to act in the telematic space as a scenic performance space?

Telematic, immersive performance requires addressing perceptual relationships, not only in terms of how an audience relates to sonic emissions, but how they relate to the use of the two-dimensional surface of the screen as a space for potentiating bodily performance. Already when we worked on the telematic performance of *Mojave*, our first collaborative work, we made use of the Zoom background tool. We tried three different types of visual experiences with this tool for the musical performances: film projection, slide projection, and single image.

In order to study the different parameters of corporeality in the performance of telematic music, it is necessary to analyze the role of the body from the point of view of the performer and the public. One question that is implicit in this relationship is not only how we are seen by the audience but also how we see ourselves in the performance situation. In the video conferencing setting, the image of ourselves is always present, we see ourselves all the time, and we mirror ourselves—none of this is common to the usual situation of performing on the stage.

For the performance of *Virtual Study 5*, I worked with a watercolor by the Brazilian artist Saverio Castellano. I wanted to situate my image in space due to how his painting includes geometric shapes. In the two-dimensional frame of the monitor one can establish a geometric relationship to the point of inducing the gaze of those who see to understand the multiple dimensions that are within the image (fig. 11).



**Figure 11:** Geometric shapes in the performance of *Virtual Study 5*

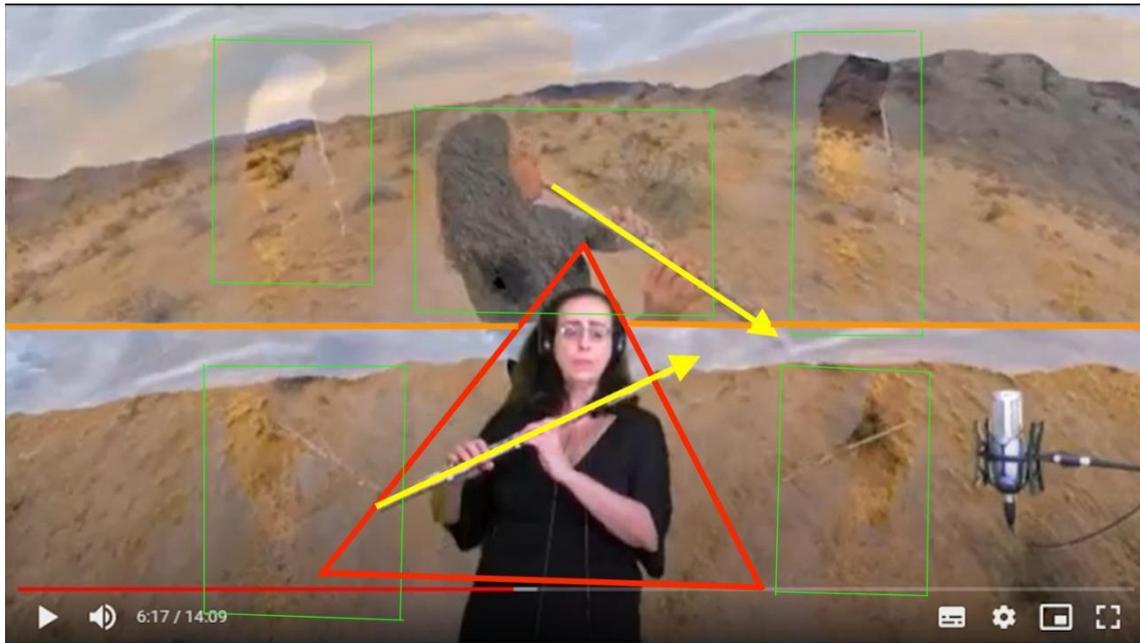
In figure 12, the images illustrate different geometric shapes, the use of space horizontally and vertically, and the proximity and distance to the camera. The position of the flute indicates the direction of movement that takes place through a perspective exerting a relationship between the proximity and distance of the camera. The introduction of the microphone in the scene evokes the presence of a technological device.



**Figure 12:** Different perspectives in the performance of *Virtual Study 5*

For the performance of the entire cycle of *Virtual Studies* at the NowNet Arts Conference on November 7, 2021, Chagas created a video consisting of 3D footage of myself performing in the desert of Mojave in January 2020. The video combines five layers of overlapping images exploring effects of transparency and out-of-phase movements created through very subtle changes of video speed (fig. 13). Additionally, the principles developed for the telematic performance of *Virtual Study 5* were improved with the use of a HD camera, studio lighting, and a chromakey background. I was able to explore the space of my home studio much more effectively and create a greater variety of visual situations.

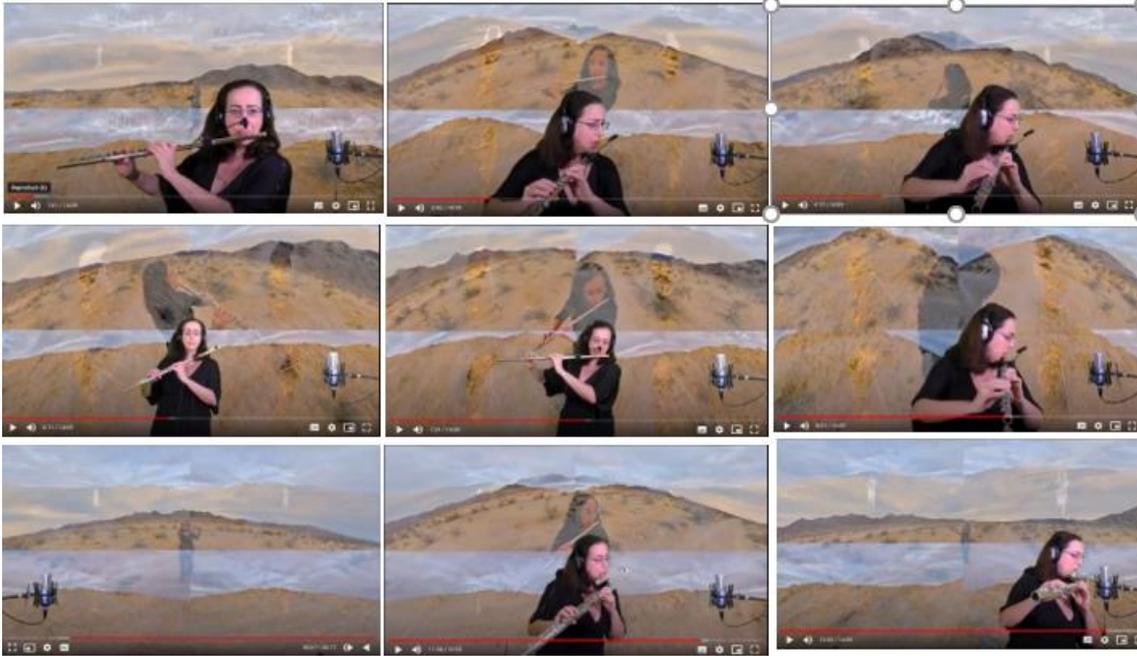
The duplication of my image playing the flute suggests two vectors that direct the movement through how it creates a dynamic of convergences and oppositions that occur simultaneously on different perspectives. The visual presence of the microphone reinforces the concept of making technology visible in the virtual scene. Other vectors of motion are present on the diffuse layers and transparencies of the overlapping images. The combination of virtual and on-site images creates a game of absence and presence; this can be considered a metaphor of the post-human condition (fig. 13).



**Figure 13:** Geometric shapes, lines, and vectors in the virtual stage

In figure 14, we see performative elements that are similar to *Virtual Study 5*, but we made a more significant use of the physical space by exploring coordinate directions. This included the absence of the “performer,” e.g., when I disappear briefly to reach down and pick up the bass flute from the floor. We developed a patch of movements, changing my position in relation to the camera to each of the five studies. In addition, I incorporated silences and physical immobility, trying to intensify the emotional environment of the music. I tried to emphasize the specific mood qualities of each study.

We tried to create an emotional path of great connectivity and invisible telematic energy between two performances that were physically separated by a large distance (I was in São Paulo and Chagas in Riverside, California). I sought to connect deeply with Chagas while we both remained in a state of maximum concentration and preservation of energy in order to create a resonant, immersive space flowing from and into each other.



**Figure 14:** *Virtual Studies*, frames from the NowNet Arts Conference 2021 performance

## Transnational Telematic Chamber Music: Connecting Creative Communities

The project *Transnational Telematic Chamber Music: Connecting Creative Communities* was conceived and supervised by Paulo C. Chagas. It was developed between March and June 2021. The performers under my direction included undergraduate students in a flute class and members of the Ensemble LaFlauta, both from the Music Department of the University of São Paulo (FFCLRP-USP); at the University of California, Riverside (UCR), the student UCR Concert Band performed under the direction of Professor Lauren Wasynczuk. The main objective of the project was to implement the practice of audiovisual telematic chamber music between students of the two universities in Brazil and the United States. The project culminated in two concerts at the University of California, Riverside. The first one was held at the *¡Que Viva Mexico!* conference on May 16, 2021, and the second was part of the annual final concert held by the UCR Concert Band on June 2, 2021.

In addition to *Virtual Studies*, we performed my composition *Modules*, a work based on *Virtual Studies* for ensemble and electronics that uses the same Max patch of *Virtual Studies*, in both concerts. The piece is composed of short modules that are repeated and alternated by the musicians and serve as elements for improvisation. It is a simple musical structure based on the principle of alternating sounds and silences that incorporates the latency of the internet; as such, the composition tries to explore the particularities of performance in a virtual environment.

*Connecting Creative Communities* was accomplished with JackTrip software for network audio communication, Zoom video-conferencing software, and Max software for electronic sound-

processing. Each member of the ensemble was required to have a minimum level of equipment for using JackTrip such as an ethernet cable, interface, and microphone. The Max patch developed by Chagas received the mono input from all musicians and processed the sound in real time, creating a multilayered, resonating sonic environment that greatly improved the quality of the virtual performance space.

The students volunteered for the project and met once a week. The first step to make the connection was to install the JackTrip software on each performer's computer. Chagas invited Synthia Payne, a JackTrip consultant, to help with setup. She demonstrated how to install JackTrip on Windows machines, which was a difficult task for us and the students. Synthia Payne's tutorials were very useful.<sup>14</sup>

Sets of audio equipment consisting of a microphone, interface, and headphone were made available to the students at the University of California, Riverside. All the students in Ensemble LaFlauta were provided with headphones, some with an interface and microphone, and others with microphones that had a USB output and an in-built interface. The three teachers involved in the project used Apple computers.

Students had also to learn how to deal with the specifics and limitations of the equipment, whether the microphone, interface, or internet speed. We constantly worked in search of sound clarity on each system. Adjustments were made to the audio system and buffer size according to the internet speed available to each participant.

We collaboratively elaborated a visual concept for the project. This was determined by the interaction between the musicians and the flow of the performance. We used the profile and background possibilities available on Zoom to create different designs for each piece. In *Modules*, the same blue image with the words "Connecting Creative Communities" was set in each musician's profile and background (fig. 15).

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<sup>14</sup> Synthia Payne, "Jacktrip (command line version) for Windows 10 Instructions," YouTube video, accessed January 7, 2022, <https://www.YouTube.com/playlist?list=PL1PiOF-Vo5KA-xxBue6BjdrEQAXOzDlNM>.



**Figure 15:** *Modules*, “Connecting Creative Communities” visual on Zoom that was displayed before the musicians played

The performance cues for each musician were given in real time through the Zoom chat tool. In order to promote a state of continuous attention and to establish a kind of gamified relationship among the students, I decided to always change the order of when they would each play. With this strategy I aimed to stimulate peer listening and sonic interactivity.

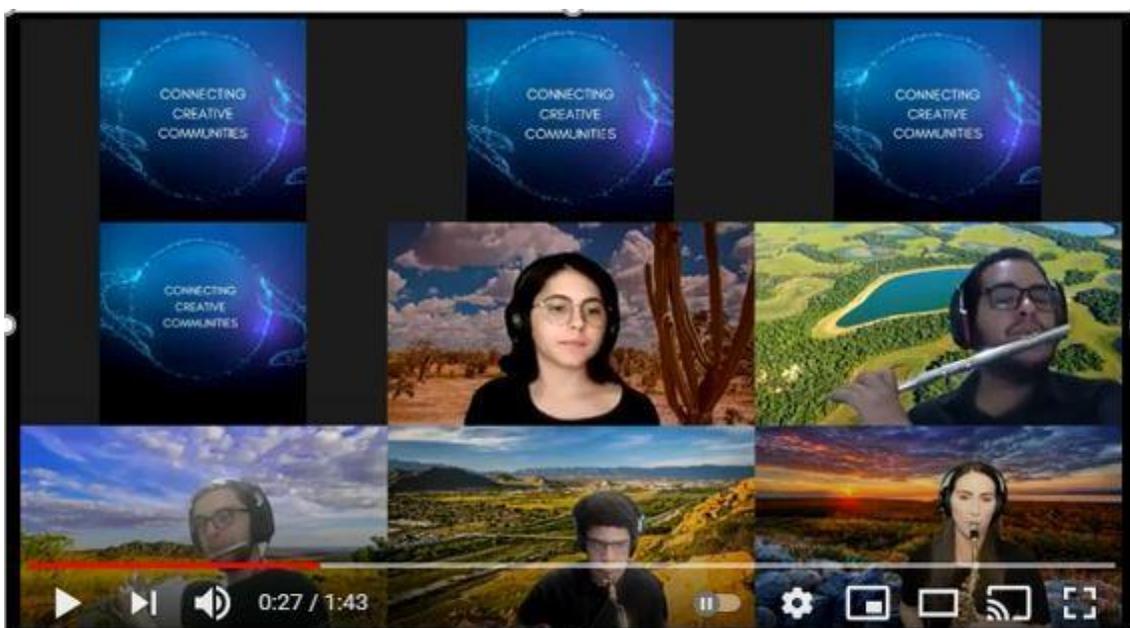
We decided that the musicians should close their cameras when reaching the end of the score so that the performance of *Modules* ended with the same visual pattern as in the beginning (fig. 16).

For the performance of *Virtual Studies*, we kept the same profile images with the words “Connecting Creative Communities.” We also adopted additional images for the background. These images consisted of Brazilian and North American biomes chosen by the musicians. For each study we changed the settings by grouping the musicians differently.



**Figure 16:** *Modules*, visual on Zoom when the musicians play

In addition to the visual concept, we developed a musical concept with pre-recorded sounds of flute incorporated into the Max patch. These were long, continuous sounds exploring extended flute techniques and harmonies with quarter-tone variations. These sounds created sonic textures that functioned as introductions and backgrounds for the five *Virtual Studies* (fig. 17).



**Figure 17:** *Virtual Studies*, background of Brazilian and North American biomes

## Virtual Environment

As a virtual environment implies physical distance, it significantly transforms the paradigm of communication, especially because of the absence of the body in shared space. The latency of sound and image establishes new rules for communication between performers. Flusser, Ascott, and Chagas have provided descriptions of virtual and telematic chamber music and the continuous feedback between musicians and apparatuses.<sup>15</sup>

Chagas and I created different telematic performances of *Virtual Studies* in order to continuously try to develop technological, sonic, and performative solutions to improve the potential for perceptual immersion. We worked collaboratively on many levels, including by making decisions relating to each other's expertise. Along with being a video maker, Chagas is an accomplished composer and researcher in music and audio technology. As a flutist, I was driven to intuitively contribute to these realms as well. We constantly searched for connectivity in a variety of domains: we spent a lot of time working on the details of performances, editing images, and mixing sound. Even when the network connections were not precise, we were looking for different paths for getting information and sharing decisions. We tried to work in video-conference settings as much as possible for our aim was to make the virtual space a common place of ideas, shared emotions, and musical experiences.

Telematic arts can be considered an extension and enlargement of electronic music, especially when musical instruments are processed by technical apparatuses and all communication is mediated by technology. Musicians begin to shape the sound of their instruments by working directly within the framework of the possibilities of machines and by exploring its particular qualities such as computer performance, microphone characteristics, network speed, and software technology. According to Chagas, this dialogical mechanism between humans and machines is an agent of transformation of artistic, social, and political relations:

The convergence of information technology, telematics, and the audiovisual allows us perhaps to dare take a decisive step in the direction of interactive artistic communication, by which we would enter a post-medial era. The dialog between humans, machines, and apparatuses (live electronics, networking, and multimedia) would set up new categories on the condition that a new social, political, and aesthetic practice will free us from traditional media and meaningless language.<sup>16</sup>

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<sup>15</sup> Flusser, *Into the Universe of Technical Images*; Ascott, *Telematic Embrace: Visionary Theories of Art, Technology, and Consciousness* (Berkeley: University of California Press, 2003); Chagas, *A Música de Câmara Telemática: A Metáfora de Flusser e o Universo da Música Eletroacústica* [Telematic Chamber Music: Flusser's Metaphor and the Universe of Electroacoustic Music].

<sup>16</sup> Chagas, *Unsayable Music*, 202.

## Pedagogic and Artistic Outcomes

During the *Connecting Creative Communities* project, the students learned to deal with music technology on several levels. This included configuring their computers for being able to participate in real-time sound sharing, working on the emission of sound into the microphone, sharpening their listening skills, and exercising their sensitivity and intuition in order to interact with network latency. In the virtual space, we already deal with delay when listening to the emission of our own sound. But latency becomes a musical, expressive element when emphasized by the sound processing algorithm on the basis of delay and feedback.

We could observe an improvement in listening—whereby listening is the fundamental aspect that governs all collective musical practices. The quality of listening to oneself and to the others established a strong musical connection among the participants of the ensemble. *Virtual Studies* has proven to be extremely pedagogical work regarding collective listening, the placement of musicians in a virtual environment, and their interaction with apparatuses. The canonical character of the work, which is based on the polyphonic concept of imitation, helped this experience even more. Expressive parameters were worked with an emphasis on the group's sound quality seeking to improve tuning, vibrato, and sound control.

Moreover, the experience of chamber music promotes social skills. In the scenario of social isolation, this action enabled students from both universities to spend time together, make music, establish friendships, and challenge physical, linguistic, and cultural barriers. As a concluding note, I would like to bring up a quote from a previous article by Chagas and myself that highlights love as the fundamental aspect of telematic immersion. We wrote:

The possibilities of artistic collaborations between participants in remote locations, interacting via electronic networks, can facilitate interactive art and interdisciplinary, as Ascott pointed out in his seminal writing of 1960s.<sup>17</sup>

The telematic paradigm involves not only the technology of interaction among human beings but between the human mind and artificial systems of intelligence and perception. It transcends the body, amplifies the mind into unpredictable configurations of thought and creativity, and can contribute to the emergence of a global consciousness. The holistic potentiality of telematic art supports Ascott's metaphor of love in the telematic embrace. Like gravity, passionate attraction draws together human beings and connects them. Global telematic embrace would constitute an "infrastructure for spiritual interchange that could lead to the harmonization and creative development of the whole planet."<sup>18</sup>

The impossibility of sharing common space during the social isolation imposed by the Covid-19 pandemic led us to search for solutions to continuing musical practice at a distance. Telematic music provided not only a path for musical performance but also opened up new

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<sup>17</sup> Roy Ascott, *Telematic Embrace: Visionary Theories of Art, Technology, and Consciousness* (Berkeley: University of California Press, 2003), 109–156.

<sup>18</sup> Ascott, *Telematic Embrace*, 245; Chagas and Bomfim, "With Love," 278.

collaborations with composers and other musicians living in different locations that expanded and enriched the possibilities of artistic practice and research. The concept of telematic immersion, which I have been pursuing in partnership with Paulo C. Chagas, resulted in the composition and performance of several new pieces for flute, electronics, and 3D video. We developed a very close partnership that surpassed the borders of our individual competencies and led us to explore new territories of creativity and performance; in particular, the partnership provided me with technological autonomy to make this artistic project viable. Furthermore, we had the opportunity to apply our experience in the context of artistic pedagogical projects that significantly benefited the students at our universities. In short, telematic music has proved to be fertile ground for new collaborative architectures that we intend to expand in the future by deepening our artistic collaboration and research work.

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## Appendix

### Duo Carrascoza/Chagas

*Virtual Study 5* (For flute, bass flute, and electronics)

Premiere: Cássia Carrascoza (flute and bass flute) and Paulo C. Chagas (electronics). Festival Música Estranha, virtual event, telematic performance. São Paulo, April 24, 2021. [YouTube video](#), 45:50–52:40.

Second performance: Cássia Carrascoza (flute and bass flute) and Paulo C. Chagas (electronics). International Encounter Hespérides, virtual event, telematic performance. São Paulo, May 22, 2021. [YouTube video](#), 11:10–16:42.

*Virtual Studies* (Immersive telematic version for flute, bass flute, electronics, and video)

Premiere: "Virtual Studies." NowNet Arts Conference 2021, virtual event. Stony Brook, New York, November 6, 2021. [Conference program](#).

Second performance: "Virtual Studies." 3<sup>rd</sup> International Cycle of Sound Convergences, University of São Paulo, virtual event, telematic performance, Ribeirão Preto, São Paulo, December 2, 2021. [YouTube video](#), 33:38–46:59.

### Project “Transnational Telematic Chamber Music: Connecting Creative Communities”

*Virtual Studies*, complete cycle (For ensemble and electronics)

Premiere: University of California, Riverside (UCR) Concert Band, Ensemble LaFlauta, and Paulo C. Chagas (electronics). Festival ¡Que Viva Mexico!, virtual event, telematic performance. Riverside, California, May 16, 2021. [YouTube video](#), 6:09:00–6:32:10 (with *Modules*); [YouTube video](#) (complete cycle), 6:15:13–6:32:10.

Dress Rehearsals: “Virtual Study.” UCR Concert Band, Ensemble LaFlauta, and Paulo C. Chagas (electronics). Virtual event, telematic performance. Riverside, California, May 26, 2021. [YouTube video](#), 5:05–21:05; “Virtual Study.” UCR Concert Band, Ensemble LaFlauta, and Paulo C. Chagas, electronics. Virtual event, telematic performance. Riverside, California, June 2, 2021. [YouTube video](#), 4:35–18:15.

Second Performance: “Virtual Study.” UCR Concert Band, Ensemble LaFlauta, and Paulo C. Chagas (electronics). Concert program of the UCR Concert Band, Riverside, California, June 2, 2021. Virtual event, telematic performance. [YouTube video](#).

### Ensemble LaFlauta / Telematic

*Virtual Studies*, *Study 1 and Study 5* (For ensemble and electronics)

Ensemble LaFlauta and Cássia Carrascoza Bomfim (electronics). 3<sup>rd</sup> International Cycle of Sound Convergences, Virtual Connection concert, University of São Paulo, Ribeirão Preto, São Paulo, Brazil, virtual event, telematic performance, November 30, 2021. [YouTube video](#), 16:40–22:15.