

# Telematic Music Activity

## Interactive Electronics, the Internet, and Graphic Scores

from composer **Scott L. Miller**

Spring 2020 introduced a new reality concerning music making for practitioners of every style and genre. My pre-pandemic approach typically employed real-time interactive electronics in chamber music settings, with classically trained performers of acoustic instruments. The technical challenge before me in March 2020 was how to implement multiple audio processing networks over the internet using home quality internet connections, prosumer hardware, and the diverse quality of performing and recording spaces available in each unique home.

Along with the technical challenge came an implicit creative challenge; in the absence of near-zero latency, what musical style or approach to music performance and recording would be both effective and satisfying?

Seeking answers to these questions has led me to develop a reliable and sonically acceptable approach to rehearsing, recording, and producing concert broadcasts of chamber music with interactive electronics (specifically, Kyma). Several different collaborators and ensembles have performed and recorded with me many dozens of times the past 18 months. These include my duo **Willful Devices**, with clarinetist Pat O’Keefe; **Zeitgeist** (Heather Barringer, Patti Cudd, Pat O’Keefe, Nikki Melville); **rarescale** (Carla Rees, Sarah Watts); **Dilate Ensemble** (Gloria Damijan, Carole Kim, Luisa Muhr, Jon Raskin, and myself), and the **Miller-Vidiksis-Wells trio** (Adam Vidiksis, Sam Wells, and myself).

My work with each of these ensembles has progressed simultaneously, and there has been a fair amount of overlapping problem solving, both technical and creative. The performers in these

groups range in location from Wellington, New Zealand to Minnesota, the United Kingdom, and Central Europe. This range of 19 time zones introduced a surprising obstacle to overcome early on—the scheduling of rehearsals and performances when it is acceptable to make sound without disturbing neighbors in all locations.

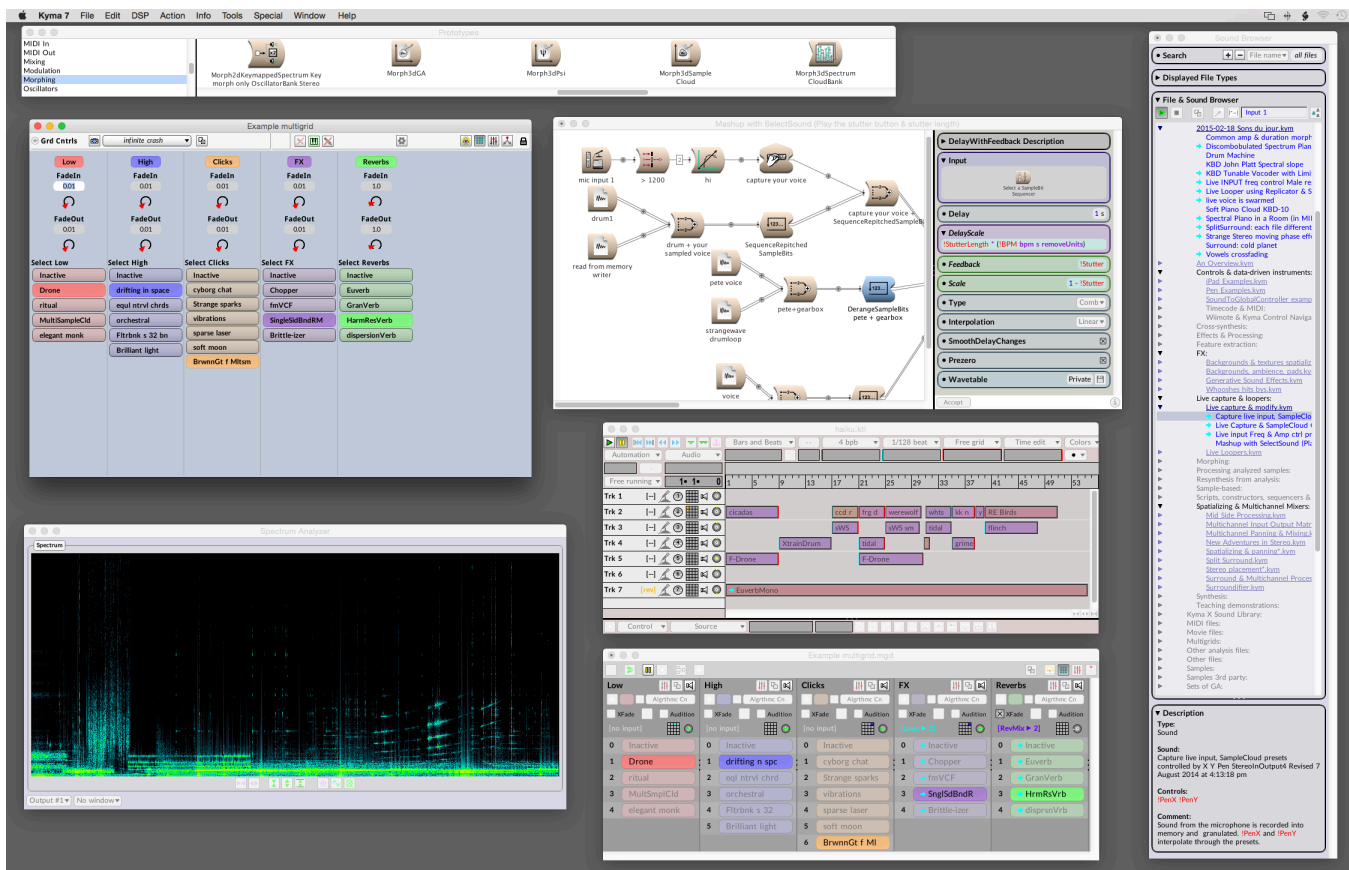


To quote Agostino DiScipio, “air is the interface.” This works differently over the internet.

### Pre-Covid Musical Practice

The interactive sonic network I normally create with Kyma and performers would be in the same room, connecting electronic and acoustic sounds with microphones and speakers. To quote Agostino DiScipio, “air is the interface.” The nature of sonic behavior in a large space, speaker and microphone selection and placement, and an ecosystemic approach to DSP programming in Kyma allow this to work without uncontrollable, howling feedback. The feedback networks, instead, generate data that informs how electronic sound is synthesized and acoustic sound is processed. And when recording, each microphone and electronic output is recorded to an individual track, more or less isolated from the sound of the other sources. Additionally, each performer is monitoring a mix of other’s sounds, sometimes with their own added, according to personal preference.

This works differently over the internet.



Kyma sound design software environment (from [kyma.symbolicsound.com](http://kyma.symbolicsound.com))

In the new, post-pandemic paradigm, the sonic network is distributed across communication networks often intended for business meetings and conferences. The software I and many others first employed attempts to mitigate feedback automatically, disrupting the data generating feedback networks at the heart of this approach. This software is also designed with an ear toward recreating a spoken conversation, trading audio quality for immediacy. And finally, it is modeled on the conference call paradigm, with all voices treated equally in a shared virtual space, usually a monophonic affair.

## Early Experiments

My initial experiments began with solo collaborators located in a few different locations—Pat O’Keefe (clarinets) in Minnesota; Carla Rees (flutes) in the UK, and Adam Vidiksis (drum kit) in Delaware. Using slightly above-average

ISP connections, my first goal was to create an interactive electroacoustic network with Kyma in my home studio and the performers in theirs, with the hardware and software at hand.

Our first approach involved multiple individual sessions of Skype, FaceTime, and Zoom. While successful in the end, this suffered from:

**A.** A reliance on software designed for spoken word communication that is unfavorable to musical instrumental sound.

**B.** The pairing of video streams with each audio connection, exponentially impacting the demand on available internet bandwidth.

**C.** Multiple devices (at least three computers in my studio alone).

**D.** A very long technical setup process prone to surprise feedback loops and general instability.

Together, we gradually explored the use of low-latency software that was being renewed,

more widely disseminated, or newly built in response to the sudden demand created by the pandemic lockdowns. This included open source solutions with a long history (JackTrip), web-based implementations (SoundJack), and new apps (QuackTrip, Sonobus). Some of these create peer-to-peer connections and others work with a hub server to distribute multiple connections efficiently.

## NowNet Arts Lab Ensemble

An important activity for me during this period was participating in the NowNet Arts Lab Ensemble, led by Sarah Weaver, Director of NowNet Arts Inc. Sarah has decades experience creating and producing network arts, and during the early months of the pandemic, was leading the exploration of how to create network arts with consumer quality services, software, and hardware. Especially important, the Lab Ensemble is populated with musicians and visual artists of tremendously diverse technical experience and competencies. The Lab Ensemble—which I continue to participate in—introduced me to JackTrip software, a community of seasoned users and fearless newbies, and many like-minded artists (this is where the members of Dilate Ensemble met and first worked together).

Participating in the Lab Ensemble has been tremendously instructive purely from observing Sarah Weaver's work as director of the group. One of the most important things I learned as a participant and observer is how to guide the installation and use of telematic software. This is no small accomplishment in so many cases, and yet essential to the enterprise of telematic musicking! My participation has also taught me how to technically prepare for and conduct a rehearsal and a concert, and introduced me to the unique aesthetic dimensions and many possibilities of network arts.

## QuackTrip and Netty-McNetface

By the end of summer 2020, I found the greatest quality, reliability, and ease of installation/use to be with QuackTrip, a patch by Miller Puckette that runs on the Pure Data (Pd) application. QuackTrip creates a peer-to-peer connection, and by running

multiple instances, we could successfully establish low-latency networks of three musicians with discrete two-channel connections of uncompressed audio.

Eventually, we settled on Puckette's Netty-McNetface to more efficiently network as many as 12 different musicians. I continue to work with JackTrip in some situations, but for my particular musical goals with telematic music, Netty-McNetface is usually the networking software solution that meets my specific needs. Its greatest advantages over JackTrip are the ease of installation on both Mac and Windows machines, and the general user interface experience. I designed a Netty Primer that I share with each performer when we begin a project, and this enables me to get them set up individually with success very quickly, while the Primer serves as a reference for later troubleshooting that I can refer to as necessary.



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Having said that, a great deal of progress has been made with JackTrip's interface, installation, and documentation in the past year, and there is a tremendous community of musicians and technologists working hard to improve the user experience.

## Graphic Scores Spring 2020 and Summer 2020

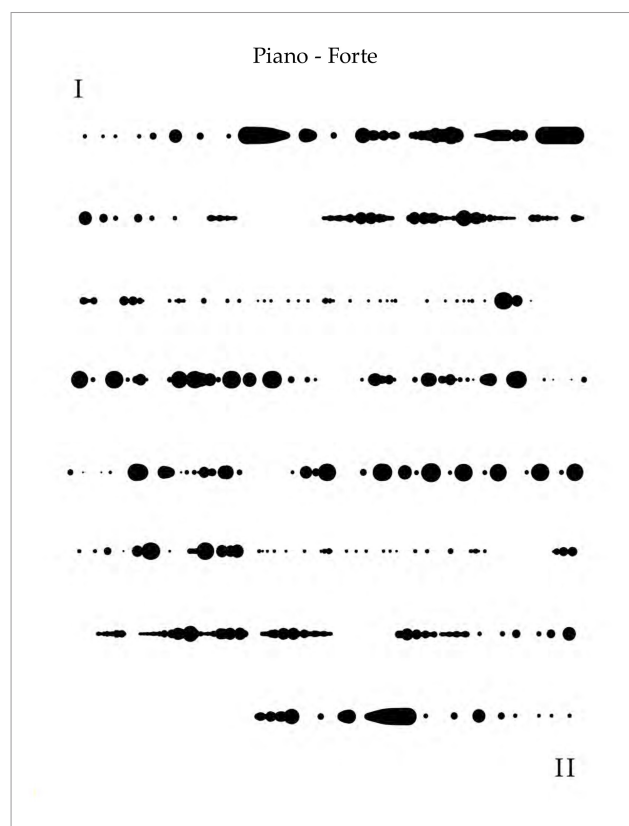
The initial use of communication networks intended for business meetings left me interested in hearing how specific contrasting musical elements behave and sound in that environment. In addition to the compromises necessary with regard to audio quality and accuracy, the latency that is an inescapable part of transmitting sound globally precludes music that is rhythmically intricate or precise at a certain threshold.

I chose, therefore, to work with graphic scores.

The first collection of scores, *Spring 2020*, focus on particular aspects of sound, indicated by the titles, leaving other dimensions open, such as instrumentation, timbre, tempo, and pitch. I do recommend individual movements have a duration of 2.5 - 5 minutes each, which retains performer flexibility while imposing a reasonable durational frame on the experience.

The second collection, *Summer 2020*, adds to the works titled with elemental musical attributes, and includes more abstractly titled works, some titled by date, others with higher level musical structures, such as Sonata and Round. The graphic scores I have created since these two collections have tended to favor the use of more arcane, pseudo-scientific graphic elements and dispensed with musical titles.

As mentioned above, the instrumentation of the graphic scores is open. This is because I was working with a variety of different performers early on, and this provided me with contrasting data, so to speak, regarding the musical element targeted in a given score. And since I was adding performers and expanding the size of ensembles as my technical ability increased and allowed, I created the scores so they might be performed by any number or combination of acoustic and/or electronic instruments, including the human voice.



"Piano-Forte" from Scott L. Miller's Spring 2020

Of course, two performers reading the same score simultaneously—even if in the same direction—may well map identical graphic information to utterly different musical parameters, creating an additional density of sonic information in performance.

*High-Low II* is another early work from the *Spring 2020* collection of scores. It is an embellishment of *High-Low*, designed to encourage performance by ensembles rather than soloists. Again, it uses the familiar organization of systems of graphics, with two horizontal lines of information per system, and the title suggests pitch.

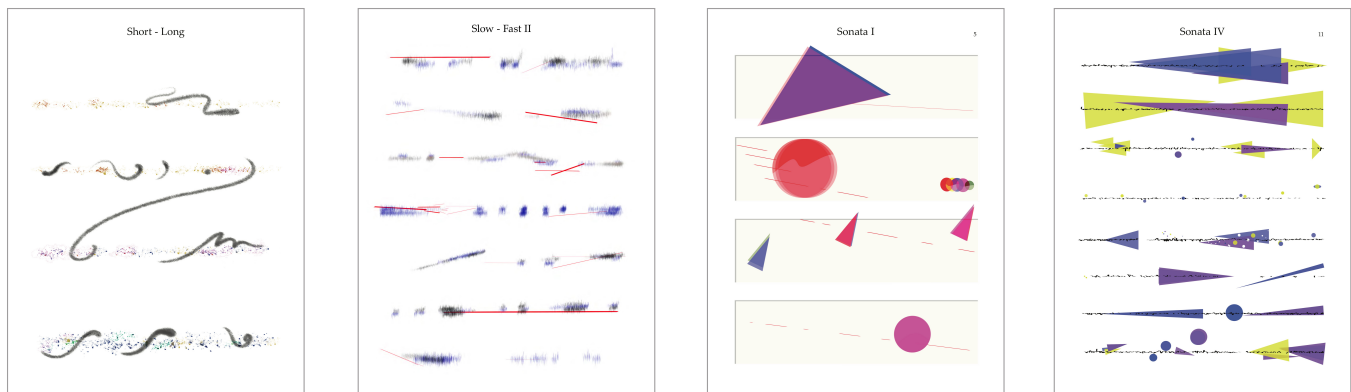
This score features the use of color, with two contrasting colors overlapping in each high/low line. In performances, the colors are frequently interpreted as timbral information, the size and density of the graphic cloud of color as intensity, or dynamics, and/or rhythmic activity.

In several scores, such as *Slow-Fast II*, *Short-Long*, and *24 May*, I maintain the system-like organization but explore moving across the systems

**Two performers reading the same score simultaneously may well map identical graphic information to utterly different musical parameters.**

One of the first scores I created was *Piano-Forte*. The graphic information is organized in a familiar way, as systems, which suggest reading from left to right, and top to bottom. I tried orienting the graphics vertically, rotated 90°, but performers were not pleased with that, so I went with the more conventional layout. I did add a **I** and **II**, however, to suggest reading this as a table-top canon by two performers, which is how it has been performed by several duos.





(left to right) "Short-Long" / "Slow-Fast II" / "Sonata I" / "Sonata IV" by Scott L. Miller

with superimposed graphics. These function in multiple ways, reorienting the direction of reading, or presenting a counterpoint of independent parts for multiple performers or a solo performer to map onto various parameters. Contributing to this is the addition of numbers on the score, the juxtaposition of clean lines with texturally contrasting graphics, and breaking the symmetry of the systems. This is all done with an eye towards flexibility of interpretation by creating a density of information that is contrasting and independent.

As my comfort with telematic technology increased, I moved past creating scores targeting elemental musical dichotomies. I chose to reference a familiar large scale structure with *Sonatas I-IV*, taking graphic inspiration from the intense, contrasting colors and geometric shapes of the Memphis Studio look of the 1980s. And in *Round I* and *Round II*, I fully break with the traditional score layout in an effort to put performer's attention on the relationship between themselves and their partners.

*Exit Velocity* represents a considerable departure from both a traditional music score layout and my original motivations for creating graphic scores to test telematic music potential. It was commissioned by Zeitgeist as part of COINCIDENT, a year-long telematic project I have been working on with the ensemble. *Exit Velocity* was written to be premiered by a combination of forces from Zeitgeist and the Cleveland-based ensemble, No Exit.

In this score I work with graphic elements that

allude to data visualization, with different charts and numeric elements. The title refers to the metric of how fast a baseball is hit by a batter, and the instructions on how to read the graphic score data continue the baseball batting metaphors. The data and graphics are all an utter fiction; I made the decisions based on visual aesthetics, and applied the baseball metaphors at the end of the compositional process. I did this with an eye towards creating a specific process or structure to be followed by each performer that is sufficiently complex as to demand a lot of their focus during performance.

**Telematic music [has the]  
potential to fall out of sync  
despite our best efforts.**

This decision was made in order to exploit telematic music's potential for music to fall out of sync despite our best efforts, and thus to exaggerate the sense of polyphony in the composition. The individual parts are open to broad interpretation by each musician, but with sophisticated (complex?) mappings of various graphic information that demand the performers focus on their part a great deal to realize them sincerely. All of the parts can be viewed together in composite, in the score, but there is at once both too much information and too much that is open to interpretation for it to

unify the ensemble's performance. It is, in a way, as much an artifact of the telematic performance as a recording is.

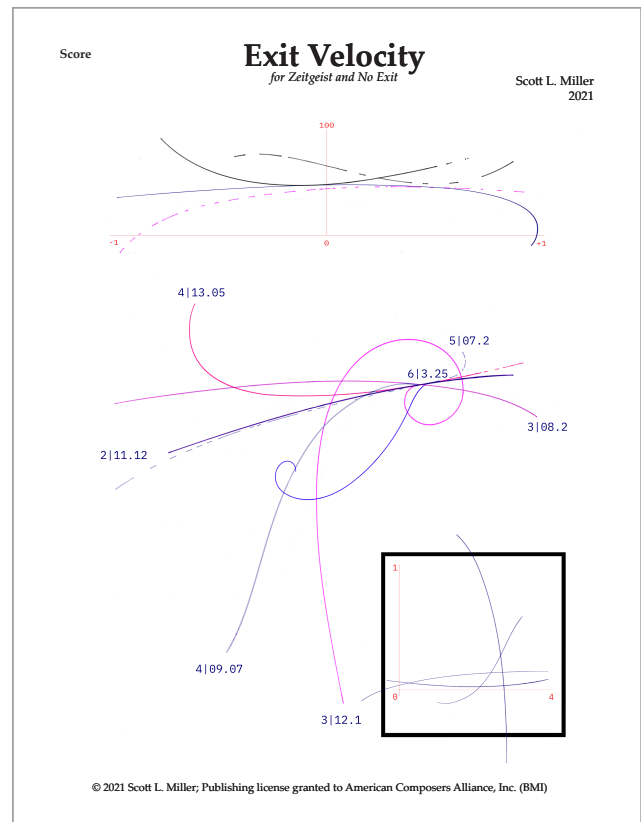
With *Exit Velocity*, I managed to successfully rehearse and record the greatest number of participants telematically, a total of six. Of the six, two were in a shared room with a stereo microphone. This enabled me to individually track their performance (with some bleed) while only using a single network connection, reducing the bandwidth demand. Attempts to add a seventh performer proved to be too difficult to do with this particular composition. A factor was also recording three of the other performers using two channels, rather than just one, an additional strain on bandwidth. While these performers required two microphones to capture the best recording of their instruments, a solution would be to have them mix the mics locally into a monophonic signal to send via Netty-McNetface.

**But for me, it is the aesthetic dimension of the whole enterprise that justifies the effort.**

### Kyma Processing in the performance of graphic scores

I began creating these graphic scores so I could learn how to make a networked environment to perform my music in. My typical role, besides composer, is as an electronic musician and improviser. This includes the real-time processing of acoustic signals, whether as part of a through-composed work or a free improvisation, and my performance of synthesized sound, as an electronic instrumentalist.

Developing a reliable and clean signal path from distant performers to my Kyma system for processing, and returning the sound to the performers for monitoring, was the first job. Success there was really technical, independent of musical outcome. But for me, it is the aesthetic dimension



**Exit Velocity (score)** by Scott L. Miller

of the whole enterprise that justifies the effort.

One aspect of the processing and recording sound transmitted over the internet is the resulting clicks and pops due to buffer underruns and network issues that arise. This happens under the very best of circumstances. Editing out unwanted clicks has become a new step in mixing and post-processing for me. At the same time, there is a long tradition of music that embraces glitches and noise in the system. So I have been favoring many processes that result in textures and timbres indistinguishable from these otherwise unwanted artifacts in my music the past year. I certainly haven't abandoned the goal of a polished, excellently produced, and subtly mixed final product, but I have embraced an aesthetic that includes a lot of noisy and glitchy sounds.