ARRAY2019 – *Agency*

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ARRAY2019 -- AGENCY

Editorial

For the 2019 issue of Array, we focus on the idea of "Agency" in electronic and computer music, explored through the artistic and theoretical reflections of composers, performers, engineers, and musicologists.

How do algorithms and artificial intelligences create a particular character through the decisions they make? How do we interpret the intention of nonhuman agents in the process of musical creation and analysis? Is it possible to tell the difference between the intention of outside agencies from a projection of our own biases? How does the surrounding context integrate into the work itself?

The writings present a collection of contemporary approaches and perspectives from the field, examining topics ranging from the agency of digital signal processing and sonic analysis algorithms, to the design of inclusive instrument systems, object based composition, and relational aesthetics.

This issue is accompanied by a set media examples:
http://dx.doi.org/10.25532/OPARA-45

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Feeling Like an Agent

by Ritwik Banerji

"Much better. Seemed responsive."

These are the brief, written comments of an improviser — let's call him "Charlie" — after the third of ten takes during an experiment conducted at the Center for New Music and Audio Technologies in the fall of 2010. His remarks refer to his experience of playing with Maxine, a virtual performer of free improvisation I designed several years ago to listen and respond to improvisers as if it were just another human player [Banerji 2016]. As he makes clear, he finds, for whatever reason, that this particular take, in which he played a custom-built digital instrument with a highly sensitive tactile control interface and Maxine played a combination of percussion and live sampling, to be a superior experience to the two that preceded it.

So then what was the difference that led him to give a more positive appraisal of this piece? While Charlie's sense was that the system was audibly demonstrating that it was listening to his playing, nothing could be further from the truth. Like any other participant of this pilot study, Charlie was wholly unaware of the real conditions under which he was playing with Maxine. Whereas in the first two takes, the system was in fact receiving live audio signal from Charlie, the system was set to listen to a dummy track during this third take. Nevertheless, Charlie finds that Maxine is demonstrably more sensitive in this third case.

Of the takes where Maxine was deliberately set to not listen to anything Charlie was playing, he found that the system was more responsive (and that this was a positive attribute of the experience) in only two of four. Likewise, he certainly found that the system was listening in a handful of the other six takes, when Maxine was, in fact, listening. All the same, Charlie's comments reflect a very curious state of affairs, in which an individual has been led to believe that his effect on his social environment far exceeds what any reasonable rational, scientific perspective would conclude.

More formally, Charlie's experience in this experiment exemplifies a rather unsettling phenomenon, increasingly observed across a broad range of studies of human agency [Wegner 2002, Bayne 2008, Desantis/ Roussel/ Waszak 2011], wherein one's first-person understanding of the degree and form of one's effect on the situation is drastically different from the amount of agency which one actually has. In such situations, the nature of agency itself — as a scientific fact of how events or changes are caused — does not change; from a technical standpoint, perceptions or illusions of agency are wholly irrelevant. Rather, it is that a combination of elements in the situation brings the human subject to understand that they were the cause of events when nothing of this sort is true.

As strange or convoluted as such problems may seem — and indeed, no one should fail to register them as such — they are of relevance for a broad swath of artists using technology, and particularly computation, as a means of achieving their creative goals. More importantly, the differential between agency one believes they have and agency the same subject actually has further illustrates the tremendous importance of a rigorous approach to the evaluation of new systems and tools at the intersection of computation, sound, and music. While a designer can do a great deal to attempt to offer the human musical participant a feeling of agency, that feeling of agency cannot be directly produced. It cannot be guaranteed even if the system itself is constructed such that the human collaborator's actions are continually analyzed and used to drive the system's behavior.

Charlie's encounter with Maxine allows for an analytical distinction between two layers of agency:

1) the factual, scientific lines of causality by which an entity causes changes of states of affairs in the real world and

2) evidence that such causality is in effect.

This distinction becomes quite helpful in analyzing how many other improvisers have made sense of what was happening in the course of their interactions with Maxine. Strictly speaking, the system always receives live audio signal from the human performer. This signal is constantly being analyzed and is in no way filtered before it passes through the system's feature extraction layer. From a purely technical standpoint, this means that the human participant always has a significant degree of agency with regard to how the system will behave.

All the same, many improvisers who have encountered this system have had experiences with it which are radically different from Charlie's. For the most part, performers have felt that they had little agency in the system's performance. However, the meaning and desirability of this feeling of agency is by no means universal across all improvisers. For example, one Berlin-based American cellist, "Francis," found his experience of playing with Maxine to be positive, to the point that he felt it was preferable to some improvisatory encounters he had with human musicians. At the same time, he flatly declared that he felt that the system "didn't listen." On a purely technical level, what Francis says is not really true. Though there are inevitable differences between what the complex of the human auditory system does and the remarkably reduced version of this sensory, cognitive process which forms Maxine's perceptual layer, it remains that Maxine is "listening," whether Francis feels this is the case or not.

The "facts" aside, it obviously didn't make enough of a difference to Francis that the system was listening to what he was playing. If he had agency in the system's behavior, then there was insufficient evidence for him to come to an understanding that he had much of an effect on its choices at all. While Francis found it favorable that the system lacked an ability to demonstrate that he had agency in its behavior (or "listen," as he put it), another improviser found the same trait undesirable. Like Francis, "Laurie," an American trumpeter also based in Berlin, found that there wasn't much evidence that the system actually listened to what she was playing, an element of the system's behavior she found so irritating that she stopped in the middle of a piece to tell me that this was what she felt.

In both of these cases, the human participant's understanding of the matter is "wrong," in the sense that the conclusions they make about the situation would not stand up to scientific reasoning. The system is always taking information from the human player; it is always listening. Be that as it may, it would be quite foolish of me to tell them that. Aside from the obviously confrontational nature of such a declaration, it ultimately matters quite little whether the system receives information from the environment. What's important is that the performer actually feels that they had an influence on what Maxine actually does since this is the primary sensory basis for any claim they may subsequently make that they felt a degree of agency.

Returning to Francis' understanding of his agency in playing with Maxine, as well as his preferences regarding how such agency should be marked (or not) in improvisatory interaction, a further complication arises in the inherent ambiguity of this kind of "interactional" framework. Broadly speaking, there are two ways that an actor could lead another to believe that the first was not listening or that the second had no agency in the actions of the first:

1) the first actor could simply not listen, not taking any information or auditory input of any kind, or

2) the first actor listens intently, keenly analyzing the actions of the second, but never doing anything that un-equivocally indicates that information has been received from the first agent.

In the first case, the second actor has no agency; it is also quite likely that they experience no agency (unless we are talking about Charlie). But what do we say of the issue of agency — whether experiential or factual — in the second case? How does one distinguish between a deliberate choice not to respond (after having actually received information or registered sensation) and the nearly identical case in which a lack of a response is because no information or sensation has at all been received?

Under what conditions would a human participant still find that this kind of exchange offers some evidence or indication that one actor had agency in influencing or shifting the course of action of the other participant? In the end, it may be practically impossible to really tell the difference between an improviser (whether human or machine) that actively avoids displays of attentiveness and one that behaves as if it simply has a complete inability to hear what others are doing in its presence.

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Intimacy with Objects
by Heather Frasch

"Technology is not something that is simply added to the body from the outside. Technology is a supplement, an aspect of the body that adds to it while it qualitatively alters that very body..." [Manning 2007, p. xxii]

Blurred Categories:
Techno-limbs: contact lenses, glasses, ...
Techno-tools: pencils, paper, flute, computer, ...

.... nuanced extensions of my physical body.

Sonic creations:
kinetic sound sculptures, digital instruments, haptic interfaces, manipulated objects ....

.....intentionally focusing on micro-motion for heightened intimacy.

Blurred Categories :
composition, instrument, object, form, performance, installation

"We find it familiar to consider objects as useful or aesthetic, as necessities or vain indulgences. We are on less familiar ground when we consider objects as companions to our emotional lives or as provocations to thought. The notion of evocative objects brings together these two less familiar ideas, underscoring the inseparability of thought and feeling in our relationship to things" [Turkle 2007, p. 5]

My instrument, *Digital Boxes* (image 1, p. 9), intentionally hides performative activity behind an assembly of cigar boxes. Referencing acousmatic listening, the electronics, sensors, objects, and performer's actions are not revealed to the audience.
The boxes themselves hint at a symbolism of something secret, saved or unknown. They do not depict, but allude.

"A symbol is only a true symbol when it is inexhaustible and unlimited in its meaning, when it utters in its arcane language of hint and intimation something that cannot be set forth, that does not correspond to words. It has many faces and many thoughts, and in its remotest depths it remains inscrutable" [Tarkovsky 1989, p. 47]

My composition *"I touch what I cannot quite reach..."* uses shadows projected onto rice paper in the place of

Heather Frasch, *Digital Boxes*, www.heatherfrasch.net/digitalboxes (Oct, 15. 2019).
Photographer: Karin Weissenbrunner.

lids of modified boxes to amplify the motion of small kinetic sound sculptures. Quivering materials are unveiled while still obscured.
In this project and that of the cigar boxes, the presence of the 'seen' and lack of presence of the 'unseen' evoke poetical meaning.
Their focus is on the vibrancy of the material — physical and sonic.

"Sensation is a state in which action, perception, and thought are so intensely performatively mixed that their inmixing falls out of itself. Sensation is fallout from perception" [Massumi 2002 in: Manning p. 97-98]

Influenced by the writings of Gaston Bachelard, who uses the memory of "houses as a tool for analysis of the human soul" [Bachelard, p. xxxvi], my composition *"weaving broken threads"*[7] uses objects that remind me of past places I've lived: acorns and pine cones from the trees on the front lawn of my childhood home; pencils from my anti-modern technology phase in Philly; wooden slates like the ceiling beams in my beloved apartment in Lyon, France. In the compositional process, I build connections among these places: places I wasn't ready to leave, others I stayed longer than I should have, places where I felt alone, places with big windows, others with quirky curves... As a modular composition, it allows me to examine a range of connections between self, memory and objects.

"Sensation is an event. It creates spaces for experience as well as gaps, holes, emptiness and losses. 'Meaning' is not guaranteed." [Manning 2007, p. 45]

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Initial Remarks on Analyzing Acousmatic Music from the Perspective of Multi-agents
by Kıvanç Tatar

Agency and Agents

The notion of agency can be traced back to the age of Enlightenment within the philosophical discussions of whether instrumental rationality or moral norm-based action is the truest expression of human freedom [Emirbayer & Mische 1998]. The terminology of agency and agents appeared later across disciplines such as Social Sciences, Cognitive Sciences, Applied Sciences, Computer Science. Although there is no consensus on the definition of agency in Social Sciences and Philosophy, an agent is a well-defined term in Computer Sciences, specifically in the fields of Artificial Intelligence and Multi-agent Systems. In their book on Artificial Intelligence (AI), Russell and Norvig [2010] define an agent as "anything that can be viewed as perceiving its environment through sensors and acting upon that environment through actuators."

An agent perceives its environment using sensors while a percept is the sensory data input at any given time. A percept sequence is a histogram of what an agent perceives for a period, and an action is a set of actuators. An agent is a function that associates a percept sequence to an action [Wooldridge 2009], in a perception-action duality.

Agents situate in an environment where they perceive the stimuli and carry out actions within the environment in response to the stimuli. The notion of perception-action has also been brought up in the literature of acousmatic music. Horacio Vaggione [2001] proposed the action-perception relationship in the acousmatic composition process, concentrating on the agency of composers and their relationship with the composition. In Vaggione's perspective, the composer is the agent that acts in the sonic environment by adding, removing, or altering the sonic objects.

Musical Agents

Artistic contexts often involve interactivity between agents; hence, agent-based approaches for artistic applications greatly benefit from establishing a typology of agent behaviors. My doctoral studies focused on audio-based musical agents using unsupervised machine learning. The idea behind these studies was to come up with an agent-based framework where the learning utilized a set of audio recordings so that the musical aesthetics of the agent could be conveniently changed by using different sets of audio recordings. The first step towards developing this flexible musical agent framework, was to to propose a typology of musical agents emerging from the current literature. To do so, Philippe Pasquier and I [2018] surveyed seventy-eight agent-based systems for music to discover a typology of musical agents, which implement the technologies of Machine Learning, AI, and Multiagent systems (MAS) for musical applications. The resulting typology categorizes musical agents though the dimensions of: agent architectures, musical tasks, environment types, number of agents, number of agent roles, communication types, corpus types, input/output types, and human interaction modality.

Our typology identifies six levels of musical agent behaviors:

1) Reactivity: Agents respond to the changes in the environment in a timely fashion.

2) Proactivity: Agents can perceive their environment and plan future actions.

3) Interactivity: Agent can interact with other agents (human, artificial, or biological).

4) Adaptability: Agents learn from their environment to improve competence or efficiency.

5) Versatility: Agents are domain-inde-pendent.

6) Volition and framing: Agents can explain why they choose certain actions when asked by other agents.

Temporality

In comparison to the agency of the composer within the sonic environment of a composition, we can analyze temporal sonic events in the composition using the theory of agents. Temporality is a fundamental aspect of both acousmatic music compositions and the perception-action duality of agents. The temporality within fixed-media works of acousmatic music allows us to apply agent theory to the analysis of acousmatic compositions. We can decompose a composition to its sonic events, and approach sonic gestures as agent behaviors.

If we approach the sonic gestures in the environment of an acousmatic composition as actions of a set of agent behaviors, how do we group sonic gestures as actions of a single agent? The relationship between consciousness, will, and action within the notion of agency has been previously approached by psychologist Daniel Wegner [2003]:

"When a thought appears in consciousness just before an action (priority), is consistent with the action (consistency) and is not accompanied by conspicuous alternative causes of the action (exclusivity), we experience conscious will and ascribe authorship to ourselves for the action." Wegner here summarizes the “mental apparent causation” theory in Social Psychology. This relationship between the thought and action of signifies self-agency with an implication of a body, because thoughts and actions occur within the body of an agent. In the case of acousmatic music, the disembodiment of sonic actions breaks the connection between the body and the action of an agent, which makes it difficult to correlate sonic actions to non-observable bodies of agents within a composition. Although the correlation between the body and the sonic action is missing, the sonority and sound similarity still function to perceptually group sonic gestures and appear as if they are actions of an unknown agent.

Thus, the agency of the listener decides the level of perceived similarity in the grouping of multiple gestures into actions of a single agent.

Incorporating the agent literature to the analysis of acousmatic music, we can analyze fixed-media artworks as if they are occurring in real-time. This approach is similar to the way we experience animations in Computer-Generated Imagery (CGI), which like music compositions, are also often temporal works of pre-rendered fixed-media. When the audience views a sequence of actions in CGI animation, a character may appear to have a sense of agency, like a character in a movie. The observer views the character's actions in real-time, and perceives the occurrence as if the decision-making is also happening in real-time, even though the artist has prepared the actions in advance. While the preparation and fixed-media aspects of CGI animations and acousmatic music are similar, the perception of causality in acousmatic music differs from CGI in terms of the embodied representation of actions. We visually observe the body of a character in animations, and perceive a sense of causality between action and effect, and may infer a sense of agency and temperament based on the character's interactions with its environment. In acousmatic music, the visual embodiment aspects of the sonic actions are missing, and so in most cases the causality of a sonic event is not directly observable, which in turn obscures the agent behind the actions.

Situation

Agents exist in the environment where they carry out actions. Thus, the properties of sonic environments of acousmatic musical agents can be examined in relation with the technology and acoustical spaces they exist within. In some cases, the acousmatic composer creates a real-world sonic environment and spatializes sounds in real-world locations using a multi-channel speaker setup. For example, in the twelfth concert at the ICMC 2019, Natasha Barret's "Dusk Gait" spatialized sonic gestures in the real-world sonic environment using a ring of 16 speakers. In other cases, composers utilize psychoacoustics to create a virtual sonic environment. For example, using virtual reverberation and binaural spatialization techniques, composers can imitate a virtual room that is different from the room of the listener. The balance of the absence and presence of sound constitutes to a perception of a virtual space, which covered in depth by Barry Truax in the book of Acoustic Ecology [2001].

Agents with agents: towards an analytical framework

Using our typology of agent behaviors such as reactivity, proactivity, interactivity, adaptability, coordination, and communication drawn from the literature on multi-agent theory [Weiss 2013, Wooldridge 2009, Tatar & Pasquier 2018], an analytical framework could be developed to provide insights on behavioral qualities of sonic actions within acousmatic compositions.

For example, looking at the agency of the listener in grouping sonic gestures to form a perceptual connection between a non-observable agent body and its sonic actions, we can recall that the process of grouping sound gestures is related to the principle of sound similarity. It should then be possible to apply computational approaches to identify perceptual agents through studying the similarity between sonic materials.

Our previous work on preset generation using OP-1 synthesizer by Teenage Engineering [Tatar, Macret & Pasquier 2016], is an example of one approach to the analysis of sound similarity. In this work, we developed a Multi-objective Genetic Algorithm to find an OP-1 preset that matches a given target sound, by calculating the sound similarity based on the Euclidian distance of envelope, spectrum, and spectral envelope from the target sound. This three-dimensional approach allowed us to work with a non-deterministic synthesizer such as the OP-1. A similar approach could be used to algorithmically cluster sound gestures in an acousmatic composition, and computationally identify the potential perceptual connections between sonic actions and non-observable agent bodies.

The correlation of sound gestures and sonic agents could then form the basis of new kinds of analytical frameworks, agent behaviors as outlined above, could be automatically identified and used to understand the complex relationships between sound gestures and action-perception linkage in temporal multi-agent interactions.

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Instrument Environments

Andrea Neumann in conversation with Rama Gottfried

"The work of Andrea Neumann has always been very inspiring for me, the way that she sets up different situations of interaction in her instrumental/object system, where each element seems to have a real character development aspect to it. So when we were thinking of people to speak to on the topic of agency, I thought of her work right away. The following interview took place at her studio in Berlin, sitting next to her "inside-piano" setup." (Rama Gottfried)

Array: Could you give us an overview of your instrument?

Neumann: I would say the core of the instrument, or the inner life, is actually the piano frame, with the strings. Instead of the usual heavy metal frame, it is made of aluminum, and so it's smaller, with fewer strings, and also shorter strings, but it's all strings. With two separate damper pedals, one for the lower strings and one for the higher strings. I think I would call this section the most "acoustic" part, even though it is of course also amplified, but I can play it in a way that you can hear acoustically. Sometimes it sounds a little bit like a guitar, but I would say it sounds like a piano.

I also needed a space to put my other objects and preparations, and so the builder, Bernd Bittmann, added this metal plate that I can use as a table space, to arrange the preparations before using them. The metal plate section is somewhere between an acoustic and electronic sound.

For the preparations, I sometimes use a spring, or a clothespin that I can bow, which gets amplified by the contact microphone mounted on the metal plate, and on the metal plate I also have different types of surfaces attached (sand paper and cloth) that sound all different. I found that amplifying this metal plate seciton of the instrument gives another flavor, another sound quality to it, much more metallic. Often I play these surfaces with brushes, or steel-wool, or with a metal-tongue.

And then I have the whole mixer area that is purely electronic. I developed an approach to control mixer feedback that I discovered by mistake. I once put a wrong connection, and then all of sudden I had this *[plays a heavy percussive sound]*; and then I figured out how to play with it.

All these different sections, or areas, run through the mixing board. The acoustic sections have a pickup. There's a pickup at the resonance frame, there's a pickup on the metal plate, and I also have a guitar pickup that goes on the strings.

What is really beautiful is to combine all these sections with the electronic sounds. With these four pickups that I use, all of them connect with the electronic sounds, so these worlds can be connected. And I can also decide how much. Sometimes the strings can sound really distorted like an electric guitar, and also the metal plate sounds can get really noisy. So there is a possibility between really big noises, or drones, and really fragile sounding acoustic little string sounds.

Talking about the preparations: I think I was looking a lot for preparations that would sound alone. So I have these magnets that can play on the strings, and then *[places a stack of magnets on strings and sets them in motion, creating a tremolo sounds, as the magnets wobble back and forth; then turns up the gain on the mixer, which amplifies the lower resonances of the string]*.

It can sound for quite a while, but also not too long. And when I put them here on the bridge, they sound all of a sudden like *[plays drier, percussive version of the sound, with a plate reverb trail, increasing in speed until it becomes a pitch]*.

Array: Would you say that this idea of agency is mostly related to the autonomy of the preparations? But then you also have the amplified network system,…

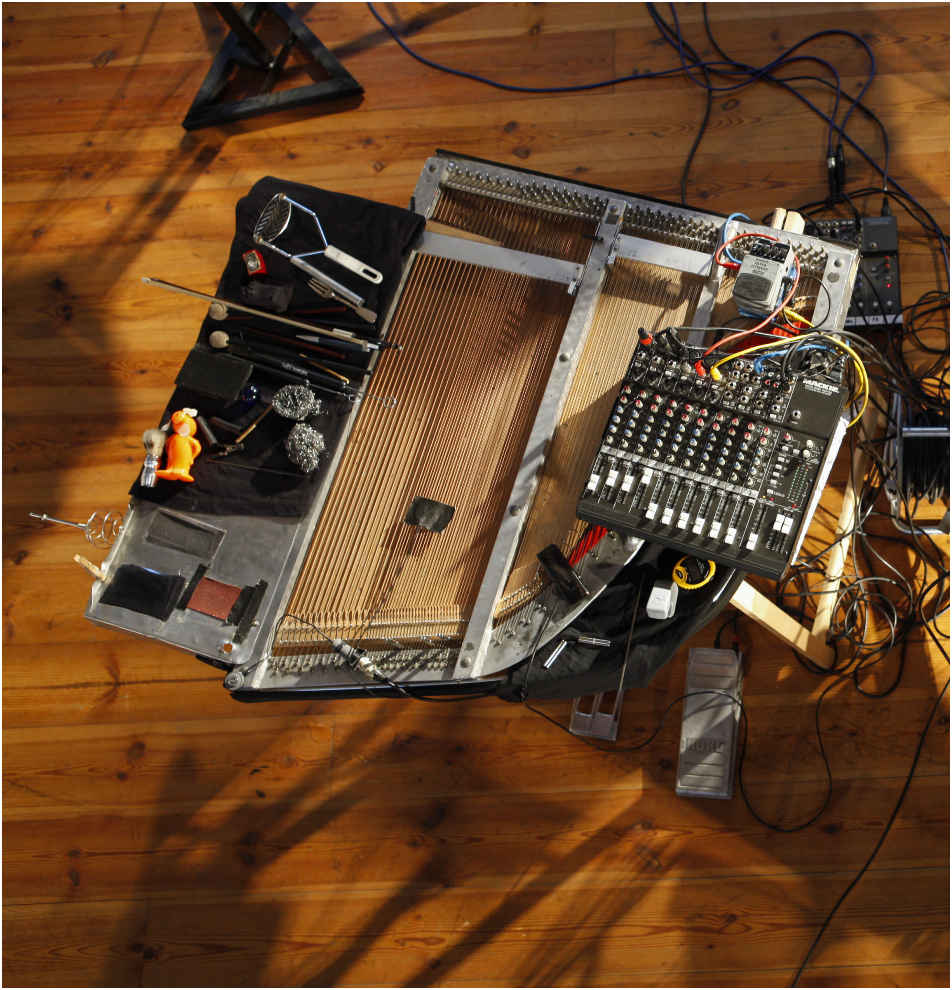
Neumann: There's agency everywhere. For example: I have these percussion brushes, and when you use them for playing the strings, when you want to have a certain intense string sound, you press the brushes so they go around the strings. Shall I also play it for you?

Array: Sure!

Neumann: *[Plays intense, perforated scraping sound, strongly pressing the brush strands into the strings, with the brush oriented vertically, and the brush strands mostly pulled into the handle part, so only a short section of the brush is extended]*

It's different from when you do it this way… *[plays the same brush but lightly, in a more horizontal gesture along the string]*.

But eventually, the brush strands



Andrea Neumann's instrument. Photographer: Anja Weber.

ended up getting very chaotic; almost broken, or crushed, from the pressure on the string; so now I can't open and close the brushes anymore. And this led me to get a new set of brushes, which I discovered have a different sort of quality *[picks up a new set of brushes]*. I was never interested at first, but then I found that when I push the brush strands out completely, and I go onto the metal plate … *[plays fully extended strands of the brushes on the metal plate, amplified with contact mics, which picks up the resonance of the brushes' metal strands]*.

Array: Beautiful.

Neumann: It's almost like a pitch right?

Array: Right! like a bell…

Neumann: Yeah. So, I don't know if it's "agency," but I discovered this only because the other brushes broke.

Array: Right. I am also seeing these different kinds of resonances at play, which by nature are a type of inter-action between the form of the object and the excitation method; plus the amplification, which has its own set of affordances…

Neumann: Yes, but also … *[suddenly sets a spring mounted to the metal plate into motion which plays a long resonant texture]*.

Array: Ah, right, the springs have a kind of resonant autonomy…

Neumann: *[Bows on wooden clothes-pin mounted on metal plate]* These are also resonant in their own way, but very noise-based. There is a little bit of pitch in it, but, yeah… Maybe I'll show you the way the feedback works.

Array: Yes please!

Neumann: *[starts improvising with distorted a mixer-feedback system, with input from various other microphones on the system]*.

Array: Ah! Cool, I always wondered how you got that distortion sound, so it's actually mixer feedback.

Neumann: And also other people can enter the system. When playing into open channels, for example if you have a trumpet playing, it will influence the distortion.

This situation is really cool, because of the networking and hybridization.

Even other people outside of the instrument will be part of it. And I have to say, they enjoy it a lot when they feel they can influence the way the sounds develop. And I enjoy this a lot as well. I don't have to do anything, I just say, *[with an inviting gesture to other imaginary performers],* "ok please" …

Sometimes even when you talk it makes sudden vocal sounds that alter the feedback pattern.

[The system starts distorting when she speaks] What I really like too, is a setting that only has an effect from time to time, or just when I do something like playing short gestures on the strings, that trigger the feedback in short burst and then becomes silent.

This is so alive, right? *[gestures for me to say something]*

Array: Yes! *[No distortion on my voice]* Hmmm…

Neumann: *[System distorting whenever she speaks]* Louder,… you have to speak louder!

Array: Ah! *[No distortion on the voice]* I think it only listens to you. It's your pet.

Neumann: No… *[Distorting]* Louder! you have to speak louder!

Array: [*Loudly and distorting in the system]* OK I'LL SPEAK LOUDER.

Neumann *[laughs]*

Array: Cool, so it's this network, and there all these different actors, some of them you are setting into motion, some are other people in the room, and you have all these things that are going into the mixer, and… well, it's a network, or an environment?

Neumann: Yeah, true. I think this is very nice, that other people, musicians in the room can be, I mean it's not forcing, but they can be part of this environment. It's connecting, not only by playing musicians that are connected by playing music together, but in an acoustical way, there are interactions, and that is really nice.

Array: How would you summarize your approach to this idea of agency within your work?

Neumann: As a general pattern in my practice? Maybe, "to put things into motion." Putting things into motion – which doesn’t necessarily mean producing sound – and letting each element have their own motions. This can happen on completely different levels. It happens between my finger and the strings, but also between me and this feather that will just walk alone, or this fork. It happens between mixer and instrument, and it happens between other musicians who are triggering some mixer sounds, and it also happens between movements and sounds, and when I compose for other people too: it’s also a way to put things into motion. To embrace the interferences that happen; to be open to the interferences that happen; maybe this is a way of discovering environments, or elements of the world, and welcoming the qualities of what happens in these relationships. There’s something quite essential in that. When things get into vibration and something unexpected emerges, this is maybe one of the most beautiful things that can happen. It’s interesting to see how this can happen, with all of these details, and all these different ways of producing sound and movement.

Hand / Cup / Stone
by Evelyn Ficarra

In the second showing of my piece Piano Bench Variations, I placed stones and cups inside an open piano bench, on which a video projection of these same cups and stones were 'played' with, by a pair of video hands, to make sounds. Without any prompting, one participant knelt by the work, reached into the bench and began moving the cups and stones against each other, mimicking the hands in the video, and enjoying, as I had done when I made the video, the agency of creating sounds and small choreographies through handling objects. The next day, a student of mine asked – 'How did you do that?' 'What?' I asked. "How did you make the video follow what the man was doing?' 'Ah!' I said. 'Other way round!'

These questions around where agency lies run as an undercurrent in my work, at every stage. First of all, I am expressing my own agency – or so I imagine – through my compositional process. My core impulse as a composer is an attraction to sound, in particular to a process of recording sound and reanimating it in different contexts – musique concrète, mixed electroacoustic / instrumental music, collaborations in film, dance and theatre, and gallery-based installations. Key to this practice is playing with objects to make sounds. I choose the sounds / objects I love, which resonate with my ideas, and pull them together into audiovisual pieces, exerting what I imagine to be my direct agency. By direct agency I mean that I am in direct physical contact with materials, exerting power over them, using them to express and explore a creative idea. More specifically, I improvise with physical objects as instruments, exploring their sonic capabilities, alone and in combination, and record the sounds they make for further electronic manipulation. I may then turn those objects into audio speakers and re-use them to re-animate their own recorded sound, setting objects and sounds in a scene together (e.g. as part of a sound installation).

Objects I've been interested in lately include teacups and other crockery, broken pianos, stones, pieces of wood and metal. On closer consideration, how much am I in control of, or exerting power over, these objects, and how much am I interacting with them in a dialogue? Through physical

Evelyn Ficarra, *Piano Bench Variations*, 1078 Gallery, January 2019 interaction, I am asking questions of the objects. What sounds can these objects make, how do they behave when subjected to different pressures? I might have direct agency, but I can't have sole agency, because I'm not fully in control. I don't know, in advance, what sounds will emerge. I can't predict how, or even whether, a teacup will break, when I hurl it against the strings of a clapped-out upright piano, or which strings I'll hit, or how many fragments there will be or how they will fall. It is my energy that sets the process in motion, but it is the stored energy in both the teacup and the piano that erupts at the point of impact. In that sense there is a shared agency between the objects and me, and the objects guide me in the process of making.

This shared agency continues into the electronic realm, through technology-dependent acts of audio recording, then to further, digital interactions with the material in the computer. What is the agency of a recorded sound? R. Murray Shafer speaks of the 'schizophonic' nature of recorded sound, its alienated separation from the original source. Is this kind of disembodiment a loss of agency? Or is it a further distribution of agency – now the sound originates in the computers, and comes to me through headphones or speakers. Now the relationship is between me and the computer, and again I'm not fully in control - surprises come at me via the software, when I subject the sounds to digital processes whose sonic result I can't always confidently predict. The computer becomes another partner in agency, as do the loud-speakers through which the sound is reanimated – another variable in a long chain.

After so many years working with recorded sound, I've become somewhat skeptical of professional audio speakers – not of their brilliancy of sonic reproduction, I am still seduced by that – but of their theatrical inertness, their quality of 'there-to-be-heard-not-seen'. Moving away from the concert hall into the arena of sound installations, in gallery shows or as site-specific work, I'm now bringing the original physical objects back into the artistic equation, creating an uncanny – perhaps ungainly – fusion or collision – between the object and the sound recording of that object. Thus the sound of a teacup being stirred emanates from the teacup itself, or the audio-image of a hand

Evelyn Ficarra, *Piano Bench Variations*, Sussex Humanities Lab, March 2019

playing the piano is projected onto that piano, using a transducer to make the piano resonate with its reimported sound. Could one see this reanimation as giving agency, in the form of physical presence, back to the object? Or is it an artificial or prosthetic agency, achieved through technological ghosting, creating a zombie object, undead, a kind of puppet? If a computer is running the sounds from behind the scenes, is it too sharing agency, perhaps through randomized sound selection, becoming a kind of stand-in for me as sonic puppeteer?

The final layer of agency lies of course with the listener / participant. My recent collaborative show Broken Open offers four separate pieces (TEA POeT, Ghost Cup, Falling, and Piano Bench Variations) grouped loosely together on a small stage. The audience can experience them in any order, for as long or as briefly as desired, with a wide latitude of proximity. They could even, if they wanted, touch or handle pieces, as did the participant mentioned earlier. They decide how much attention to give, how long to stay with each piece, what angle from which to view it. Ideally, they make these decisions in response to objects and the sounds they make.

A teacup draws them in by whispering, but then the tray on which it sits shocks them by beginning to shake... then their attention is drawn from behind by the sound of china smashing onto piano strings, or a bowl of broken crockery which emanates with the sound of clinking shards. With these pieces, I offer sound/object choreographies and micro-landscapes to the audience, and each participant sculpts their own journey and constructs – or not – the meanings. My hope is to evoke a space for the exploration of narrative, musical and poetic resonance, which reveals itself, and is co-created, in line with how much time, attention, and quality of thought an audience member gives to the work. It's a relational agency, an agency of imagination, shared between objects, participants and artist, in a given space and time.

Defining Ecosystemic Agency in Live Performance. The Machine Milieu Project as Practice-Based Research.

by Agostino Di Scipio and Dario Sanfilippo

Premises and overview

In live performance setups, computing resources typically represent powerful yet subordinated technical agencies, piloted by practitioners or implementing well-planned automations and compositional algorithms. The necessary analog equipment is viewed, to a large extent, as a neutral chain of electroacoustic transductions, transparently channeling and amplifying input and output sound signals. The local physical environment is itself either ignored or "tuned out," implicitly understood as irrelevant to the performance process and to the actual sound events it brings forth.

In a different perspective, the complete performance framework can be understood, instead, as an integral "performance ecosystem" [Waters 2007, 2013], and the whole field of interactions between human performer(s), equipment (computer devices and analog electroacoustics) and the surrounding environment can be addressed in its terms and turned into a creative medium. In earlier experiences, the authors of this paper have independently designed their performance ecosystems as complex dynamical systems to be creatively explored in live performance and sound installations contexts [Di Scipio 2003, 2008; Sanfilippo 2013, 2018]. In 2014 they started a collaborative effort, which was eventually given the project title Machine Milieu.

The idea is to consider the human performer, equipment, and performance space as three sites of agency mutually connected in the medium of sound, capable of developing an integral and possibly autonomous performance ecosystem based on site-specific sonic information only ("sound is the interface" [Di Scipio 2003]). Central is the notion that the computer-implemented processes involved may somehow "make sense" of what happens sound-wise in the local, shared environment, and act accordingly.

This effort points to a situated, and hybrid process whose system dynamics, whose musical identity, or Self, develops from its structural coupling with and exposure to an array of external forces and agencies (i.e., to several "non-Selves," or "other

Selves") present in the local environment [Di Scipio 2011]. We lean on Maturana & Varela's [1980] well-known discussion of autopoiesis in living systems: an autopoietic agent is a system that develops its Self as its component parts work together and construe a whole by making something in and to the environment to which they are structurally coupled, while allowing the environment to bias their operations. Our idea is to implement an autopoietic dynamics able to determine the emergence of consistent behavior in sound. While the interacting parts bring forth a whole, the whole in turn biases or bends the individual parts in their further doing and thus reinforce the ensemble in its distinct dynamical behavior. Both "upward" and "downward" causations are involved in the unfolding of complex dynamical systems [Benkirane et al. 2002].

Such kind of agency can be likened to a minimally cognitive system [Etxeberria et al. 1994, Barandirian et al. 2006], i.e., an entity that construes information about its surrounding in order to establish a positive and indeed constructive relationship with it. In Maturana and Varela [1980], living systems are understood as cognitive systems. Crucial here is the Batesonian definition of information as something built and processed by a system coupled to an environment [Bateson 1972]. The inevitable difference between information construed by the system for itself, and what "really" is out there, is what keeps the system process going. For Bateson, a bit of information is notoriously defined as a "difference which makes a difference": a differential quantum that travels and spreads across the circuit and undergoes a process of recursive interactions and transformations. Information and computation in a cognitive agent were defined by Heinz von Foerster [2007] as recursive processes in a system having sufficient complexity in dealing with the environment. This relates also to Robert Ashby's notion of a minimum of requisite variety [1958] necessary in order for a system to be capable of self-regulation.

In Machine Milieu, we design a bundle of recursive processes which shape an overall ecosystemic ensemble with no central site of agency, no unilateral control over the ensemble or any of the single parts. Each manifestation of such an assemblage is specified by a set of interdependent processes and variables. That results in a complex dynamical system

[Benkirane et al. 2011, Mitchell 2009] where agency at the level of the individual parts is negotiated and mediated with agency at the level of the emerging whole. Changing the conditions of operations (physical environment, analog equipment, and the runtime variables of computer-implemented processes) creates a different system with its own set of evolving ecosystemic dynamics, revealing different potentials emerging from the same structural design. Many repeated explorations of such a performance ecosystem are required in order for its sonic potential to be assessed.

We may eventually call music the traces of such process in sound. By and large, music is always something that happens in a well-balanced triangular interaction of humans, tools, and places.

Autonomy and feedback in live performance

Defining autonomy in music systems is a difficult task [Bown & Martin 2012]. In bio-cybernetic terms, a system can be called an autonomous agency to the extent that it regulates itself by observing the traces it leaves in the environment. It is both open and closed to the environment (hence, to other agencies inhabiting the environment): it eventually "closes onto itself" through the environment to which it is open [Maturana & Varela 1980, Clarke & Hansen 2009]. A fruitful notion of autonomy in music-related systems, then, would include this operational loop through an environment hosting a variety of sources of sonic information. In other words, a system's autonomy requires a level of heteronomy, born of heterogeneous forces situated in and mediated by the sound environment. We attribute ecosystemic agency to a system whose composite process does not only "de-emphasize [...] the categorial split between humans and machines" [Rutz 2016b] but also relativizes or waives the split between the human-and-machine couple and the environment.

This notion of autonomous agency implies a qualified notion of interaction, understood as the "mutual influence" of two or more structurally coupled entities. In a performance ecosystem, both humans and machines should be acknowledged autonomous behavior to the extent that they can act (sound-wise) in the environment while also changing their actions upon contact with other agencies in the environment. Feedback should be seen as a structural feature.

Clearly, “autonomous” is not to be confused with “automated.” Automation, implies centralized control. In typical computer music designs, sound events are “automatically” scheduled, or driven, by some formal rules (either a deterministic or indeterministic process), which shape the musical flow in a domain entirely independent of – and fundamentally (in)different to – the medium of sound (be it understood as signal or as a physical and perceptual phenomenon). In our design, leaning as much as possible on the experiential milieu of sound, we develop larger musical articulations out of the material acoustical environment and its “background noise.” Viewing the performance ecosystem as an autonomous agency developing itself based on situated acoustical events can be a significant shift in substantiating an operative metaphor of the “living,” as evoked in live (living) performance practice as well as in the live (lived) experience of sound and music [Di Scipio, forthcoming].

The implementation of multiple feedback delay networks (FDN) is a central factor in our practice, for the peculiar dynamical characteristics they exhibit seem well suited to human-machine interactions in the context of music performance [Sanfilippo & Valle 2013]. In our strategy, even the slightest “differences” in the medium enter into the system, whether originating from performers' actions, ambience noise, or machine output, and are then circulated, and modulated across a network of feedback mechanisms. When the differences are truly informative (in Batesonian terms), a larger process is triggered, resulting in short-term and long-term variations, at both the smallest time scale (signal contours and related timbral percepts), and the general unfolding and behavioral transitions in the systems.

Description of the MACHINE MILIEU project

General infrastructure

A sketch of the Machine Milieu infrastructure is seen in Figure 1. It includes two performers with their Computer Units, microphones, and loudspeakers, to be placed at strategic positions in the performance space (Environment). Bold lines stand for audio signal flows, dashed lines for control signals. Note that several feedback paths can be traced across the complete infrastructure.

The signal processing in the two Computer Units is made dependent on both the sonic context, as captured through microphones and internal analysis, and the performers' direct access to relevant variables in the processing algorithms. Since performers typically act depending on what they hear in the environment, by delivering sound at specific positions in the performance space, the loudspeakers act not just as endpoints of the sound-generating system, but as means to elicit the space's acoustical response, which will, in turn, affect the computer processes (via the microphones).

Performers can be committed to acting not only on the computer variables, but also on loudspeakers and microphones (e.g., changing their position or altering the acoustical context in other ways, causing acoustical shadows and other mechanical effects in the sound diffusion). They can hardly know beforehand the long-term consequences of their actions, but they will eventually face them and feel the necessity to mitigate any undesirable drifts. Incurring a loss of control into "drifts" is not inappropriate, as it may "stress" the system to

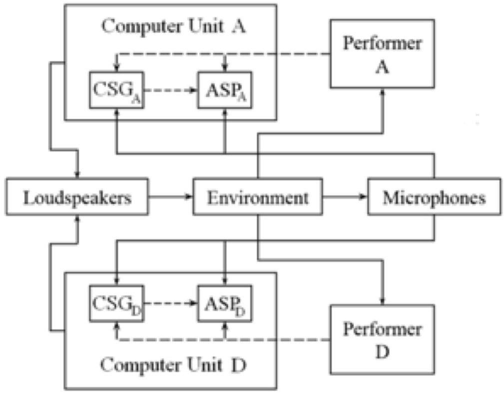


Figure 1. Generic layout of the Machine Milieu infrastructure.

operate in boundary conditions which reveal otherwise unattainable behaviors. One should handle such situations cautiously, making sure the process does not get stuck at the boundaries of its inherent system dynamics, eventually resuming more viable working conditions.

Technical aspects

At the present stage, all digital signal processing algorithms in Machine Milieu are implemented with Pure Data Vanilla and with Kyma/Pacarana. The bulk of it consists of time-variant FDNs though which several nonlinear signal transformations are intermingled. Several positive and negative feedback mechanisms are included, meant to counterbalance local exchanges in the network and to create a larger variety in the resultant sound fabric. Feedback mechanisms are also used to implement a recursive structure across the set of signal processing algorithms, turning some of the latter into iterated nonlinear transformations.

Audio signal processing (ASP)

Audio-rate signal transformations are expected either to proliferate the in-coming signal (thus incrementing the total sonic energy in the ecosystem) or to smooth out and even to dissi-pate energy. We opted for time-domain over frequency-domain processing methods, mainly for computational load and real-time constraint considerations.

The Machine Milieu system makes uses of various custom implementations of: sampling/resampling methods, asynchronous granulation, waveshaping (nonlinear wave transfer, modeling distortion), cascaded FM (also in feedback configurations), pulse-width modulation (PWM), high-pass and low-pass, as well as all-pass and comb filtering, and feedback delay networks (FDN).

It should be noted that multiple FDN configurations are involved: some are simply to dispatch signals across the set of audio processing methods, in some cases creating recursive paths and contributing to the developing of different layers of sonic transformations across different time spans; while other FDN configurations, instead, are arranged in ways that de facto get closer to what would be called a "reverb unit" (depending on the question of time scales).

Once the Machine Milieu performance is on its way, sounds born from the two Computer Units overlap and merge with those emanating from the environment (ambiance, noise). In addition, the output of one Computer Unit will feed the input of the other, and vice-versa. When working in feedback conditions, the signal processing transformations will effectively feed each other creating all sorts of multiple processing paths, potentially feeding back into itself (depending on the electroacoustic setup and the room). Thus, the recursive design turns them into iterated functions, and iterated nonlinear functions, due to the inherent nonlinearities in the signal processing transformations, and in the circuitry of the analog transducers involved. All of this creates a complex dynamic system, which contributes to the range of sonorities emerging in the process.

Control signal generation (CSG)

Control signals are generated here as real-time mappings and transformations of data streams obtained from the real-time analysis of sonic properties in the input audio signal. As they are generated, they are also applied to runtime variables in the audio signal processing algorithms. While typically working in the sub-audio frequency range, here control signals are processed as audio signals, and accordingly, they can be mapped into the audio range and used as modulation signals, resulting in audible spectral modifications.

We parse control signal generation in two main tasks: an analysis step, and a processing step.

Feature-extraction and analysis

We cannot predict specifically which kind of sonority will be subject to analysis – it may range from "silence," to background noise, or any ambiance phenomena, to musical gestures eventually born from the performance process itself (of which, however, not much can be said beforehand). Therefore, it is not possible to pre-select specific feature-extraction methods and "tune" them for optimal performance with specific kind of input materials. A more comprehensive approach is needed, exploring more generic analysis methods, and submitting the analysis process parameters to controls signals generated in the performance process (CSG feed-back).

More fundamentally, we do not presume "feature-extraction" methods can "pick up" or "track" any information in the sound environment: what we do instead is to leverage the energies present in the environment (however patterned, or randomly scattered they might be, in time and space) to shape various low-frequency signals used to drive audio signal processing transformations. This approach leans on a constructivist epistemology [Von Foerster 2007], according to which the general idea of pulling information from the environment is misleading and should be replaced with a notion that information is (to be) shaped, construed, not "extracted." In principle, we should abandon a terminology that implies the objecthood of "data" as information collected in the environment, as properties of a sound event, or of its auditory image. Also misleading would be to say that, based on observed data, the computer will or may manifest a kind of adaptive behavior: adaptation implies the predefinition of optimal target results, and that is not our task.

The main sonic features considered include loudness, density, brightness, noisiness, and roughness. Overall, these are sonic features that can be loosely referred to as perceptual criteria.

Density is an unusual descriptor. We understand it in terms of root mean square (RMS) values calculated over extended signal segments (in the order of few to several seconds), eventually correlated with peak envelope tracking (attack transients) or other statistical analysis ("amount of attack transients" in a given time frame). In that sense, density means more than anything else a "level of activity," or "busyness." Note that density and loudness can be considered as perceptual correlates: the two may be descriptive of the same feature (energy expense in time), but at different time scales. We often derive control signals based on RMS estimates of loudness and density at multiple time scales.

Brightness and noisiness are calculated via original algorithms operating in the time domain (adaptive equal-power crossover cutoff; adaptive zero-crossing rate differentiation). Another strategy is via averaged responses of large-width band-pass filters, allowing to compare energy levels (loudness) across different spectral regions, and eventually correlating patterns between regions. Roughness estimation uses envelope tracking through instantaneous amplitude, calculated via analytic signals and differentiation (transient detection). Depending on sonic complexity, brightness, noisiness, and roughness may be perceptually correlated, and roughness may also correlate with density estimations.

Mapping and processing

Feature-extraction methods provide us with streams of source data, from which multiple control signals can be shaped. Various mapping operations can then be adopted. In broad terms, we can distinguish between linear and nonlinear mapping functions of the source data, and between direct or inversely proportional mapping functions.

Whenever possible, a mapping strategy of "one-to-many" appears especially valuable: a single stream of source data is turned into several control signals. Sometimes (very rarely) it is useful to resort to a "many-to-one" strategy, doing higher-order statistics of multiple data streams and ending up in a single, generic descriptor, integrating the various source data.

Sequences of mapped values are then also submitted to signal processing (simple filters, delay units, etc.). We call this "control signal processing." The low-frequency signals thus generated are to modulate the control variables in the audio signal processing algorithms. Thus, they become vectors of dynamical behavior, allowing for different developments across shorter and longer time spans, and resulting in timbre variations (signal level transformations) and larger structural articulation (musical gestures).

Musical agency based on site-specific sound

Because they are generated as a function of the total sound in the performance space, control signals loop back onto themselves through the space, affecting their subsequent unfolding. Also, some of the feature-extraction parameters (e.g., window size in RMS estimation, or filter bandwidth, etc.) are themselves driven by controls signals (in a strategy of "adaptive filtering"). Such circumstances, stem from the recursive design of the ecosystemic process. They represent feed-back mechanisms at control signal level, and give rise to second, or higher-order emergent patterns in the resulting sounding activity.

The latter annotation may be taken to clarify that, in the approach taken here, the real-time and real-space (site-specific) generation of control signals should be acknowledged a crucial role: it provides the potential for the unsupervised articulation of sound and music at performance time. By resorting to higher-order analysis and statistics of lower-level data, Machine Milieu reveals a kind of situated and autonomous agency capable of bringing forth a sense of consistent and oriented process in sound.

From the standpoint of a single Computer Unit, the total sound at any time originates both from its process as well as from the companion Computer Unit – from other sources in performance space, if that is not acoustically dry or idle. Also, the sound captured by the microphones and input to the computer is never identical with the sound delivered by the loudspeakers, because the microphones will also capture all sorts of phase (de)correlated acoustical reflections in the performance space. Measuring the differences between signals at the digital to analog (output) and analog to digital (input) converters is a way to track down the contribution of the single Computer Unit from the total sound, and to capture what is acoustically added (or subtracted) by the local environment. Complex dynamics of Selves and non-Selves can then be established, which is after all the core job of the CSG methods involved.

Rethinking networked computing musical agencies

Densely connected network systems have long been investigated in the context of algorithmically oriented performance practices (e.g., The Hub [Trayle 1991], and the early League of Automatic Music Composers [Bishoff et al. 1978], not to mention today's live coding practices). Haworth [2014] discusses the ecosystemic and technical structure in networked performance ensembles such as The Hub, where the connective medium is typically provided by formal protocols of music data and their transfer along digital channels (MIDI, OSC, if not the stream of digital samples itself). Knotts [2015] discusses the "distribution of power" patterns implicit in networked performance, comparing them with political models.

In the Machine Milieu project, the main sites of agency are integrated as components of a sounding ecosystem: their individual agency, as well as their collective interdependencies, remain under the spell of the permanent mechanical (acoustical) mediation of the local environment. The connections are not through digital nodes and terminals, but rather along the lines of acoustical propagation in the air (diffused via electroacoustic transducers, whose nonlinearity also adds to the contingent materiality of the ensemble). We sympathize with Tim Ingold's critique of the widespread notion of "network" [see Ingold 2011], although we do not feel necessary in the present paper to replace "network" for "meshwork," as Ingold does in his philosophy of anthropology.

A related question can be raised, as to what exactly is meant by "computing" in such a hybrid context. Assemblages of densely interconnected human, electro-mechanical, and digital agencies make it difficult to tell where precisely computations take place, particularly when made dependent on the specific physical space [Di Scipio 2015]. In Machine Milieu, computer operations do not necessarily represent the most decisive factor, as far the sounding results are concerned: no symbolic representation, no short- or long-term patterning is formalized in the computer. Yet, can we not say sound and music are being somehow computed, presumably by the overall ecosystemic agency set at work? No syntactical rules are declared; still, a sense of consistent interplay of affordances and limitations, a sense of structure, characterizes the complete performance ecosystem in its real-time and real-space process. The situatedness and contextual dependency of computing resources foster a view of "algorithms" as agencies foreign to an abstract and "immaterial" ontology [Rutz 2016a]. Some sound artists today seem to take a quite radical approach to the materiality of computation [Jordan 2015]. In a larger view, a notion of ecosystemic agency would also stress the distributed and hybrid structure of computation.

Modes of performances

We consider three distinct modes of Machine Milieu performance: automatic, participated, and conducted.

Automatic performances means performers shift aside, or refrain from being part of the ecosystem process, letting the network of signal interactions proceed unsupervised. In that case, the two Computer Units are interfering with each other, while also changing their process based on sounds they have delivered in the room at earlier stages.

It is wrong to say that such a performance does entirely without any human intervention. Listening carefully to the room's sounding character, setting the initial conditions to the overall technical process (fine-tuning of variables, placement of microphones and speakers, and more) – all of that is crucial. However, once that is fixed, performers join the audience and hear the growth and development of sonic materials, at least as long as satisfying behaviors seem to arise. When the potential inherent to the particular working conditions seems exhausted, the performers will intervene to alter the working conditions. In rehearsal, we often work like this a few times, trying to grasp the peculiarities of the autonomic process as different from a performance involving the participation of human agents.

Participated performance means becoming active in the ecosystem. Performers have the following options: (1) they may operate directly on the ASP and CSG variables, manually adjusting numerical values in the signal processing algorithms (via a computer graphic user interface or an external controller); (2) they may reconfigure the mapping and the dispatching of control signals; or, (3) they may act directly on microphones and loudspeakers, changing their position or otherwise modifying their functionality. In some instances, we also utilized small resonators – "found objects," such as carton pipes or boxes, or even hands and mouth – to create a smaller acoustical niches around the microphones.

For each of these options, there might be several "degrees of participation," depending on how responsive and active a performer is in the ecosystemic process. In the Machine Milieu sessions we have had so far, this was experimented by taking different improvisational approaches. Improvisation is very often used when performing with feedback systems [Bowers 2002, Green 2013, Sanfilippo & Valle 2015], in fact improvisation itself can be said to be intrinsically based on feedback, where current actions are mostly determined by listening and promptly reacting to whatever results from earlier actions. Yet, a generic notion of improvisation may not help to qualify the human performer as a site of agency in its strict interrelationship with non-human (algorithmic and environmental) agencies. However improvisational, participated performance is mostly an ongoing negotiation of one's role in the ecosystem process: one takes part in a complex web of continuing exchanges. In our practice, this often translates into an attempt to stabilize the dynamical process for a duration, to support prolonged textures rich in sonic micro-variations. In systemic terms, this is like introducing a form of negative feedback and may represent a challenging task to pursue, given the enormous amount of collateral working conditions and possible sources of perturbations. However "free" and improvisatory, and however "discreet," human actions and goals are constantly put into question by the innumerable, subtle and often unseizable interdependencies among the ecosystem components.

Conducted performance consist of more definite and frequent actions; performers might have a more significant impact on the ecosystemic dynamics, and can eventually pursue more gestural and dramatic developments. In a sense, that opens to more typical musical conducts, where performers take the lead over the available resources and the overall ecosystemic dynamics. They could be said to be "playing." More precisely, they are trying to instrumentalize the performance ecosystem, forcing it towards wanted, specific results.

In actuality, a complete instrumentalization of the technical infrastructure remains out of the question, provided that the structural coupling of the parts (computers, electroacoustic equipment, and performance space) do not only provide affordances but also imposes limitations. Not everything is possible. Limitations may be particularly evident when performers force the process (either inadvertently or purposefully) to operate close to their boundary conditions. This is especially when, perhaps in an approach of "radical improvisation," performers push the process to its limits. In which case, the interplay of affordances and limitations may give special sonorous evidence to the inherent system dynamics.

Paradoxically, such circumstances may be revealing of what we could other-wise call musical form: a delimited field of forces, within whose limits systemic consistency is preserved.

In actual Machine Milieu performance sessions, things are usually more nuanced and coupled than illustrated with the sharp, three-fold classification provided here. Also, the classification does not imply any hierarchy of performance modalities. It only illustrates possibly useful ways to practice and investigate the porous boundaries between the environmental agency that could be acknowledged to our performance ecosystem, and the small and yet significant margin of maneuver afforded to intentional human behavior. What remains crucial is the notion that all agencies involved are taken in a flow of ongoing exchanges or mutual determinations, which cannot be fully characterized in themselves as separate from others.

Final remarks and research implications

By designing it a hybrid (digital, analog and mechanical) sound-generating infrastructure, and by experimenting with the complex network of interdependencies of its compo-nents, we conceive of Machine Milieu as a workshop for performers and listeners to ponder questions of con-text awareness, ecosystemic dynam-ics, materiality of algorithms in daily life, and questions of autonomy and agentivity. However varied, such issues converge into the quest for a definition of agency in overly technologized music environments.

Based on our efforts, and in consideration of research work in ecosystem theory and system ecology [Jørgensen & Müller 2000], we would say that a viable definition of ecosystemic agency is better delineated by rethinking the notion of interactivity (nowadays frequently charged with severe misunderstandings) in the light of the more encompassing notion of structural coupling, a concept rooted in general system theory, and more apt to connote the ways by which living systems deal with the space they dwell in [Maturana & Varela 1980].

Indeed, definitions of liveness in live electronic music performance [Emmerson 2013, Sanden 2013] may take advantage of a closer examination of the structural coupling inherent to hybrid assemblages such as computer and electroacoustic music performance infrastructures. We think that the sheer presence of human performers operating in and across an overly technologized playground is, in and of itself, insufficient to characterize liveness in such contexts. We rather suggest that liveness is found in the way machines, performers, and physical environments are creatively coupled and made to co-evolve. This view may harmonize questions of liveness, as tackled in performance studies, with broader theoretical perspectives today emphasizing the environmentalization of agency [Clarke & Hansen 2009, Hörl 2013] and the materiality of the digital [Parisi 2013].

The sound-mediated and distributed agency illustrated by the Machine Milieu performance ecosystem is probably an example of what philosophers Hans-Jörg Rheinberger and Michael Schwab would call an "experimental system," applied in the context of practice-based artistic research [Schwab 2013, Crispin & Gilmore 2014]. For us, it provides a platform for under-standing musical and sonic creativity as an emergent and indeed ecosystemic phenomenon.

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In Memoriam: Dexter Morrill (1938-2019)

by Chris Chafe

Dexter Morrill was a trailblazing musician with a knack for computers. Dex's recent passing reminds us of how lucky we are when we have the chance to work with pioneers and then follow in their footsteps. The extended world around Dex included a big family and a group of wonderfully creative musicans, and it was my good fortune to get to know many of both groups. Immediately, Dex's verve and music struck all who knew this composer/performer, and he was someone predisposed to sharing everything he made. He was a huge influence and is sorely missed. This sounds kind of trivial, but I was recently painting a place and it came to mind while I was doing it how he once told me painting was never done, that he paced the task one side of his house a year. Shortly after wrapping up my what I was doing, word came that he had passed on. Hanging with Dex implanted all sorts of life lessons. Above all, it's the lessons around music which endure so strongly. These are lasting things to celebrate.

Dexter G. Morrill, Charles A. Dana Professor of Music emeritus at Colgate University, was born in June 17, 1938 in North Adams, MA. He began trumpet lessons at age eight and by 19, studied with Dizzy Gillespie at the first Lenox School of Jazz. At Colgate University '60, he studied composition with William Skelton and led a Dixieland jazz band, the Colgate Hi-Five. He began graduate studies at the Leland Stanford Junior University and studied composition with Leonard Ratner and orchestration with Leland Smith, completing his MA in 1962. From 1962-64 he was a Ford Foundation Young Composer Fellow in Missouri, and later taught at St. John's University in New York, that commissioned his Three Lyric Pieces for violin, premiered by Ruggiero Ricci at Lincoln Center in 1969. Morrill studied composition with Robert Palmer at Cornell University and received his DMA in 1970. He returned to teach music at Colgate in 1969 and established one of the first main-frame computer studios in the world, with help from colleagues at Stanford. He collaborated with John Chowning and Leland Smith at Stanford; Max Matthews and conducted analysis/synthesis of trumpet tones. He was a guest researcher at IRCAM in Paris, France in 1980, and received several composition grants from the New York State Arts Council and the National Endowment for the Arts. Morrill worked on a special jazz project for Wynton Marsalis, and authored A Guide to the Big Band Recordings of Woody Herman and The American String Quartet – A Guide to the Recordings. In 1984, he received a NEA grant to compose his most prominent work, Getz Variations. It was written for, and premiered by saxophonist Stan Getz, and incorporated jazz improvisation and computer-generated sounds. During the 1980s, Morrill developed a MIDI trumpet instrument with Perry Cook, and performed in many concerts around the world. His compositions received performances in the United States, Canada, Australia, Argentina, Brazil, Great Britain, Poland, Czechoslovakia, and most West European countries, and for ensembles including the Northern Illinois Philharmonic and the Syracuse and Baltimore Symphonies. Throughout his career, he was active in composing for ensembles and conventional instruments and recording works with solo artists. Dexter passed away July 2, 2019, of complications from Progressive Supra Nuclear Palsy (PSP).

In Memoriam: Mark Ballora (1962-2019)

by Dafna Naphtali and Margaret Schedel

Ballora was an influential computer musician, data sonification expert, researcher, author, composer, a tireless and ingenious comic/prankster, devoted father and husband, and a very beloved Professor at Penn State. An alum of Theater Arts program at UCLA, Ballora completed two masters degrees at NYU (Music Technology, Music Composition) before moving on to McGill University to complete his PhD. He joined the faculty at Penn State University in 2000, since then teaching courses to a generation of students in music technology, history of electroacoustic music, musical acoustics, and software programming for musicians, and authoring several books.

Even in our community of kind weirdos who love sound, Mark stood out as one of the kindest and most wonderfully weird composers of electroacoustic music. Schedel always pictured a nimbus of ideas swirling around his head, so it was not so surprising when older pictures of him showed a full head of curls, still with that same grin that let you know you too could have fun and rigor in a field you loved.

Mark constantly collapsed contradictions, born in the Bay Area, he was a deadhead who followed the band around and got into electronic music because of the culture of bootleg recordings and the amazing Meyer sound speakers the band designed in collaboration with John Meyer. It was the achievement of his lifetime to be able to create sonifications for Mickey Hart and the Mickey Hart Band, on their albums Mysterium Tremendum (2012) and Superorganism (2013), the film Rhythms of the Universe (2013), which Hart conceived with cosmologist George Smoot, and Hart's performance Musica Universalis: The Greatest Story Ever Told, presented at the American Museum of Natural History (2018). One of his sonifications of a pulsar was played as a memorial at Virginia Tech Cubefest this year. Mark was so humble about this work, but couldn’t contain his glee at scoring backstage passes to the Dead reunion tour. At a NAMM a couple of years ago, I saw how much Hart respected Mark as a musician and a scholar, and how Mark years into the project still couldn't quite believe that he was working with one of his early idols.

Mark had a special power of making you believe you could do anything you set your mind to. Schedel had the privilege of watching him teach in March of this year. He was immaculately prepared but left so much room for the students to talk and bring their own perspective into the lecture. He was clearly loved by most of his students, and Penn State will not be the same without his whirling kinetic energy. Through his work with sonification he was embedded into multiple facets of the university. Schedel is working on a book about interdisciplinary in the academy and through Mark was able to meet at least twelve people who generously gave of their time. It was clear he was well-respected at the university, and beyond respect, his colleagues were somewhat in awe of his ability to move between science and music.

In his sonifications, Ballora had a commitment to both to data and aesthetics — he truly wanted to create musical compositions from the data and he spent hours tweaking every single parameter of his code to create compelling soundscapes that also elucidated the data. His significations of tropical storms and hurricanes were some of his most funded, and popular work. In June 2017, he was co-recipient of two prestigous interdisciplinary seed grants awarded by The National Academies Keck Futures Initiative (NAKFI) and the Gulf Research Program that will involve working with marine biologists to create sonifications of ocean-related data. When Schedel was visiting him, he was in the process of putting this work online and they discussed how to make his work accessible, and posted in such a way that it wouldn't break when web audio inevitably changed its backend. He wanted people to not only understand the relationship of the sound and the data, but also the programming behind it and was in the process of creating Jupyter notebooks to allow the public to manipulate his code and mappings. He was justifiably proud of his work, but was also very open to others building upon his initial IP.

Schedel was Mark's paper chair for the International Conference on Auditory Display (ICAD) that he chaired. Mark fully supported her idea to have a call specifically about aesthetics and they spoke a length about how to make the conference as inclusive to sound study scholars in addition to musicians/coders. At the time, Schedel's father was very sick, and she stayed an extra day at home before coming out to the conference. Mark not only took over her duties for the first day, he took (and made her take) time on the second day to truly talk to me about her feelings in the midst of running an international conference. When she posted on Facebook that her father passed, Mark called her as soon as he saw and was incredibly comforting in a difficult time. Many people have expressed that their stomachs dropped the when they found out about Mark's untimely passing via Facebook. The outpouring of support for him and his family and all the anecdotes about his life made Naphtali and Schedel realize that this guy who they thought was so special was also truly special to so many people around the world.

Schedel will never forget the ICAD concert where he put the audience backstage in a huge theater at Penn State. He created intimacy in a cavernous space through lighting, and the concert had the impact and resonance of a huge hall with the closeness of a living room concert, once again collapsing contradictions. That was Mark in his element as the master of ceremonies, introducing the concert in such a way that we cared for the works before even hearing them, and putting everyone at ease while explaining complex ideas. He will be sorely missed, Schedel will be looking for that bald head bobbing atop that loose-limbed gait, hoping for one more conspiratorial grin for years to come.

Mark wrote a myriad of articles describing uses of sonification (rendering scientific datasets with sound) in the areas of cardiology and computer network security. His work will live on. A celebration of Ballora's life was held at Penn State on September 29th, drawing family and friends, students and PSU colleagues, and a legion of former colleagues and students from around the world, including a large contingent from his days at NYU. Many more who could not attend sent messages to be read at the event. It was abundantly clear to those in attendance that Ballora had a profound influence on his colleagues and students, not just in the information conveyed and ideas researched, but also in the genuine care and investment he made in all he came in contact with personally and professionally.

Ballora will be missed by all of his former colleagues. No doubt this is especially true for those (like Naphtali) who were in the trenches with Ballora in grad school at NYU in the 90's, and who count Ballora as part of their extended family. A large number of NYU colleagues made the trip for his memorial at Penn State because our outsized few years together sharing a cramped office influenced everything we have done since.

He was intellectually curious, a great educator, thorough and relentless researcher, and brough humor to it all. Ballora is survived by his wife flutist Agatha Wang and son Ian.

Ballora's family has requested that memorial gifts be made to the Penn State School of Music https://raise.psu.edu/RememberingMarkBallora.

All gifts will be directed by the School of Music in consultation with the family to best celebrate Ballora's academic legacy.

Current issues
by ICMA Board

After thorough discussions, the following text was adopted by a Board vote and presented at the Member Meeting in June 2019, yielding further input.

Your feedback is welcome (please provide it here: https://bit.ly/2Y0LgDX) and indeed crucial in order for the Diversity Statement to support the dynamic, creative, and representative development that ICMA desires.

Diversity Statement of the International Computer Music Association

The International Computer Music Association aims to be an inclusive association with the goal of promoting computer music in all its forms of expression. ICMA embraces styles, genres, thinking, and tools, that actively, passionately, and profoundly connect music and computing. Membership is open to individuals of all ethnicities, countries of origin, gender identities, ages, backgrounds, and other differences, as well as to institutions and corporations that share our passion. In bringing together di-verse communities, we welcome each and everyone's contribution to form-ing a balanced representation of the richness of our collective experience.

The Board works for the benefit of its members, and actively seeks ways to continue to develop the diversity of the membership body. The Interna-tional Computer Music Conference is organised annually by institutions and passionate individuals across the world, in different countries in all regions of activity, i.e. the Americas, Europe, and Asia-Oceania. The ICMA provides needs-based travel grants to student members. Together with the local organiser committee each year, the Association and its Board strive to increase the diversity of attendees, invited keynote speakers, featured composers, institutions, publishers, and other conference stakeholders, through open calls for participation and through dialogue with the larger communities we serve.

The Board recognizes that achieving diversity is an ongoing and evolving process, requiring active efforts to reach creative communities that have historically not been able to participate fully. To this end, together with the local conference organizers, the ICMA endorses family-friendly conference policies and practices that make it easier for caregivers to participate in activities, and we strive to encourage and support participation from women and other underrepresented member groups. We are committed to developing the Association within a forward-looking and sustainable framework that takes into consideration factors that influence inclusiveness, including (but not limited to): the carbon footprint of conference travel, data privacy, and intellectual property.

As an ICMA member and/or ICMC participant, you can help the process towards more diverse conference experience, by:

- Recommending diverse speakers and/or program committee members to the Board and Conference Organisers;
- Forwarding calls for proposals to relevant affinity groups with the message that we are looking for a diverse participation: stylistically and in all other ways;
- Circulating information widely, also amongst colleagues from marginalised groups;
- Encouraging and enabling students from underrepresented groups to participate;
- Speaking up when you see marginalisation and intimidation;
- Offering feedback on ICMA's strategies for making the conference more welcoming and supportive;
- Sharing your ideas and suggestions that help to realise diversity.

This version of the Diversity Statement of the International Computer Music Association (computermusic.org) was adopted by the Board on 2019-06-19.
It is based on texts published by NIME (www.nime.org/diversity/), O'Reilly Media (https://www.oreilly.com/conferences/diversity.csp), and others.

Link for sharing the ICMA Diversity Statement: bit.ly/2IPpxbu

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