

## In and Out of Phase

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### 1. PROGRAM NOTES

A complex system is more than the sum of its parts. Qualities emerge from the interactions between those parts that cannot be understood by knowing only how each part behaves. One needs to follow the tendencies in the phenomena that the collective gives rise to. This project deems the performer-instrument relationship a complex system of interdependent agents rather than viewing the instrument as an object that the performer controls. Expanding the system by introducing new agents opens the door to new musical processes and expressions. The system in this performance consists of a contrabass, two transducers, a computer, a bass player, and a computer-transducer (CT) player. Each agent affects how others contribute to the sonic outcome. The figure below shows a crude map of how they affect each other. However, only the sounds produced by this system elucidate its behavior.

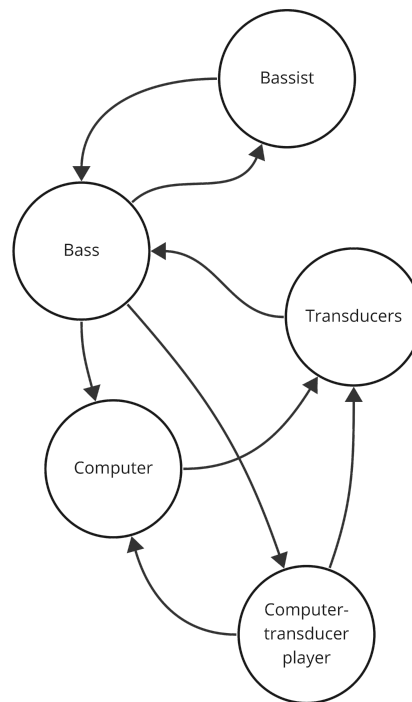


Fig. 1. Causal relationships between the agents.

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## 2. PROJECT DESCRIPTION

The reciprocal nature of the performer-instrument relationship has been apprehended in various ways. Some consider the instrument as an extension of the performer's body. [1] Others have imagined the performer as an extension of the instrument. [2] Then there are those who see the performer as the instrument. [3] However, these perspectives tend to hold on to the human-nonhuman binary that leads us to discriminate between entities based on various assumptions about how humans and nonhumans interact and affect systems. In this project, the artists decided to leave behind such assumptions and view the performer-instrument relationship as a complex system of interdependent agents that has the potential to transform, expand, and distribute agency. In other words, the performer (a human agent) and the instrument (a nonhuman agent) need not engender a specific hierarchical structure of causal relation; their interaction is rather in flux. Each agent mediates the other's operation. It may even be possible to incorporate new agents (human and nonhuman) to grow the system and spread the network of causal relations. This project endeavors to do just that. By achieving this, the artists aspire to create new possibilities for human-nonhuman interactions, tactile and computational sound production, and process oriented musicking.

The system developed for this project consists of a contrabass, two transducers, a microphone, a computer (laptop), a bass player, and a computer-transducer (CT) player. The following figure (Fig. 2) shows how the nonhuman agents share information.

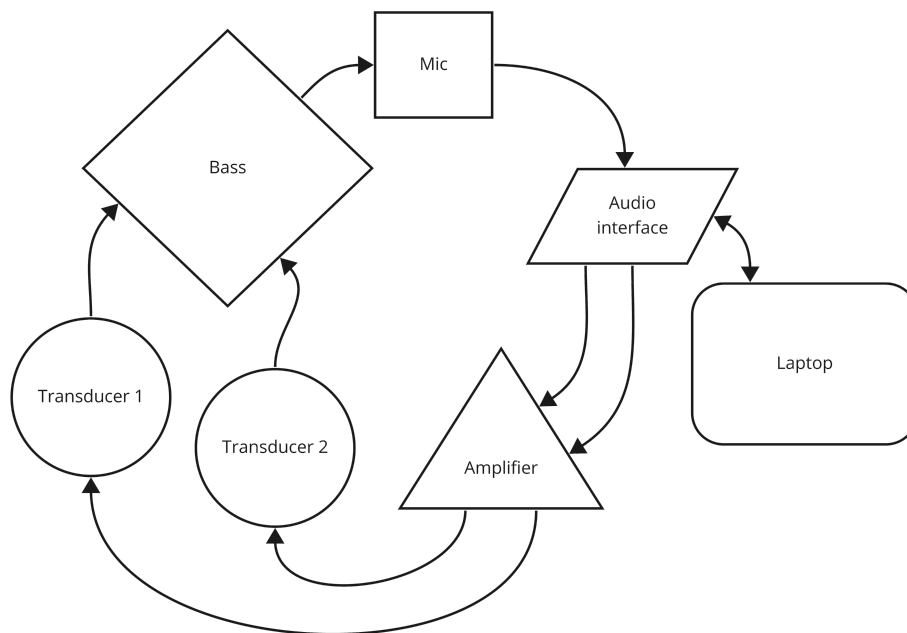


Fig. 2. Information flow between nonhuman agents.

This is how these agents contribute to the system.

- i) A microphone attached to the double bass picks up sounds played on the bass including those instigated by the transducers.
- ii) A collection of resonant filters in a Max patch detects the partials present in the microphone signal. The detection of a partial triggers the generation of a sine tone whose frequency is some ratio of the detected partial's frequency. The ratio is decided by probabilities associated with the difference between the detected frequency and 360 Hz (the significance of which is described later).
- iii) This patch also “smears” the incoming signal by convolving it with a synthesized impulse response that prolongs the sound while getting rid of transient information.
- iv) The generated tones and the smeared signal get played through different transducers that excite the body of the bass.

(The audio interface and the amplifier are assumed to be transparent for the sake of simplicity. Future developments in the project may explore how consequential their contributions might be.)

The nonhuman agents form a feedback loop that makes every agent responsible for how other agents operate in one way or another. The human agents also continuously affect each other and the nonhuman agents and are affected by the nonhuman agents. Information goes through various stages of translation between physical, computational, and cognitive domains. The bass player and the CT player improvise within this system generating sonic situations that determine future states of the system.

The contrabass used has five strings that are tuned as follows: I – 90 Hz, II – 72 Hz, III – 51.4287 Hz, IV – 40 Hz, and V – 32 Hz. As such, 360 Hz appears as a harmonic on I, II, III and IV. This allows the artists to use the frequency as a focal point in their improvisation. The further the tones created veer away from this frequency, the more chaotic the system becomes. The system becomes more stable when the tones are closer to 360 Hz.

Playing with this system leads to new territories with each performance. The artists are interested in creating an improvisational language that may guide their performance. They find the idea of a “phase space”—a concept that originates in the field of mathematics known as nonlinear dynamics—relevant in this regard. A phase-space-like chart would provide information about how performers may change their actions based on the current state of the system. An example of such

a chart is shown below (Fig.3). This chart tells the performers how to change the pitch intervals they play when certain pitch-related situations manifest.

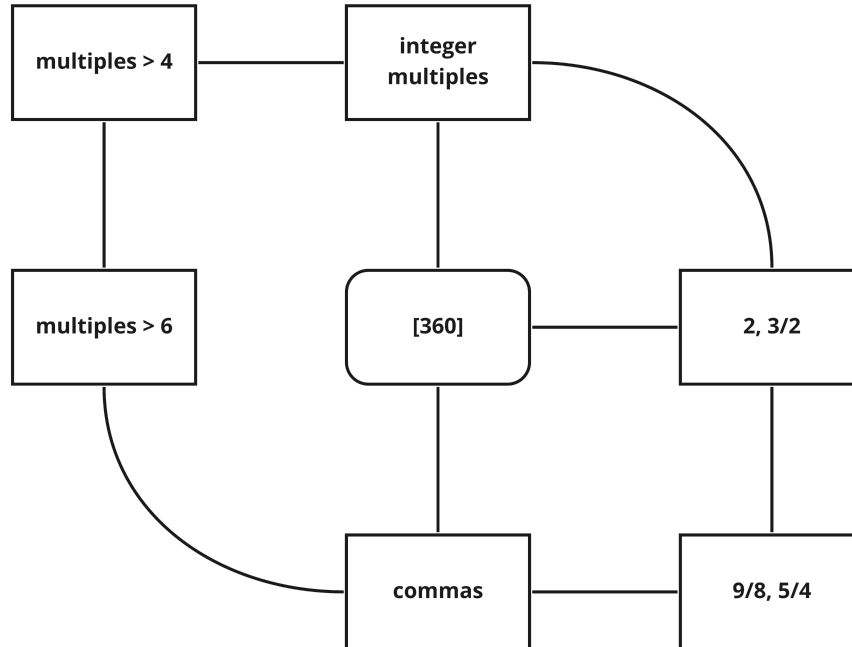


Fig. 3. A chart utilizing the concept of “phase space.”

Among the theories that inspired the artists to develop this project was “actor-network theory” (ANT). In Bruno Latour’s work [4] on the theory, we find the concept of heterogeneous “agents” that mediate relationships between other agents. These agents are both human and nonhuman, and they are considered equally capable of influencing systems that emerge from their interactions. This theory also suggests the notion of translation which happens when information flows from one domain to another, something we find very relevant to our project where information flows between physical, digital, and cognitive domains. ANT also defines systems as evolving structures rather than stationary. Katherine Hayles’s concept of the “posthuman” [5] and Donna Haraway’s “Cyborg Manifesto” [6] also served as important references to the artists.

In summary, the artists are interested in the process that emerges from the interaction between human and nonhuman agents in a complex system. They focus on how the behavior of the system evolves instead of reducing the system to its parts and fixating on how they affect the outcome. Sound is a highly suitable medium to experience and investigate the behavior of the system as every agent in this system acts on it. However, the performers experience the system not just as a sound-production mechanism but also as a moving and vibrating entity through

touch. Further exploration into this project may lead to ways of sharing that experience with the audience.

### 3. PERFORMANCE NOTES

Both the bass player and the computer-transducer (CT) player are expected to improvise. The bass player may choose to play the contrabass in any manner using any articulation. The CT player may vary the levels of the input to and output from the Max patch using a MIDI controller with CC controls (such as Novation Launch Control XL). By doing this, they alter the level of audio fed to the processing algorithms and how the body of the contrabass is excited by the transducers. They may also trigger playback of sine tones of frequencies corresponding to the natural harmonics of the bass strings using the interface of the Max patch. Additionally, they may detune the output of the Max patch by  $\pm 10$  Hz using the MIDI controller. Both performers always have the option to touch and change the position of the transducers.

The performance is initiated by the bass player. The CT player activates the transducers at some point introducing the sounds produced by the Max patch. The performers may choose to react to the sounds heard by varying the pitch content of the sounds they produce/manipulate, dynamic levels, and articulation. They may generate rhythmic patterns using microtonal deviations when playing the same pitch. Performers may also decide on a “phase space” prior to the performance that may tell them how to vary the abovementioned parameters when certain situations manifest. The performance ends when the bass player decides to stop and the CT player disengages the transducers.

### 4. MEDIA LINK

- Video: <https://youtu.be/bDjcRRQ-oAo>

### ACKNOWLEDGMENTS

The authors would like to thank Glenn Cornett and Teodora Stepančić for providing the venue and the opportunity for the first performance of this project. The recording linked to this proposal is of that performance.

### ETHICAL STANDARDS

The authors are aware of NIME's principles and code of practice on ethical research and have made all efforts to conform to them in the development of this project. The authors acknowledge that they have used computer technologies that are not open source (such as Max). However, they agree to make the Max patches they have created available to anyone who is interested without any cost. The authors also acknowledge the environmental footprint of the electronic devices (laptop, microphone, exciters, audio interface, amplifier, and audio cables) used in this project.

### REFERENCES

- [1] Nijs, Luc, Micheline Lesaffre, and Marc Leman. “The Musical Instrument as a Natural Extension of the Musician.” LAM-Institut jean Le Rond d’Alembert, 2009.
- [2] Cavdir, Doga, and Ge Wang. “Borrowed Gestures: The Body as an Extension of the Musical Instrument.” *Computer music journal* 45.3 (2022): 58–80.

- [3] Donnarumma, Marco, and Atau Tanaka. "The Body as Musical Instrument." *The Oxford Handbook of Music and the Body*. Oxford University Press, 2019.
- [4] Latour, Bruno. *Reassembling the Social: An Introduction to Actor-Network-Theory*. Oxford: Oxford University Press, 2005.
- [5] Hayles, N. Katherine. *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics*. Chicago: University of Chicago Press, 1999.
- [6] Haraway, Donna. "A Cyborg Manifesto: Science, Technology, and Socialist-Feminism in the Late Twentieth Century." In *Simians, Cyborgs and Women: The Reinvention of Nature*, 149-181. New York: Routledge, 1991.