

Feedback System and Performative Expression in Totem

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Abstract. This paper delves into the compositional process and performance of the work *Totem*, a piece I composed in 2019 triggered by the desire to explore and manage the unpredictability of feedback system. The paper outlines the development of the created system that leverages physical feedback, by incorporating acoustic instruments and exploring their resonant properties. An analysis of instruments preparation, system components, and the performative gestures highlights the symbiotic relationship between the musician and the feedback mechanism. The dramaturgical aspect emphasizes the ritualistic interactions of the performer with the feedback system, symbolizing a journey towards self-acceptance and challenging societal norms. The paper also discusses the technical setup, including the system in Reaper and Max, score, spatialization technique, and the collaborative dynamics between the performers. Insights from the performer's experience further contextualize the performative and sonic exploration within *Totem*, offering a comprehensive overview of the piece's approach to live electronic music performance.

Keywords: feedback system, live electroacoustic music, performative gesture.

About Totem and its Context

Totem is a composition created in 2019 to explore and manage the unpredictability of feedback systems through a blend of performative gesture, live electronics, and spatialization. The piece was premiered at the Studiosaal of the HFM Hanns Eisler Berlin as part of the concert program of the Berliner Lautsprecherorchester (BLO), with performer Dustin Zorn on stage and spatialization by Wolfgang Heiniger.

The BLO, developed by Wolfgang Heiniger and Kirsten Reese, features an orchestra of approximately 40 individually controllable loudspeakers, each adjustable in volume. These loudspeakers range from standard models, familiar from home stereo systems and sound reinforcement setups, to exotic transducers and structure-borne sound transducers.

The loudspeakers, built into unique resonators, transform from mere sound projectors into musical instruments. Unlike conventional setups that aim for perfect reproduction of a virtual sound field, the BLO emphasizes the unique sounds of the loudspeaker instruments, creating an interplay of sounds within an artificial space (Heiniger, Wolfgang. "Mehr! Kleines Handbuch des Lautsprecherorchesters." Draft version, Unpublished, April 9, 2015). Live recording is available at this link¹.

My particular interest in physical feedback lies in its ability to generate complex sounds. Unlike electronic feedback, which involves digital circuits and processes,

¹ <https://www.youtube.com/watch?v=UnsXmSA2tug&t=81s>.

physical feedback utilizes the sound produced by acoustic instruments or other sound sources.

Before composing *Totem*, I selected the instruments to be used. I chose a snare drum, a tom-tom, and a plastic construction tube, each prepared with a speaker attached inside. To understand their frequency and resonance responses, I used a dynamic microphone moving it closer and further away in order to generate feedback.

The tom-tom, with its deep shell and wooden construction, produced a resonance that emphasized low frequencies. The plastic construction tube, on the other hand, had a sharp, piercing quality and behaved similarly to a notch filter. The snare drum added a vibrant, cutting timbre, rich with harmonics due to its metal shell and tensioned snares.

By combining these instruments, I achieved a complex interplay of timbres. The low-frequency resonance of the tom-tom contrasted with the sharpness of the plastic tube, while the harmonic richness of the snare drum further enriched the soundscape.

Finally, to address any unwanted sound effects, I defined the parameters for a limiter applied to the input volume and preamp, ensuring a better control over the sound dynamics within the system.

By transforming these instruments from their traditional roles into ‘sound objects’, I aimed to explore their resonant properties and timbral characteristics independently of their conventional uses. This approach allowed for a more experimental exploration of sound.

Another reason *Totem* relies on physical feedback is that, instead of concentrating on the performer’s manipulation of the feedback, exploring the resonant properties of the prepared instruments allows for greater flexibility in gesture.

In *Totem*, the gesture is primarily one of impulse, characterized by a strong theatricality that serves as a fundamental key to the work’s meaning. This theatricality manifests through the dynamic interplay between the musician and the prepared instruments, creating a performance environment that emphasizes spontaneity and interaction. The gestures involved are not merely mechanical but are infused with intention and expressiveness.

Simon Emmerson discusses the significance of gesture in live performance, highlighting how physical movements can shape the auditory landscape and influence the listener’s perception. In *Living Electronic Music*, Emmerson explores how physical gestures interact with electronic sound to create a performative dialogue, thereby enhancing the overall artistic expression (Emmerson, 2007, pp. 93-95). He introduces the distinction between ‘local’ and ‘field’ functions, where ‘local’ refers to a direct, perceivable relationship between a performer’s action and the resulting sound, while ‘field’ encompasses broader sonic processes that establish a sense of space or wider context beyond the performer’s immediate actions (Emmerson, 2007, pp. 94-95).

In *Totem*, this concept is particularly evident as each impulsive gesture triggers a sonic response, reinforcing the idea that the physical actions of the performer are intrinsically linked to the resultant sound. Furthermore, the field function is embodied through the role of the second performer, who is positioned not on stage but at the mixing console. This ‘hidden’ performer manages the spatialization of sound, ef-

fectively ‘playing the space’ and shaping the listening environment through complex sonic processes. This approach aligns with Emerson’s notion that field functions can involve activities not directly localized to the main performer but contribute to establishing a dynamic and evolving auditory landscape (Emmerson, 2007, pp. 94-97).

The relationship between local and field not only enriches the listening experience but also deepens the emotional resonance of the piece, inviting reflection on the nature of sound and performance itself. By engaging with these impulses and spatial manipulations, *Totem* becomes a living entity, continuously evolving through the interactions of the main performer, the second hidden performer at the mixing console, the feedback system, and the performative space, embodying Emerson’s theories on the interplay between local and field functions.

Technical Setup: Instruments Preparation and System Configuration

The setup for *Totem* includes three main instruments, each chosen for its distinct sonic properties:

- Snare Drum
- Tom-Tom
- Plastic Construction Tube

Each instrument is modified with speakers placed inside to exploit their resonant characteristics. The performer uses a dynamic microphone to interact with the instruments, generating feedback by varying the distance and angle of the microphone through specific gestures, such as sweeping motions, rotations, or sudden changes in proximity. These gestures allow the performer to shape the timbre, intensity, and duration of the sound in real time. The captured sound is processed through the system described in detail later in this paper, then diffused and refined by the second performer, who manages the spatialization. The sound is then reintegrated into the performance space, allowing the exploration of a wide range of sonic textures, from subtle resonances to powerful and dynamic sounds.

The sound processing is controlled through a combination of Max and Reaper. The Reaper MIDI score sends control messages to the Max patch, which manages various parameters, including pitch, delay, and auto-gain. The patch processes the sound in real time and routes the output to six distinct channels. These channels are then sent to the second performer located in the control room, who manages the spatialization by distributing the sound across a larger multi-channel system, shaping the listening environment dynamically.

Dramaturgy

As shown in Fig. 1, the assemblage of the three instruments on stage represents a phallogentric totem.



Figure 1. The setup of *Totem*.

Over the course of the piece, the performer's interactions become more deliberate, almost ritualistic, symbolizing the process of self-discovery that comes with confronting societal taboos and embody the tumultuous journey of self-acceptance.

The performer's interactions with the feedback become a bold declaration of embracing one's authentic sexuality, regardless of societal norms or judgments. The piece challenges both performer and audience to confront the discomfort of crossing boundaries and questioning norms.

It is in this scenario that the performative gesture assumes a very important role: it does not shape, it does not manipulate the feedback but is subject to it and is aware of it.

As if the feedback were imposed by a hierarchical system, the performer seeks freedom.

The gesture, in its being an impulse, draws when it seeks and dreams of its freedom of expression, it asks for confirmation in its dialogue with the space, it becomes inflamed when it wants to break out of the norms until, by throwing the microphone into the tube, it rejects them totally, finally arriving at self-acceptance (when the performer sits down and the light in the room goes out).

Description of the system

The first step was to establish a hierarchical system that could manage or at least reduce the unpredictability of feedback. I wrote a patch in Max and a MIDI score in Reaper.

The function of the Reaper project is to send information, while the patch operates on this information. Between these two functions lies the gesture of the performer, whose role is to direct the microphone to generate the sound event. Without this precise gesture, the desired sound event would not be generated.

In *Totem*, the musician on stage does not manipulate or control the feedback but merely generates the sound event through their gesture. These gestures are written in a score that consists of graphics and text describing the type of gesture to be performed.

On the opposite side of the room, at the mixing console and not on stage, is the second performer, who spatializes what is generated. The spatial movements are not written but are agreed upon at the time of the performance, allowing for spontaneous interpretation by the performer and establishing a dialogue between the two performers. This might be perceived as a manipulation of the gesture performed by the first performer, but in reality, the second performer, provides an image and add color to the sound in the performance space.

MIDI Score, Max Patch and Score

The piece consists of:

- Reaper MIDI score
- Max Patch:
- Graphic score with textual annotations

As shown in Fig. 2, the CC messages written in the Reaper MIDI Score are sent to the Max Patch which executes.

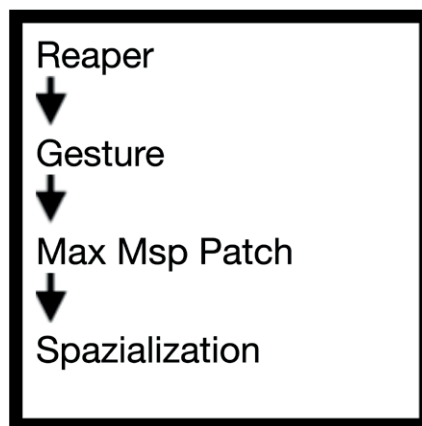


Figure 2. The data flow in *Totem*.

Messages		Parameters
<i>Reaper</i>		<i>Max</i>
Velocity	→	Random Pitches On
Velocity OFF	→	Random Delays On
07 Volume MSB	→	Fader Pitches
08 Balance MSB	→	Volume Microphone
CC 09	→	Volume Delay
10 PAN POSITION	→	Volume Pink Noise
12 Control 1 MSB	→	Volume AutoGain
16 GP SLIDER 1	→	Feedback Chords
CC 30	→	AutoGain speed (rallentando and accelerando)
39 Volume LSB	→	Filter Cutoff
CC 53	→	Preamp Volume
CC 60	→	AutoGain Speed

Figure 3. Correspondance between software controllers and audio parameters.

The list in Fig. 3 explains the relation between software controllers and audio parameters.

In Fig. 4 are two examples of Reaper MIDI score.

The Max patch can be explained by breaking it down into several sections:

- Input Section: this section handles the incoming audio signals from the microphone. It ensures that the input level is set correctly and prepares the signals for further processing.
- Pitch section: it allows for versatile control and variation of the generated frequencies in two ways:
 1. it generates a sequence comprising six distinct pitches that are randomly distributed across six distinct outputs;
 2. the pitch series can ascend and descend while preserving the relationships between the frequencies.
- Delay section: delay effects are used to enhance depth, spatialization, and rhythmic complexity. As in the pitch section, delay sequences are distributed across

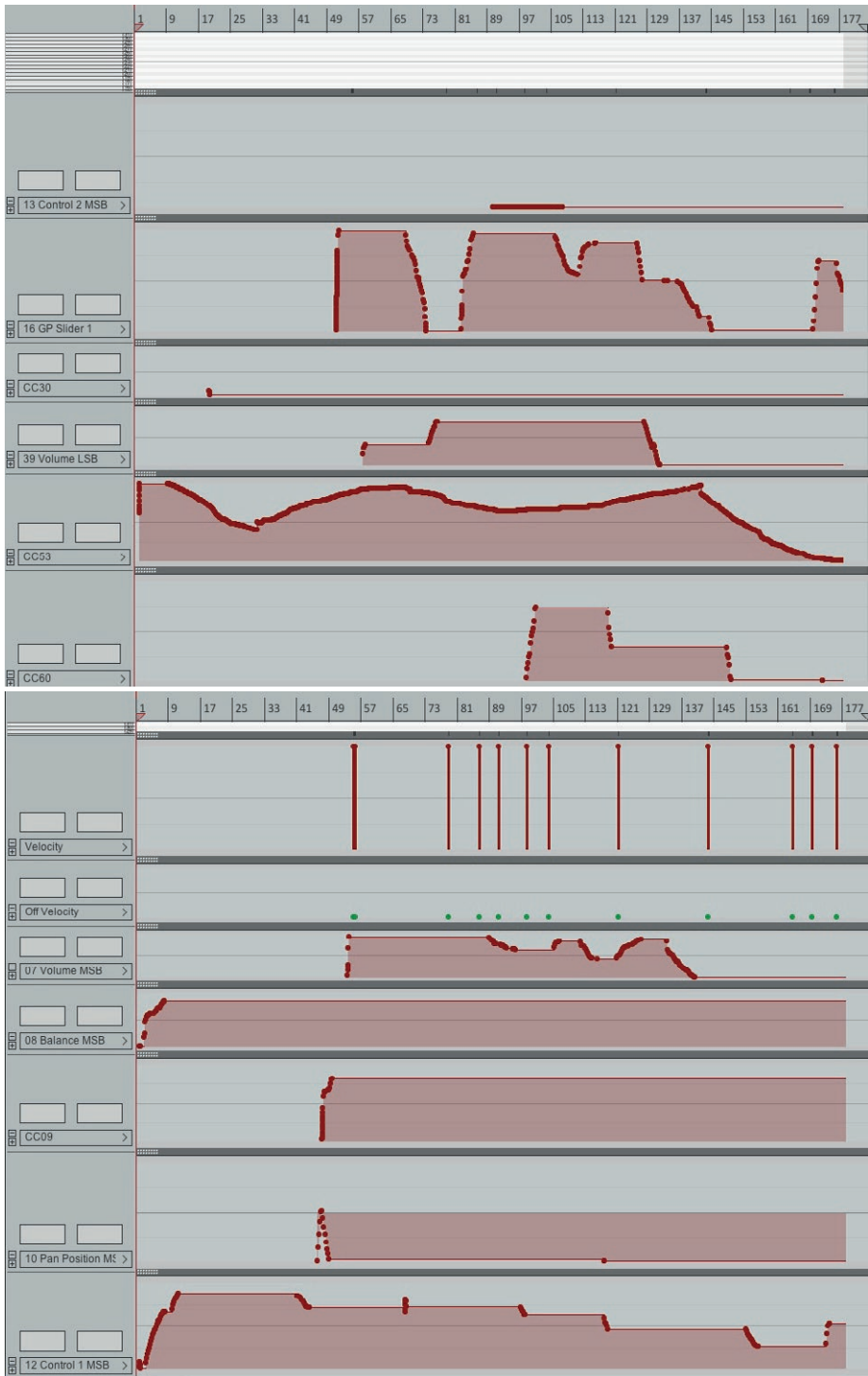


Figure 4. Reaper MIDI score.

six distinct outputs, contributing to the creation of randomly generated rhythmic structures.

- Autogain Section: governed by automatic gain control, this section dynamically adjusts the amplitude of the audio signals to maintain consistent volume levels. It has a speed feature that can introduce rhythmic variations and vibrato effects.
- Color Section: this section modifies the timbre and the quality of the audio signals. It includes pink noise that is produced inside the instruments and interacts with the feedback sound, and a cutoff filter which contributes to add color and cut undesired frequencies.
- Routing Section: it manages the distribution of audio signals to different six outputs. It ensures that each processed signal is correctly routed to six outputs.

Score

The score provides detailed instructions while allowing room for the performer's creative interpretation, particularly in aspects like dynamics and tempo. This approach aligns with Simon Emmerson's concept of "control intimacy," which builds on F. Richard Moore's (1988) idea that effective mappings between performer actions and sound results are essential in live electronic music. Moore argues that "control intimacy" enables performers to achieve subtle and nuanced control over sound, a quality that is often compromised in electronic performances due to the limitations of loudspeakers and amplification (Moore, 1988, p. 21). Emmerson (2007) further elaborates that maintaining this intimacy is crucial for preserving the sensitivity and expressiveness associated with traditional instruments, even within technologically mediated performances (p. 95).

In *Totem*, the score's instructions for gestures – such as moving a microphone toward or away from an instrument – are precise but not rigid, allowing the performer to adapt in real-time to the evolving soundscape. This flexibility supports a dynamic relationship between performer and sound, ensuring that the performance remains coherent and expressive, as Emmerson suggests. This approach helps to bridge the gap between "real" and "imaginary" soundscapes, as discussed by Trevor Wishart (1986), who distinguishes between sonic landscapes that are real, imagined, or a combination of both, shaped by the performer's actions and the spatial context (pp. 146-147).

The score's aleatory elements, including variations in repetition and timing, are designed to accommodate gestures that initiate sound events, which are then processed and spatialized. The timeline's alignment with specific sound events ensures a structured flow, while allowing for the expressive freedom necessary for the performer to navigate the unpredictability of the feedback system. This openness facilitates a dialogue with the second performer in the control room, responsible for spatializing the sound. Within the dramaturgy of *Totem*, this interaction between the two performers is crucial for achieving a sense of performative freedom and enriching the expressive potential of the piece.

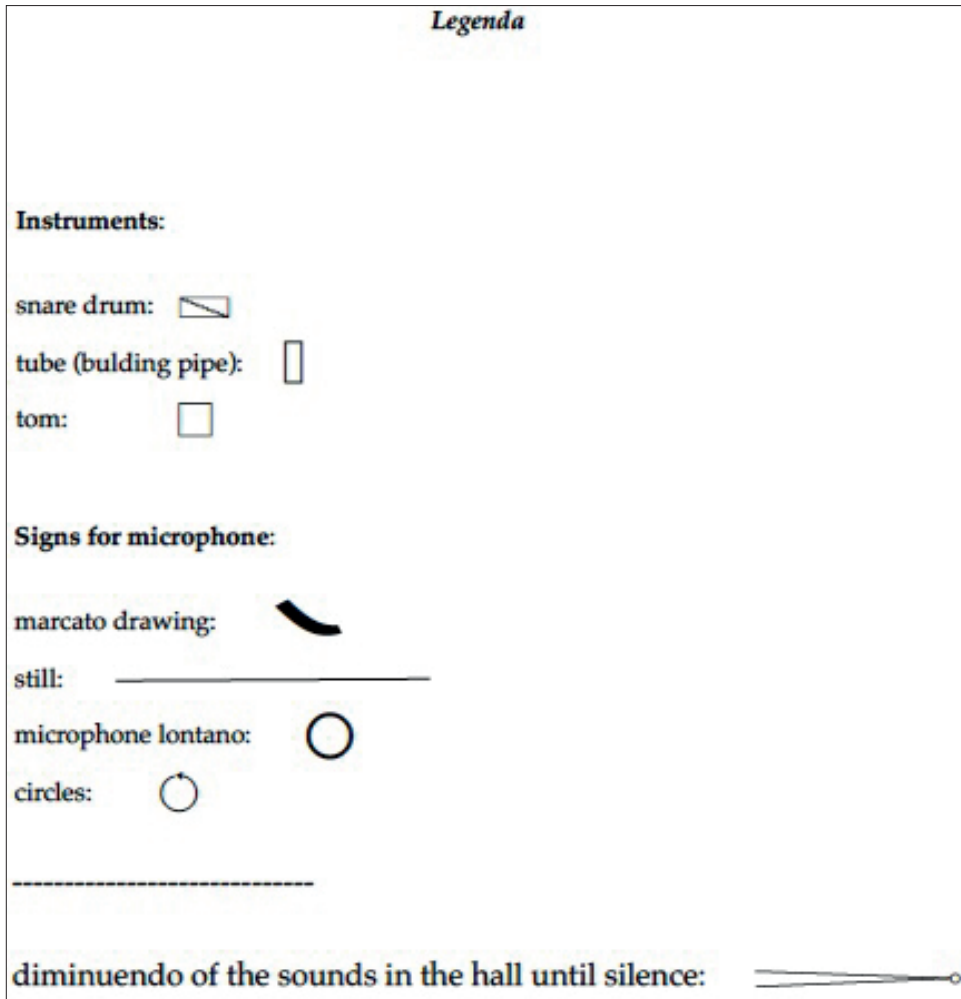


Figure 5. Score legenda.

Spazialization

Spatialization occurs on two levels. At a micro level, it stems from the routing within the Max patch, which distributes the sounds toward six distinct outputs. At a macro level, it involves the interaction of the second performer at the mixing console, who assigns these six outputs to multiple channels (based on technical feasibility) and can distribute them further across various channels. The design of the sound space rests with the spatializer, allowing for freedom of choice. This macro-level approach eliminates staticness, imbuing the piece with a certain freedom through improvisation.

The hierarchical system's role gradually diminishes, reinforced by the quality of the feedback's sound. Through the interaction between pitch and delay, the transformed

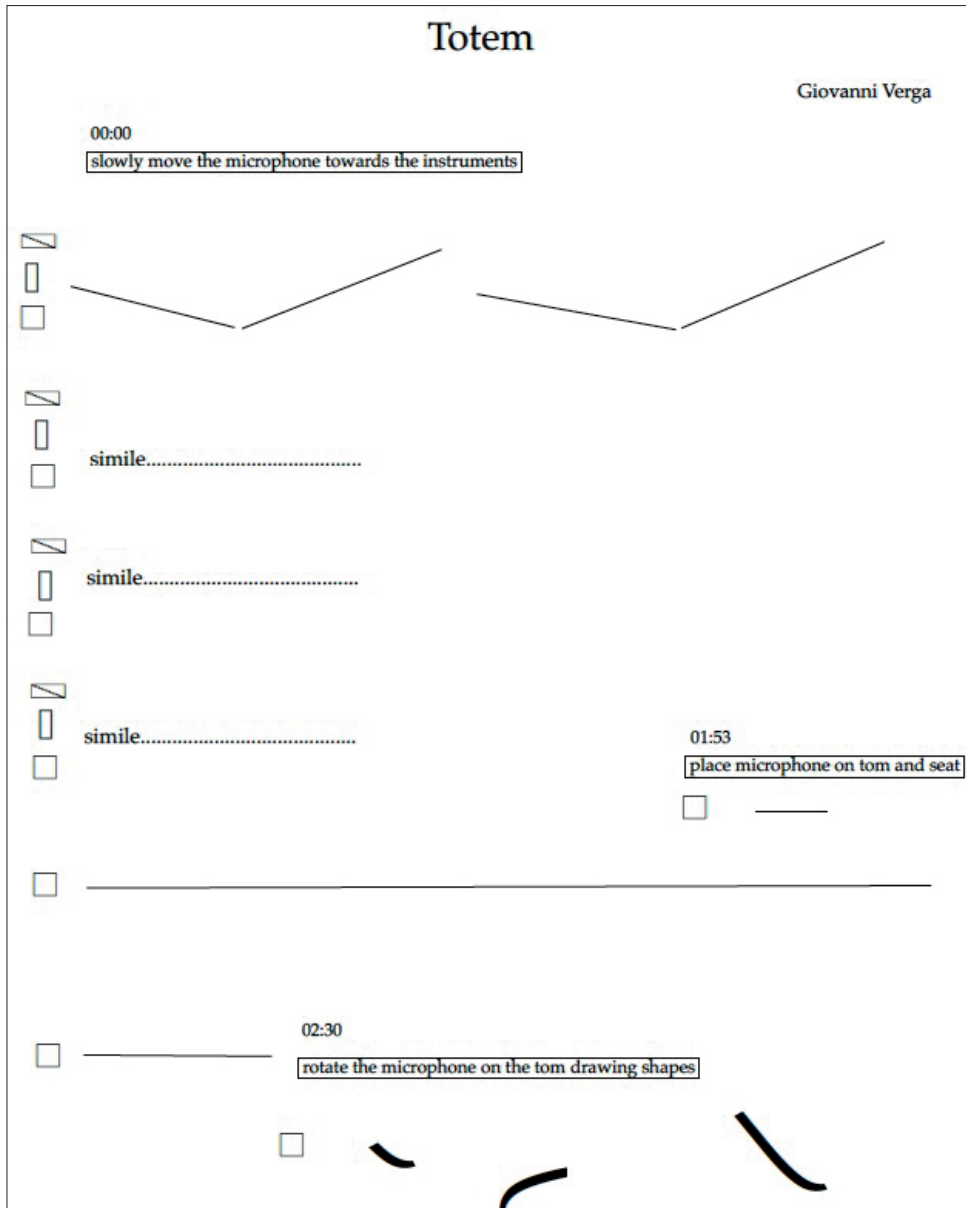


Figure 6. Score excerpts.

feedback becomes vibrant and colorful, resonating throughout the hall and complementing the performers expressive intent. This interaction expands the dialogue between the performer and the spatializer, enriching the performance space.

Improvisation in the spatialization process of *Totem* aligns with Agostino Di Scipio's idea of the performative and adaptive nature of the performance space. Di Scipio in *Sound is the Interface: From Interactive to Ecosystemic Signal Processing*,

03:30
move the microphone closer and further away from the instruments, freely drawing shapes in the air

05:00
hold the microphone tight in front of the tube

sempre fermo

06:20
start additive circles

The score excerpts are organized into sections. The first section, starting at 03:30, includes a checkbox and three curved lines. The second section, starting at 05:00, includes a checked checkbox, a vertical rectangle, a circle, a curved line, and a horizontal line. The third section, starting at 06:20, includes a checked checkbox, a vertical rectangle, and a series of circles. The fourth section, starting at 06:20, includes a checked checkbox, a vertical rectangle, and a series of circles.

Figure 7. Score excerpts.


argues that the performance space acts not merely as a passive environment but as an active, generative element that interacts with and transforms sound. He describes this approach as a shift from traditional interactive music systems to an ecosystemic

07:45


continuum circles

sempre senza fermarsi

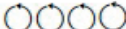
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molto accel.



08:15

 insert the microphone into the tube and let it slowly slide to the bottom

leave the microphone inside the tube and sit down. seat until the room is totally dark




Figure 8. Score excerpts.

perspective, where sound generation and processing are tightly coupled with the surrounding acoustic environment, forming a recursive relationship between the system and its ambiance (Di Scipio, 2003, pp. 271-273). By allowing the spatializer to improvise, *Totem* leverages this adaptive characteristic of the space, enabling real-time adjustments and enhancements to the sonic landscape. The dynamic interaction between the performer's gestures and the spatializers control of sound distribution creates a responsive dialogue with the acoustic environment, making the space an active participant in the evolution of the feedback sound. This approach resonates with Di Scipio's concept of a self-organizing system, where feedback from the environment continually shapes the unfolding sonic processes, reinforcing his view that the performance space plays a crucial role in shaping the sonic event (Di Scipio, 2003, pp. 272-274).

Performance and Performer

In *Totem*, the performer's gesture is not proprioceptive, meaning it does not directly correspond to the generation of sound or fulfill the performer's expectation, as described by Denis Smalley in his article *Spectromorphology: Explaining Sound-Shapes* (1997). Smalley explains that 'proprioceptive gestures' are characteristic of instrumental music, where the physical action of the performer has a direct and predictable connection to the sound produced, creating 'the feel of the sound' as an extension of the musician's body movements. This relationship allows for an anticipation of the sonic outcome based on the gesture².

However, in *Totem*, the musician does not experience such direct control or predictability over the sound, as the feedback system introduces an element of uncertainty. The performer is not always aware of what they are creating, making each gesture more about interaction with the system than executing a predetermined sonic intention. Despite this unpredictability, the gesture maintains a theatrical quality visible to the audience, providing the performer with a form of expressive security. This expressive quality allows the performer to contextualize and differentiate their actions, even when the feedback does not respond as expected, while still resonating with Smalley's notion that in electroacoustic music, gestures can serve expressive and communicative roles beyond their functional aspects.³

In this regard, I asked the performer Dustin Zorn some questions which I think are interesting to report here:

me: Could you please describe your experience as performer?

D. Zorn: Performing *Totem* was a profoundly physical experience. The inherent unpredictability of the feedback required heightened situational awareness, where the sound became directly connected to my movements. The feedback guided my hands and body, influencing where they needed or wanted to go. Decisive performative actions, whether dictated by the MIDI score, the spatialization, or my own impulses, posed a challenge: how quickly could I regain control over the sonic outcome or 'ride' the chaos? This interplay between control and unpredictability created a dynamic and engaging performance environment.

me: How did you interact with the spatialization? Did it influence the performance?

D. Zorn: The spatialization fundamentally transformed the context of my performance. I became acutely aware of the changes, feeling as though I was performing in a duo situation. When the sound expanded into the hall, it felt like my auditory and situational awareness had to similarly expand. This shifting auditory landscape required me to adapt continuously, making the performance feel more collaborative and dynamic.

² Smalley, 1997, pp. 113-115.

³ *Ibidem*.

me: Since your role was of merely about generating sound do you feel as co-creator of the piece ?

D. Zorn: In terms of feeling like a co-creator of the piece, I do not. The context for my actions was so meticulously detailed that my role felt more like that of an interpreter rather than a creator. The structure and instructions of the piece always guided me to where I needed to go, so my creative contribution was more about interpretation. I lent the piece my body and ears to be present in the room, bringing the composition to life through my performance. My involvement was about embodying the work and responding to its demands, rather than contributing to its creation.

Conclusion

In the compositional context of *Totem*, my intention was to blend performative gesture with feedback generation and spatialization. Rather than treating the performer as a mere manipulator of sound, I sought to elevate the significance of their gestures as creative acts that directly influence the ongoing sonic narrative. Consequently, the unpredictable nature of the feedback was intentionally left un-manipulated by the performer, entrusting this function to the software. Encouraging exploration and experimentation in sound production, this approach invites performers to engage dynamically with the sonic environment they create, adding an expressive function to their gestures. This dynamic engagement not only enriches the sonic landscape but also deepens the expressive potential of the performance, allowing the performer to interact meaningfully with the feedback and spatialization processes.

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