#10
GESTURAL AND TEXTURAL APPROACHES WITH THE EMBODIED GESTURES INSTRUMENTS

THEODOROS LOTIS

The old man motioned me in with his right hand with a courtly gesture, saying in excellent English, but with a strange intonation. 'Welcome to my house! Enter freely and of your own free will!'

—*Bram Stoker, Dracula*

10.1 Introduction: gesture and texture

In all types of traditional instrumental music, sound production is intertwined with the gestures and the bodily movements of the performer. Furthermore, the instrument is regarded as an extension of the body of the performer (Nijs, Lesaffre, & Leman, 2013; Schroeder, 2006; O'Modhrain, 2018). Both instrumental and vocal gestures serve as means of expression through the performer's physical motion and muscular energy. In this view, gesture is related to texture and vice versa in an inseparable way within a form-and-content relationship.

The relationships between gesture and texture can be examined under the lens of different scientific and artistic fields, including mathematics and physics, computer science, bio-arts, cognitive psychology, neuroaesthetics, neurobiology, neurophenomenology and more. The notions of gesture as forming principle and of texture as spectral behaviour are of paramount importance for the appreciation of the 'live' element in music performance (Emmerson 2007, 2001, 1994b) and of the interactions that emerge between a sounding body and a listening mind. Performative gestures and musical textures are active parts of a broader dynamic process that is related to the understanding of the musical act (Zanetti, 2019). Reybrouck (2021, p. 2) examines this process through information-

https:/doi.org/10.34727/2022/isbn.978-3-85448-047-1_10. This work is licensed under the Creative Commons Attribution-ShareAlike License 4.0 International (CC BY-SA 4.0).

processing models of cognition as well as operations of sense-making and models of enactivism and embodiment:

> . . . that emphasize the self-organizing aspects of cognition as an ongoing process of dynamic interactivity between an organism and its environment (Schiavio et al., 2017). Musical sense-making, in this view, is not to be reduced to a conception of musical experience as a kind of abstract, decontextualized, and disembodied process as advocated by the cognitive approach to music listening and analysis. It should address, on the contrary, the actual lived experience of music, which involves more than internal cognitive processing and detached aesthetic appraisals. (Maeder & Reybrouck, 2016)[1]

Denis Smalley (1986, p. 83) examines the unfolding of music in time and the process of sense-making in terms of gestural and textural interdependency:

> The relationship between gesture and texture is more one of collaboration than antithesis. Gesture and texture commonly share the structural workload but not always in an egalitarian spirit. We may therefore refer to structure as either *gesture-carried* or *texture-carried*, depending on which is the more dominant partner.

Thus, a sonic structure that contains intense gestures, frequent onsets and spectral transformations is perceived as gesture-driven, whereas a structure with minimal spectromorphological changes is perceived as texture-driven. However, a sonic structure always contains both gestural and textural elements in different proportions.

Smalley's description of interdependency implies that both gesture and texture carry complementary information about the source, the identity, the formation and the internal characteristics of sonic events. Although Kersten (2015, p. 196) is referring to the acoustic array and the musical invariants,[2] his point may support Smalley's argument that 'there seems to be a lawful causal relationship between the physical structures of sounds. . . and the stimulation of the auditory system'. For Smalley (1986, 1997), the physical structures of sounds can be decomposed into gestural and textural relationships: gesture generates spectromorphological and textural expectations and texture reflects its gestural origin. What Smalley suggests is that gesture and texture are essential elements of the acoustic array that transmits the sound and feeds the auditory perception (a sound-receiving system) with information.

However, the predominance of electronic technological tools in music creation challenged the relationship between gestural activity and spectromorphological development. Simon Emmerson (2001) argues that 'electricity and electronic technology have allowed (even encouraged) the rupture of these relationships of body to object to sound' (p. 194). This rupture becomes apparent especially in live or real-time performances where vision and optical stimuli play an important role in deciphering the gesture-field[3] and the gesture-to-sound causality. As Smalley (1997) puts it,

[1]Further analysis is needed in order to decode the relationships between musical stimuli and the mechanisms of active reception by the listener. However, a full discussion of that issue is beyond the scope of this chapter which concentrates mainly on the spectromorphological implications of gesture and texture in composition and performance. A detailed examination of the topic can be found at Reybrouck, 2021; Kersten, 2017 and 2015; Schiavio, 2017; Emmerson, 2007, 2001, 1994a and 1994b.

[2]See also Balzano, 1986.

[3]According to the 'local/field' distinction (Emmerson, 1994, p. 31), '*Local* controls and functions seek to extend (but not to break) the perceived relation of human performer action to sound production. While *field* functions place the results of this activity within a context, a landscape or an environment'. In our case the term *field* is local and refers to the *gestural topology* of the performer, i.e the area within which the performer performs his/her gestures. Hence, gesture-field defines the space in which the performer acts.

> We should not think of the gesture process only in the one direction of cause-source-spectromorphology, but also in reverse—spectromorphology-source-cause. When we hear spectromorphologies we detect the humanity behind them by deducing gestural activity, referring back through gesture to proprioceptive and psychological experience in general... Not only do we listen to the music, but we also decode the human activity behind the spectromorphologies through which we automatically gain a wealth of psycho-physical information (pp. 113–114)

Bodily motion and causal gesture underlie all perceived spectromorphologies and relate them to their source. Whenever the inherent relationship between gesture and its resulting sound diminishes or disappears, the reference to the causality loosens up, granting its place to the realm of remote surrogacy.[4] As a result, performers and audiences become increasingly alienated from purely physical sound production.

This alienation can be detected at different stages of a live or real-time performance. The 'amplification' of human gesture, often through new interfaces and disproportionate or naïve mapping procedures, may create distorted and unreal sonic structures. A performer in front of a laptop producing gigantic masses of sound by merely pressing a button is a common example. 'The loss of appreciation of human agency within the sound world loses our immediate sense of the "live"' (Emmerson, 2001, p. 206). Consequently, the bond between performer, audience and sound perception is moderated, if not vanished, and the perspective of cause-source-spectromorphology is utterly blurred. It is a holy sacrifice though, an Iphigenian oblation for the winds of a *new perspective* of dislocated experiences (Emmerson, 2001, p. 204). Although Xenakis (1985) was referring to a new model of artist-conceptor, his remark suits this new perspective: '…an abstract approach, free from anecdotes of our senses and habits' (p. 3).

A suitable compromise is described by F. Richard Moore as *control intimacy*[5], a notion that refers, for example, to minute textural differences caused by tiny alterations of embouchure position on a tube or bow pressure on a string. Grand or minimal, a gesture is a composite act with multiple impacts on the production of sound, as we will examine later.

For the moment, the old question persists: Shall we try to liberate the sound from its source? Shall we let it separate itself from its source and continue its own life in new spatial perspectives? Or, shall we hold the sound bounded to its source within the limitations dictated by the dynamic range of the performer's own gestural typology and the instrument's physicality? A great number of electroacoustic music works, whether acousmatic or with live and real-time elements, intersect in the shadow of this bifurcation. Karlheinz Stockhausen's *Kontakte* for example, '…presents intricate networks of relationships whereby differences between instrumental and electroacoustic practice and theory can appear simultaneously to conflict and support each other' (Dack, 1998, p. 86).

[4]According to Smalley (1986) remote surrogacy defines a state '…where links with surmised causality are progressively loosened so that physical cause cannot be deduced and we thus enter the realms of psychological interpretation alone'. (pp. 82–83).

[5]'For subtle musical control to be possible, an instrument must respond in consistent ways that are well matched to the psychophysiological capabilities of highly practiced performers… *Control intimacy* determines the match between the variety of musically desirable sounds produced and the psychophysiological capabilities of a practiced performer' (1988, p. 21).

10.2 Voices

Voices[6] [7] by Theodoros Lotis is a piece for one performer and Embodied Gestures interface, tape and electronics. Its duration is 10 minutes and 36 seconds. The piece proposes a proto-human[8] linguistic theatre consisting of primordial sonic elements and interpreted by voices of instinct reactions, voices that transmit impulsive expression, voices of humans, birds and frogs, and voices of fear, surprise, intimacy, intrusion, complaisance, ignorance, and caress. *Voices* uses two main categories of sonic material confronting the physical and mental states of mobility versus immobility and corporeality versus asomatous insubstantiality:

1. A collection of *vocal onomatopoeias* and articulatory *phones* and *phonemes*[9] related to the archetypal feelings of astonishment, fear, bewilderment, revelation, need, quandary, irony, uncertainty or ambivalence that are deeply rooted in the formation of the origins of emotional life and to innate feelings or primary affects. These onomatopoeias, phones and phonemes should not be regarded as representatives of any reality but rather as parts of a hypothetical expressive language uttered by imaginative prototypical humans. The following figure presents an attempt to transcribe the prosodic pitch and intonation of some of the phones and the phonetic segments in *Voices* into the International Phonetic Alphabet (IPA):[10]

[ˈe.hæ]	[ˈm.hɛ]	[m.ˈheɪ]	[hɑ:jə]	[həʊˈpɑː]	[hɒp]
[nəʊ.hai]	[heɪ]	[ɑːˈhɑː]	[aʊ.ə]	[baˈhiː]	[ʌˈiː]

Figure 10.1: ***Prosodic characteristics of phonetic segments in* Voices**

2. Sounds of *dancing bodies* submitted to gravity and trapped into their own corporeality: bodies in motion or stillness, in closed or open spaces, periodically inactive or carved by inertial forces.

[6]*Voices* uses as its primal sonic material the voice of the director and musician Giorgos Nikopoulos from his film 'The Ox' (recordings: Giorgos Gargalas) and dance improvisation recordings by Christina Mertzani, Enangelos Poulinas and Evangelia Randou (recordings: Theodoros Lotis). Other sounds used include voice (Agnese Banti), violin (Nikolas Anastasiou), clarinet (Esther Lamneck) and percussion (Giorgos Stavridis) (recordings: Theodoros Lotis and Demetrios Savva).
[7]*Voices* is commissioned by the artistic research project Embodied Gestures and had its premiere in October 2020 at the Echoes Around Me Festival in Vienna. Thanks to Thomas Gorbach and Enrique Tomás for initiating the commission. A performance of the piece can be accessed from the website https://vimeo.com/561752213
[8]The Proto-Human (also Proto-World and Proto-Sapiens) language is the hypothetical genealogical predecessor of the current languages. Both term and concept are speculative and rather unpopular in historical linguistics. The term Proto-Human refers to a monogenetic linguistic origin of all languages, possibly during the Middle Palaeolithic era. For more information, see Ruhlen and Bengtson (1994).
[9]Phones and phonemes are phonetic segments. Phonemes are specific to a language while phones are not. More information on phonetic segments can be found at Port, 2008; Perreault and Mathew, 2012.
[10]These phones are part of the script of the film 'The Ox' by Giorgos Nikopoulos.

I consider these two sonic categories as paradigms of expressive articulation of what I might call *embryology of primary emotions* since body and voice are both vessels of all instinctive gestural behaviour. In my approach, the term embryology refers to a) the utterance of vocal/phonetic segments, and b) the sounds of corporeal movements. I consider both a) and b) as archetypal, pre-linguistic fertilizers of human communication. Beside language and music there are inarticulate sounds, groans, moans, exclamations and cries—not related to specific languages or musical styles—that can form musical elements. Beside dance there are unsystematic bodily movements that can be organized into choreographies. In that respect, the sounds of human utterances and of bodies in mobility or immobility included in *Voices*, focus the attention on the evolutionary struggle to rise, to move and to communicate. Chaitow, in his foreword to Beach (2010) describes these tasks as '. . . adaptative processes involved in our anti-gravity evolutionary struggle to rise from the floor—where sitting, squatting, crawling and wriggling are more appropriate—to the upright where standing and walking become possible' (p. viii).

Throughout the six scenes or movements of *Voices* the construction of phraseology, including composed and composite objects, rhythmical structures and leitmotifs serves the articulation of primal emotions via gestural behaviour and textural evolution.

10.2.1 Typology of gestures in *Voices*

Gesture is often regarded as a motion trajectory from a point A to a point B, an abstract vehicle that advances the textural content forward (Smalley, 1997; Hirst, 2011). In *Voices*, however, the kinetic behaviour of gestures is of minor importance. It is their narrative abilities that are substantial. In other words, it is not the teleological character of the gesture that prevails but rather its narrative appraisal. Gestures lose their property as textural chisels, thus liberating their potential to narrate and to create time as storytellers.

Gesture encompasses spectromorphological changes in texture by pushing the *musical narrative* to its logical (formal/systematic) and ontological (informal/intuitive) implications. Logical implications refer to the temporal structuring of the sound, which contains the *onset* or *attack* (how a sound starts), the *continuant* (how it continues) and the *termination* (how it ends) (Smalley, 1997, p. 115). Ontological implications refer to the grouping of onset-continuant-termination into the perceptual categories of *beginning*, *middle* and *ending*. The structural elements of onset, continuant and termination create spectral expectations. For example, an onset/attack may be soft or abrupt, sudden or gradual, expected or unanticipated. Accordingly, a continuant may have the character of statement, transition or prolongation (Smalley, 1997, p. 115). A continuant is always the outcome of an onset. A termination is always the outcome of an onset plus the continuant: the end of the story of a sound. In other words, the continuant happens because of the onset, and the termination because of the onset and the continuant. Both continuant and termination are contingent on the onset. At a higher structural level, the elements of onset, continuant and termination are shaped by a gesture. For example, when a piano key is pressed down by a high velocity gesture, the attack of the resulting note will be sudden and abrupt, followed by a prolonged continuant and a gradually decreasing termination. I refer to these interrelated structural stages as musical narratives. Throughout *Voices* gestural typologies are used in order to shape textures and utter the musical narrative.

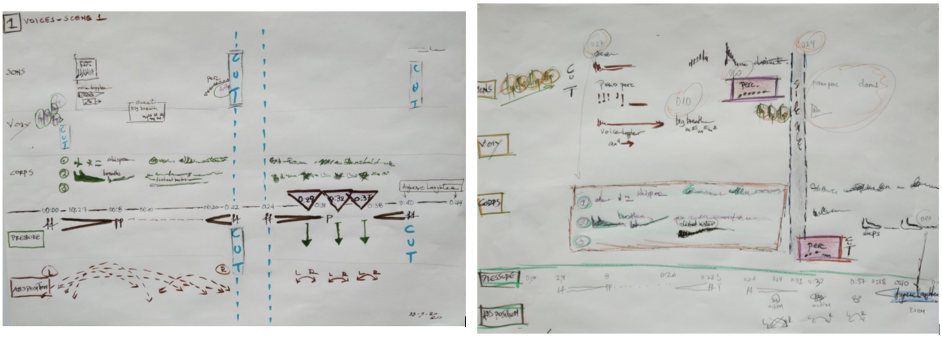

Figure 10.2: ***Graphic score of*** **Voices** ***(Photo: Theodoros Lotis, 2020, CC BY-NC 4.0)***

The gestural typology in *Voices* does not seek to divide time into small or larger linear temporal structures but rather to establish a style of floating narration. Hints of this style are given in the graphic score by the words ‘cut’, ‘silence’, ‘distant’, ‘whisper’, etc. (Figure 10.2). Thus, gestures act as timeless formative vehicles that connect the evolution of sonic morphologies with their narrative function.

10.2.2 Typology of textures in *Voices*

Most of the sound material in *Voices* consists of recordings of syllables, phones and onomatopoeias, and movements of dancers’ bodies. The vocal category comprises mostly vowels and, therefore, its spectral content is often harmonic with varying intonation. The dancers’ recordings are largely of noisy character with eminent attacks and diverse dynamic ranges. The textural character of the sonic material, whether grainy, noisy or harmonic, is interrelated with its spatial context. Minor or major spectral alterations are directly affected by spatial transformations and vice versa. This is especially the case in the fourth scene of *Voices*, where textural variations emerge through spatiomorphological modifications. Occasionally, texture provides the setting for gestural activity, a backdrop for the vocal and the corporeal sonic material.

10.3 The C4

‘The Controller #4’ (C4) (Figure 10.3) is a member of the Embodied Gestures family of interfaces. The Embodied Gestures project proposes

> . . . a new paradigm of interfaces for musical expression especially designed to emphasize a performer’s gestural embodiment within an instrument. For that, ‘embodied gestures’ explores the possibilities of shaping the physical affordances of designed digital instruments with the intention of inspiring particular forms of gesturality. Specifically,

> [the] objective is to study the implications of designing musical interfaces which can afford the same type of gesturality that a particular sound inspires.[11]

The C4 interface operates on the basis of two fundamental types of gesture: *pressure* and *rotation*. It is built around an ESP32 microprocessor which sends wireless OSC data captured by its sensors. This information may be used for parametric mapping and sound generation at host devices (i.e. a computer). The C4 is a rotation encoder with pressure sensing capabilities. It can be used by rotating its handle (generating four increments/decrements per step) and pressing it towards the centre of the instrument.[12]

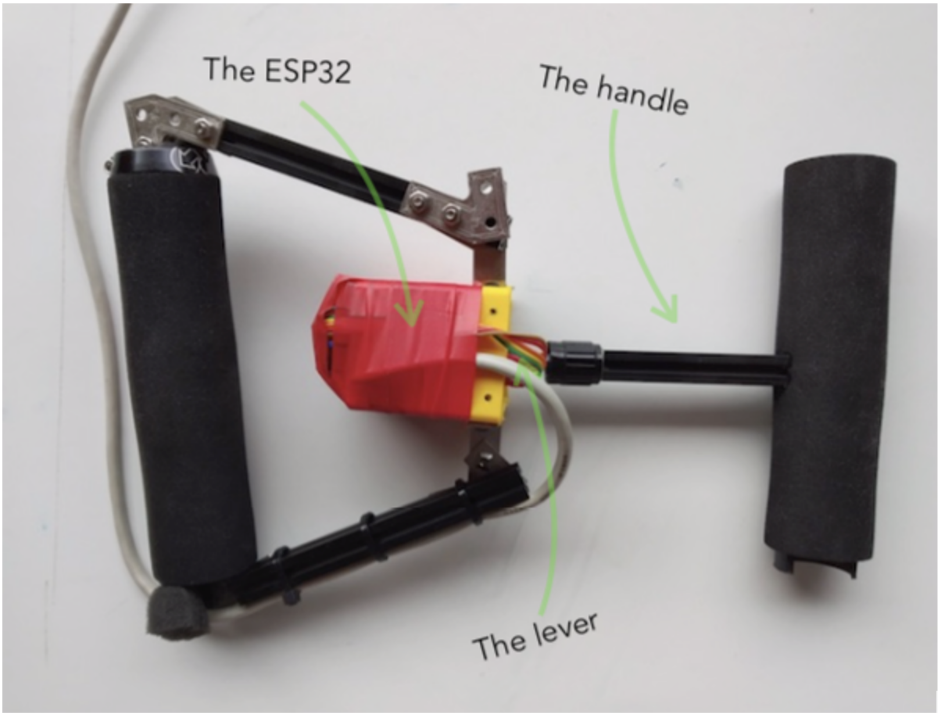

Figure 10.3: ***C4 interface prototype (Photo: Theodoros Lotis, 2020, CC BY-NC 4.0)***

The C4 affords the reinstatement of the performative physical activity as the control mechanism for spectromorphological evolution. It reestablishes the gesture-to-sound re-

[11]More information about the instruments can be found in the chapter *Embodied Gestures: Sculpting Sonic Expression Into Musical Artifacts* (Tomás & Gorbach) of this book. The instruments are the outcome of a collaboration between the Institute of Media Studies, University of Art and Design, Linz and the Institute for Technology Assessment & Design, Vienna University of Technology funded by the Austrian Science Fund FWF, Programm zur Entwicklung und Erschließung der Künste (PEEK AR99-G24).

[12]Although in technical terms the C4 is an interface, it can also be described as an instrument since it is compatible with various performative actions, including different types of gestures. In that sense, the C4 can be regarded as both a performance controller that controls sonic parameters and as an instrument that hosts highly expressive performative gestures.

lationship and the tactile and visual features of the performance. As Smalley (1997) indicates,

> Sound-making gesture is concerned with human, physical activity which has spectromorphological consequences: a chain of activity links a cause to a source. A human agent produces spectromorphologies via the motion of gesture, using the sense of touch or an implement to apply energy to a sounding body. A gesture is therefore an energy-motion trajectory which excites the sounding body, creating spectromorphological life. From the viewpoint of both agent and watching listener, the musical gesture-process is tactile and visual as well as aural. Moreover, it is proprioceptive: that is, it is concerned with the tension and relaxation of muscles, with effort and resistance. In this way sound-making is linked to more comprehensive sensorimotor and psychological experience. (p. 111)

Although the C4 is not the source of the sound itself but rather the tool for its gestural articulation, it affords stimulation and control for sensorimotor integration in performance.

Apart from reassembling '. . . some of the cause/effects chains which have been broken by recording and computer technology' (Emmerson, 1994, p. 31) by addressing the issue of the stationary 'live' sound in performance, the C4 re-establishes the proprioceptive energy of the performer (tension and relaxation of muscles, effort and resistance) and the awareness of physical presence and motion.

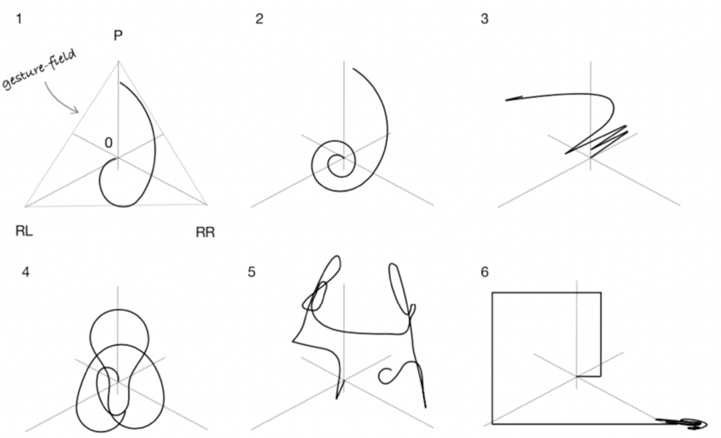

Figure 10.4: ***Gestural curves for pressure and rotation with the interface (Tomás & Gorbach, 2021) (Photo: Theodoros Lotis, 2020, CC BY-NC 4.0)***

10.3.1 Typology of gestures

The C4 renders two main models of gestures: *pressure* and *rotation* (including variations such as swing and rebound). Pressure is a round-trip action model for exerting force between two poles: from a point of equilibrium to a point of maximum pressure and back (Vande Gorne, 2017, p. 19). It deals with the evolution and transformation of both gestural behaviour and spectral content. Its attributes include velocity, direction, acceleration and deceleration. Rotation is an archetypal model due to its cyclic and repetitive character (Vande Gorne, 2017, p. 20). It involves both a motion and a function. As a function, rotation can be applied to other types of gestures including pressure (rotational pressure, which equals the pressure-release phenomenon). Figure 10.4 demonstrates six curves in shape-space corresponding to the evolution of gestures with the C4 in the gesture-field absolute space of the performer. Gestural improvisations on the C4 were recorded with a camera. The most frequently occurring gestures of the improvisations were examined and outlined roughly in the sketches below.

The sketches in Figure 10.4 describe some of the gesture typologies within the gesture-field. Such paradigms include the *cochlea* (1, 2), the *linear* (3), the *butterfly* (4) the *free* (5) and the *square* (6) typologies as well as the *centrifugal* and the *centripetal* tendencies of the rotational gestures. The square typology (6) represents discrete, sequential and unidirectional gestures. The three axes represent the directions of pressure (P), the left direction (RL) and the right direction of rotation (RR). All the gestures of pressure and rotation start from the point 0, which indicates the position of balance of the C4.

The exact timing of gestural activity during performance is outlined in the *action score* of *Voices* (Figure 10.5).

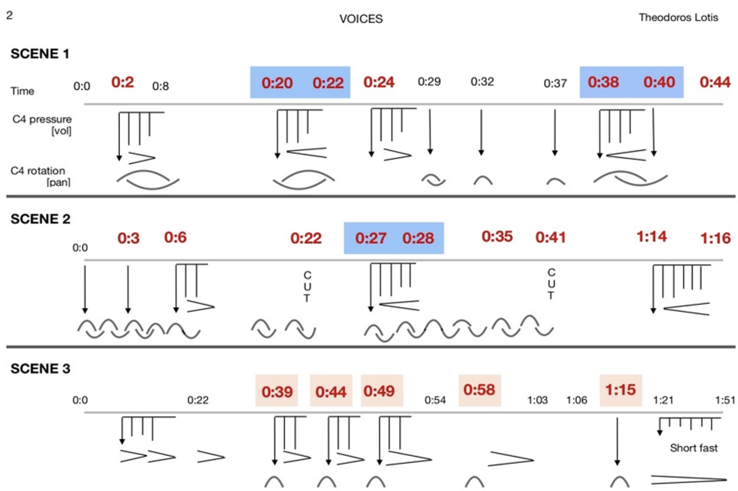

Figure 10.5: ***Page 2 of the action score for scenes 1, 2 and 3***

As indicated in the score, the volume is controlled by pressure and the panoramic by rotation. The performative gestures are divided into the following categories:

- Long gestures with low velocity / fluid. These gestures concern both the pressure and the rotation of the handle. They are mainly preoccupied with the control of the overall volume and the panoramic.

- Short gestures with high velocity /agitated. They undertake the microstructural spectral evolution (as in scene 4 of 'Voices'). They are often preoccupied with the articulation of agitated sonic figures and instant shifts in the stereo image.

- Circuitous gestures. The circuitous category comprises itinerant motions within the gesture-field. As the gesture-field is delimited by the hands and the physical motion of the performer as well as the motion of the C4's handle, gestures can wander free or predetermined within these limits. Thus, the 'live' element can, yet again, be anchored firmly in the domain of the physical, and the energy-field can be '. . . associated with the creation and release of [mechanical] tension which, as we know, is at the source of the gesture-field' (Smalley, 1992, p. 528).

- Loop enforcement / patterns. The cyclic and repetitive character of both rotation and pressure enforces the creation of loops and rhythmical patterns.

10.3.2 Anatomy of a gesture with C4

Figure 10.6: ***A gestural paradigm for* Voices**

In Figure 10.6 we can observe the representation of the temporal evolution of a hypothetical gesture produced by pressing and rotating the handle of the C4. The gesture is divided into four discrete parts which are also indicated in Figure 10.6:

(i) Latency of gesture (preparatory phase). This is the opening stage of the gesture. It may last for only a few milliseconds. It is better defined as a *revived present*, a moment of restoration of consciousness that is often experienced during intuitive improvisations. Between a very recent past (the residue of a previous gesture or a fainted sound) and the expectancy of an immediate future (of a new sound or gesture to be born) there is a moment of revived present that is identified with the preparation of the gesture and lasts as long as the preparation itself. Thus, this momentary and often hesitant latency becomes a site of discovery and discourse.

(ii) Body of gesture. The main part of the gesture is articulated by circular, linear, semi-linear or sigmoid curves on the C4 (Figure 10.4).

(iii) Residue of gesture. This stage concerns the closure of the gesture. It usually possesses a circular or semi-circular trajectory and its intention is to conclude the gesture.

(iv) Restorative stage of gesture. On many mechanical instruments and controllers with a handle, the lever does not always fully return to its original position. Due to construction restraints the lever often remains within the confines of positive numerical values even after its motion is stopped. This drawback requires a subsidiary (restorative) gesture that is not intended to produce sonic information but to revert the lever to its original position.

10.4 Mapping network

The mapping of mechanical performative gestures—such as the ones produced by the C4 interface—to sonic attributes raises some important questions: 1) Which and how many sonic attributes will be influenced by a gesture? 2) With what percentage or *weight* will these attributes be affected? These questions point out a fundamental issue of the mapping, which may be called *justification of mapping*. That is, to what extent can the produced sound be justified by the instrument's gesture and the predetermined mapping?

Control operations can be complex and must be analysed prior to any mapping. An act of control, such as the movement of the C4's handle, is determined by several parameters, such as the absolute position of the handle, its velocity and inclination, the degree of pressure exerted, etc. A prior to mapping analysis can demonstrate which of these parameters play a major role and which have minimal or no effect on the sonic attributes.

10.4.1 Overdetermination

These observations point towards the phenomenon of *overdetermination*,[13] whereby an event is certified by multiple causes, any of which would be sufficient to account for it. Consider the following example: A single movement of the arm that moves the bow on a string comprises various components, including pressure, velocity, direction, acceleration, deceleration and inclination. That means that for every alteration in the sound (pitch, spectral content etc.) multiple parameters join forces in collaboration. This rule is considered as absolute. Although only one of these parameters (e.g. pressure) can be used—and usually is in one-to-one mapping strategies—for the alteration of a sonic attribute (e.g. pitch), this alteration cannot be fully justified by that use. For example, the channelled energy (kinetic, mechanical, automatic, robotic or physical) that moves a potentiometer is often reduced into a single value that reflects the position of the potentiometer, ignoring, at the same time, all the other components of its motion such as the speed, the acceleration, etc. This omission of cooperative components may be referred to as *underdetermination*. In reality, however, no change can be made without the holistic synergy of multiple parameters. In mapping, as with the bow, a number of parameters

[13] The term overdetermination (Überdeterminierung) is used by Sigmund Freud in The Interpretation of Dreams as a key feature that explains the presence of multiple causes in a dream.

that cause even the smallest change in sound should be taken into account. This is done by defining weights for each parameter.

Overdetermination in *Voices* is treated by an intermediate application called *Mapping Network*[14] that determines the rate of each parameter in the production and evolution of sonic events. Ellinas (2020) describes the software as follows: ‘Mapping Network is an application for making complex MIDI controller-to-software mappings. Aiming to mimic the overlapping one-to-many and many-to-one gesture-to-sound mappings found on acoustical musical instruments. The interface is designed after the pin matrix popularized by hardware synths[15], with the addition of specifying percentages (or weights) to each mapping, rather than choosing just whether two parameters are mapped or not. Mapping Network has also built in a rate-of-change calculation feature for control parameters, enabling the use of motion as an excitation gesture for sound’.

10.4.2 The C4 and weighting distribution in *Voices*

Figure 10.7 illustrates the processing method of triggered sounds in *Voices* and the weight distribution in mapping.

Initially, the C4’s rotation and pressure lever sends its values to the Mapping Network application (2), where they are weighted via a Max patch (1).[16] Part of the sonic material in *Voices* is triggered by a simple Markov model. The Markov model is a Max patch which works with a weighted transition table of probabilities. When active, the pressure lever triggers a series of random numerical values, which enter the Markov patch and cause the calculation of weighting values and transition probabilities. According to these probability values, different sonic grains with durations between 100 and 300 milliseconds are triggered from a buffer of audio files. Subsequently, the sonic grains are processed by a pitch shifter that randomizes their pitch and by four delay lines in a Max4Live device (3).

Let us analyse the example in Figure 10.7. Mapping Network (2) is divided into columns (inputs) and lines (outputs). The first two columns accept values from the pressure and rotation lever of the C4. The third column (nul) is a bogus input for all residual weights.[17] Each line represents a parameter mapped onto the Max4Live device. In Mapping Network each parameter is correlated with a percentage or weight. In the given

[14]Mapping Network is an Open Source software developed by Demetrios Aatos Ellinas as part of his bachelor’s thesis in 2020 at Ionian University. The software is written in JavaScript and its code can be accessed at https://github.com/dimitriaatos/mapping-network

[15]Pin matrices were used for patching audio and control signals in synthesizers such as the EMS VCS3, the Synthi 100 and the ARP 2500.

[16]Since the C4 is an OSC controller, its communication with the Mapping Network software introduces latency and data loss due to the OSC-to-MIDI conversion. This issue is partly addressed by filtering/smoothing the OSC data before reaching the Mapping Network software. In my personal experience (after several performances of the piece) the amounts of latency and data loss do not constitute a major drawback, and they do not notably affect the relationship between the gestures applied to the body of the C4, the audio processing and the resulting sound. In cases where the C4 is used wirelessly, the latency between the interface and the computer is even greater.

[17]A close examination of Figure 10.7 demonstrates the function of the last column, or bogus input. Consider the output line of amplitude 1 (Amp 1). It receives a weight of 0.0 (or 0%) from the C4 pressure column and a weight of 0.594 (or 59%) from the C4 rotation column (see line 5 at the bottom right corner of Figure 10.7). The residual weight of 0.406 (or 41%) remains unused in the third bogus column (nul).

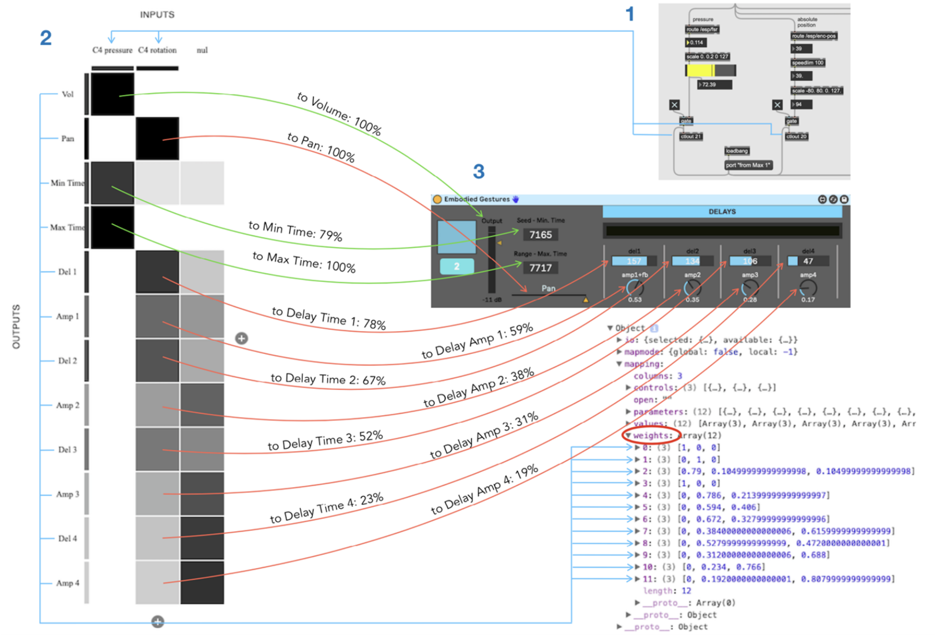

Figure 10.7: ***An example of weight distribution in* Voices *(Photo: Theodoros Lotis, 2021, CC BY-NC 4.0)***

example, the overall volume in the Max4Live device and a minimum and a maximum time in the Markov model (i.e. how often a probability is calculated or how often a sonic grain is triggered) are controlled by pressure and supplied with weights of 100% (1.0), 79% (0.79) and 100% (1.0) respectively (green arrows). Likewise, the delay times 1 to 4 are controlled by rotation and supplied with weights of 78% (0.78), 67% (0.67), 52% (0.52) and 23% (0.23). The delay amplitudes 1 to 4 are also controlled by rotation and supplied with weights of 59% (0.59), 38% (0.38), 31% (0.31) and 19% (0.19) (red arrows).

The numbers given above are determined by a trial-and-error intuitive approach, which mimics the ‘bow-on-a-string’ paradigm: by increasing or decreasing the pressure one can affect various sonic parameters to different degrees. Each of the six scenes of *Voices* has its own preset of weightings. Different performers of the piece can choose and apply different sets of weights for each scene. This method of mapping defines and justifies the resulting sound by acknowledging parametric nuances and level sensitivity. In addition, it allows for a certain degree of *mapping indeterminacy* as the synergy of multiple parameters with different weights does not lead to completely predictable results. As in the case of the bow, although we know how a *sul ponticello*—that combines pressure, inclination, etc.—will be heard, we can only predict the resulting sound to a certain extent.

10.5 Codetta

Liveness in performance is directly related to the distribution of the performer's energy through the instrument. Hybrid instruments such as the C4 and the Embodied Gestures family of interfaces in general attempt to restore the importance of gestural activity and the vitality of the performer's energy-field. For this purpose, any mapping strategy in a live or real-time performance should consider the importance of parametric weighting and the fact that certain sonic attributes are conditioned by multiple parameters, i.e. the texture of a violin note is conditioned by the pressure of the bow, its velocity and inclination, etc.

In that respect, taking into account the different rates of influence that each parameter imposes on the sound (overdetermination), we allow for a level of control intimacy by restoring the body-to-object-to-sound relationship. Emmerson (1994b) concluded his paper on the typology of local/field thus:

> The mapping of performer gesture to control function: expression is multidimensional hence individual parameter choice and scale may need to be the result of a cluster of parameter controls each following a different law: hence the creation of global control functions which 'decide' more detailed values. (p. 34)

REFERENCES

1. Balzano, G. (1986). Music Perception as Detection of Pitch-time Constraints. In G. Balzano and V. McCabe (Eds.), *Event Cognition: An Ecological Perspective*. New Jersey: Erlbaum.
2. Beach, P. (2010). *Muscles and Meridians. The Manipulation of Shape*. Edinburgh: Elsevier.
3. Bengtson, J., & Ruhlen, M. (1994). Global Etymologies. In, *On the Origin of Languages: Studies in Linguistic Taxonomy*. Stanford: Stanford University Press.
4. Dack, J. (1998). Strategies in the Analysis of Karlheinz Stockhausen's Kontakte fuer Elektronische Klaenge, Klavier und Schlagzeug. *Journal of New Music Research, 27*(1–2), 84–119.
5. Ellinas, D. A. (2020). A Control-to-sound Mapping Model Based on Acoustic Musical Instruments Aimed for Live Electronic Music Performance. Theory and Application. (Bachelor Thesis). Ionian University.
6. Emmerson, S. (1994a). 'Live' versus 'Real-time'. In, *Contemporary Music Review, Vol. 10*, Issue 2: 95-101. doi. 10.1080/07494469400640331.
7. Emmerson, S. (1994b). Local/Field: Towards a Typology of Live Electroacoustic Music. Paper presented at the ICMC 1994 Conference: Aesthetics, Philosophy, Criticism. Retrieved from https://quod.lib.umich.edu/i/icmc/bbp2372.1994.009/1 (accessed: 1/12/2021).
8. Emmerson, S. (2001). Losing Touch?: The Human Performer and Electronics. In S. Emmerson (Ed.), *Music, Electronic Media and Culture*. New York: Routledge.
9. Emmerson, S. (2007). *Living Electronic Music*. New York: Routledge.
10. Fauconnier, G. (1997). *Mappings in Thought and Language*. Cambridge: Cambridge University Press.
11. Hirst, D. (2011). From Sound Shapes to Space-Form: Investigating the Relationships Between Smalley's Writings and Works. *Organised Sound, 16*(1), 42–53.

12. Hunt, A., Kirk, R. (2000). Mapping Strategies for Musical Performance. In M.M. Wanderley, & M. Battier (Eds.) *Trends in Gestural Control of Music*. Paris: IRCAM.

13. Kersten, L. (2015). Music and Cognitive Extension. *Empirical Musicology Review, 9*(3-4), 193–202.

14. Kersten, L. (2017). Extended Music Cognition. *Philosophical Psychology, 30*(8), 1078–1103.

15. Ladefoged, P. (1960). The Value of Phonetic Statements. *Language. 36*(3), 387–396. doi:10.2307/410966

16. Lotis, T. (2016). Site and Time Specificity in the Performance of Live Electronics. *OuvirOUver, 12*(1), 74–84. Universidade Federal de Uberlândia. doi: 10.14393/OUV18-v12n1a2016-5

17. Lotis, T. (2018). The Soundscape of a Terrorist Attack as Materiology for Live Performance and its Performative, Social and Ethical Implications. Paper presented at the Proceedings of Digital Culture & Audiovisual Challenges Conference. Ionian University. Corfu. Greece

18. Maeder, C. & Reybrouck, M. (Eds.) (2016). *Sémiotique et Vécu Musical. Du Sens à l'Expérience, de l'Expérience au Sens*. Leuven: Leuven University Press.

19. Moore, F. R. (1988). The Dysfunctions of MIDI. *Computer Music Journal, 12*(1), 19–28. doi: 10.2307/3679834

20. Nichols, J. 1998. The Origin and Dispersal of Languages: Linguistic Evidence. In N. Jablonski, & L. Aiello (Eds.) *The Origin and Diversification of Language*. San Francisco: California Academy of Sciences.

21. Nijs, L., Lesaffre, M., & Leman, M. (2013). The Musical Instrument as a Natural Extension of the Musician. In H. Castellengo (Ed.) *Music and its Instruments*. Sampzon: Editions Delatour France.

22. O'Modhrain, S., & Brent Gillespie, R. (2018). Once More, with Feeling: Revisiting the Role of Touch in Performer-Instrument Interaction. In S. Papetti & C. Saitis (Eds.) *Musical Haptics*. New York: Springer International Publishing

23. Perreault, C., & Mathew, S. (2012). Dating the Origin of Language Using Phonemic Diversity. *PLOS ONE, 7*(4). doi: 10.1371/journal.pone.0035289

24. Port, R. F. (2008). All is Prosody: Phones and Phonemes are the Ghosts of Letters. Keynote address presented at the Speech Prosody 2008 International Conference Proceedings. Retrieved from https://www.researchgate.net/publication/241113855_All_is_prosody_Phones_and_phonemes_are_the_ghosts_of_letters (accessed: 1/12/2021)

25. Reybrouck, M. (2021). *Musical Sense-Making. Enaction, Experience, and Computation*. New York: Routledge.

26. Ruhlen, M. (1996). *The Origin of Language: Tracing the Evolution of the Mother Tongue*. New York: Wiley & Sons.

27. Schiavio, A., van der Schyff, D., Kruse-Weber, S., & Timmers, R. (2017). When the Sound Becomes the Goal. 4E Cognition and Teleomusicality in Early Infancy. *Frontiers in Psychology, 8*.

28. Schroeder, F. (2006). Bodily Instruments and Instrumental Bodies: Critical Views on the Relation of Body and Instrument in Technologically Informed Performance Environments. *Contemporary Music Review, 25*(1–2), 1–5. doi: 10.1080/07494460600647360

29. Smalley, D. (1986). Spectro-morphology and Structuring Processes. In, S. Emmerson (Ed.) *The Language of Electroacoustic Music*. New York: Harwood Academic Publishers.

30. Smalley, D. (1992). The Listening Imagination: Listening in the Electroacoustic Era. In J. Paynter, T. Howell, R. Orton, P. Seymour. (Eds.) *Companion to Contemporary Musical Thought*. New York: Routledge.

31. Smalley, D. (1997). Spectromorphology: Explaining Sound-shapes. *Organised Sound, 2*, 107–126.

32. Vande Gorne, A. (2017). *Traité d' Écriture sur Support*. Ohain: LIEN Revue d' Esthétique Musicale.

33. Xenakis, I. (1985). *Arts/Sciences: Alloys*. New York: Pendragon.

34. Zanetti R. (2019). What Is a Musical Act? Understanding Improvisation Through Artefact and Performance. In R. Stanevičiūtė, N. Zangwill, & R. Povilionienė (Eds.), *Of Essence and Context*. Cham: Springer. doi: 10.1007/978-3-030-14471-5˙17