Intra-Agencies [CeReNeM Journal, issue 4]

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Abstract

In my recent practice I have developed a model of composition based on cybernetics, ANT, and interactions between human and material agencies. This model is a strict application of two overlapping processes enacted within a nonlinear and indeterminate acoustic environment. Typically this environment is musical/acoustic material that is metastable and extensible, affording stable patterns under certain conditions; multiphonics are a simple but non-exhaustive example of this. This article presents my current work-in-progress, a piece for solo cello, (1) discussing treatment of the instrument as a nonlinear space of acoustic continua (rather than event-based musical actions), and (2) outlining a theoretical basis for the performative exploration of such unstable musical materials by referring to research in the sociology/anthropology of science and technology (Lucy Suchman's theory of Situated Actions), and philosophy of science (Andrew Pickering's theories of human and material agencies).

1. Introduction

Since 2011 I have been working on pieces that are open-form performative explorations composed around the balancing of two agencies in an unstable instrumental medium; these are the human agency of the player, and the material agency of the instrument. In this article, I will talk mainly about intra-actions, my new work for solo cello – written for cellist Seth Woods – which is concerned with a continuous and indeterminate spectral exploration, revealing the partials of the open strings using the bowing hand alone.

Human agency is (relatively) straightforward, comprising the intention and agency of the performer, guided by the field of their personal culture, the specifics of the score instructions, and their response to the instrument in performance. It is taken as a matter of course that the player performs with integrity towards the score. Material agency is a way of referring to what the instrument "wants" to do, as a co-constructor of the performance on an equal footing with the human actors. This agency is the instrument's

"preferences" and tendencies arising from its physical materiality, acting variously to both facilitate and undermine human agency in ways that may not be knowable outside the temporal frame of the performative "now". The interaction of these two agencies involves a complex feedback of multiple and overlapping forces, which I characterize as a cybernetic system. Cybernetician Stafford Beer describes such systems as "exceedingly complex systems", where the variables are too great and they interact in ways that cannot easily be analyzed (quoted in Pickering 2010, p. 23). Andrew Pickering goes further, describing cybernetic systems as those "so complex that we can never fully grasp them representationally, and that change in time, so that present knowledge is anyway no guarantee of future behaviour … an ontology of unknowability" (ibid.). Of course such systems are not rare: most of the natural world falls into this category, from weather systems to human and animal behaviour to the interaction of bacteria in pond water. In this sense, cybernetics can be seen as being parallel to chaos theory and non-linear dynamics as a way of viewing complex systems. However, in most cases such systems are made analyzable by modern science through modelling and simplification, reducing the variables until they are manageable, so the system can be, as Pickering describes it, "assimilated to [modern science's] representational schema" (ibid., p. 24). A system is not objectively "cybernetic", rather, cybernetics is a way to look at systems and interactions that does not try to reduce or represent, a phenomenal ontology that, as Pickering says, "confront[s] us, instead, with interesting and engaged material performances that do not entail a detour through knowledge" (ibid., p. 21). In musical performance, I find that cybernetics resonates with concepts of indeterminacy and open-forms, where the contingency of materials and environments are integrated into the compositional logic of the work.

2. The piece

Intra-actions is presented as a text score that explains the two processes at work in performance:

- the local process, the material technique of performance on the instrument, and

- the global process that structures the piece through feedback with the instrument.

The local and global are processes at two different timescales within the same sounding continuum, and they interact to generate the structure of the piece.

The local process is the collection of cello-specific techniques wherein the player uses the right-hand only to reveal and bring out partials within the spectrum of the open cello string: only open strings are used in the piece. This technique is described both procedurally, and in terms of the sounding objective: the player attempts to match, through repetitive application of the two processes, non-fixed pitches revealed as isolated partials on different strings. The available partials are then the local pitch-environment of the piece, a Markov system of available pitches and their different probability weightings. On string instruments, different strings will have different weightings of the available partials, meaning that some partials are more likely to sound than others: for example, the D-string may favour the 5^{th}, 7^{th} and 9^{th} partials while the A-string always produces a clear 8^{th} partial, but only produces the 7^{th} partial if the 3^{rd} sounds before it. This allows for an open-form composition, because the possible pitch outcomes of each iteration of the process are bounded and weighted but not predictable: a process that was first explored in my string quartet a metastable harmony (2012). This process is further discussed in section 3 below.

In a talk on architecture and materiality, Lars Spuybroek gives a beautiful description of the wool-threading processes of Frei Otto, in which a dense lattice of woollen threads is transformed once dipped in water. The water alters the materiality of the system and previously discrete threads merge to form clusters and paths. Spuybroek says that "they start as movement and end up as structure" (Spuybroek, 2012). The global process in intra-actions aspires to this. It is an algorithm that carries the sounding outcome forward in time, and alters the environment in a way that allows structure to emerge without changing the underlying "local" process; rather it alters the ground upon which the local operates. The global process is the continuous reiteration

of the local process nested within a set of rules that periodically change the environment by both moving the local process to different strings, and by detuning the strings: detuning the string far enough will alter the weighting of partials in its spectrum and thus alter the availability of pitches, the environment. The global process, as presented in the score, looks like this:

1. Continuously bow an open string (sul pont & flautando will probably work best) until one stable partial (between partials 2–20 approximately) dominates and the fundamental recedes or disappears completely.

2. Bow a string adjacent to that used in (1), but aim for a partial with the same sounding pitch as was achieved in (1). If a stable partial is achieved that is the same pitch as (1) then goto (3), else goto (4).

3. Return to the string played in (1) and attempt to play the same partial as was achieved in (1). Simultaneously, detune one string that was not used in (1) or (2). If the same partial is achieved then goto (2), else goto (4).

4. Detune the string currently being played, then end, begin process again with another string. Goto (1).

This process also attempts to replace the contingency of human preference with a material contingency, giving the player a reason for almost all of their actions by tying them to the instrumental response.[1] The strictness of the process affords greater latitude for the agency of the material to affect the path taken by the piece. It is important to understand here that the player, in seeking or aiming for a pitch, is only given one attempt. Once there is a clearly isolated partial the player must move on to the next

1 Only the choice of which string to detune in (3) is left completely up to the player, but this would most likely be strongly influenced by material agency in the guise of instrument care and maintaining even tension across the strings.

A brief aside on detuning. This is always carried out with the left hand while the right hand continues bowing; any resultant “pings” as the tuning peg slips and sticks again are an expected perturbation of sounding surface. Detunings should always be as small as possible, almost imperceptible; however, the nature of the instrument means that some larger slips of tuning are inevitable. Also, detuning one string will almost certainly afffect the tuning of other strings. The purpose of the detuning is to alter the string formant as this will alter the weighting of the partials for that string, and thus the pitch environment.

stage of the process. This can be understood with reference to anthropologist Tim Ingold's concept of "wayfaring", where he discusses walking as a continual motion through the world, adjusting your movement relative to the environment, and opposes it to "transport", moving from point A to B and ignoring in-between places (Ingold, 2011). The performance of intra-actions is all about the revealing and exploration of these in-between places, the local teleology of the processes guiding rather than specifying.

3. Material

A central premiss of these pieces is that the material is non-linear[2] and unstable to varying degrees, and this instability means that in repeating the same action there is the probability that the player will not produce the same pitches each time, though the resulting variability will be bounded by material agency. The material of the piece allows only a limited number of outcomes: or at least that only a limited number of outcomes are realistically likely. As an example of similar processes in my earlier work, the series of pieces called There are neither wholes nor parts (2011–) uses only multiphonics on single-reed wind instruments. Although multiphonics are highly variable in pitch content (even from player to player and instrument to instrument) most tend to have only one or two dominant pitches which can be isolated by the player, and a host of subsidiary pitches that are more difficult to isolate; most cannot be isolated. Each set of fingerings is a stable resonating column of air with a specific (inharmonic) spectrum of pitches. The player can apply any or all of a multitude of processes to filter this spectrum, altering breath pressure, embouchure, teeth position, vocal cavity shape, and so on to isolate partials or create subsets of partials within the multiphonic, depending on what the material agency of the instrument allows. There are neither wholes nor parts builds on the idea that each set of fingerings on the instrument is essentially a separate instrument with its own resonances, its own harmony, and that these different harmonies can be connected through common tones

[2] For sources that address fundamental non-linearities in sound production, see Chaigne, Touzé, & Thomas (2005), Fletcher (1989), Keefe & Laden (1991), Popp & Stelter (1990), and Touzé, Thomas, & Amabili (2010).

and so on; the situation becomes truly multi-dimensional once differences between players themselves are included. Each different player brings their own self to the piece via natural variability in vocal cavity and mouth shape, and this affects both the harmony and its affordances. Thus the player and the instrument form an assemblage of interacting parts that lead to a unique sound. When playing traditional music-with-notes, this uniqueness is the player's "tone", part of their musical personality, but it does not affect the availability of pitches. However, the unstable musical material of my works is chosen to maximize the potential for these differences to have a direct effect on the available pitches: because pitch is the medium through which I engage with the sonorities. The point – partly at least – of these pieces is that they enact the uniqueness of the player/instrument assemblage. Learning to perform these pieces is the act of exploring the uniqueness of the available paths through the possible pitches afforded by the performatively resonant assemblage. As Spuybroek again puts it, "we're not mastering matter, we're having matter solve our problems for us" (Spuybroek, 2012).

For quite a while I was unsure if it would be possible to continue this compositional idea into the domain of string instruments, the problem being that string instruments do not have available to them the same variety of spectral harmony. On wind instruments, the resonance is often fundamentally inharmonic, with each fingering offering a quantitatively different resonance and spectrum, but vibrating strings are always the same set of harmonic partials, merely transposed from string to string. I experimented with adding weights to the strings to alter the spectra, which was successful in harmonic terms[3] by skewing the harmonic series into more interesting bell-like shapes. However, it was not very practical because the materials used to weight the strings were not reliable: blu-tack or fishing weights work fine on plucked guitars but the constant vibration of a bowed string is too much, the blu-tack simply falls off. The breakthrough, after several months of experimentation, required a shift of viewpoint. The wind pieces were built around the comparison of varying multiphonics that all contain a certain pitch as a pivot: the listener hears the pitch-thread from event to event

3 This resulted in a side-project, a work for solo electric guitar which is prepared with weighted strings.

and the changing multiphonics create ambiguity by either masking the common pitch (making the thread more obscure at points) or by suggesting other possible threads that may or may not be taken up in the piece. The string technique sidesteps the problem of limited harmonic variability by shifting the locus of ambiguity away from pitch content and onto timbre. The string player uses the right-hand alone to reveal partials through continuous bowing, a drone-like state where attention – in performing and listening – becomes focused on the weighting of the pitches in the spectrum. This trade-off shifts the ground of the environment, from one with many different pitch possibilities to one with mostly fixed pitch possibilities but more subtle shades of weighting between them. On wind instruments, the multiphonics each have only a very small amount of isolatable partials. The wind players I have worked with have been able to create subtle "ghosting" effects by varying the levels between multiphonic and isolated partial, but the system is still largely binary, either a partial or a full spectrum, with limited shading possibilities between. On string instruments, especially lower pitched instruments like the cello, sustained tones allow a large range of spectral subsets with extremely subtle gradation of weighting between partials. It takes much more effort to isolate individual partials on a bowed string using the right hand only, and the partials don't often "pop" out as they do on wind instruments.

Figure 1 shows a spectrogram of the technique on a cello C-string. The example clearly shows sections with prominently sounding isolated subsets of partials. The 7^{th}, 8^{th}, and 9^{th} partials are strongly present in the first half of the example: as a sounding percept, these three nearby partials overlap significantly, the acoustic energy spills over and flows between them, making them perceptually ambiguous. At time-indices 200 and 204, the 17^{th} partial is prominent as energy is reduced in the subset partials 7–9. At index 206 the 9^{th} partial is strong enough to cause the 18^{th} to resonate, implying its own series. Only at index 216 is the "C" percept present; the fundamental is not audible but is implied by the 2^{nd}, 4^{th}, and 6^{th} partials.

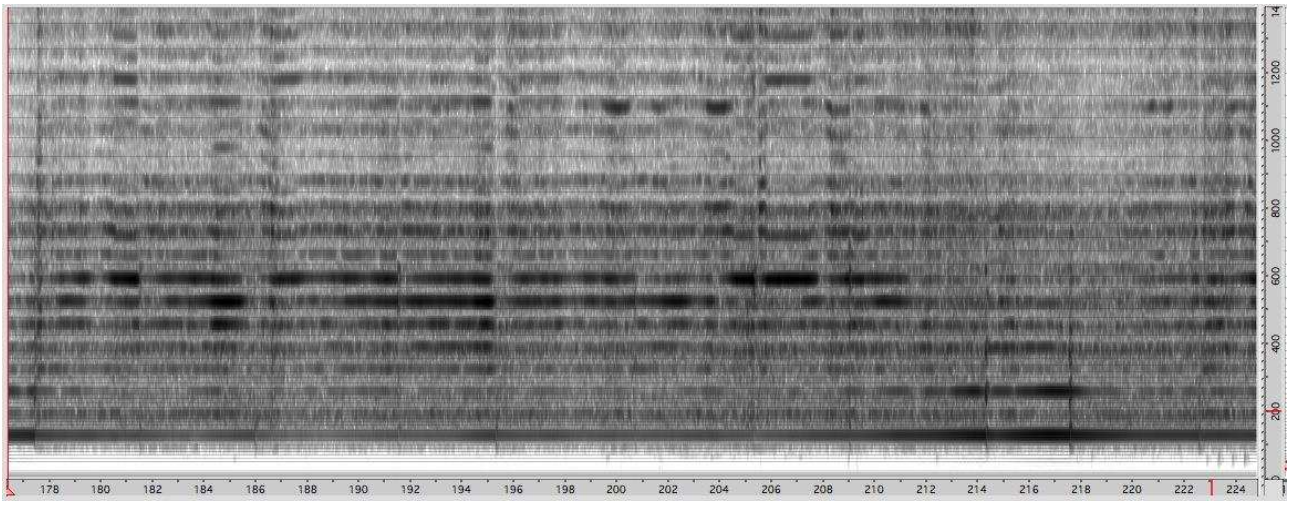

Figure 1: Spectrogram of cello C-string showing subsets of isolated partials.

The subtle differentiation of partial weighting in the string technique is also a function of the sustained bowing. The woodwind pieces rely on repetition and continuous presentation of similar multiphonics to create networks of difference and ambiguity. The string pieces can drone continuously and this allows the ear to concentrate on the internal structure of the spectrum, allowing partials to be exposed more easily, or affording greater levels of nuance and ambiguity. This almost didactic interest in exposing the inner structures of sounds has roots for me in the spectral school of composition, Grisey most notably, but more fundamentally in the work of Alvin Lucier.

4. Human agency

Having outlined the physical materiality of the instrument, and its agency, I would like to turn to the performative human agency. Although the scope of this article does not allow a detailed examination, there are some brief points worth addressing which will illuminate both the above discussion and the piece as a whole.

While the global process is completely procedural, the local process must explain the basic sound production upon which the global process “procedes”. The indeterminate

nature of the material agency obviates a performance practice based in aesthetics of control/specificity. Instead, and reflecting back on Ingold's "wayfaring", the score is not a plan that determines action causally, but is rather a set of principles to guide interaction between the player and the material-environment (instrument, space, acoustic): the global process is procedural, but this acts upon a local process of sound production which is less specific, is goal-oriented, but on a level more abstract than the pitch-specificity of staff notation. Lucy Suchman's work on "situated actions" is relevant: the music here emerges from the performance of a set of instructions situated within two overlapping contexts, the player's implementation and understanding of the local process, and their immediate responses to the material agency of the instrument. Both of these situations happen in real time, profoundly influence each other, and are only based in the instructions of the "plan" of the score text. Suchman says: "however detailed, the plan stops short of the actual business of [action] … The purpose of the plan in this case ... is to orient you in such a way that you can obtain the best possible position from which to use those embodied skills on which, in the final analysis, your success depends" (Suchman, 2007). The score here is an "orienting devices whose usefulness turns on [its] translation to action within an uncertain horizon of contingencies" (ibid.). The instruction of the local process in this work seeks to avoid specificity or representation and provide only principles for outcomes and continuation, as Philip Agre suggests: "instead of seeking foundations it would embrace the impossibility of foundations (positively)" (Agre, 1997). The score does not define specific pitches to be realized, but rather actions to be performed, with the outcome being a "determinately indeterminate"[4] pitch in the form of an isolated partial or subset of partials. The outcome is performative, as the score calls for only a "stability" of sound given a specified input effort. The human agency is guided by the score but this is only one agent in a dynamic co-construction; the agency of the material is equal in guiding the performance.

The score defines goals in terms of audible pitch, this gives the player targets to aim for that are contingent on the material agency of the instrument. Because the musical

4 "Determinately indeterminate" is a formulation I have seen attributed to Husserl's phenomenology, but at the time of writing I have been unable to track down a specific source.

material is unstable, the score here cannot be considered as a text for musical interpretation, the point of the score is not to create a set of specific sounds or musical representations, but to enact a network of agencies within an environment in a way that is self-perpetuating.

Bibliography

Agre, P. (1997) Computation and Human Experience. Cambridge: Cambridge University Press.

Chaigne, A., Touzé, C., and Thomas, O. (2005) 'Nonlinear vibrations and chaos in gongs and cymbals', Acoustical Science and Technology 26(5), pp. 403–9.

Fletcher, N.H. (1989) 'The nonlinear acoustics of musical instruments', Journal of the Acoustical Society of India 17, pp. 78–92.

Ingold, T. (2011) Being Alive: Essays in Movement, Knowledge and Description. London: Routledge.

Keefe, D. H. and Laden B. (1991) 'Correlation dimension of woodwind multiphonic tones', Journal of the Acoustical Society of America, 90(4), pp. 1754–65.

Pickering, A. (1995) The Mangle of Practice. London: University of Chicago Press.

Pickering, A. (2010) The Cybernetic Brain: Sketches of Another Future. London: University of Chicago Press.

Popp, K. and Stelter, P. (1990) 'Stick-Slip Vibrations and Chaos'. Philosophical Transactions: Physical Sciences and Engineering 332(1624), pp. 89–105.

Spuybroek, L. (2012) The Sympathy of Things. [Online] Available at:

http://anthem-group.net/2013/07/06/lars-spuybroek-the-sympathy-of-things/ [Accessed 21 August 2013].

Suchman, L. (2007) Human-Machine Reconfigurations. Cambridge: Cambridge University Press.

Touzé, C., Thomas O. and Amabili, M. (2010) 'Forced vibrations of circular plates: from periodic to chaotic motions', ASME/IDETC 2010 (International Design Engineering Technical Conference), Montreal, Québec, Canada, 15–18 August 2010.