"Building an instrument" in the Collaborative Composition and Performance of Works for Piano and Live Electronics

Dr Zubin Kanga
University of Nice-Sophia Antipolis[1]
Royal Academy of Music, London

This paper examines three cases of recent works for piano and electronics in which I was the pianist and co-collaborator. These cases focus on the collaborative creation of new 'instruments' and highlight specific challenges for the interpreter in both developing the work and delivering the performance. In creating these auto-ethnographic cases, I built on my own doctoral work in the field as well as the of Heyde and Fitch (2007), Clarke, Doffman and Lim (2013), Östersjö (2008), and Roche (2011), all of whom have examined their own creative practices to explore many different models of collaborative relationships.

When I mention the creation of instruments, I'm drawing on a definition of composition posited by Helmut Lachenmann, who defines composition as an instrument (Lachenmann 2004, p. 3) . As Samuel Wilson explains, Lachenmann's metaphor is about reimagining the relationships between body and instruments:

> 'Building an instrument' is not a neutral thing – in the creation of the new is an inherent confrontation with tradition and the 'natural' way of things… as the body is always involved in playing instruments, building instruments encompasses wider concerns about what we understand the body to be, how we use our bodies and how bodies are performed. (Wilson 2013, 57)

With interactive electronic instruments, the mastery of these mediums is a collaborative goal for composer and performer, as described by Atau Tanaka:

> If an instrument is to become a communicative vehicle for the musician, he must attain a certain fluency. In musical instrument performance, we often talk of the state where the musician 'speaks' through their instrument. Ultimately, this produces virtuosi who combine unparalleled technical proficiency and expressive charisma on

[1] Zubin Kanga's post-doctoral position in the CTEL research centre at the University of Nice-Sophia Antipolis is part of the GEMME project on Music and Gesture, supported by funds granted by the ANR (National Agency for Research, France).

> their instrument. Creating a performer/instrument dynamic this intimate is a worthy goal in computer instrument design . . . How to achieve this intuitive musical fluency with a technology-based instrument becomes an artistic challenge (Tanaka 2000, 399).

The case studies examined in this chapter are networks of relationships between technologies: the old technology of the piano and the body of the pianist. None of these relationships are unique to the works I examine – indeed, the presented works simply show similar artistic processes across a variety of interactive technologies that are part of the *lingua franca* of electro-acoustic music.

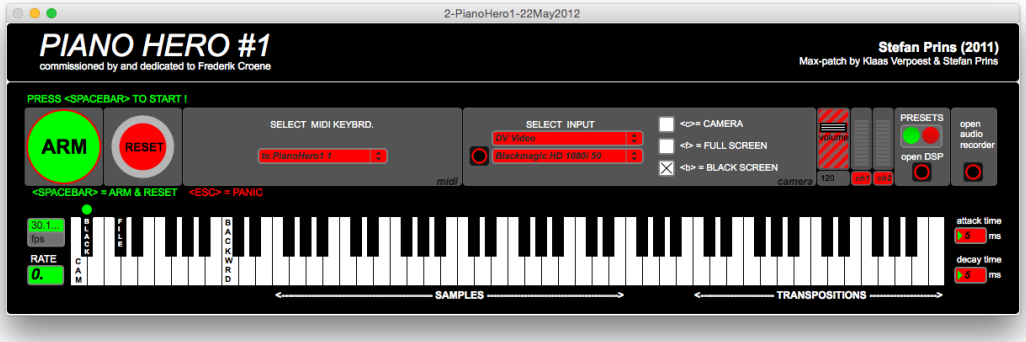
I propose that there are particular characteristics of electro-acoustic instrumental systems that make them more problematic to master than conventional instruments, and that the result is that the instruments themselves dominate collaborations, the content of the scores, and the interpretation of the performer. Mastery is only possible through collaborative testing by both performer and composer as neither have the requisite knowledge to understand the complete system.

Case Study 1:

***Piano Hero No. 1* for MIDI-keyboard, live electronics and video (2011) by Stefan Prins**

I will begin with *Piano Hero No. 1* by Belgian composer Stefan Prins, a work I performed during my recent Dark Twin tour around Australia in May.[2] In *Piano Hero No. 1*, the performer plays a MIDI keyboard which controls a video avatar of a pianist playing on the inside of a piano. Example 1 shows a screenshot for the Max patch of *Piano Hero No. 1*, to be used with the MIDI keyboard, with samples in the central register, 'transpositions' (changing the speed of samples) in the upper register and other functions to be applied to samples in the bass.

[2] For more on Stefan Prins, see www.stefanprins.be



Example 1: Screenshot of the Max patch of *Piano Hero No. 1*

In a nod to video games (with the title alluding to the Guitar Hero game franchise), *Piano Hero No. 1* has two parallel performances connected by the technology. The use of another pianist in the output video is particularly novel, creating a single hyper-pianist out of the two performers (live and prerecorded). Although the work is fully notated like a conventional keyboard piece, the role of the keyboard as video-controller rather than conventional piano-like instrument raises some important work-specific performance practice questions.

The subtleties of the relationship between my performance and that of the avatar became clear to me when I posted a rehearsal video on Facebook, in the lead-up to my performance. Example 2 shows a screenshot from this rehearsal video, showing a sample involving the wooden keys being used to play on the strings.

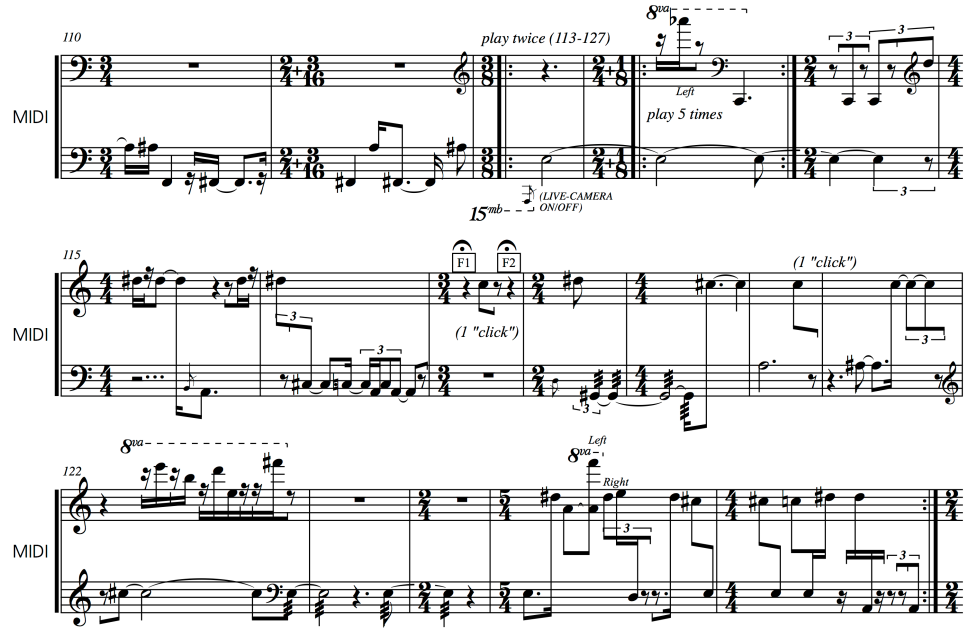
Example 2: Screenshot of a rehearsal video of *Piano Hero No. 1* at the University of Technology Sydney, 30 April 2015

Replying on Facebook, Prins elaborated on the importance of pianistic details such as articulation, making the following observations:

> I just watched your little rehearsal video, looks good! Some remarks:
>
> 1. Make sure that the audience can really see your hands (in other words: try to put your score + stand as horizontal as possible, so they don't block the view on your hands).
> 2. I noticed that sometimes the 'transposition' (speeding up/down) of the samples didn't work. That happens when you play two notes too legato. What happens inside the computer then is this: if you attack a note and only then release the previous one (as one does when playing molto legato), the computer will get the signal of the release of the previous key after it gets the signal of the attack of the key that you actually would like to transpose. So when you then hit a key in the transposition part of the keyboard, you will actually not transpose the latest pressed key, but the previously released key. So: on those moments be sure to play non-legato! (Facebook message to the author, 6 May 2015)

Prins' comment suggested that although my articulation did not directly affect the articulation of the output it was still vital to the resulting performance. The articulation required is dependent on the idiosyncrasies of the instrument, whether or not these aspects are intentional goals to aim for, or unintentional hurdles to jump because of the programming.

The importance of these subtle differences in technique become much more obvious when we look at the one passage where there is a break from the video samples and from the keyboardist-avatar relationship. Here, the entire virtual instrument cuts out, leaving only a camera behind the performer to observe their silent movements.



Example 3: *Piano Hero No. 1* by Stefan Prins, bars 110-126

The part, shown in Figure 3, is notated with a repeat – the first time through, the low A (bar 112) triggers the video samples to turn off and the web-cam to come on, creating a silent theatre of movement, while in the second time through, the low-A turns the original video-sample system back on and the video samples are triggered and manipulated as per the rest of the piece (this is the section discussed above that Prins was commenting on). The repeated passage shown in Example 3 above only works when the gestures are exactly the same each time through. The large leaps in the right hand over the left and the passages of start-stop tremolos are all obvious gestural markers for the audience to recognise both times through. On the effect of this moment, Prins states in an email:

> First of all I felt it would be important to "break" the setup and framework of the piece at some point, to give the piece an extra dimension, and to have it raise some questions. What is reality? What is virtuality? Without that section, this would be easily answered: the live pianist is real, the projection is virtual. But suddenly you see the real pianist projected! How does that change our perception of reality and virtuality? How does the mediated version of the pianist change our perception of him and of his movements? At the same time it also refers to surveillance.
> It could also raise the question: can we trust what we see (are we really seeing live footage from a webcam or is it prerecorded?). It sets a new point on the line between "real" and "virtual" that until then has been bipolar. Suddenly things become more complicated. (Email to the author, 30 May 2015)

In this case, I had to negotiate between the differing priorities – creating gestures that are theatrical enough to make their structure clear so that they can be recognised as repeating the second time, but also controlling my articulation so that the output video is correctly triggered. This negotiation could not be notated, nor could it be fully explained by Prins – it was a function of my relationship with the instrument. These interpretative challenges changed subtly with different keyboards and different halls with different placements of screens and webcams – Example 4 shows a screenshot of the video of my performance on 9 May 2015 in Sydney.

Example 4: Screenshot of performance video of *Piano Hero No. 1* by Stefan Prins, recorded live on 9 May 2015, Sydney Conservatorium of Music.

Case Study 2:
_*derivations* for soloist and live electronics by Benjamin Carey

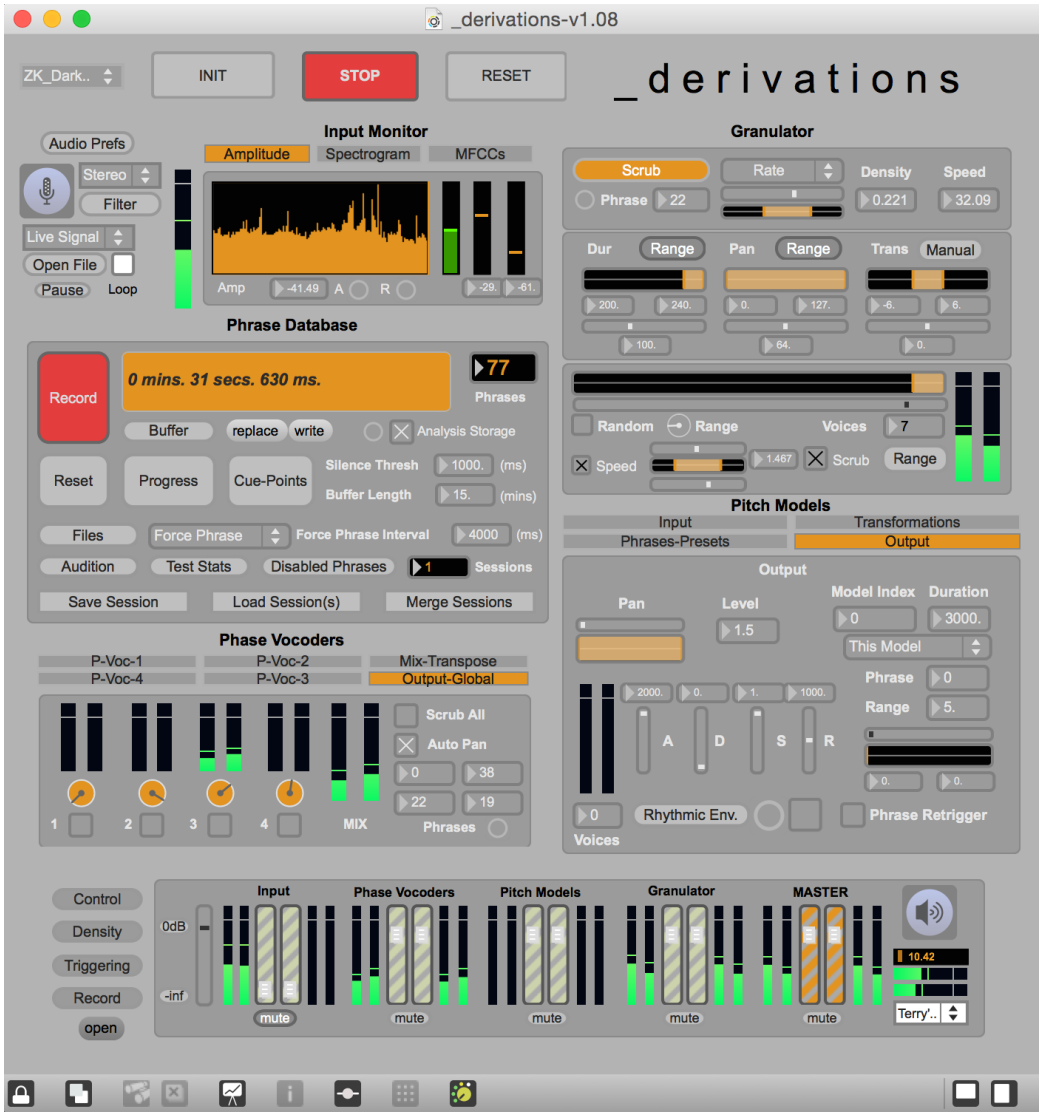
From this very focused and minimal point of negotiation within Prins' 'instrument' let us move to the other extreme with Benjamin Carey's _*derivations*, another work I performed during my Dark Twin tour in May 2015.[3] Carey's work is an open system, a piece of software that uses techniques similar to speech recognition software to memorise phrases I

[3] For more on Ben Carey, see www.bencarey.net

play, manipulate them, then match them in the moment to a current phrase. The screens a' of the system is illusory and highly dependent on the skills of the improviser in manipulating this instrument.

This type of system has numerous predecessors. These include George Lewis' Voyager system, IRCAM's OMax system which similarly uses MFCC's, François Pachet's Continuator which uses markov models and Oliver Brown with his Zamyatin system, among others. What is common to all these and Carey's work, is the tension in these types of systems between perceiving the instrument and electronics as separate, duetting partners, similar to what Georgina Born calls "an improvising musical machine that incorporates a dialogic imagination" (Born 2012, 33) and perceiving them as a single hyper-instrument.[4] Example 5 shows a screenshot of the Max patch for *_derivations* – note the count of 77 'phrases' recorded from my playing, recognised and categorised as discrete phrases, and stored for future use when improvising.

[4] Georgina Born goes on to describe George Lewis' Voyager:
In a reflexive and parodic anthropomorphism, Lewis has designed into the system a quasi-human agency and subjectivity replete with expressive powers, an aesthetic imagination, and a capacity for intersubjective negotation, while all of these are taken to be fuelled by a machinic 'experience' of alterity.
Georgina Born on George Lewis' Voyager (1995), writing in (Born 2012, 186).



Example 5: Screenshot of Max patch for *_derivations*

In rehearsals, I began to understand that the phrase matching algorithm was more sensitive to extreme differences of colour than to subtleties of pitch, which Carey confirmed, saying "it really responds best to extreme differences of timbre. It doesn't do so well with melodic contours" (Transcribed from workshop 30 April 2015) We discussed the software's subtle restrictions on the improviser after one of our rehearsals, "It's something that has no form built into it but the way that that sampling works kind of enforces a way of dealing with its capacity… it limits your formal trajectory" (Transcribed from workshop with the author, 30 April 2015)

Thus, the peculiarities of the system encouraged me to use similarly extended techniques as a way of generating material. Knowing that I was filling up the memory bank with material at the beginning of the work, I deliberately began by using several different

extended techniques inside the piano: plucking the strings, on the main length of the strings as well as behind the bridge, strumming the strings, knocking the frame and using harmonics and muting. These were all tools used to build up a bank of phrases that relied more on colour than on pitch material for their interest.

The timing and form of the use of these different techniques was determined by the software: only after it was matching and imitating one technique would I move on to the next one, allowing me to do the physically impossible and play both inside the piano and on the keyboard at the same time. My own goal of virtuosity here directed a play of impossible physicality and sound that has been a point to strive for so many works I have performed in the past. In an interview, Carey agreed that my approach played to the software's strengths as well as its restraints:

> I think your materials suited the work because they showed a different perspective on the way in which the software can work, which is the point! The soft, plucked materials showcase the independent nature of the various 'players' in the software, much the same as the way I have been working with it recently with non-pitched materials – exposing the process quite transparently. This I'm used to hearing. The richer, pianistic gestures focused upon a single tone created a dense textures from which you could diverge – you drove it into a place where you could play on top of recurring layers, which worked well. . . I think software like this influences and constrains less than it directs and controls performers. The mode in which you were working definitely influenced your structural choices. You knew that you could nudge the software in a certain direction over time, creating a formal arc for your performance. Although this might sound like a form of performer control, I think it's actually a type of interactive constraint on the possibilities of the performance. The synthetic 'shadowing' of your sound also brought out a tendency to explore in a limited harmonic space. I have observed other performers setting up these kinds of structures using this performance mode, for sure. (Interview with the author, 29 May 2015)

The central question around this type of work remains: Is *_derivations* a 'musical work' or merely a tool for an improviser? Carey explains:

> The musical text is, in effect, the boundaries and constraints of such a human-machine musical interaction as influenced by the machine's perceived capabilities. Navigating these possibilities in a truly interactive sense is the task laid out for the musician. Interpretation can therefore be characterised as the navigation a space of potential relationships between human and machine agency, a context envisaged and brought forward by a system developer to a live performance context (Carey 2015).

In this case, the instrument is the work itself– even without a score, the system's constraints direct the character of the work and its form. It directs me to find an optimum variety of techniques, and the optimum timing of their introduction and recapitulation. My virtuosity is multiplied by the instrument, but only once I have mastered its quirks through repeated

testing. Example 6 shows a screen shot from the video of my *_derivations* on 9 May 2015 in Sydney.

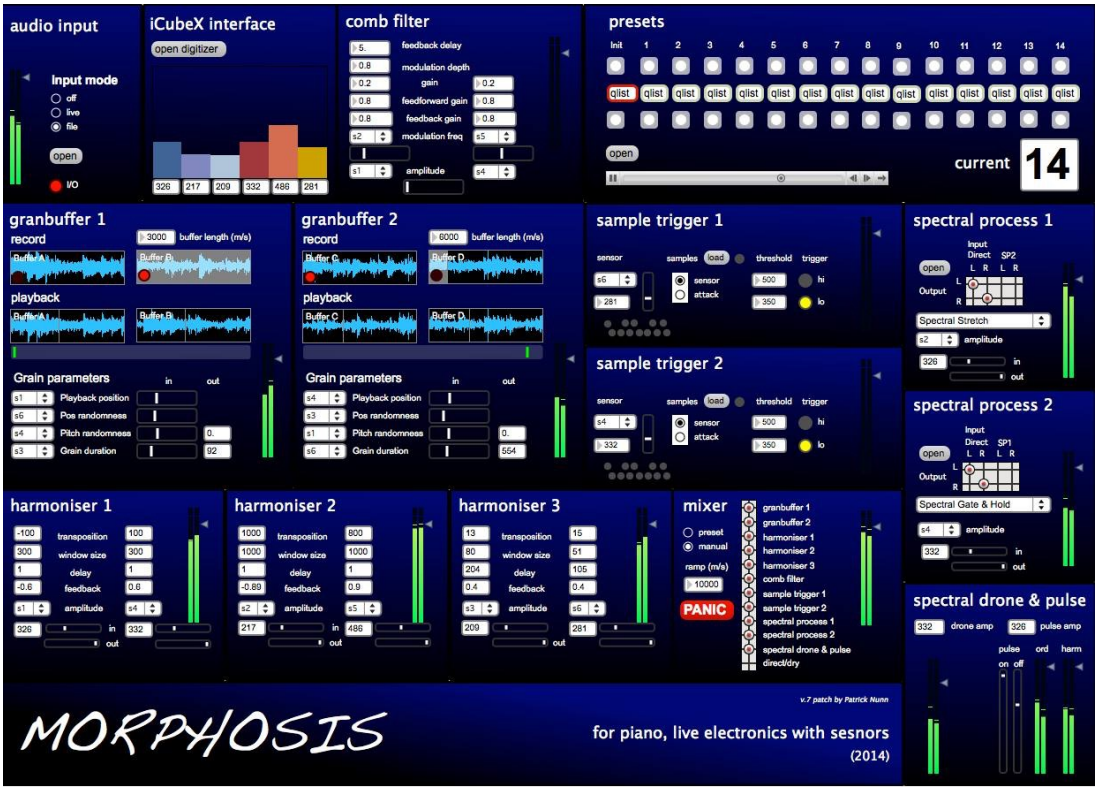
Example 6: Screenshot from performance video of *_derivations*, recorded live, 8 May 2015, Sydney Conservatorium of Music

Case Study 3:

***Morphosis* for piano, 3D sensors and live electronics (2014) by Patrick Nunn**

An even more complex type of instrument building can be found in the collaborative creation of *Morphosis* by British composer, Patrick Nunn; a work I premiered in June 2014 in London.[5] The work features sensors that react to my technique as well as to extra-pianistic gestures that I can add in the middle of the performance. The work is scored, but these extra gestures are not. And most interesting for our discussion, the collaboration began before the work was composed, and the instrument was built around me as I simultaneously learnt how to use it. Example 7 shows the Max patch for Morphosis, with the 6 bars in the top left showing the live data from the two hand sensors (three dimensions for each hand).

[5] For more on Patrick Nunn, see www.patricknunn.com



Example 7: Screenshot of Max patch for *Morphosis*

Morphosis is written for piano, 3D sensors and electronics. The sensors function as both gyrometers and accelerometers. We have already seen in the previous two cases discussed above that these virtual instruments are difficult to learn and master because of the complexity of their mechanisms and relationships to conventional pianism. Nunn made a conscious effort to increase the complexity of this relationship, rather than simplify it. We discussed this in a workshop in 2013:

> ZK: It's impossible to get each parameter individually.
> PN: Which brings an interesting approach to it. Similarly to a violinist's bowing hand that's always moving in multiple dimensions, we can set up the electronics so it operates almost in a three-dimensional way. So you'll know you can't just do this [rolling wrists] by itself because you'll affect something else at the same time (Transcribed from workshop with the author, 7 November 2013).

Example 8 below presents some of the functions of the sensors from late in the piece when the effects attached to each movement are so complex that they become almost impossible to predict and control. The 'Granbuffer' section shows how the movement of the hands controls which parts of the memory bank of recent sounds the patch is manipulating, the 'Harmonisers' and 'Spectral Freezing'show control over the type of

sound manipulation and the 'Sample Trigger' controls the use of recorded samples (such as gong-like prepared piano sound).

Granbuffer 1+2
LEFT: (s1) BACK/DOWN>FORWARD/UP – Scans buffer 1 playback position (start>end)
RIGHT: (s4) BACK/DOWN>FORWARD/UP – Scans buffer 2 playback position (start>end)
LEFT: (s3) CENTRE>LEFT or RIGHT – Decrease buffer 2 position randomness
RIGHT: (s6) CENTRE>LEFT or RIGHT – Decrease buffer 1 position randomness
LEFT: (s1) FORWARD/UP >BACK/DOWN – Increases buffer 2 pitch randomness
RIGHT: (s4) FORWARD/UP >BACK/DOWN – Increases buffer 2 pitch randomness
LEFT: (s3) CENTRE>LEFT or RIGHT – Decrease buffer 1 grain duration
RIGHT: (s6) CENTRE>LEFT or RIGHT – Decrease buffer 2 grain duration
Harmoniser 1
BOTH: (s1+s4) FORWARD>BACK – Increases amplitude independently
Harmoniser 2
BOTH: (s2+s5) CENTRE>ROLL OUT – Increases amplitude independently
Harmoniser 3
BOTH: (s3+s6) CENTRE>LEFT or RIGHT – Increases amplitude independently
Comb filter
BOTH: (s1+s4) FORWARD/UP>BACK/DOWN – Increases mod freq independently
BOTH: (s2+s5) RIGHT>LEFT – Increases amplitude independently
Sample trigger 2
RIGHT: (s6) CENTRE>LEFT or RIGHT – Triggers 'piano harmonic' samples
Spectral Freezing
LEFT: (s1) BACK/DOWN>FORWARD/UP – Increases amplitude
Spectral Filterbank
RIGHT: (s4) BACK/DOWN>FORWARD/UP – Increases amplitude.[6]

Example 8: List of sensor movements and resulting in functions in 'Preset 7' of the *Morphosis* Max patch.

When workshopping the score and system as they were developed, Nunn began to tailor and calibrate the system to my idiosyncratic technique. He commented in a workshop:

> PN: It's funny how your range is so remarkably different to what I thought it would be.
> ZK: You thought it would be much bigger?
> PN: Yeah.
> ZK: Well when it's chords that are widely spaced, there's not much option, in a way. It's the lateral movement….
> PN: I would rather you play like you normally do and I adapt the system to you.
> ZK: Yeah, and it'll change over the coming weeks as well as I learn it.
> PN: That's fine, and we can refine stuff. It's very quick to adapt. (Transcribed from workshop, 9 May 2014).

[6] Composition notes provided by Patrick Nunn.

However, on 22nd May, he found the opposite result during our testing:

> PN: There's more movement from your hands than I imagined. There are moments when there was lots of gesture stuff going on, when I need to restrict the movement that the computer senses. At the moment it's going right off the spectrum and coming back.
> ZK: Maybe I'll need to write in instructions for what to do in particular rests. Whether to keep still or move around more. (Transcribed from workshop with the author, 22 May 2014).

The result is a complex system that is tailored to me, yet one that I still need to learn to understand how to play.

In our final workshops, the focus turned towards my own learning of the system. In many of our exchanges, Nunn would begin by teaching me which effects were attached to each type of movement, allowing me an entry point to understanding the relationship between sensors and sounds, as the following exchange demonstrates:

> PN: With the chords, let me try and explain. This shape in the left hand [rotating left hand forward and backwards] is not just doing one thing but several things. The first thing it's doing is scanning through the last three seconds you've played. So if you hold it still, you can actually freeze it on a sound.
> [I play through and attempt this type of control with the left hand].
> As you can tell, it's wiping every three seconds, so it's continuously changing. The other thing you can do is that while you're playing that chord you can [rotating right hand forward and backward] control the octave jumps. You've also got these [rotating hands left to right]. The left hand is controlling the grain size so flat is producing quite a piano-like sound, but if you turn it sideways [I try this out]. Were you turning your left hand.
> ZK: No sorry that was my right hand.
> PN: I see, so that's controlling the longer buffer. Each hand is controlling a different buffer (Transcribed from workshop with the author, 22 May 2014).

Example 9: Screenshot from video of the workshop with Patrick Nunn on 22 May 2014.

From this starting point, where I would learn by imitating (or even mirroring) Nunn, I began to explore passages on my own. In one workshop, I simply repeated a passage with three chords, then trying different hand movements: slow then fast, violent and jerky then almost still, moving in single axis then exploring more complex multidimensional movements. This more autonomous period of performative testing was the most useful for me in attempting to find some level of control.

The result of this process of testing is an 'instrument' that I can consciously control in only a limited fashion, but that still sonifies the natural gestures of my pianism. As Nunn explains,

> You do have control because you're making the sounds, you're making the shapes but you're not consciously affecting anything (Transcribed from workshop with the author, 14 May 2014).

Thus Nunn's system enables a mechanism which is determined by my movements, yet always out of reach of complete mastery.

Conclusion

In all these cases, I have shown that working with technology-augmented instruments poses new and different challenges to the 'new instruments' that Lachenmann refers to. The precise function and inner workings of these instruments

is so complex as to be opaque, with neither composer nor performer able to predict, even with advanced schemata how the instrument will interact with the performer's body in performance. It is a 'black box' to use an engineering term, and its quirks and precise abilities can only be mastered through thorough collaborative testing (and a type of performative reverse engineering). I would like to suggest that this holds for all electro-acoustic works, including those with fixed tape parts (but that is a subject for a future research project).

In addition, these cases have shown that the technologies are far from being merely tools or mediums for expression. Their characteristics dominate the works, reducing the relevance of the scores to the work's identity and constraining the performer in unpredictable ways, even when the composers have intended a great deal of musical and gestural freedom. The instruments play me as much as I play them and performing the work is impossible without an intimate understanding of the relationship between body and technology, a relationship that cannot be notated or described, but explored and embodied.

References

Born, Georgina. 2012. "Digital Music, Relational Ontologies and Social Forms". In *Bodily Expression in Electronic Music, Perspectives on Reclaiming Performativity*, edited by Deniz Peters, Gerhard Eckel and Andreas Dorschel, 163-180. New York: Routledge.

Carey, Benjamin. 2015. "Interpretation in human-machine improvisatory performance". Bencarey.com blog, 8 January 2015, accessed 30 May 2015. https://benjamincarey.wordpress.com/2015/01/08/interpretation-in-human-machine-improvisatory-performance/

Clarke, Eric and Mark Doffman, Liza Lim. 2013. "Distributed Creativity and Ecological Dynamics: A Case Study of Liza Lim's 'Tongue of the Invisible'". *Music & Letters* 94/4: 628-663.

Fitch, Fabrice and Neil Heyde. 2007. "'Recercar' - The Collaborative Process as Invention". *Twentieth Century Music* 4/1: 71-95.

Kanga, Zubin. 2014. "Inside the Collaborative Process: Realising New Works for Solo Piano", PhD thesis, Royal Academy of Music, London.

Lachenmann, Helmut. 2004. "Philosophy of Composition: Is there such a Thing?". In *Identity and Difference: Essays on Music, Language and Time*, edited by Jonathan Cross, 77-70. Ghent: Leuven University Press.

Östersjö, Stefan. 2008.*SHUT UP 'N' PLAY! Negotiating the Musical Work*. Lund: University of Lund Press.

Roche, Heather. 2011. “Dialogue and Collaboration in the Creation of New Works for Clarinet”. PhD thesis, University of Huddersfield.

Tanaka, Atau. 2000. “Musical Performance Practice on Sensor-based Instruments”. In *Trends in Gestural Control of Music* (CD-ROM), edited by Marcelo Wanderlay and Marc Battier. Paris: IRCAM.

Wilson, Samuel. 2013. “Building an Instrument, Building an Instrumentalist: Helmut Lachenmann’s Serenade”, *Contemporary Music Review* Vol 32 No. 5: 425-436.