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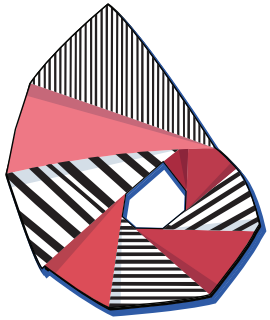

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The Instrument as the Source of new in new Music

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Abstract: Like any traditional instrument, the potential of a new instrument and its possible music can only be revealed through playing. How can we treat technological matter as yet another material from which our notions of possible future instruments can be constructed, intrinsically intertwined with and informed by a practise of performance? Our approach to developing instruments for musical performance strives to not just make technology, but aesthetic and cultural objects. A musical instrument is not an interface and should not be designed as such, instead, instruments are the source of new in new music. We would like to present an instrument design process conducted with a musician as visionary and agenda setter. As the instrument grows and evolves through the various stages, it remains playable and faithful to the desire to make music. The resulting objects are experimental prototypes of technological matter, which allow analysis and meaning to be specified through physical and tactile interaction with the object itself. At RTD2015 we will present a range of these intermediate prototypes and play the finished instrument.

Keywords: Instrument; embodied; making; improvisation; performance, prototype.

'The musical instrument is a vehicle for the desire to make music. It is both something that must be internalized, incorporated and made flesh and something other, without which we could not get to that sound from the world beyond' Joel Ryan (Ryan and Andersen, 2014).

Introduction

This paper describes an embodied design process conducted as a collaboration between a musician and a researcher. It takes its origin in the musician's desire to rebuild and re-imagine a cello as the site, not only for the generation of musical sound, but also for the complex modification and processing of that sound through software. The underlying concern is to not just improve on an existing instrument or make it suitable for electronic music, but rather to create structures that might fit better with the artist's mental images of the music. As such, we are not directly concerned with traditional usability issues such as potential increases in efficiency, but rather we aim for increased flow, intuitive modes of expression and unbroken periods of concentration within the experience of playing music.

Methodology and Context

This project is conducted within an art setting at a studio for electro-acoustic music. The focus of the work done at the studio is to use any available technologies and techniques to facilitate artists in building new instruments for their professional musical practise. Our community tends to focus on improvised and experimental electronic music centered on live performance. Within this setting it is natural for us to make use of a broad range of techniques from theatre, dance and performance. We take inspiration from the experimental theatre work of Boal (1992), the art practice of estrangement as described by Shklovsky (1917) and Dewey's notion of experience as a process of becoming (1958).

This type of work is similar to critical design methods such as Placebo Designs (Dunne and Raby 2002), practical methodologies like the Future Technology Workshops (Vavoula et al, 2002), and techniques for inspiration and understanding of users like the Cultural Probes (Gaver et al 1999). Techniques of ideation can also draw on traditions of craft, and technology as a "magical unknown" has been used as the jumping off point for a range of workshop techniques that begin with material exploration (Andersen 2012, 2013, 2014). In this case we specifically make use of the making of non-functional mock-ups as a way to imagine a technological/musical element that is yet to be build. These then act as props, through which the participant can express their intuitions and concerns with a given technological or musical notion.

Making New Instruments

A new instrument should provide an intuitive interface between gesture and sound, which allows for the development of virtuosity. In this way, an instrument should provide a long lasting and fulfilling interaction that exceeds the novelty of its modifications and extensions. Similarly, the new instrument should be capable of surprising the performer and allowing the continual renewal of musical possibilities through exploration, practice and discovery. A new instrument also requires a certain level of stability and durability, providing the longevity suitable for traveling and performing. It should also provide a sense of reliability, allowing the performer to act with immediacy, focusing on aesthetic and musical considerations rather than the technical details that lie behind the interface.

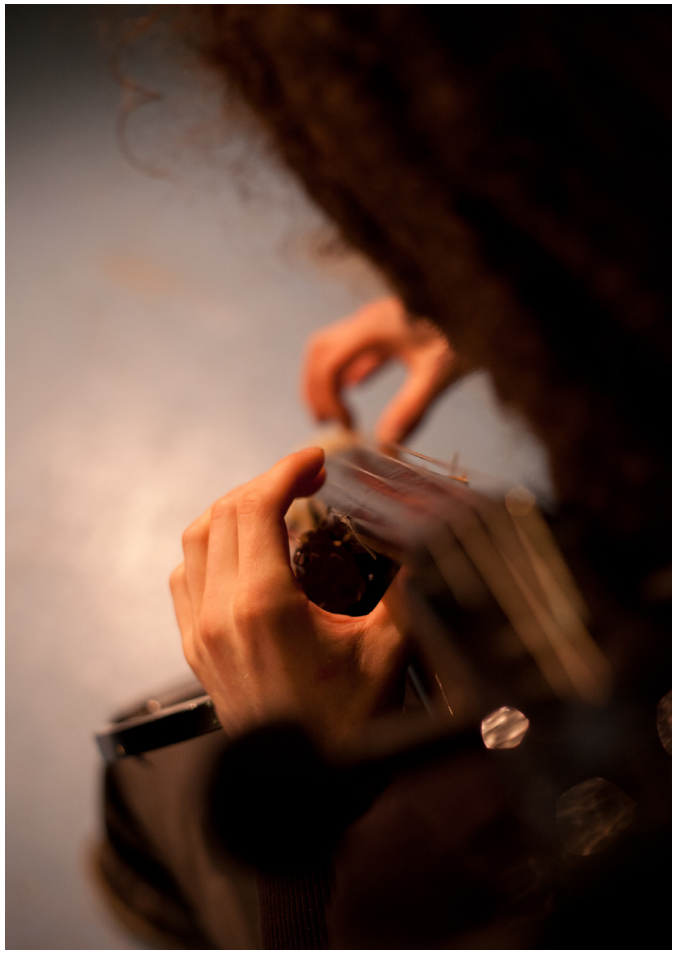
When it comes to playing an instrument, whether it is traditional or new, the body of the performer has always been in the centre of things, with the control and sound properties of an instrument intimately linked to it's acoustical properties, technical execution, size, weight and construction (see also Gibson's theory of affordances (1977)). Considering new technology for creative expression, through the framework of objects and instruments, allows us to address the potential design and solution space through the performing body of the musician.

To facilitate an initial embodied conversation about instruments for creative expression, we build tentative and hypothetical instruments as non-functional physical mock-ups and prototypes. Each resulting hypothetical instrument reveals new strengths and weaknesses in a proposed instrument design, but more importantly the process temporarily frees us from considering practical and technical limitations and concerns.

Non-functional Prototypes

We make use of physical making as a way of allowing us to think with our hands and then letting the resulting object support the imagining and talking about that, which is yet to be fully understood or even imagined. The resulting objects can be seen as active props, animated and investigated through playing. The prop allows us to fantasise and guess about its functionality and use. Certain features will be accidental, dictated by the limited material available and the short time in which it was built, but as the maker stands up to explain and "play", all features (intended and unintended) work together to inspire and inform the presentation. In that moment of heightened alertness, the prop itself instructs us as to how it should be handled and used.

This process makes use of mechanics similar to pretend play: the ability to represent one object as two things at once, the ability to see one object as representing another, and the ability to represent mental representations (Lillard, 1993). The child knows that the stick in his hand is a stick and yet



Process Notes:

"My experiences with improvising and playing acoustic instruments led me to an interest in real-time electronic music. The detailed and expressive control of the cello is well suited to this and provides a wide range of possibilities for transformation using software."

"Processing electronic sound provides the potential for creating more dynamic transitions and transformations to the cello sound."

"I used to achieve this by using a separate commercial interface with sliders and switches to modify the sound from the cello. As the cello usually requires two hands to fully articulate the acoustic sound, reaching over to the controller creates a break in the flow of the performance - both cognitively and physically. This is problematic when improvising, as it becomes difficult to act spontaneously and intuitively."

"My first explorations of the cello involved developing an understanding of the instrument's sonic and physical properties through playing, practice and reflection."

at the same time, within the game, it is also a sword. We can hold these two realities at once, they are both in some sense true simultaneously. This mirrors Augusto Boal's games where educated, highly attuned forms of listening and paying attention allows the players to gather knowledge through improvisation (1992) and is in turn reminiscent of Callois' game spaces (1961): as in a game we erect a tent in time where experimentation can take place.

The Cello

The cello was chosen as point of departure due to both its physical form and tonal qualities. For the purpose of this project it acts as both sound source and physical interface for the real-time creation of improvised electronic music. A long list of qualities makes the cello uniquely suited for such an exploration.

The cello offers a wide range of sounds and intuitive control over subtle transformations of the sound's timbre and texture. More specifically, the range of percussive and tonal sounds, that can be made using the bow and fingers offer many possibilities for producing sound: plucking, bowing, scratching, bouncing, tapping, scraping.

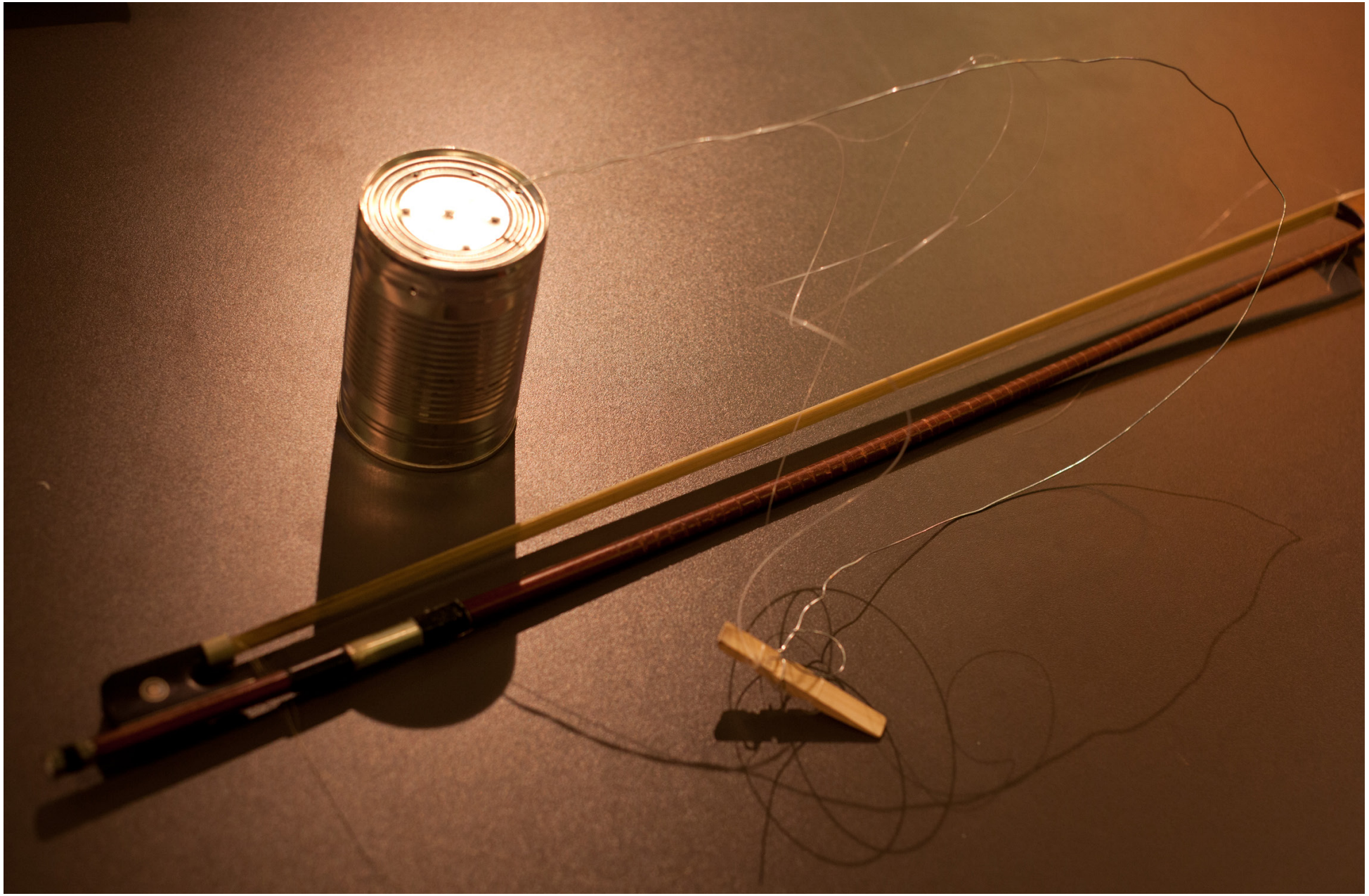
The different materials, shapes and edges of the bow allow for different playing techniques, producing a wide range of percussive and tonal, continuous and discontinuous sounds. The use of the bow also amplifies the performer's movements - allowing for subtle manipulations to be made to the sound.

The large size of the fret board provides a high resolution for the control of pitch, allowing very small movements to make large tonal differences. In addition to this, the amount of finger and bow pressure applied to the strings results in diverse differences in the density/spectral content of the sound.

The quieter tapping and scratching sounds, produced by playing the bridge directly, have a more direct/closer quality, picking up more detail, which compliments the thicker/more full sounds of the strings. The complexity and interdependence of these aspects lead to a deeply engaging and responsive interaction with the instrument, whilst retaining intuitive control of the sound.

Understanding the Unmodified Instrument

We start by reconsidering the qualities of the un-modified cello. Through examining and exploring the traditional playing techniques and sonic qualities, an understanding develops regarding what is and is not possible with the instrument in it's initial state. In particular, the relationship between the bodies of the cello and performer are considered with issues of balance and stability revealing themselves as significant. Whilst



Process Notes:

"By building a series of conceptual models of the cello, we reduced it to its fundamental components, so that we could gain a better understanding of the functionality and physical processes involved in the instrument."

"We experimented with resonance, vibration, and physical stance by constructing and playing cello-like devices made from cups, cans, string and elastics. We did this to explore the instrument from different angles and reveal the extent that each orientation between the cello and the performer constricts or frees the experience of playing."

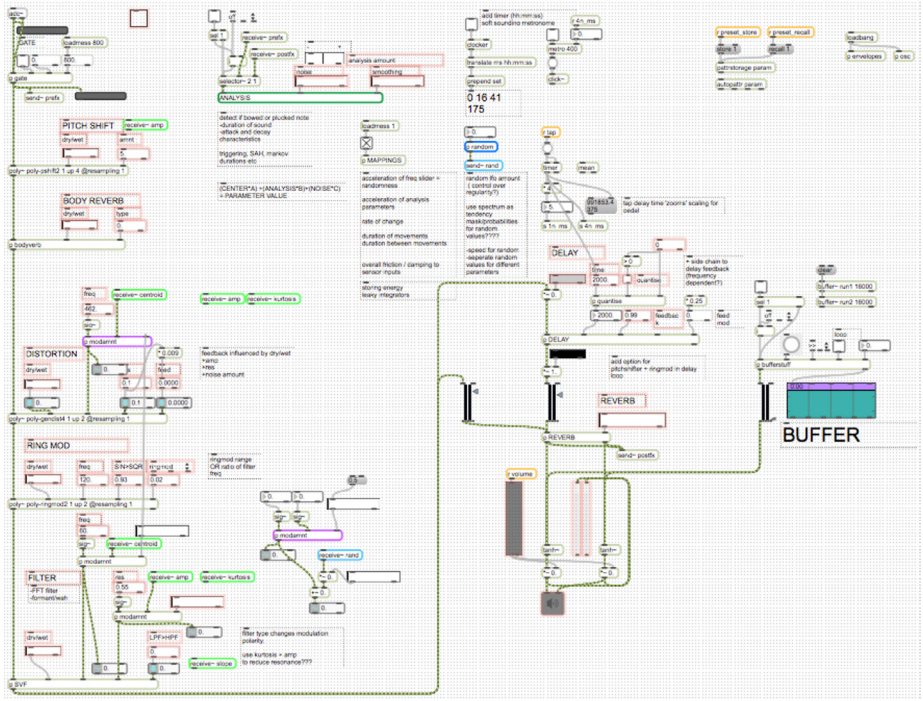
"The cello revealed itself through different perspectives/modes of interaction and this helped me build an embodied and conceptual knowledge of the instrument's affordances and limitations. This process focused on stability, balance and symmetry between the body of the instrument and my own."

playing in the traditional posture, the performer is required to support the instrument. This means that, the instrument must be stable enough to support the pressures exerted by the performer and allow freedom of movement around the cello body.

The movements made by the performer and their resultant sound are analysed in order to gain a better understanding of the limits of stability and the connections between sound and gesture. The cello is a relatively large instrument, this is advantageous as it provides a high-resolution control of pitch, but the physical distance between the note positions on the cello body require significant time for each transition. The instrument also requires both hands in order to be played in the traditional manner, with the control and articulation severely compromised when using only one hand.

Processed Sound

The use of electronics frees the performer from the need to continuously transfer energy into the instrument in order to produce sound. The use of delays and sampling allows the creation of layers, which can be used to create iterative transformations, build momentum and references in time, which in turn manipulate the sense of direction in the music. This allows the creation and manipulation of sound in multiple time domains and playing modes.



Process Notes:

"Draw the sound you want to be able to make. Drawing directly on the hand is a gesture similar to a musical gesture in improvised music. There is no room for hesitation and the result is both surprising and well known. Abstract conceptions of time can now be examined in the physical domain, gaining perspective and developing strategies."

"The elasticity, malleability and structure of interwoven rubber bands helped explore the ways in which we could expand/translate this into the digital/mappings. In this way, the models focus on the experiential aspects of this interaction and generate techniques for navigating the complexity of the software through intuition and gesture."

"The instrument integrates acoustic and digital elements using a combination of audio analysis and interrelated mappings. This allows the software to create either complimentary or contrasting reactions in the resultant sound through the introduction of noise and probabilistic functions."

Amplification allows us to magnify the input energy provided by the performer and draw attention to the quieter sounds and textural details. Similarly, compression and distortion add weight, impact, and density to the sound. In comparison, the use of filtering allows for reductions to be made in the spectrum of the sound, accentuating the tonal/textural differences that can already be made with the bow. Through this process the instrument is understood and approached as a platform or interface for exploring the combination, connections and interaction between acoustic and electronic sounds.

By focusing on the transition between gestures and playing modes as well as the various ways the cello can be played as an object, removed from its historical context, possible directions for modifications and extensions can be imagined and developed. Similarly, through the exploration of different sound making techniques and the possibilities of combining them in a musically interesting way a new vocabulary of gestures can be developed.

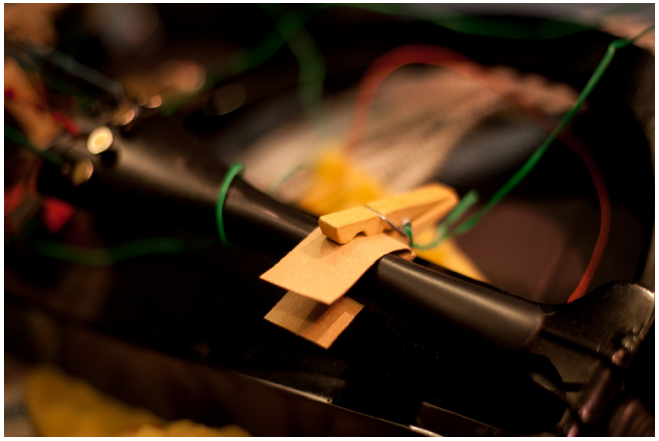
Making it Malleable

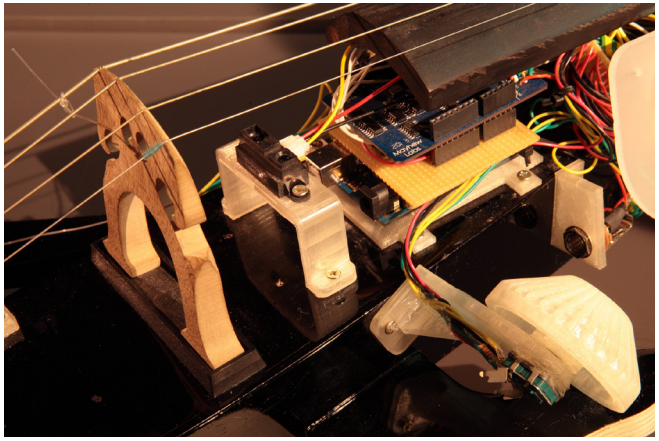
In order to identify the functionality and properties of the cello's fundamental components, a series of explorative conceptual models are created. These are simple string instruments that mimic aspects of size, movement and material qualities of the cello. Through this process the instrument becomes malleable and we gain a clearer understanding of the origins of its physical form. These simplified instruments allow us to twist, bend and manipulate the different elements, exploring the affordances and limitations of the shapes and materials.

Software and Hardware

The new hardware interfaces function as physical representations for the state of the software, allowing the performer to navigate using visual, physical, and sonic feedback. In addition to this, the sound produced by the cello is analysed by the software in an attempt to determine the intentions of the performer and create complimentary and contrasting transformations to the resultant sound. In this way, the electronic parameters are influenced by interactions with the acoustic interface and create an interdependence between the two domains.

The introduction of noise and probabilistic functions into this data stream allows the performer to control the influence and stability/predictability of the instrument's sonic reactions. This miscommunication with the instrument can be used to manipulate the sense of continuity within the music, surprising the performer and allowing for discovery and exploration of new sounds.





Process Notes:

"The functionality of the software is transferred to the cello body using sensors to provide precise and direct manipulation of the software parameters. At first we achieved this with cardboard representing the unfinished state of the instrument and providing a sense freedom when making modifications."

"As a dialogue develops between me and the instrument, extensions and transformations to the sound and gestures can be imagined. In this way, the act of playing remains the main source of momentum and evaluation for the project and ensures an integration between the new and the old vocabularies of technique."

"We focus on the subtle and detailed control over a wide range of sounds made possible with the bow, including adding extra strings to the cello and cutting notches into the bow itself. By experimenting with different materials for the strings, I became aware of their different abilities and the subtleties of friction and pressure that are involved in controlling the sound."

The Roles of the Hands

Whilst making modifications our main concern remains the physical relationship between the cello and the performing body in order to remain alert to issues of balance, counter-balance and symmetry. From this, the placement and mapping of sensors are organised around the bimanual playing techniques of the cello and guitar (left side of body = pitch/ timbre, right side = duration/ volume). This is particularly effective, as it compliments the characteristics of the cello whilst incorporating previously obtained instrument techniques.

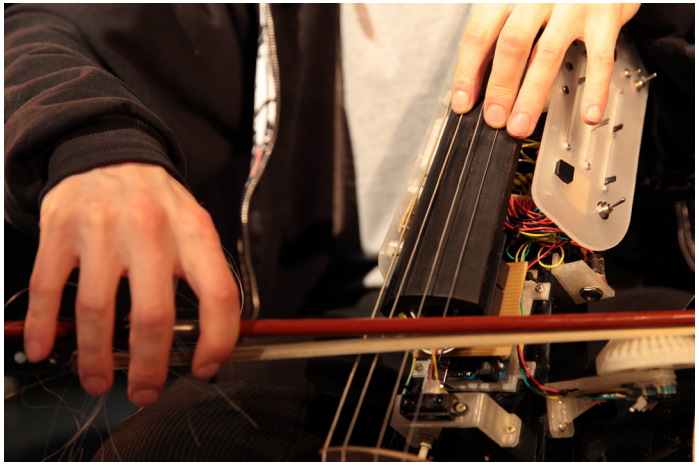
This can also be seen in the vertical placement of sliders, complimenting the linear and vertical movements of the left hand, whilst providing a visual representation of the software parameters for the musician. The placement of the sliders also acts as fret markers, facilitating orientation and accessibility with the fretting positions of the left hand. Furthermore, bow'able dials were added, expanding the capabilities of the bowing hand and allowing for fast, unbroken transitions between controlling digital and acoustic elements of the instrument.

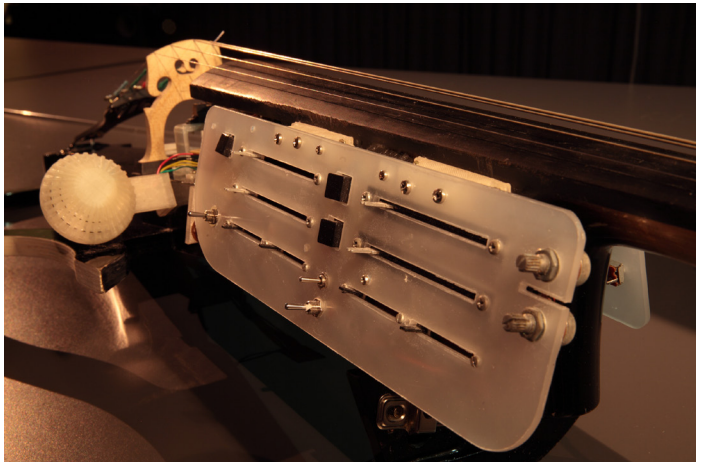
After each modification, time is spent playing the instrument in order to develop the technical skills necessary to determine the suitability of the changes. This process provides direction for the development of the new instrument by revealing what is physically possible, building on pre-existing abilities and imagining what could be learned. In this way, each parameter evolves its own unique character, informed by its sonic qualities and the physical properties and associations it conveys.

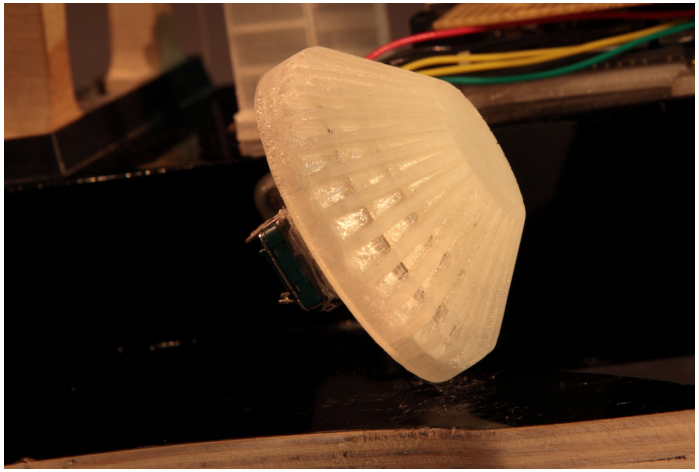
What Remains

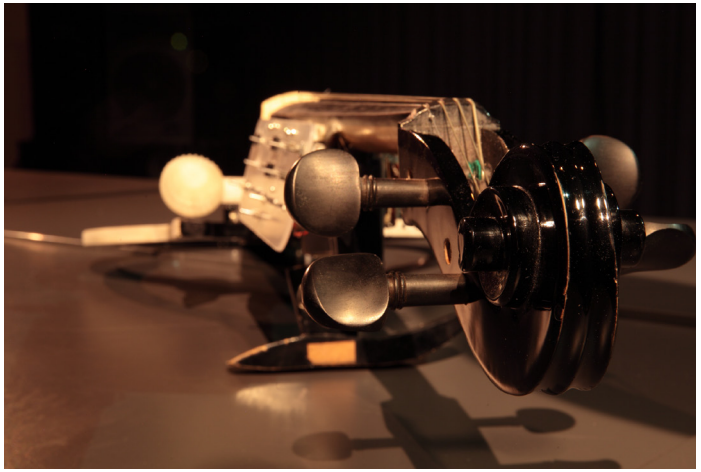
Throughout this process we have considered the instrument in the light of a desire for make a new kind of music. At this point, each function and element has found it's place on the modified body of the cello. The work currently in progress is centered on the physical remaking of the cello into a new unified body, where the new and old physical aspects of the instruments are joined into a new whole.

In retrospect, the process can be described like this: The cello initially presents as a well known whole, a finished instrument. Through the disassembling and adding of new powers and functions, it metaphorically breaks apart and becomes fractured, and we get the opportunity to consider it in its elements and units. Suddenly each string and fret has to argue for its own inclusion, just as each new software component, we add to it. As this process moves along, the cello is played and experimented with continuously, but where the experiments fragments the cello, the playing acts as the driver to allow the instrument to come together again as a new whole. This push-pull process continues until the cello can re-emerge as a fundamentally changed instrument, stable in its new form and









Process Notes:

"The position and mappings of the additional sensors are influenced by the bimanual techniques of the cello."

"The vertical placement of sliders compliments the vertical movements of the left hand while playing. The sliders also provide instant visual feedback regarding the state of the software parameters."

"Similarly, the bow'able dial allows the bow to be used to control the software directly in a fluid and non-disruptive manner."

"The material of the old instrument begins to meet, foreshadowing the body of the new cello."

"Through the iterative process of playing, reflection and modification, a new hybrid character emerges from the combination of gestural and sonic possibilities. In this way, the act of playing provided the momentum and direction for the development process of the instrument."

functionality. At this point it will become the main performing vehicle for the musician.

And then the performance itself becomes the test bed, where the unexpected curves into your plans and you are forced to reconsider everything; from your premises to the gage of wire in your cables. (Ryan and Andersen 2014)

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All photos by Dan Buzzo.

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