

**4th International Conference  
on Live Interfaces**

Inspiration, Performance, Emancipation

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**ICLI 2018**  
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**on Live Interfaces**

Inspiration, Performance, Emancipation

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## **HASGS**

# The Repertoire as an Approach to Prototype Augmentation

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### **Abstract**

This paper discusses the development of HASGS regarding augmentation procedures applied to an acoustic instrument. This development has been driven by the compositional aspects of the original music created in specific for this instrumental electronic augmented system. Instruments are characterized not only by their sound and acoustical properties but also by their performative interface and repertoire. This last aspect has the potential to establish a practice among performers at the same time as creating the ideal of community contributing to the past, present and future of that instrument. Augmenting an acoustic instrument places some limitations on the designer's palette of feasible gestures because of those intrinsic performance gestures, and the existing mechanical interface, which have been developed over years, sometimes, centuries of acoustic practice. We conclude that acoustic instruments and digital technology, are able to influence and interact mutually creating Augmented Performance environments based on the aesthetics and intentions of repertoire being developed.

### **Keywords**

Saxophone  
Augmented Instruments  
Gestural Interaction  
Live electronics

## Introduction

Augmenting an acoustic instrument places some limitations on the designer's palette of feasible gestures because of those intrinsic performance gestures, and the existing mechanical interface, which have been developed over years, sometimes, centuries of acoustic practice (Thibodeau and Wanderley 2013). A fundamental question when augmenting an instrument is whether it should be playable in the existing way: to what degree, if any, will augmentation modify traditional techniques? The goal here, according to our definition of "augmented", is to expand the gestural palette, at the same time as providing the performer with extra control of electronic parameters. From previous studies conducted by this research team we can say that the use of nonstandard performance gestures can also be exploited for augmentation and is, thus, a form of technique overloading.

It seems straightforward to define musical gesture as an action pattern that produces music, is encoded in music, or is made in response to music. The notion of gesture goes beyond this purely physical aspect in that it involves an action as a movement unit, or a chunk, which may be planned, goal directed, and perceived as a holistic entity (Buxton and Meyers 1986). Movements used to control sound in many multimedia settings differ from those used for acoustic instruments. For digital electronic instruments the link between gesture and sound is defined by the electronic design and the programming. This opens up many possible choices for the relationship between gesture and sound, usually referred to as mapping. The mapping from gesture to sound can be fairly straightforward so that, for example, a fast movement has a direct correspondence in the attack time or loudness of the sound. However, with electronically generated sounds it is also possible to make incongruent, "unrealistic" links between gesture and sound. The gestural control of electronic instruments encompasses a wide range of approaches and types of works, e.g. modifying acoustic instruments for mixed acoustic/electronics music, public interactive installations, and performances where a dancer

interacts with a sound environment. For these types of performances and interactions, the boundaries between, for instance, control and communicative gestures tend to get blurred. In the case of digital interactive performances, such as when a dancer is controlling the sound produced, there is very little distinction between sound-producing gestures, gestures made, or accompanying movements. To give enough freedom to the performers, the design of the interaction between sound and gesture is generally not as deterministic as in performances of acoustic music.

In our perspective, augmented instruments and systems should preserve, as much as possible, the technique that experienced musicians gain along several years of studying the acoustic instrument. The problem with augmented instruments is that they require, most of times, a new learning process of playing the instrument, some of them with a complex learning curve. Our system is prototyped in a perspective of retaining the quality of the performance practice gained over years of studying and practicing the acoustic instrument. Considering the electric guitar one of the most successful examples of instruments augmentations and, at the same time, one of the first instruments to be augmented, we consider that the preservation of the playing interface was a key factor of success, allied to the necessity of exploring new sonic possibilities for new genres of music aesthetics. The same principles are applied to the Buchla's Keyboard from the 70's, that stills influence new instruments, both physical instruments and digital applications. With HASGS is our intention to integrate the control of electronic parameters organically providing a degree of augmented playability within the acoustic instrument (Portovedo, Ferreira Lopes and Mendes 2017).

## Recent Work

HASGS was initially developed within a DIY approach, justifiable by the repertoire that motivated the project. It is the repertoire that has been influencing the way this system has been developing. We consider the concept of Reduced Augmentation because, from the idea of having all the features of an EWI (Electronic

Wind Instrument) on an acoustic instrument, this could lead to performance technique overload, as well as making the acoustic instrument too much personal in terms of new hardware displacement. The proliferation regarding to the creation of augmented instruments in the NIME context is very big, but just a little number of them acquire recognition from the music market and players. As any musical instrument is a product of a technology of its time, augmented instruments are lacking the validation from composers and performers apart from their inventors. Due mostly to the novelty of the technology, few experimental hyper-instruments are built by artists. These artists mostly use the instruments themselves. There is no standardized hyperinstrument yet for which a composer could write. It is difficult to draw the line between the composer and the performer while using such systems. The majority of performers using such instruments are concerned with improvisation, as a way of making musical expression as free as possible (Palacio Quintin 2008).

In the first prototype of HASGS, we were using, attached to the saxophone one Arduino Nano board, processing and mapping the information from one ribbon sensor, one keypad, one trigger button and two pressure sensors. One of the pressure sensors was located on the saxophone mouthpiece, in order to sense the teeth pressure when blowing. Most of the sensors (ribbon, trigger, pressure) were distributed between the two thumb fingers. This proved to be very efficient once that the saxophonist doesn't use very much of these fingers in order to play the acoustic saxophone. This allowed, as well, very precise control of the parameters assigned to the sensors. The communication between the Arduino and the computer was programmed through Serial Port using USB protocol. This communication sent all the MIDI commands. The computer was running a Node.js program that simulated a MIDI port and every time it received data from the USB port, it sent that data to the virtual MIDI port.

A second prototype of HASGS was experienced having the features of the first prototype but adding a second device for augmentation. The MYO armband was considered an optional, or second layer, to the augmentation process.

The communication between the device and the computer was done using the bluetooth protocol. In this case, the mappings were based on Myo object for Max/MSP written by Jules Françoise. The creation of mappings using an application sold by Thalmic Labs were also possible, more precisely if using a DAW like Ableton Live. The MYO armband was used to collect data from its Accelerometer, Gyroscope, orientation of Quaternions and from eight Electromyograms. The analysis of MYO's behavior according to the normal position of different saxophones performance was possible to collect very different values. This showed to be an enormous potential to characterize involuntary gestures, as well as imprinting characteristics of bio feedback data to the pieces.

## Present State

Taking in consideration that this system is still not a finalized interface, but an evolutionary prototype, our third version, presented here, started with the substitution of the Arduino Nano by an ESP8266 board. The communication between the sensors and the data received into the computer became wireless due to this fact. Both the computer and HASGS connect now to a Personal Hotspot created by a mobile phone API. This specification will allow much performance freedom to the performer, allowing now space for the integration of an accelerometer/gyroscope. To the previous sensors in the system were added two knobs allowing independent volume control for two parameters (Image 1). Regarding the use of the optional MYO Armband we started to use MYO Mapper developed by Balandino di Donato which proved to be more flexible, not only with Max/MSP but as well with other software.

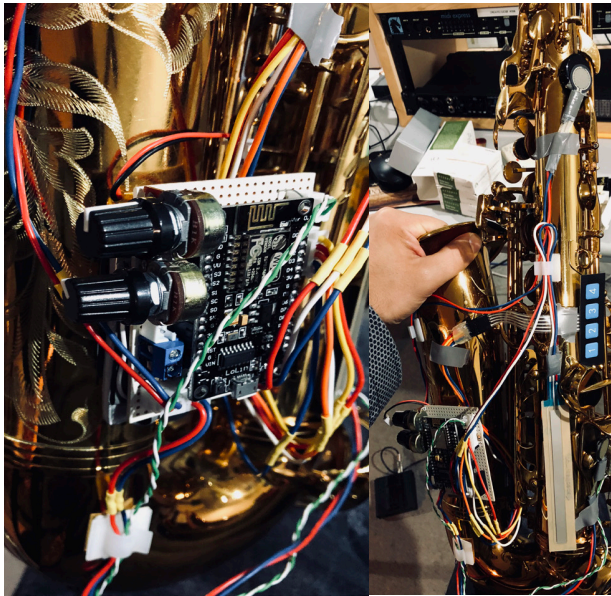


Figure 1. ESP8266 board and sensors of HASGS

In the process of developing the repertoire, a new table of instructions regarding communication between the sensors and the computer was sent to composers. We asked for a normalization on the software used, giving preference to Max/MSP. In that way, the table mentioned before showed the objects and attributes regarding the mapping of each sensor. An Max/MSP abstraction was produced for that purpose (Figure 2).

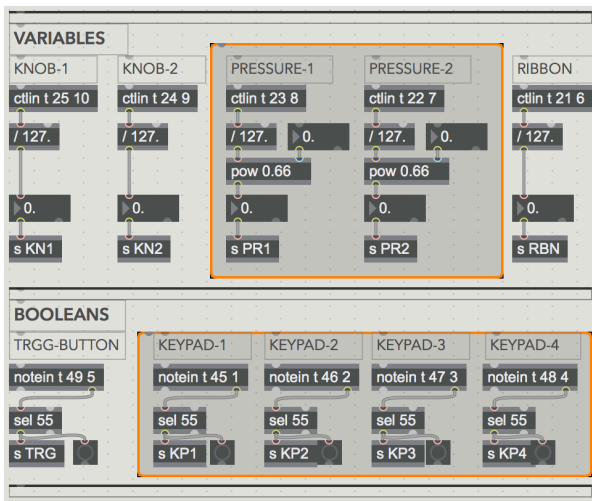


Figure 2. Max/MSP Abstraction for income data from HASGS sensors

## Repertoire

While new repertoire is being created, notational development is very much dependent on the composer's preferences and how they decide to use devices and sensors. The new pieces being written show us that expressive notation will be represented with symbols and graphics, very much like the pieces composed for acoustic instruments these days. Expressive notation is not dependent of technology nor of the device's control associated with new instruments for the producing of electronic music. Notation in music has been constantly evolve over time, according to the desire of producing new sounds or new sonic textures. This evolution has contributed largely for the development of extended techniques and instrumental virtuosity. Yet when acoustic instruments are played or combined in unconventional ways, the result can sometimes sound like electronic music (Roads 2015). One of the things to be considered, regarding to the new repertoire for augmented instruments, and more precisely, to this augmented saxophone system, is the presence of multiple layers of information, something that still not common when writing for a monophonic instrument (Figure 3).

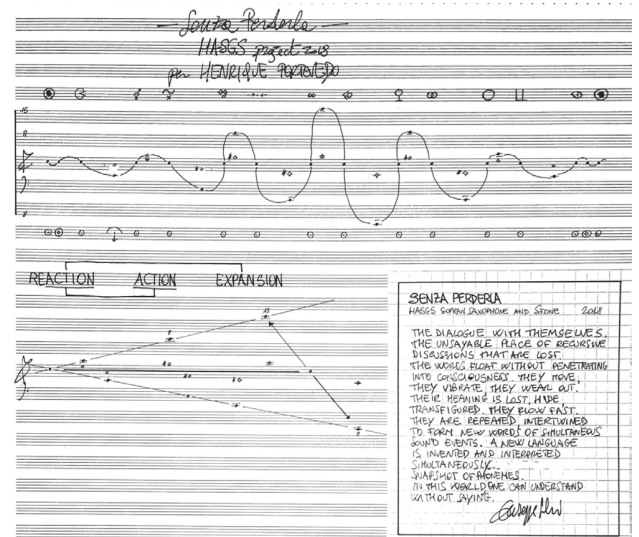


Figure 3. Example of Notation for HASGS

In the following examples of some pieces being written for HASGS, we describe the composer's approach as well as describing their musical intentionality allowed by the systems itself or its possible evolution. This is part of the corpus of study that is motivating the evolution of HASGS to acquire more or less sensors, more or less features.

### **Cicadas Memories**

Composed by Nicolas Canot, Cicadas Memories is much more an improvisational process than a piece of written music. It was commissioned to be performed as a part of the HASGS (Hybrid Augmented Saxophone of Gestural Symbiosis) project. It explores a method that eventually introduces a non-standard musical way of thinking: the present of the live performed music is (at last partially) controlled, altered by the actualization of the past. In the case of CICADAS Memories, this means that the actual gesture of the player will alter (one minute later) the electronic sound-field used as the sonic background for the saxophone's rhythmic patterns (also created by the keypad's « 4 bits » layers of memory). Therefore, the performer has to develop two simultaneous ways of thinking (and acting) while performing: a part of his mind for the present (the patterns imposed by the software but created by the player's past action on the keypads), another one for the future (its gestural connection to the sensors). He has to deal with two temporalities usually separated in the act of live music performance: he writes the future score and improvises on his past gestures, in the present time. CICADAS MEMORIES could be defined as a *multi-temporal* sensitive feedback loop. Regarding the sonic / musical context, this explores the thinking of the piece as a process (maybe under the influence of Agostino di Scipio's thinking) rather than «written music».

### **Senza Perderla**

Composed in collaboration between the programmer Balandino di Donato and the composer Giuseppe Silvi, Senza Perderla it's

a "Duo" for acoustic saxophonist and Virtual Saxophone in Physical Modeling Synthesis controlled by HASGS including MYO. The Synthesized Sax will be reproduced by S.T.ONE Loudspeaker so both physical (internal) than acoustical (perceived) characteristics of saxophone are reproduced. Using not only HASGS technology, the piece is structured with: a wire-piezo transducer fixed between ligature and embouchure; a disc-piezo transducer at the bell; an omnidirectional microphone inside the tube, under F plate; the two piezo are used to track pitch and amplitude of saxophone; the omnidirectional microphone is used to create controllable feedback between tube and loudspeaker, being used alone, with air, with tone. The notation system is organized with the following criteria: the first sinusoidal description of tones represents pitch expansion during the duration of the work; diamonds are soprano sax, normal heads are for esax; the ideograms above the system describe sound places, the toponomics of that sounds; the ideograms at the bottom of the system describe sound processing (Figure 3).

### **Verisimilitude**

Composed by Tiago Ângelo, the setup for this piece, written for tenor saxophone and the HASGS system, uses a single speaker placed on front of the performer at the same height as the saxophone's bell. A play of acoustic sound source and electronic (processed and generated) sound using computer music techniques is driven in three sections - A, B and C (Figure 4) - each with its own specific processors and generators, implementing different mappings and control levels not only from the HASGS controller but also from real-time sound analysis.

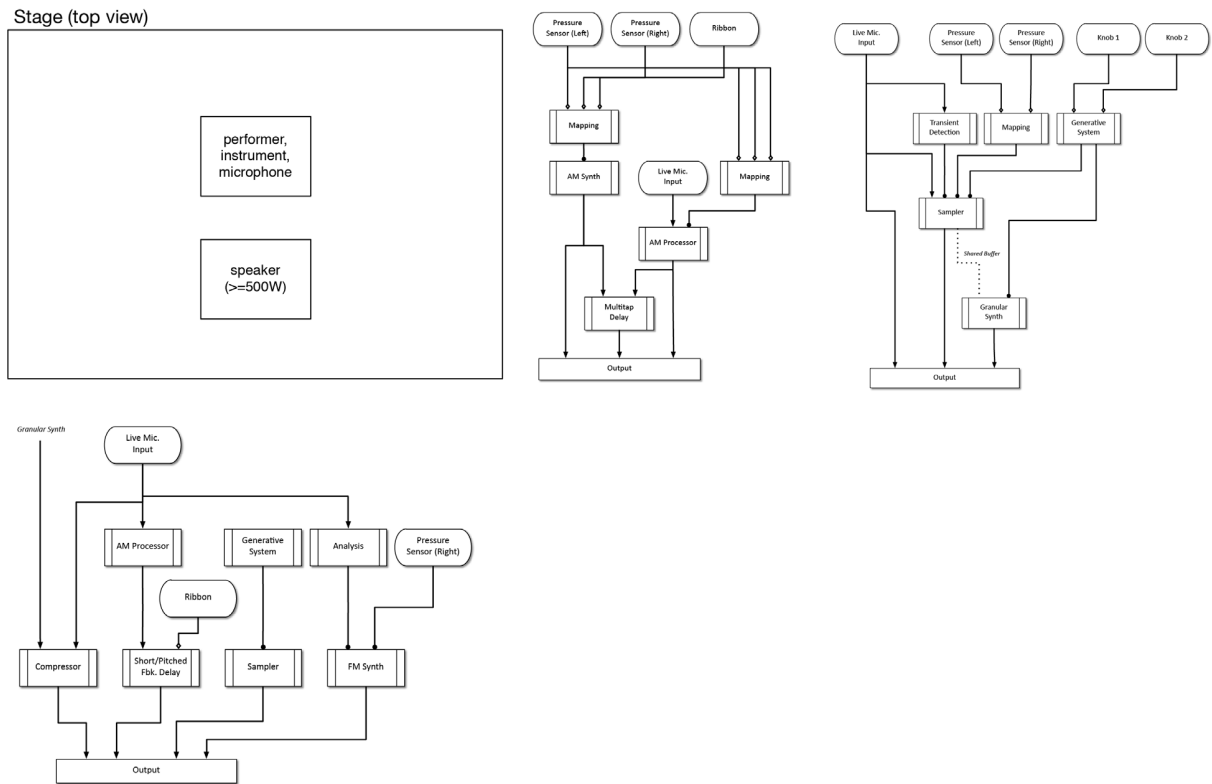


Figure 4. Verisimilitude's diagram of compositional sections

## Comprovisador

Comprovisador is a system designed by Pedro Louzeiro to enable mediated soloist-ensemble interaction using machine listening, algorithmic compositional procedures and dynamic notation, in a networked environment. In real-time, as a soloist improvises, Comprovisador's algorithms produce a score that is immediately sight-read by an ensemble of musicians, creating a coordinated response to the improvisation. Interaction is mediated by a performance director through parameter manipulation. Implementation of this system requires a network of computers in order to display notation (separate parts) to each of the musicians playing in the ensemble. More so, wireless connectivity enables computers – and therefore musicians – to be far apart from each other, enabling space as a compositional element. Comprovisador consists of two applications – host and client. The adaptation for HASGS has been

done mapping its keypad to preset's selection, ribbon for phrase amplitude and instrumental density, as well as other sensors to control spatialization and instrumentation.

## Conclusions and Future Work

Starting as an artistic exploratory project, the conception and development of the HASGS (Hybrid Augmented Saxophone of Gestural Symbiosis) became, as well, a research project including a group of composers and engineers. The project has been developed at Portuguese Catholic University, University of California Santa Barbara, ZKM Karlsruhe and McGill University Montreal. The idea to benefit of this augmentation system was to recover and recast pieces written for other systems using electronics that are already outdated. The system intended as well to retain the focus on the performance keeping gestures centralized into the habitual practice of the acoustic instrument, reducing the potential use of ex-

ternal devices as foot pedals, faders or knobs. Taking a reduced approach, the technology chosen to prototype HASGS was developed in order to serve the aesthetic intention of some of the pieces being written for it, avoiding the overload of solutions that could bring artefacts and superficial use of the augmentation processes which sometimes occur on augmented instruments prototyped for improvisational intentionality. Traditional music instruments and digital technology, including new interfaces for music expression, are able to influence and interact mutually creating Augmented Performance environments. The new repertoire written by erudite composers and sound artists is contributing then for a system intended to survive in the proliferation of so much new instruments and interfaces for musical expression. The outcomes of the experience suggest as well that certain forms of continuous multi parametric mappings are beneficial to create new pieces of music, sound materials and performative environments.

Future work will include a profound reflection on the performative aspects of each piece, evaluating the mapping strategies of each new piece that is being written for HASGS. The notational aspect of the pieces being created will be, as well, a key aspect of this research, and how it could contribute to new interpretative paradigms. In the scope of this paper we decide to focus on the aesthetic of each piece and how HASGS could serve as the interface of their musical intention, how to influence them and how the prototype can evolve.

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