Hypo Chrysos: Action art for vexed body, Xth Sense, and biophysical media

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Abstract
Hypo Chrysos (HC) is a work of action art for vexed body and biophysical media. During this twenty minutes action I pull two concrete blocks in a circle. My motion is oppressively constant. I have to force myself into accepting the pain until the action is ended. The increasing strain of my corporeal tissues produces continuous bioacoustic signals. Blood flow, muscle sound bursts, and bone crackles are amplified, distorted, and played back through eight loudspeakers. The same bioacoustic data stream excites an OpenGL-generated swarm of virtual entities, lights, and organic forms diffused by a video projector. The work brings together different media so as to creatively explore the processes wherein physicality, adaptive biotechnology, and musicianship (or better, the lack of) collide.

Keywords
Bioacoustics, biophysical music, adaptivity, action art, physicality, strain, HCI.

ACM Classification Keywords
J.5 Arts and Humanities : Arts, fine and performing.

Introduction
Hypo Chrysos (HC) is a *biophysical* media performance. Here the term biophysical addresses audio and visual media that emerge as a joint result of biological and physical mechanisms of the body. HC is based on the Xth Sense (XS), a biophysical musical instrument I am developing and performing with since March 2011 (Donnarumma, 2011). As opposed to other biosensing controllers such as the Biomuse (Knapp and Lusted, 1990) (that deploy electrical signals released by the body), the XS depends on a microphone that picks up subcutaneous mechanical vibrations, or better, sounds that originate within the muscle fibres (mechanomyogram or MMG). The XS uses these sonic vibrations as sound material to be processed according to the same data stream. The performer controls the live sampling and spatialization of the muscle sounds, which the computer diffuses through the loudspeakers. This a model I refer to as *visceral embodiment*. For the interested reader I recommend my related discussion included in a recent paper presented at the conference on New Interface for Musical Expression (NIME) in May 2012 (Donnarumma, 2012).

Agency without musicianship
John Cage, while referring to the compositional process of *Sixteen Dances*[1], states that sonic events do not need to be defined by the composer in order to exist, and be meaningful within a composition. By *drawing* the overall movement of music and leaving aside the need for control over the musical qualities, sound forms simply emerge. In this case, music is a result of the composer's (and the player's) *acceptance*, rather than *control* (Cage and Charles, 2000). In this work, the performer's role is certainly not that of a musician in the strict sense of the term. In HC the goal is not to create or play music, but to simply pull a weight. Because of the intense strain, the player has little time to think about playing and must focus on the proprioceptive sense in order to resist the strain and continue to move. In this condition, it is difficult to attribute any musical intention to the gestures. The strain level of the player's tissues describes the movement of music, and the nature of the sonic events cannot be controlled, or intentionally determined. By forcing the body into a condition of intense physical exertion musicianship is deterred. But how to find then a meaningful link between the performer's corporeality and the resulting music?

By studying the muscle sounds produced under constant exertion, it was shown that, after a large peak in the MMG appears at the onset of the contraction, the signal amplitude becomes

1 A dance piece for Chris Cunningham (1951).

very low[2]. This suggested the idea of increasing the XS sensitivity; by doing so, the instrument not only captures weaker MMG signals, but also the sound of the blood flow[3]. The result is a continuous and dense stream of low frequencies modulated by sudden muscle bursts. Although these sounds are extremely difficult (if not nearly impossible) to control, the varying intervals in their movement represents a source of meaningful microtonal variations. Nor the music or the moving images are *controlled* by the body, they rather *emerge* from within its tissues. This strategy helps explore how the organisation of the sonic experience can be abstracted from the player's cognitive process and made apparent through the agency of the sensory system.

Mapping textural richness

During the performance of HC, the acoustic waves originating within the veins and the muscles of the performer's body are digitally magnified. The sounds are manipulated by means of a two-stages DSP system, which consists of a stack of feedback delay lines and distortion effects (fuzz and all pass). At first, the soundscape consists of dispersed, punching low frequencies. Then, multiple sonic instances of the signal are stored, distorted, and fed back into the system. Being that the input is continuous, a wall of sound slowly emerges. A frequency band is added during each section by varying the distortion drive, and eventually, the sound spectrum becomes thick and harsh.

The mapping system consists of a small array of continuous events; this helps avoid a complete saturation of the system. A drawback of using a limited set of control features is less sonic richness, therefore, a strategy that diversifies the sonic outcome by optimising little control data was developed. The feature mapping does not change significantly throughout the piece, as it was found that subtle changes of the same mapping were more useful. For this purpose a multi-layered scaling function was designed. The idiom is fairly simple: before the actual mapping takes place, the incoming MMG data stream is processed by a custom, logarithmic or exponential function; the stream can then be offset by setting a custom range, and eventually reversed. The variations on the soundscape of HC depend on temporal domain features extracted from the forearms MMG, which provide the less jittery data (Donnarumma, 2012). The features are mapped to the wet mix of a delay effect and a distortion unit, to the feedback amount of two delay lines, and to the degree of a cosine panner. By using a minimal one-to-many feature mapping and varying the curve scaling and range offset of a continuous MMG stream, the XS can produce a uniform soundscape in which richness is experienced through manifold microtonal variations. Moreover, the body physiological state before playing, and the exhaustion accumulated throughout the performance drastically influence the control features. This is how textural variances of the soundscape exist, albeit not actually planned beforehand, nor consciously enacted.

Another computational idiom purposely coded for HC is called *anlz.rhythm*, a rhythm tracking algorithm. Rhythm here, refers to the cadence of muscles contractions, in other words, how many times a MMG feature reaches a user-defined threshold. When the feature peaks Y times, the algorithm generates a trigger. This starts the playback of a pre-recorded sound sample. The Y value can be either set by the user, randomly generated, or autonomously defined by the XS according to the player's current muscular energy. The idiom is used throughout the piece to trigger *signals*[4], such as a single reverbered percussion hit or a masking sound effect indicating the transition from one scene to another.

References

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2 This was later confirmed by reviewing the related scientific literature, namely Orizio, C., Perini, R., Diemont, B. et al., 1990

3 This, in fact, has a frequency response similar to the MMG, only much lower in amplitude.

4 The term here is intended as in the soundscape studies glossary.

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