Microinteraction in Music/Dance Performance

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ABSTRACT

This paper presents the scientific-artistic project *Sverm*, which has focused on the use of micromotion and microsound in artistic practice. Starting from standing still in silence, the artists involved have developed conceptual and experiential knowledge of microactions, microsounds and the possibilities of microinteracting with light and sound.

Author Keywords

motion capture, microinteraction, artistic practice

ACM Classification

H.5.5 [Information Interfaces and Presentation] Sound and Music Computing, J.5 [Arts And Humanities] Arts, Fine and Performing

1. INTRODUCTION

Music-related motion unfolds at many different spatial and temporal levels; from the tiniest and shortest actions found in, for example, the vibrato of a finger on a violin string, to the full-body actions of some percussionists [11]. This paper will refer to three different spatial levels when describing music-related motion:

1. *Micro*: the smallest controllable and perceivable actions, happening at a millimetre scale (or smaller)
2. *Meso*: most sound-producing and sound-modifying actions on musical instruments, such as moving the fingers on a keyboard or MIDI controller, happening at a centimetre scale
3. *Macro*: larger actions, such as moving the hands, arms and full body, happening at a decimetre to metre scale.

In the world of acoustic instruments, there are lots of examples of micro-level interaction, or what will be referred to as *microinteraction*, such as the minute actions found in the mouth of wind performers, or in the fingering of string players. There are also some, but arguably fewer, examples of what Wessel and Wright called "intimate" control of digital musical instruments (DMIs) [19].

There are probably several reasons why we (still) see quite few examples of microinteraction in the NIME community. It is, of course, possible to blame the MIDI protocol and its limitations [16], but we should remember that alternatives, for example Open Sound Control (OSC), has been with us for almost two decades [20]. Still, most commercial controllers and a lot of devices presented in the NIME community are built around a meso-level button/knob/slider paradigm, even though it is technically possible to build things smaller and faster. An explanation for this may be that many developers and users perceive *meso*interaction to work (sufficiently) well for many applications.

It appears that the focus on "gestural" controllers,[1] has led to an increased focus on *macro*interaction. Examples of such large-scale, and comparably slow, interaction are full-body motion capture performances bridging over to interactive dance [2, 17]. This trend may be explained by the availability of new technologies, for example the Wii and Kinect. Such motion tracking devices typically afford fairly large-scale and slow interaction, partly due to technical constraints in the temporal speed and spatial resolution. However, the more expensive inertial and optical motion tracking systems are certainly capable of tracking human motion at both spatial and temporal micro-levels [10]. So the main reason for the seemingly lack of focus on microinteraction, may be a conceptual one rather than technical.

The challenge, then, is to figure out how micro-level motion could be used meaningfully in a DMI context. This paper explores how full-body motion at the micro-level can be used in the contexts of interactive music and dance. The case study to be presented is the scientific-artistic research project *Sverm*,[2] which explored micromotion from the starting point of standing still (Figure 1).

Figure 1: Picture from a standstill session during a *Sverm* workshop. Reflective motion capture markers can be seen on the heads of the performers.

[1]See [7] for a problematisation of *gesture* in a NIME context.
[2]`http://www.fourms.uio.no/projects/sverm/`

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NIME'15, May 31-June 3, 2015, Louisiana State Univ., Baton Rouge, LA.
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2. THE SVERM PROJECT

The *Sverm* project grew out of the acknowledgment that a lot of studies of gestures and expressive human motion, whether in a linguistic context [12, 15, 4] or in a musical context [18, 5, 6], focus to a large part on meso-level actions. But what about the micro-level, what does it constitute and can it be used in artistic practice?

Looking at the human body, there are numerous starting points for investigating micromotion. All life processes, including those of plants, animals and human beings, are carried out in *chronobiological* cycles [13]. The periods of such cycles vary greatly, from molecular motion inside our bodies, tremors (involuntary muscle contractions) in the milliseconds range, and breathing and pulse cycles every few seconds, to 24-hour circadian sleep/wake cycles, etc. Motion happening at both spatial and temporal micro-levels, that is at the millimeter and millisecond range, are often regarded as primarily involuntary and unintentional. Yet, the "invisibility" of such micromotion is also at the core of how we perceive others, as documented through the various types of facial *microexpressions* [3].

To look more into the phenomenon of micromotion from an artistic perspective, I teamed up with dancer-choreographer Kari Anne Vadstensvik Bjerkestrand, who has extensive experience working with different types of detailed and slow motion, such as through the practice of Tai Chi Chuan. Together we carried out a pilot study in which we decided to explore micromotion through the act of standing still in silence for ten minutes at a time. We did fifteen such sessions, recording our motion with a motion capture system (Qualisys Oqus 300) and video cameras, as well as taking notes and discussing our subjective experience of standing still.

As we found in [8], and which has been reported in studies of the "human pendulum" [1], we easily experienced how our swaying, shifting of weight, breathing and heart beats influenced our micromotion when standing still. The motion capture measurements revealed that the *quantity of motion* (QoM) of a head marker was in the range of 4–9 mm/s, calculated as the first derivative of the magnitude of the position vector. Though this is a comparably low number, this micromotion of standstill was also observable to the human eye, even at some distance. So we became interested in developing the concept of standstill further, looking at how it could be used for artistic applications.

The concept of standing still is neither new to music nor dance. Cage's 4"33' is but one example of how the seemingly lack of sound and motion can lead to a heightened awareness of surrounding percepts. In the visual arts, video works of Bill Viola[3] explore stretching time to such an extent that the videos feel like still images. In dance, the Japanese buto-tradition is famous for very slow motion sequences. The duo Eiko and Koma,[4] for example, have been carrying out performances in which they have been standing, sitting or lying almost still for extended periods of time. One example is their 1998 performance installation *Breathe* in which they lay naked still on the floor for several days.

3. EXPLORING STANDSTILL

As opposed to the above-mentioned examples, our artistic interest has been on exploring how we can work with the micromotion and microsound found when approaching standstill. From a performance perspective we were also curious to see whether, and to what extent, it is possible to train a person's ability to use such micromotion for interactive control of sound and light.

[3] http://www.billviola.com/

[4] http://www.eikoandkoma.org/

Figure 2: The quantiative motion capture data was always accompanied by subjective notes written down after each rehearsal session.

Continuing the *Sverm* project, I was joined by a group of five artists (two musicians, two dancer-choreographers and one scenographer). We employed the same strategy as tested earlier, standing still together on the floor for 10 minutes (Figure 1). The results from an analysis of 38 such recordings were presented in [9], and these confirmed our previous findings: the average quantity of motion (QoM) of a person standing still for 10 minutes at a time, measured with a motion capture marker placed on the head of subjects, is around 6.5 mm/s. Furthermore, the running QoM of each person was remarkably linear for each recording, and also very consistent from recording to recording.

More careful analysis of the data revealed clear person-specific patterns in the data sets. At the temporal micro-level we mainly found quasi-random motion happening on the scale of milliseconds. This may be caused by the swaying of the body, as the ankles work to keep the body in balance [14]. At the temporal meso level we found periodic motion at intervals of approximately five seconds, which likely corresponds to our respiratory patterns. These patterns were more systematic and individual, in fact to such an extent that we were able to identify a person by only looking at the plots of the micromotion. Also at the temporal macro-level, we found person-specific patterns, such as "spikes" at regular intervals. These can probably be explained by postural adjustments, or periodically larger inhalations. So, despite the fact that there is certainly some "noise" in the data, there is also much meaningful information.

The experience of standing still together has eventually ended up as our "warm-up" exercise for workshops and rehearsals. Not only does it help the group to find a focus, but it is also a quick and easy way to relax both physically and mentally, and prepare oneself for microinteraction.

3.1 Controlling the unintentional

After learning to comfortably stand still for an extended period of time, and learning how to quickly get into such a state, we began investigating voluntary micromotion on the border to standstill. This we did by carrying out standstill sessions in which we were allowed to follow along with any small changes happening in the body. We also systematically tested out how different body postures, room placement, visual experiences (eyes open versus closed), auditory experiences (music versus silence, "active" versus "passive" listening) and mental tasks (none, meditation, imagery) affected the experiences of standing still. All sessions were motion captured, and we also wrote down our subjective notes on the experiences after each session (Figure 2).

The most important outcome of all this testing, was experiencing the limits of our voluntary and involuntary micromotion. We were eventually able to play with, and follow, any involuntary actions happening in the body, and to easily get back to the state of standstill after carrying out voluntary microactions. This experiential knowledge turned out to be important during the performances.

3.2 Handling different spatiotemporal levels

Working with microactions on the boundary to standstill quickly made it necessary to develop a vocabulary for precisely describing tasks and roles during rehearsals. Here we decided to focus on the three levels mentioned earlier, extended to both the spatial and temporal domain, as summarised in Table 1.

	Space	Time
Micro	<1cm	< 0.5s
Meso	1–100cm	0.5–10s
Macro	>100cm	> 10s

Table 1: Overview of the categories of spatial and temporal levels (approximate values).

Creating a matrix between the spatial and temporal dimensions, it is possible to think of a "micro–micro action" as an action in micro-space (less than 1 cm) and micro-time (shorter than 0.5 ms), while a "micro–macro action" is a small action carried out over a long period of time. This way of naming actions was a precise an efficient tool for practising different types of actions, both individually, in pairs and with the whole group. We did this very systematically, exploring all the different combinations for different parts of the body: a foot, a hand, upper-body, head, etc. As can be imagined, the extreme cases, that is, combinations of the micro and macro levels, were the most difficult to master, but they were also the most interesting to work with. After rehearsing for several weeks, we all became fluent at carrying out any type of action at will.

3.3 Combining actions and sounds

The next part of our exploration consisted of combining actions and sounds in different combinations: *action–action*, *action–sound*, *sound–action* and *sound–sound*. For each of these combinations we tested out all the possible spatiotemporal combinations mentioned above (micro–micro, etc.), and with different body parts for the actions and sound-producing elements (voice, body, violin) (Figure 3).

3.4 States and actions

One thing that became apparent after getting used to carrying out micro–macro actions, was how they resembled the continuous *state* of standing still. A question, then, is whether the differences between states and actions actually matter to a performer or perceiver. At first, it was not immediately clear whether an observer can actually spot the difference between a state and a micro–macro action. From a performance perspective, however, a micro–macro action is conceptually very different to a state, since they have a clear intention and a defined beginning and end. It is a very different thing for a performer to go on stage with the intention of standing still for 10 minutes, than to carry out, say, a 10-minute long head-rotation. The discovery of this difference between states and actions turned out to have a great impact on the final artistic result.

4. INTERACTING WITH ELECTRONICS

Up until this stage we had worked solely with our own bodies, using motion capture and video recordings only for analytical purposes. But one of the main elements of the envisioned artistic performance was the inclusion of live electronics, in the form of both interactive sound and light. The performance was planned as a 45-minute evening show, with seven clearly defined parts, or "pieces," each having a separate sonic and visual identity. Obviously, due to the conceptual starting point, we were careful to introduce the interactive parts very slowly and subtly into each piece, so that we could keep a focus on the standstill and silence.

Figure 3: A singer and dancer rehearsing action–sound relationships during a workshop.

4.1 Interacting with sound

We experimented with many different types of sound interaction, but ended up with two different concepts used in the performance: "waving sines" and "granulated violin".

The "waving sines" part was based on sonifying the continuous motion of the head markers of the performers with sine tones. Here we decided to use the inverse quantity of motion to control the amplitude of the tones, so that the sound's loudness would increase as the performers stood more still. This was done by sending position data from the motion capture system to a Max patch running the sound synthesis. The tones were diffused over a 48-channel sound system using vector-based amplitude panning (VBAP), so that the sounds appeared to come from the position in space of each performer. The end result was a series of fluctuating and beating patterns between the sine tones based on the involuntary and voluntary microactions of the performers in space (Figure 4).

The "granulated violin" section of the performance was based on the idea of a dancer "playing" the violin sound of the violinist. This "piece" started with the violinist performing a single violin stroke in the beginning, which was recorded and loaded into a granulator in FTM for Max. The vertical position of the dancer was used to control the playback location in the sound file, while motion in the horizontal plane was used to control the grain size and distance. Though the dancer's control actions were tiny, they became intensified through the interaction with the violin sound, and the striking standstill and silence of the violinist.

4.2 Interacting with light

An important addition to the visual part of the performance was that of interactive light. Throughout the workshops we explored a number of different interaction types and lighting systems, such as moving a spotlight around in the space following the micropatterns of a performer. One of the most effective solutions, and one that was used in performance, was that of a gradually changing light colour following a 5-

Figure 4: Rehearsing the opening of the *Sverm* performance, with each performer controlling a sine tone through a reflective marker on the head.

minute long head-rotation performed by one of the dancers. This was an example of a micro–macro action, which was so prolonged that it appeared as a state of standstill as it lasted. However, by the end of the sequence, the performer had moved her head from the front to the left, and the light had changed from blue to red. Conceptually simple, but one part that many audience members commented as one of the highlights of the show.

5. CONCLUSIONS

Starting out as a purely experimental endeavour, the *Sverm* project culminated in the creation of four short art films by Lavasir Nordrum (see a screenshot of one of the films in Figure 5) and eight 45-minute evening shows. Clearly minimalist in nature, the show consisted of different "pieces" focused around standstill and microinteraction with sound and light, and with the performers in different physical locations and constellations for each part. Even though we had been tempted to use the interactive electronics more actively throughout the performance, we were in the end satisfied about its very limited, yet effective, presence.

To summarise, the project has shown that it is possible:

- to control the act of standing still to such an extent that it can be used effectively in performance.
- to understand the differences between states and actions, and to control microaction on the boundary to standstill.
- to perform actions and sounds at different spatiotemporal levels (micro, meso, and macro) and in all sorts of combinations.
- to use micromotion to effectively control interactive sound and light through motion capture.
- to engage an audience for 45 minutes with very "little" happening.

All in all, the project has given us insights and experiential knowledge of a performance level that none of us had worked with systematically before. We therefore hope to encourage others to continue exploring microaction and microinteraction in their own scientific and artistic practice.

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Figure 5: Still image from a short film made in the project by Lavasir Nordrum.

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