Chiselling Bodies Augmented Dance Performance

Sarah Fdili Alaoui
LIMSI-CNRS, Ircam & Univ Paris Sud
1 place Igor Stravinsky, Paris
sarah.fdili.alaoui@ircam.fr

Christian Jacquemin
LIMSI-CNRS
Bat. 508, Orsay, France
christian.jacquemin@limsi.fr

Frédéric Bevilacqua
Ircam
1 place Igor Stravinsky, Paris
frederic.bevilacqua@ircam.fr

Figure 1: Marion Cavaill and Sarah Fdili Alaoui rehearsing for the performance *Chiseling Bodies*

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Abstract
Chiseling Bodies is an interactive augmented dance performance, where a dancer interacts with abstract visuals. They are massive mass-spring systems whose dynamical behaviors are echoing the dancer's movement qualities.

Author Keywords
Movement qualities, Augmented performance, Massive mass-spring systems

ACM Classification Keywords
H.5.2 [User Interfaces]: Input devices and strategies, Interaction styles.

Introduction
The notion of movement qualities is recognized by theorists and practitioners of dance as one of the main conveyor of gestural expression. Movement qualities can be defined as the ways in which movement is executed, they are produced by dynamics and are independent of the specic trajectory in space. This notion have been explored in Human Computer Interaction as an interaction modality [3]. We collaborated with Marion Cavaillé, classical dancer from the Ballet National de Marseille, to explore the extent to which an interactive system analyzing and visually representing her movement qualities

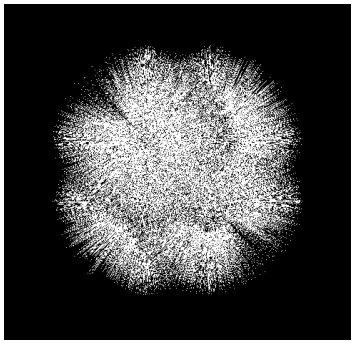

Figure 2: The visuals displayed on stage and on the dancer's body.

in real time, can be used as a tool for artistic expression in the context performance. For this purpose, we designed an interactive system providing visuals based on massive Mass-Spring Systems (MSS) whose dynamics are controlled by the movement qualities extracted in real time from the dancer's gesture. Our system offers a perceptual feedback loop suitable for dance improvisation. This choice is motivated by the desire to create an improvisational duet between a dancer and the visual feedback for a performance called *Chiseling Bodies*.

Chiseling Bodies

Following the definition of Dixon [2] and Sparacino [4], *Chiseling Bodies* is a digital augmented dance performance merging dance and an interactive virtual visual feedback. This feedback showed in figure 2 is perceived as a cloud, inseparable, bound by physical forces, whose dynamics are the only visible aspect highlighting a group behavior that reacts to the dancer's movement qualities. Its behaviors are an echo and a consistent digital presence with the dancer's movement qualities. Thus, *Chiseling Bodies* involves both the physicality of the dancer and the resulting digital behaviors.

Design and Methodology

To develop an interactive system based on movement qualities for the performance *Chiseling Bodies*, we used participatory design methodology and tools [5, 1]. The dancer was involved in design cycles where we (i)brainstormed to produce and sketch ideas, metaphors, inspirations for the performance and to define interaction scenarios (ii)rapidly prototyped the interactive system (iii)tested the prototype (iv)reported on our observations of the testing phase (v)interviewed each other about the experience of the testing phase.

The choice of such methodology is motivated by our common desire to create a performance where the interaction designer takes part in the creative process as much as the dancer participates in the design of the interactive system. In addition such participatory methodology allows to :

- Better merge the technology with the choreography in an artistic perspective;
- Explore the limitations of the technology and use it creatively;
- Provide ideas, metaphors, inspirations to enrich the interaction;
- Give the dancer a better understanding of the system.

Dancer's movement qualities	Expected feedback
Slow energy of the hand	Symmetrical rosettes forms
Continious energy of the hand	Blossoming effect
Foot kick	Chaotic effect
Drop/jump	Gravity effect
Verticality/height	Apesentor effect
Transition stillness/movement	Solidified/smooth effect
Transition between movements	Solidified/smooth effect

Table 1: The Interaction scenarios.

three iterations of brainstorming, prototyping, testing observing and interviewing led to refine and finalize the different layers of the interactive system. We track below the main points raised during the last iteration.

Brainstorming and Prototyping

During the brainstorming session of the last design iteration, we defined the set of gestures and movement qualities from the dancer's own vocabulary that we used

as interaction modalities. We then defined interaction scenarios as a set of rules between the visuals expected behaviors and the dancer's vocabulary aiming to create the duet relationship on stage. The table 1 summarizes these rules. The prototyping phase of the interactive system consisted on the following steps:

1. **Motion capture layer:** We used wireless accelerometers combined with an infrared sensor Microsoft-Kinect. We used an image processing program to reconstruct a skeleton from the silhouette and obtained the 3D positions of the head, hands, center of mass and the feet of the dancer.

2. **Extraction of the movement qualities:** We computed the following descriptors from the motion capture data:
   (a) The energy;
   (b) The kick (gestures impact) index;
   (c) The jump/drop index;
   (d) The verticality/height;
   (e) The stillness index.

3. **Generation of visual behaviors representing the movement qualities:** We developed a massive MSS (250000 masses and springs) whose topology shown in Figure 3 is hierarchical: Four heavy visible masses are linked by springs to over 50000 light visible enslaved masses arranged in a circle around it. Four ghost heavy invisible masses are linked to the four heavy ones in order to stabilize the MSS when the dancer is still.

4. **Mappings layer:** We developed different rules linking directly the MSS dynamical behaviors and the movement qualities descriptors extracted following the defined interaction scenarios summarized in table 1.

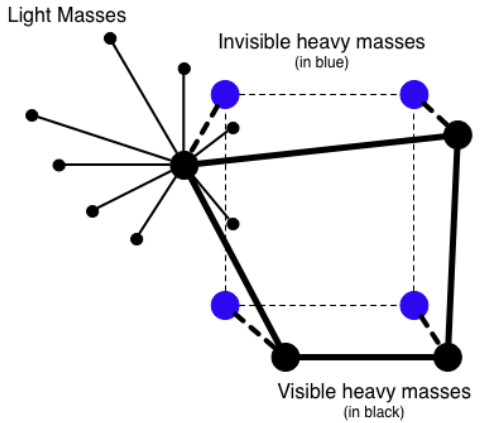

Figure 3: The Massive MSS developed.

Testing and Observing

In the last iteration of our participatory design, the dancer could test and experience the resulting prototyped system described above during one week of rehearsal. Grouped images in figure 4 represent snapshots of the recorded videos where the dancer interacts with the visual following four of the scenarios defined in table 1. In the first photo, The dancer's hand energy produce symmetrical patterns like rosettes. In the second photo, the dancer's foot kicks excites the masses of the four heavy visible masses producing a chaotic group behavior. In the third (respectively fourth) photo, the dancer's drop (respectively expansion) involve a drop (respectively a weightlessness effect) of the visuals.

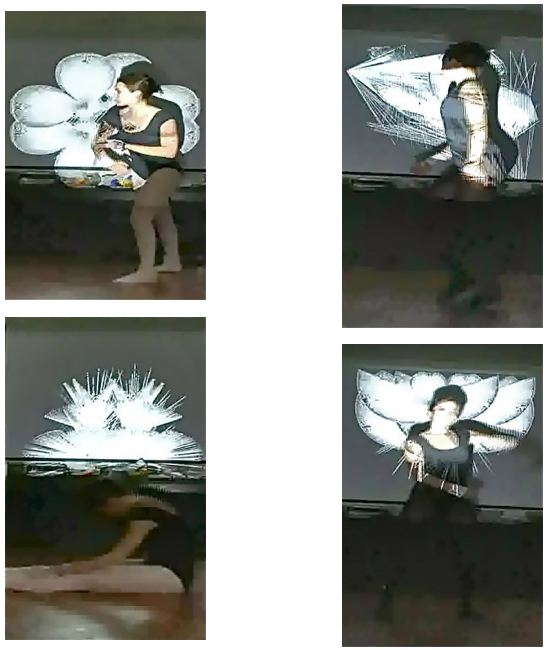

Figure 4: Snapshots of the interaction scenarios defined.

Interviewing
We report in the following paragraph on the interviews we run with the dancer at the end of the week rehearsal with the final prototype of the interactive system.

Interaction Designer (SFA): How do you see the visuals?
Dancer (MC): It's an echo.
SFA: How can you describe the echo relationship?
MC: It depends on the energy level of my movement. I'm doing the same dance sentence, the answer is always different, it's the principle of being alive like in dance.
SFA: What are the visuals compared to the dance?
MC: You see the energy spread. There is a transcription of what I do.
SFA: What influence have the visuals on your performance?
MC: It's a duet, they are listening, this is a dance partner!
SFA: What are the constraints imposed by the interaction on your performance?
MC: One must understand the system and adapt but at the same time I do not want to serve the technology. It must give space to the dance.
SFA: Do the visuals suggest symbols, metaphors or images?
MC: I want to make paintings, I want to paint and sculpt with my gesture, it's beautiful, it's just beautiful!

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