

# Man in |e|space.mov / Motion Analysis in 3D Space

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## ABSTRACT

The article documents the theoretical and aesthetical basis of the interactive dance performance “man in |e|space.mov”. The text discusses the abstraction of the human body in this performance by an interactive costume of light whose motion is analyzed by a 3D motion-rendering programme, which assembles and recombines the captured frame in real time in electronic 3D space. Thus appears a juxtaposition of 3 visions on the body making up the representation: the eye of the spectator, the camera and the 3D camera view: 3 visions constituting the contemporary body. Furthermore, the text questions the dislocation of the sensual body in physical space to the reading of body as a data in the matrix of virtual space in performing arts.

In order to investigate the meaning of the aesthetics of abstraction, and dislocation of human body in performance art and motion analysis, the article puts ‘man in |e|space.mov’ in perspective to historical references of the 20th century, in particular to the work of the physiologist and pioneer of cinema J. E. Marey and the Bauhaus artist O. Schlemmer.

## Categories and Subject Descriptors

J.5 [Arts and humanities] --- *Performing arts- dance*, D.4.7 [Interactive systems] --- *real-time systems and embedded systems*, I.2.10 [Vision and Scene Understanding] --- *Motion, Video analysis*

## General Terms

Performance, documentation.

## Keywords

Interactive dance performance, real time 3D rendering application, digital motion analysis, Marey, Schlemmer, res publica, Lab[au].

## 1. INTRODUCTION

The performance “man in |e|space.mov” was elaborated in collaboration between the French digital performance art company “res publica” and the Belgian laboratory for architecture

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and urbanism LAB[au]. It is the second interdisciplinary work after “Enjeux” [2] between dance, architecture and digital media of the two groups. Both groups question the relation of man and space in the age of digital technologies. Res publica investigates its viewpoint from theatre, LAB[au] from architecture.

In “man in |e|space.mov”, we refer to and adapt the experimental work of artists such as Oskar Schlemmer and his research on the relation “*man in space*” as well as the cinematic work of Etienne Jules Marey (*mov*). Man in |e|space.mov combines both approaches while applying them to digital media (*|e|*), which cover various art forms such as choreography, cinematography, scenography, dance, music and architecture.

The article provides a brief overview on relevant aspects of Schlemmer’s and Marey’s works. We then describe the elements of “man in |e|space.mov” and conclude with a short evaluation and some remarks of future work.

## 2. HISTORICAL REFERENCES

### 2.1 Marey - From written records to iconic language

The works by the physiologist J. E. Marey [1] established the foundation for a quantitative analysis of human motion resulting in the scientific representation of classified parameters. He developed a number of devices and sensors to record mainly human motion but also other living beings. In the 1870’s he recorded movements first by the graphic method that translates movement into lines, curves or graphs inside the Cartesian coordinate system. In the 1880’s, he integrated photography in his motion analysis, which culminates in its famous partial chronophotography (see figure 1).

With these new methods, he represented the shift from the written record of scientific observation to the treatment of data coming from devices between the observer and the object. By the extraction, decomposition and discrimination of data, the method permits the schematic visualization of complex movements. His method substituted the terms, the verbal description and the written argumentation by the synthetic comprehension of the iconic description. The body with its cultural connotation disappears in these devices and an abstract vision of pure (human) motion reappears in the Cartesian matrix.

The shift from the verbal description of the “sensual body” to the production of data from specific parameters of the disconnected and reconnected body, influenced performing arts, especially dance. At the same period the modern or contemporary dance was born, that refuses the narrative, literature-based aspects of traditional ballet. Modern dance develops strategies of

representation of motion where the body interacts with the abstract space of the stage. This period represent also the shift from a written-based society towards a society of visual and communication technologies. [4]

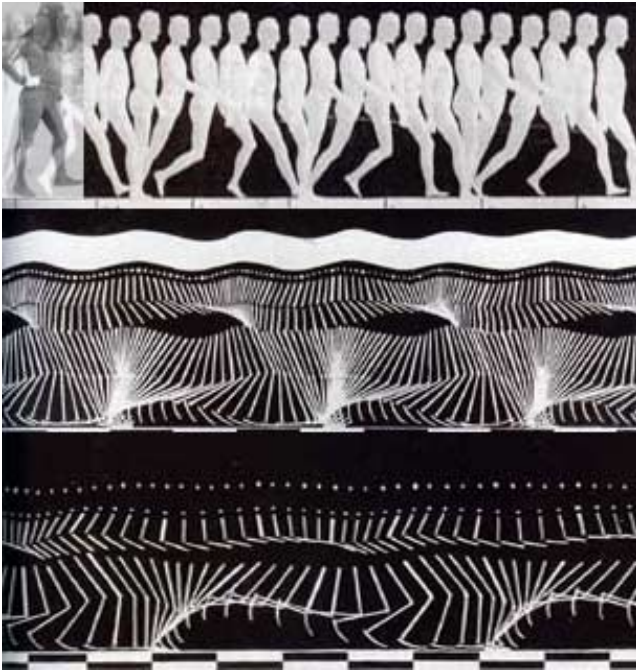


Figure 1. Jules Etienne Marey, partial chronophotography and motion capture costume

## 2.2 Oskar Schlemmer: man and space, a codified relationship

Oskar Schlemmer [5] was one of the first theatre artists who worked in a systematic and radical way on the human body as a code, and the relation of man and space. He proposed a perspective of body on stage as an abstract and symbolic representation, as opposed to the psychological and expressive approaches of German Dance in the 1920's. In his stage work, he intended to represent the exemplary, the universal instead of showing the individual or the typical. His theatre works did not intend to be a copy of reality, but an artificial (art) product in order to bring up the essential, namely the (pure) idea.

He examined the gesture/ movement as a relation of man and space that results in the formalization of human motion to geometrical forms. He opposes the laws of the cubic space of the stage to the laws of natural man. If the space is adapted to man, the stage becomes naturalistic or illusionist. If man is adapted to the cubic space the stage becomes abstract. From his viewpoint, the laws of the abstract stage are the invisible lines of planimetric and stereometric relationships [see Figure 3, left top corner – Figur und Raumlineatur, (figure and spatial delineations)].

Schlemmer was aware of Marey's work when he designed his project "Stäbetanz" (Stick dance). In here, he extended the limbs with white wooden sticks of a dancer dressed in black to emphasize the relation between man and space and the spatial delineations. He proceeded in the same way as Marey did, when he produced his partial chronophotography: the elaboration of a device, which erased the body (black costume in front of a black

background) to reveal a particular data of human motion (white lines/ white sticks on the limbs). In both examples, there is a dislocation of the represented body as a psychological- physical unit towards a representation of selected principles, parameters/ data inside a matrix (the film/ the cubic stage). This represents the shift from the approaches of the body as a cultural unity towards a mathematical relation between man and space. [6]

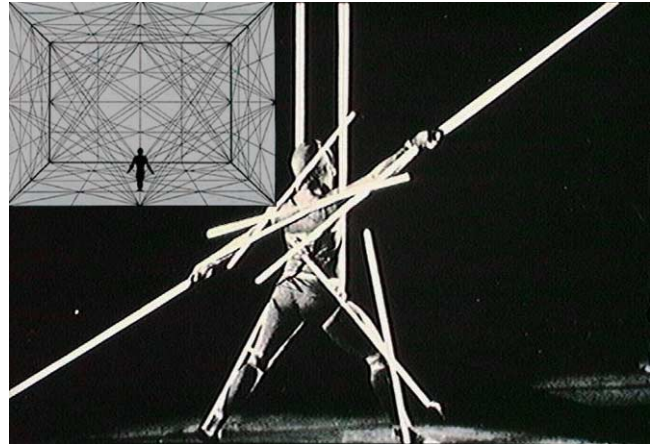


Figure 3. O. Schlemmer, "Stäbetanz", 1928 and "Figur und Raumlineatur", 1926

## 3. Man in |e|space.mov DISCRIPTION

The performance 'man in |e|space.mov ', created in 2004, examines the notion of space and movement, facilitating new perception and understanding of the relationship between body and space, through the integration of communication and computation technologies into a dance performance.

It is based on techniques that marked the beginning of the cinema but introduces a new reading of the body movement. Thus, the project renews the process of reduction and abstraction of the human body and its decomposition in 24 images/sec. through the contribution of electronics and digital technologies. In that way it questions the representation of movement by merging two forms of "motion writings": cine[mato]graphy and choreo-graphy.

### 3.1 Man in |e|space.mov: abstraction of the human body

The first element of the project, a costume of light, questions the movement of the body through structuring it by a luminous device, which focuses the perception on the geometric abstraction of the body and stripped of any cultural and psychological connotations.

The costume consists of electroluminescent wires aligned to the limbs of the dancer, which make the movement of the body visible via vertical lines. An electronic interactive component pilots wireless the luminous-electronic infrastructure to offer the possibility to fragment the perception of the body. The body thus becomes a medium of information that is the result of the electronic infrastructure and the choreography. The costume reveals a reading of the movement through its perceptive transformation, structured by a geometrical and abstract approach of the body. The relation between time, space and body/ movement is focalized through the signalization of the body by a few lines, revealing it in a pure way.

Its conception refers to the work of Schlemmer, by reinforcing the dislocation of the represented body towards a representation of selected principles (the movement of the limbs), parameters/ data (the representation of the movement) inside a matrix (the stage).

### 3.2 Man in |e|space.mov: motion analysis in 3D space

The second element is the additional visualization of the dancer's movements. For that the dancer is filmed on a dark stage and projected on two video-screens. One screen is at the back of the stage and the second one, disposed in 45° at the front of the stage. The movement of the dancer signalized by the electroluminescent device is analyzed and represented in a virtual 3D environment. The main analysis mechanism is based on isolating the bodylines from the rest of the captured image. As the body is illuminated by itself, no other light is needed, and the black part of the captured images can be put in transparency by using their alpha-channels.

The captured image in real time is assembled and recombined in the virtual 3D space (Figure 4), and projected on both screens, the frontal view of the virtual 3D camera on the rear projection and a 45° sloped vision on the front projection: the scenography recreates the virtual space as a physical setting.

In fact, there are two adjacent and complementary representations, the three-dimensional one of the dancer-interactor, represented in a diagrammatic and abstracted way, the other representing the movement, through the effects of persistence or geometrical construction in electronic space. The performance integrates the process as well as the result of Marey's device.

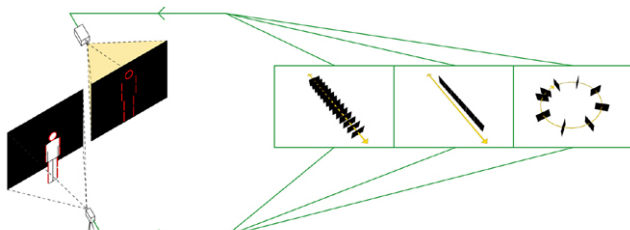


Figure 4. Scheme of the motion analysis device and the frame construction in 3D space.

In the following section we describe the 3 key parts of the performance in order to explain the play with the relation of temporal and spatial construction of cinematographic movement and the transcription or representation of movement in 3 D space.

## 4. Man in |e|space.mov EXAMPLES

The performance of about 40 min is composed by 7 sequences, each assembling and combining differently the captured frames. This dramaturgy is established while a VJ, present on stage, manipulates in real-time a number of parameters of the construction of the virtual space, such as the navigation of the virtual camera in the 3D space or the transparency level of the frames. Of the seven sequences, we describe the three most essential: the first exploring in particular movement, the second is devoted to time, and the last covers space.

### 4.1 First sequence: man walking at ordinary speed

A camera films the slow motion walking dancer on stage, while capturing only 2 frames per second. These captured images are

placed inside a 3D space loop of 2 seconds, and is projected in real time. Each loop adds new images to the sequence, thus slowly building up a strip-man like animation out of the captured images. Once 24 fps have been reached, the formed strip-man juxtaposed to the performer on stage and thus constructs a second 'virtual' dancer moving in normal time. Through this juxtaposition a dance or a movement, is constructed between the dancer and the extracted images (see Figure 5). On the one hand, the cinematic construction is directly derived from the dancer's movements but the temporal delay during the extraction capturing distinct movements constitutes an unpredictable parameter that facilitates autonomy to the self-residual images.



Figure 5. Sequence "man walking at ordinary speed" with scheme of the construction of frames in 3D space

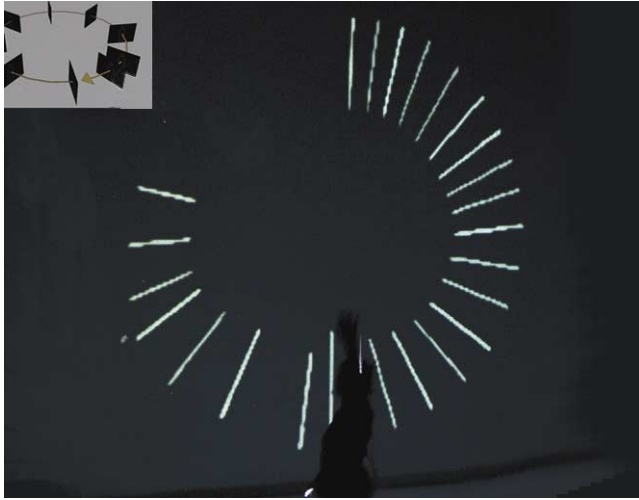
The choreography proceeds in real-time whereas the temporal parameters of the different media employed are used to construct the movement of man in |e|space.mov. This parametric approach creates a mathematical, fragmented, analytic and linguistic perspective of the dancer's body to the digital space. That doesn't mean the subordination of the body under the laws of a machine, but a way to prolong the investigations of Marey and to deconstruct the non-linear and non-continuous construction of cinematographic time and space [3].

As the sequence refers to the iconography of the well-established work by Marey on motion-analysis by photography, it provides the grounds for the ongoing development of movement investigation in the performance. This sequence is, therefore, used as the general introduction to acquaint the audience with the technology as well as the thematic means of the performance.

### 4.2 Second sequence: body-particles

The sequence "body-particles" highlights the relationship between the frequency of the captured images and the movement, or between the captured image and the covered space in a given time while referring to the most obvious analogy: the hand of a watch. The dancer describes a circle with her forearm during one minute while the camera captures and records one image/second, which creates the equation between movement and time and its denoted and connoted representation: a clock (see Figure 6).

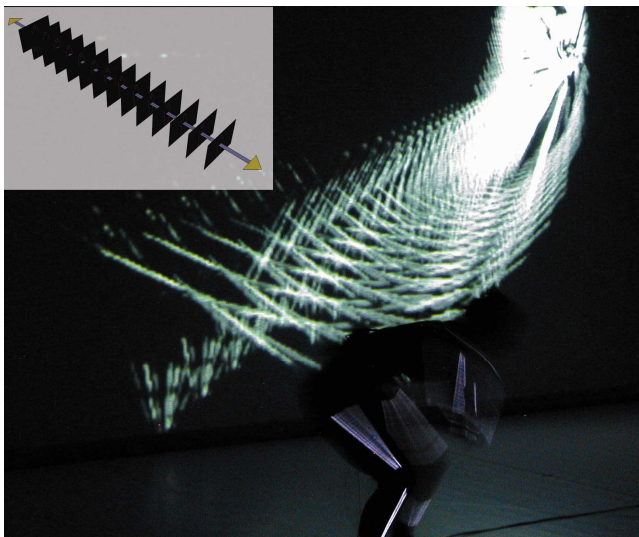
Once the clock is recorded, the dancer disappears from the stage, and particles in form of simple 3D shapes invade the screen progressively, constructing the landmarks of the virtual 3D space. The watch keeps on being present as a trace of the physical body in the virtual space. It is mostly like the transformation of a parametric presence of human motion that continues moving in the 3D space. Through navigation, the trace of the body breaks up its 2D reference marks X+Y and shows the construction of the sequence in time, represented on axis Z. The decomposition of the analogical image of time by the figure of the watch in the 3D space finally reveals its construction in time.



**Figure 6. Sequence “body particles” with scheme of the construction of frames in 3D space**

#### 4.2.1.1 Third sequence: 3D shadow

The last sequence explores the potential of the established vocabularies to blend the real space, namely the stage, and the auditorium, with the virtual representations of body movement in time and space.



**Figure 7. Sequence “3D shadow” with scheme of the construction of frames in 3D space**

The sequence, as visualised in Figure 7, shows the individual captured frames of the movement on the time axis Z, one behind the other. The transparency of the superposed pictures does not produce the illusion of a movement through retinal persistence, but deconstructs the technique of this illusion in a 3D space. The dancer, reduced to few lines and thus deprived far-going its 3 dimensional body (body space), finally produces a 3 dimensional “space-body”, as time becomes the 3rd dimension. The reference to Marey is here extended to the simultaneous presence of the dancers movement and its process of analyse by the real-time device while the 3D space reveals its temporal construction. Over the navigable virtual space the represented movement becomes the result of the choreography and the navigation in 3D space.

The three viewpoints, the eye of the public, the camera, filming the dancer’s body and the virtual 3D camera, modifying the view of the frames in 3D space, constituting together the two synchronous representations of the dancing body: the dancer and the dancing 3D “space-body”. In fact, it is the dancer and the VJ who interact in real time, or in other words, they dance together through the computer.

## 5. CONCLUSION

Since his creation, the performance has been shown several times in varied contexts with different cultural backgrounds, such as digital music festivals, exhibition openings, electronic arts or dance festivals. The spectators with an art background, for who Schlemmer and Marey are well known, appreciated the link between science, modern art and digital culture. (Schlemmer is more known as painter than choreographer and Marey is known through abstract paintings’ reception, namely by M. Duchamps) For the ‘dance public’ the relation between virtual and physical representation of human motion was less evident as it focalized its attention on the gesture quality of the dancer. For the music public, involved in audio-visual culture by music clips and VJ performances, it was simply a good show.

One of the main issues in digital performance art and also in this performance is the transparency and the experience of the real-time processing while the performance, which depends often on the visibility of the minimal gestures operating a mouse or a keyboard. This is one of the reasons that the following project will leave the spatial separation of stage and auditorium to create a symbiotic space. The public’s movement will be integrated into the device by motion tracking in order to transpose the experience of 3D space navigation to the public and to build up an interactive play between the motion of the dancer and the audience.

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