Motion structures: aesthetics of spatial and temporal transformations

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Abstract. Time-based media such as video and film often depict visual images one after another: the same visual space is erased continuously. Alternative ways of interacting with the same sequence of frames have already been explored: as a grid of frames; as a flattened image averaging a set of frames based on a particular visual feature (e.g., maximum or minimum brightness); and more recently 3D explorations. In this contribution, we introduce an experimental approach to explore and interact with time-based media. We aim at studying spatial-temporal transformations represented as a 3D object and at contributing to the ongoing research on 3D forms and shapes. We present three recent productions created from video artworks. In the end, we reflect on potential uses of our productions.

1 Introduction

Time-based media such as video and film often depict visual images one after another, which means the same visual space is erased continuously: one frame replaces the previous one. Alternative ways of interacting with the same production have already been explored. For example, by decomposing a film or video into an image sequence we can process and reorganize those images according to the properties of 2D and 3D spaces, either physical or electronic. In this article, our intention is to contribute to the ongoing research on artistic 3D forms and shapes.

Historically speaking, the depiction of time in static images and sculptures has always attracted visual artists. In the early 20th century, with the influence of Einstein's Theory of Relativity, artists strived to go beyond the 2D canvas and the 3D object in pursuit of an extra-dimension. In this context, 4D has been understood as the representation of at least two concepts: time and multi-dimensionality. The aesthetics associated with 4D have been related to the examination of non-Euclidean forms and geometric shapes as qualities for abstraction, as a symbol of liberation, as a rupture with material supports, and as the interpretation of multiple and higher states of consciousness [9].

In recent years, new kinds of projects have emerged, taking advantage of developments in image processing, computer graphics, information visualization, and media art. Through these projects, it seems the exchange of properties and processes

among domains has been a motor for creativity in the quest of alternative ways to see and interact with media.

The domain of time-based media such as film, video, and multimedia, has witnessed an expansion of techniques and technologies that were previously used mainly in other contexts: video segmentation (as in photography), video traces (as in slit-scan photography), video annotation (as in text), video summarization (or video abstraction) (as in summaries of documents), video cubism and video cubes (as in data visualization), and media visualization (including techniques such as montage, slice, and image plots) (as in scientific imagery).

Moreover, the use of 3D techniques and technologies has also been a relevant domain. Today '3D' easily appears as prefix for at least the following fields: views, data representation, data description, spatial interaction, modeling, visualization, user interface, model retrieval, capturing, printing, volume rendering. The importance of studying and using 3D structures is related to the intention to achieve or facilitate: multivariate analysis, immersion, interactivity, representation of larger volumes of information, visual analytics, visual interfaces (commonly for VR, AR, and games), representation of hyperspace, depiction of mathematical models.

As developments continue, domains expand and interact. In humanities and social sciences, for example, the most evident progresses can be appreciated among the digital humanities community. The arts posses, on the other hand, a rich tradition on digital art, cybernetic art, electronic art, hypertext literature, virtual art and, media art that comes with an extensive catalog of artworks that have been created since the beginning. Thus, celebrated art projects such as 'The Invisible Shape of Things Past' by Art+Com (1997) [1] and 'Field-Works' by Masaki Fujihata (2000) [5] consider an image sequences as an array of individual objects (video frames in these cases) that could be organized on the Z-axis (depth) according to the position of the camera that recorded them. Another case is the 'Liquid Time Series' by Camille Utterback (2000-2002) [14], which combines aesthetics of video traces and the physical movement of participants. More recently, artists create and make available the software and programming code used to produced a piece. In such cases, it seems that the artwork is also the software and, perhaps more important, the different operations available to perform on some type of media. Consider the forthcoming interactive documentary 'CLOUDS' by James George and Jonathan Minard, which was created with the RGBD Toolkit (where D stands for depth). While the film was crowd-funded, the software can be downloaded for free from the creators website [6].

2 Introducing Motion Structures

In this article we introduce an approach to explore and interact with time-based media, such as film, video, and motion graphics, in a different way. Our approach is based on the idea of representing spatial and temporal transformations of an animated sequence. Our intention is to contribute to the ongoing research on artistic 3D forms and shapes. In a similar way as noted above, we consider time-based media as a series of images (or an image sequence). From this perspective, we are interested on representing the shape of spatial and temporal transformations that occur within the

visual space of the frame. The final outcome thus traces those transformations in the form of a digital object. We call our approach 'motion structures'.

From a technical point of view, we build on top of the open-source software ImageJ (developed by Wayne Rasband at the National Institute of Mental Health, Maryland) [10], which is mainly used for scientific imagery practices. Basically, we have created an ImageJ macro script that performs a series of operations that take as input a folder containing an image sequence. The script then automatically converts the images into 8-bit format, subtracts background, and finally runs the 3D viewer. From the 3D Viewer it is possible to save the result as static image, as 360-degree rotation movie, and to export it as a mesh surface.

Our first steps into motion structures initiated in late 2011. At that time we were interested on representing the shape of CGI visual effects sequences, starting with the Paris fold-over sequence from the film 'Inception' (Nolan, 2010) [12] and moving towards a fragment from the 'Game of Thrones' TV series main title sequence [13]. For the latter, we discovered an intrinsic invitation to go deeper in the interaction with a motion structure and to 3D print it as a physical piece.

Motion structures have also fostered some reflections about the relationship of a medium to its support. It seems that the possibilities to interact with a medium are determined by the software containing it. So, our macro script could be seen not only a small piece of software that allows converting an image sequence into a 3D object, but more important the operations and processes behind this process. At another level, we are also using motion structures to study visual features and what has been called in visual semiotics 'plastic signs' [8]. Besides recognizable figures within an image, there are always plastic properties such as colors, textures, and forms. Most of the time we do not attend plastic properties because they are difficult to cope and analyze, as opposed to recognizable figures such as faces, parts of the human body, animals, objects, etc. From this context, as it has been noted for scientific imagery, some processes allow for seeing the invisible (or unnoticed): spatial-temporal patterns, visual features, and software operations.

In the rest of this article we will focus on the aesthetics of spatial and temporal transformations. For this occasion, our selected image sequences come from seminal video artworks by Charles Csuri, Peter Weibel, and Bill Viola. In the end, we believe motion structures share some principles with what has been called a 'sculpturalization of images' or video sculptures [11], which are objects produced out of existent moving pictures, but which also have artistic values (rhetorical and aesthetical) on their own, mainly because they alter the viewers' expectations of traditional time and space depiction.

3 Motion Structures of Video Artworks

The introduction of video and animation technologies for recording, processing, and playing back moving pictures opened a wide range of possibilities for artists to explore and experiment on the aesthetics of space and time. Contrary to cinema, video was more accessible, malleable, and portable. It was also easier and faster to watch

and project the recorded movie. Finally, the look and size of technological image was based on lines, reproduced at a different pace than film.

The following pictures show the motion structure generated from three different video artworks.
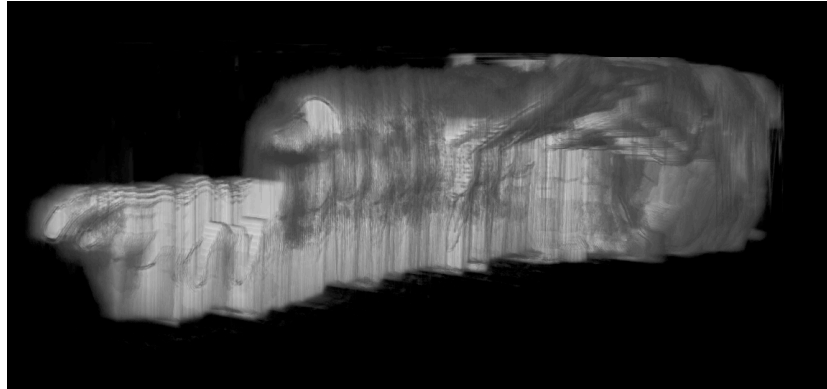

Fig. 1. Motion structure generated from Charles Csuri's "Hummingbird" (1967). 02:10 minutes, 1295 frames. This is a forward angle perspective captured from ImageJ 3D Viewer [3].
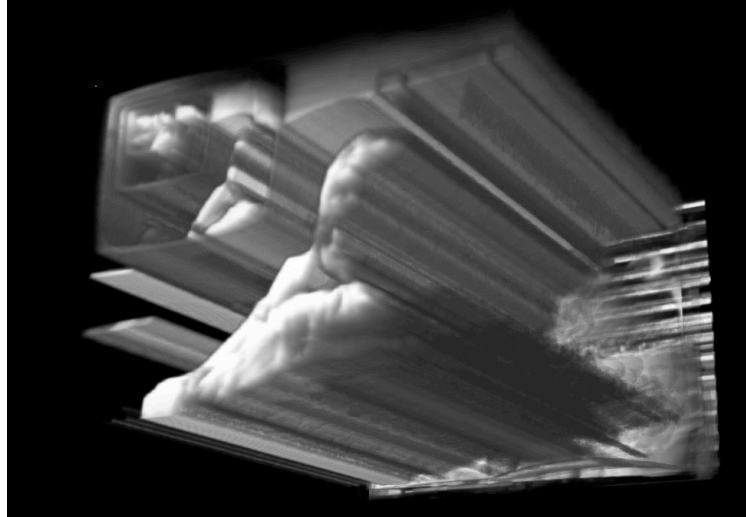

Fig. 2. Motion structure generated from Peter Weibel's "Endless Sandwich" (1969). 00:38 seconds, 378 frames. This is a forward angle perspective captured from ImageJ 3D Viewer [16].

Fig. 3. Motion structure generated from Peter Weibel's "Endless Sandwich" (1969). 00:38 seconds, 378 frames. The object was exported as mesh surface in OBJ format and then opened in MeshLab. This is a perspective inside the object.
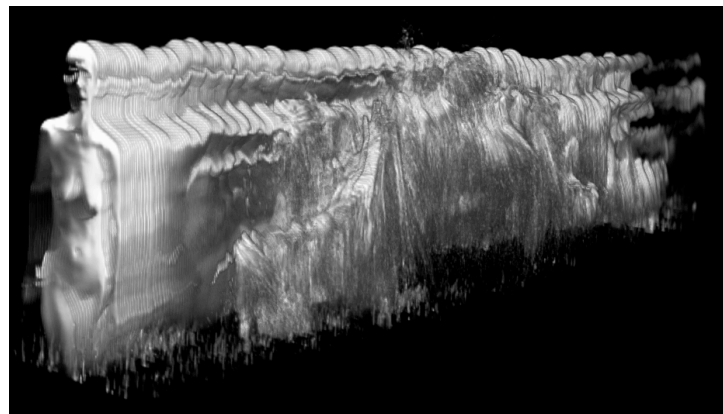

Fig. 4. Motion structure of Bill Viola's "Acceptance" (2008). 02:03 minutes, equivalent to 1231 frames. This is a reverse angle perspective captured from ImageJ 3D Viewer, which means the first figure to the left is the last frame shown in the original video [15].

3.1 Overall Observations

The representation of these seminal video artworks as motion structures allows seeing patterns of spatial and temporal transformations. The main rhetorical turn comes from a rupture of the traditional way of interacting with time-based media (i.e. one frame after another in the same visual space). The contemplative character of these artworks is then represented as a single object that depicts a rhythm that goes from simplicity

towards complexity. At the beginning of the animated sequence we observe fewer elements that evolve in time, increase in number, and occupy more space of the frame surface. This is also perceived in the form of scaling shapes that change in scale along the Z-axis.

Some reflections from the aesthetical front involve the fundamental question: why transforming a video into an object? Recent research on visual epistemology recalls the difficulties of exploring new ways of seeing things. Following the idea of what has been called 'aesthetic provocations' [4], we take into account the aesthetic approach interested on the aesthetic experience over functionality. That is, to put it simply, to focus on design instead of function. Aesthetic provocations are also a mechanism to "augment our understanding of the encoded material" through the discovery of hidden patterns; to take a look at the way the work was produced. This would require the eye to give importance to abstractness because sometimes the aesthetic production engages with non-rational systems of thought.

In our case, the video is not anymore a motion picture but an object. Aesthetics of contemplation changes to aesthetics of exploration, holding, weighting, orbiting, destructing, or decorating. It seems the fascination and invitation to 3D print a motion structure is related with the current turn of a 'culture of craft', that prefers physical presence to electronic, touch over sight, poor media over rich media [2]. As the authors propose, is that a revolt against the screen culture? Or is a motion structure an 'iconoclastic delight', irreverent enough to destruct and decompose master pieces of video art or cinema [7]?

Video art has been in itself a rhetorical movement against traditional representation of moving images. Artists working with video explored the plasticity of the video image. The aesthetics of video art has also influenced other media such as film, multimedia, and websites. We observe this influence in special visual effects, in hybrid media (media made out of different media), and media art installations. The study of transformations of space and time within the boundaries of a frame is also an endeavor to put attention on plastic properties and invisible elements of visual media. Motion structures of video artworks are a second-degree anesthetization of the shape of time and space.

4 Conclusions

We have introduced 'motion structures' as an approach to explore and interact with time-based media in a different way. We were interested on the aesthetics of spatial and temporal transformations occurring within the visual space of the frame. A motion structure implies to decompose an animated sequence into individual frames in order to perform software operations that will convert the image sequence into a virtual 3D object.

In this article we have shown three motion structures generated from seminal video artists, namely Bill Viola, Peter Weibel, and Charles Csuri. In the end, we reflect on the aesthetical values of motion structures. Because video art has been in itself a rhetorical movement against traditional representation of moving images, motion structures could be seen as a second-degree aesthetization of the shape of time and

space. For the selected artworks, they all are contemplative and occur in a single shot without any cuts. The motion structure captures well the traces of movement and the rhythm of the transformations.

Our understanding of aesthetics is related to the idea of 'aesthetic provocations'. We try to use our approach not only for the sketch of visual artworks and design, but also to contribute to a visual and software epistemology by taking into account plastic properties and software operations in a reflexive manner.

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