beyond data: abstract motionscapes as affective visualization

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Abstract

Motionscapes—the compositions of visual forms in motion—have often been used for the evocation of affects in recent interactive art forms and environments. While the motionscapes aesthetic can be informed by art theory and history, previous empirical work investigating the affective affordances of motionscapes brings new perspectives to the design language of motionscapes. The authors argue that motionscapes that are commonly employed in artistic contexts can be appropriated for the design space of human-computer interaction (HCI) as a rich modality for affective visualization. The authors propose an initial set of principles and guidelines for evoking affect through motionscapes in interactive and immersive environments.

In nature, fields of motion can usually be seen in rain, snow, fog, herds of animals, schools of fish or flocks of birds. These phenomena are all comprised of massive numbers of similar agents moving in coordinated patterns to create new types of landscapes: metaphorical landscapes that are not constructed by rocks or earth but by the dynamic transformations of natural organisms. We term such dynamic phenomena of motion motionscapes.

In recent practices of the visual arts and design communities, similar types of motionscapes manifest themselves in massive but coordinated repetitions of visual form and motion, often resembling the motionscapes in nature. A great number of artworks and design artifacts—from the fields of kinetic art, abstract cinema, motion graphics and generative design—are notable for their creation approaches and expressive qualities. Notable examples of such artificial motionscapes can be found in John and James Whitney’s computationally animated films, Saul Bass’s motion title sequences and Casey Reas’s generative drawings. In works like these, motions created using abstract visual forms are often extensively composed to further focus on the affective aspects and aesthetics [1]. Our research highlights the affective expressiveness of these more abstract motionscapes. We propose that when one better understands the underlying perceptual and interpretive principles [2], one can imbue abstract motions with affect or evoke affective responses with a better degree of certainty, thereby enriching the palette of visual forms available for affective impact.

We term this emerging field affective visualization: the principle use of visual elements to change the affective nature of a visual presentation. Affective visualization has the goal of using visual features to evoke an affective state: an experience, emotion or impression. Affective expression has been recognized as a critical aspect of the visual presentation of interactive artifacts and environments [3]. However, the affective potential of motionscapes has only recently garnered interest within the scientific and computational domain of visualization. Recent studies reveal that motionscapes have a rich potential to be employed as an expressive medium for the communication and evocation of affect [4]. While the design language of motionscapes can be informed through close readings of or case studies from art history and theory, supporting perspectives and knowledge are still needed to elicit the affective aspects of motionscapes. We propose that understandings of the “formal” qualities of abstract motionscapes can be borrowed from the visual arts and can be utilized as an approach for affective visualization in interactive environments, particularly where affect is important. We are not arguing that motionscapes belong to a genre that is designated as affective; rather, we are paying attention to the fundamental properties that comprise motionscapes, and we are studying the affective affordances of such primitive properties. In this article, we propose an initial set of empirically validated guidelines for communicating and creating affect through abstract motionscapes; we aim to apply these guidelines in interactive environments such as virtual environments, augmented reality and digitally mediated meditation and performances.

Shape as the Composition Base

Shape, the dynamic layouts of motionscape composition, has been recognized as a fundamental dimension of the motionscape design [5]. We propose that shape can be referenced as a compositional base for the creation of motionscapes, and we go on to summarize two categories of composition systems: linear and nonlinear layouts.

Nonlinear layouts represent the system of centricity, where the inner compositional forces (formed by the structured movements of the particles within motionscapes) are related to an internal center. Such nonlinear motionscapes are associated with pronounced affective impressions of urgency, threat, rejection and negativity. Thus they can be applied as visual notations for warning or to suggest areas that demand attention. The linear layouts, on the other hand, represent a system of eccentricity, where the composition forces react to a lack of compositional center. Motionscapes of linear layouts are neutral in their affective expressiveness: They have been proven to yield a calming and reassuring effect on the viewer and are thus suitable for many design scenarios, where visual elements should be neutral, less attention-demanding and less intrusive. As nonlinear motionscapes are always attached to certain positions within the virtual space in which they reside, the motionscapes can be made relevant to specific positions in the visual space for a range of local effects. According to Janet Murray, it is crucial for any interactive environment to inform the interactors about their position within the whole [6]. In the two scenarios depicted in Fig. 1, the spherical motionscape that is located at a distant point in the virtual space serves as a landmark that reminds us of the interactors’ relative position in the virtual environment and makes certain locations in the environment visible to the interactors. The spherical motionscape in this case may indicate the point at which visual force and excitement may be attached or toward which it may be directed.

Lacking a composition center, the agents within a linear motionscape can be equally distributed across a large space to create an environmental and ambient effect. In Fig. 1, the linear motionscape applied in the scenario is designed to simulate a cosmic environment, where particles within the motionscape
move gently to produce a calming atmosphere. Here, as there is no specific center or axis within the linear motionscape, the arrangement of the particle movements is therefore less threatening or aggressive than it would be in a nonlinear motionscape, and the viewer does not have to pay attention to any specific point within this environmental motionscape.

**Motion Control on an Atomic Level**

While variations in shape provide the compositional bases for the motionscape design, the motion properties of the individual atomic agents that comprise a motionscape also enrich the resulting affective expressiveness. We have identified speed, path curvature and direction as three key motion properties that contribute to the motionscape affects.

The influence of speed on the affective experience of motion has been established in a range of studies [7]. Speed is a motion property strongly associated with the intensity of the affective impressions. Motionscapes with fast motions are generally considered to be more negative, exciting, urgent, threatening and rejecting than those with slow motions. However, speed influences not only the quantitative level of motionscape affects, but also the qualitative nature of the affects. Increasing speed may not only lead to an increase in the impression of excitement, but it may also lead to change in the affect being communicated. In Fig. 1, when the particles are slow-moving, they may be experienced as calming and relaxing. When, however, those particles start to move incredibly fast, the calming affect evoked by the very same motionscape might be altered; in this case, the affective aspects of excitement and urgency may also arise. Thus, when motions are applied with the purpose of calming or reassuring viewers, the control of speed in the motionscapes is a crucial aspect that should be considered by designers.

We term the variations in the local trajectories of the atoms in a motionscape path curvature. Previously, we have described wavy path curvature as a visual phenomenon resembling phenomena in nature [8]. As when applied in motionscapes, the wavy path curvatures formed by the traces of particles may be seen as a visual reference to waves in oceans, forests or grasslands. Wavy paths, when controlled carefully, may produce impressions that are more natural, and thus, the motionscape may promote a feeling of calmness and reassurance in the visual environment.

The variations in a motion’s direction also yield significant impact on the viewer’s attention and feeling of the atmosphere in which the motionscape resides. It has been established that upward motions are perceived as positive (and vice versa) [9]; therefore, the direction of motions is relevant for visualizations that require articulating positive or negative characteristics. We attribute such association of direction with affects to natural references [10]: Downward motions seem natural and expected because of the universal effect of gravity, while upward motions may be seen as more exciting.

It should be noted that the affects evoked by a movement performed by single object may become blurry when the same movements occur under more structured compositional effort [11]. The variations in shape often lead to variations in the affects resulting from other more primitive motion properties. Therefore we suggest that the role of atomic motion properties not only be studied by investigating the expressiveness of each single particle within a motionscape, but also by examining the dynamic forms achieved by the interplay of all atomic motions.

**Dimension of Presentation**

The presentational scales—resulting from the viewpoint of motionscapes both in the virtual environment and the physical realm—function as a third instrumental dimension of the motionscape creation. The two simulations of viewer position (Fig. 2) represent two categories of design fields based on the scales of the motionscape presentation: visual components designed for a local space or ambient visualization applied to an entire environment. Motionscapes applied to a local position in a visual field are seen as more subtle and less pronounced than those applied to the entire visual field. Therefore, the scale of the motionscape can be seen as a “slider” for indicating the intensity of the intended affective impression and should be carefully considered by visual designers when deciding whether to create local visual effects or large-scale ambient effects. Applying motionscape effects to information or interface design is not so much intended to create immersive experiences per se (i.e. positioning the user within a motionscape that functions as a total immersive environment). Rather, motionscape design in such contexts is aimed at inviting the viewer’s attention when necessary—to keep the viewer outside the chaos and to allow her to jump back and forth between interface or application and herself.

**References and Notes**

Based on a presentation given at VISAP’14, 9–14 November 2014, Paris, France. The IEEE VIS Arts Program (VISAP) is a forum that encourages dialogue about the relationship between aesthetics and visualization. The theme of VISAP’14 was Art-Interpretation.

1. We expand our operational definition of affect to one of experience: When we are affected by something we experience a feeling as a result. This might be an identifiable emotion, a sense of interest, an atmospheric impression or other such feelings related to but not exactly one of the basic emotional states.
5. Feng [4].
9. Bartram and Nakatani [7]; Feng [4]; Lockyer and Bartram [2].
10. Feng, Bartram and Gromala [8].
11. Feng, Bartram and Gromala [8].