Computational Aesthetics in Graphics, Visualization, and Imaging (2012)
D. Cunningham and D. House (Editors)

The aMotion Toolkit: Painting with Affective Motion Textures

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Abstract

Visual artists and designers frequently use carefully crafted motion textures – patterns of ambient motion throughout a scene – to imbue the atmosphere with affect. The design of such ambient visual cues is an elusive topic that has been studied by painters, theatre directors, scenic designers, lighting designers, filmmakers, producers, and artists for years. Recent research shows that such motion textures have the capacity to be both perceptually efficient and powerfully evocative, but adding them to scenes requires careful manipulation "by hand": no tools currently exist to facilitate this integration. In this paper we describe the design and development of the aMotion toolkit: a palette of composable motion "brushes" for image and video based on our affective motion research. We discuss insights from an on-going qualitative study with professional visual effects de-signers into how such capabilities can enhance their current practice

Categories and Subject Descriptors I.3.3 [Computer Graphics]: Animation, perception, affective user interfaces, information visualization

Introduction

Immersive and engaging experiences in performance, interactive art, and gaming often rely on the careful design of affect: representations that convey emotion, atmosphere and influence how the environment "feels". Creators, designers and artists explore and manipulate visual elements of a scene to enhance affect, but the knowledge of how to communicate these subtle meanings remains largely rooted in personal experience and design principles that are not computationally operational; that is, there are few algorithmic models that define how to create, amplify or reduce the affect by changing elements such as colour, shadows or animation. As a result there are few digital tools that explicitly model affective representation; instead experts develop guidelines of approaches particular to the medium (e.g. lighting, sound or colour) and to the context (e.g. game, theatre, or film) that are then taught to new practitioners in these fields. Two notable exceptions merit mention: the common example of tools that assist with the creation of emotive colour palettes ("warm" vs. "cool" hues) included in visualization and artistic applications such as Tableau™ or Adobe Creative Suite™; and Seif el-Nasr's work on adaptive computational lighting for game environments [Se05].

We define affect as related to experience: when we are affected by something we experience a feeling as a result: an emotion, a sense of interest, an atmospheric impression, or other such sensations related to but not exactly one of the basic emotional states. Emotion theorists categorize emotion along three dimensions: valence (positive/negative); intensity (calm/exciting) and dominance (submissive/dominant) [Ekm99, OT90]. These are useful but not exclusive categories for considering affect: we may also consider "unemotional" dimensions such as interest (engaging/boring) or importance (important/unimportant). The importance of affect is well known in entertainment, communication and art; more recent research has acknowledged the importance of affect in visualization and multimedia applications [ZSQ09, EB06, HO07, GDC11].

Our research focuses on the affective potential of motion: in particular, the affective visualization potential of environmental (i.e., non-character-based) animation. Motion has a long history as a communicative form and motion textures – fields of motion such as swirling leaves, fog, smoke, or more abstract effects – are often used in interactive environments, video, visualizations and games to imbue atmosphere and evoke feeling [SM*11]. Complementary to previous work in adding enhancement effects to video [OAI*09, OAO11, TT10], digital images [CG*05, HE04, HP00], and character animation [GDC*11], we are developing interactive tools and techniques that provide a palette of affective and expressive motion effects for media, visualization, interaction and user experience designers. However, rather than computing these effects from previous artifacts and sequences, we seek to ground them empirically in scientific studies of affect [LBR11] and to further explore them in-depth with visual creators, performance artists and game designers [LB12].

To date we have focused on the creation of "pure" motion effects that can be applied to simple abstract elements, either singular (as in a simple dot) or in a texture (as in a particle system). We have discovered adjusting motion properties such as shape, speed and path deformation effects can indeed influence affective interpretations of the resulting textures [BN10, LBR11, LB12]. However, visual effects designers and artists work with more complex imagery than the simple textures we have previously stud-

DOI: 10.2312/COMPAESTH/COMPAESTH12/035-043

ied. We therefore developed a compositing model of adding such motion effects to a scene that will allow creators to “paint” in, combine and overlay affective motion patterns using a series of parameters identified as affective in our previous studies. In this paper we describe the design of the *aMotion* toolkit: a palette of motion “brushes” for image and video that builds on and informs our affective motion research [LBR11]. This tool serves both as a prototype for exploring the utility of such of motion brushes as well as an elicitation mechanism for exploring how designers might use such motion effects in their domains. We discuss how our on-going collaboration with visual creators is informing the evolution of the toolkit and the generation of new types of motion-based painting techniques to enhance affect.

Related Work

Motion and Affect

Motion is perhaps our most acute perceptual cue and has been found useful in traditional user interfaces and visualization tasks [BW02, BWC03, HH05]. It is also a powerful visual cue for eliciting affect [LW89, DL94, BN10]. The arts of drama [Zo68], dance [LL74], animation, cinematography and music map very complex emotions and motivations on to gestures and movement, A number of video and animation researchers have investigated methods for taking techniques from traditional 2D animation and dynamically adding them to video [CO05] and computer-generated 3D animation [JB04]. These stylizations allow artists and animators to create new effects and enhancements in the sequences, exposing new behaviours and adding nuances of meaning, but depend on the analysis (both manual and machine-generated) of existing styles and sequences of articulated figures.

While such studies focus on the movement and depiction of an articulated figure, a number of researchers have investigated the affect of more abstract motions. In early studies participants attributed very complex motivations and emotions to a set of animated geometric primitives [HS44, LW89]. Observers attributed emotions such as aggressiveness and anxiety from the motions alone. In a study of single dot animations, different trajectories elicited particular complex impressions [Tag60]. Previous studies have additionally suggested the following as candidates: velocity [ABC96, PPB*01], amplitude [ABC96], acceleration [PPB*01], direction [Tag60, BN10], shape [BW02, BN10, BLR11], effort [LL74] trajectory [Tag60], and smoothness [BN09, BN10, BL11]. (A complete review of this research is beyond the scope of this paper; readers are encouraged to see [LB12] for a more in-depth discussion.) Empirical studies of simple animations of abstract particles on a blank canvas have shown the affective potential of simple motion properties such as shape, speed, and path [BN10, LBR11]. Participants were shown different abstract motions and asked to rate them on a variety of affective scales [BN10]. Affective responses to these motions, however, were not highly detailed but rather categorical. In other words, individual emotion ratings were not distinguishable, but clustered around the traditional axes of emotions: as valence (positive/negative), intensity (calm/exciting) and to a lesser extent dominance (reassuring/threatening). In hindsight, this generality was to be expected: more nuanced interpretation relies on the context of presentation and narrative.

Motion Textures

Far less research has investigated the implications of affectively coding motion textures. Recent studies into visual com-position in video games are providing insight into specific factors of ambient motion textures influencing affect: speed, shape, direction [MNM11]. Another application of motion texture is the animation and enhancement of still images through the application of stochastic motion textures [CG*05], where motion texture is used to bring life to still images by applying generated textures to user-selected masks of the original scene. More recent work combines a static texture to an existing motion field in order to create non-physics based motion textures that behave characteristically of the exemplar input texture [MW*09].

In empirical studies of simple animations of abstract particles on a blank canvas, participants were shown different abstract motions and asked to rate them on affective scales related to the previously discussed clusters: valence (positive/negative), intensity (calm/exciting), dominance (reassuring/threatening), attraction (attracting/rejecting) and urgency (relaxed/urgent) [LBR11, LB12]. Results confirmed the affective impact of motion properties such as shape, speed, and the path deformations of the individual particles, similar to results from studies of singular motions [BN10, LBR11].

Creating with motion affect: the expert view [LB12]

Content creators use ambient motion in various ways to communicate affect and to enhance presentation and an obvious question is if, and how, they might make use of abstract motion textures. To better understand how they might explicitly use these motion effects, we developed an abstract motion texture editor using the Unity Game Engine™ that allowed a user to create motion textures composed of basic motion properties previously identified as visually evocative: shapes, path deformations, densities, speeds, and opacities [LB12]. We added a spiral shape after pilot studies where participants observed these patterns are common in both nature and in games [SM*11]. We also added the ability for the user to define motions. We explored this tool, and the resulting motion textures produced, with professional creators of visual effects from several different domains: game design, visual art, video editing, theatre lighting and stage design, and researchers in media communication and performance.

The designers were all convinced of the utility, expressive capacity and creative potential of abstract motion textures. Confirming and enriching our study results, they told us:

- Simple motion shape is evocative. The radial and spiral motions were described by the designers as having the strongest affect and lent themselves easily to additional subtle nuances and layering of affect. Most designers stated that changing the properties of the simple, regular algorithmically generated motions was sufficient to create a wide range of affect. We were surprised that there was little interest in defining the "user-specific" base motion.

- Path deformations are powerful and differentiating. They used path curvature to increase affect such as dominance, intensity and urgency in addition to being perceived as more negative and rejecting. The designers were particularly interested in the organic aspect of motion textures with path deformations that were discernibly wavy or angular. Several designers expressed the desire to emulate natural motions, notably slow spiral emitters (galaxies) and softly swaying grass.
- Motion speed is critical and even small differences change the impression.
- Texture shape is dominant. They were emphatic that linear and non-linear textures would be used in very different ways. The algorithmic differentiation of radial and spiral textures was seen as artificial, as the designers consider these aspects of the same general shape varying by both *direction* (inward-outward) and *spin* (clockwise/counter clockwise). Our game designer and visual artists pointed out the combination of the two can simulate 3D effects, proposed as a rich addition to the planar 2D textures currently supported.

Our designers had, however, a number of suggestions. They expressed a need for high level, "automatic affect" specification such as "more urgent" or "more calm", as well as a full set of low-level controls to manipulate fine details such as the sine curve of a wave. Additional motion types identified as interesting were flickers and pulses. A significant shortcoming was the lack of appropriate "waviness" specification for path deformations: rather than simple periodic functions, we clearly needed more nuanced wave behaviours to achieve the fluid and curvy effects the designers want.

The most important insight related to how designers would use these techniques. They overwhelmingly wanted a way to create, integrate and overlay these motion effects on existing visual environments in real-time: to paint them into their scenes and images rather than generating additional animations that needed subsequent integration.

Still Image and Video Motion Painting

Painting animated effects into images is well established and past research highlights the visual potential of motion for under-painting surfaces of still images and bringing life to them [CG*05, HE04, HP00]. Additional techniques exist Techniques include leveraging the use of colour-based image clustering methods and the fully automatic generation of stochastic motion textures that may be applied to specific areas of the image. These types of approaches focus on creating realism of natural phenomena and rely heavily on static scenes already having artefacts characteristic of their natural motion types (water ripples). Much of the focus of this research to date has still been predominantly on simulating natural environment effects for subtle inclusion in static images [OAI*09, OAO11, TT10].

Additional techniques utilizing motion textures or fields of motion to augment still images attempt to replicate the painterly styles of many more complicated non photorealistic rendering techniques that are well established [OMG05]. These techniques rely on previous research for image segmentation producing fully automatic or semi-automatic painterly renderings. In the creation of painterly renderings and animations from video, motion information can be extracted from the video sources or provided by the user [HE04]. Techniques for real-time painterly rendering of video for interaction rely on frame differencing with mask suppression of video noise to paint only those frames that contain movement. Optical flow techniques are also used to warp brushes embedding motion effects into the rendering [HP00].

The *aMotion Toolkit*

Our goal is to support visual designers and artists with a suite of tools that allow them enhance their creations with affective motion. The studies in [LBR11, LB12] utilised a palette of motion texture editing techniques tools that allowed the user to create a limited set of abstract textures. But how might these textures actually be used with and integrated into other media? Our expert participants expressed the desire to explore these textures in both 2D and 3D applications. We began with 2D (image space). Based on the rich affordances of the augmentation and non-photo-realistic rendering techniques discussed above, we redeveloped the abstract motion editor from previous studies into a full-fledged tool for painting motion textures into images.

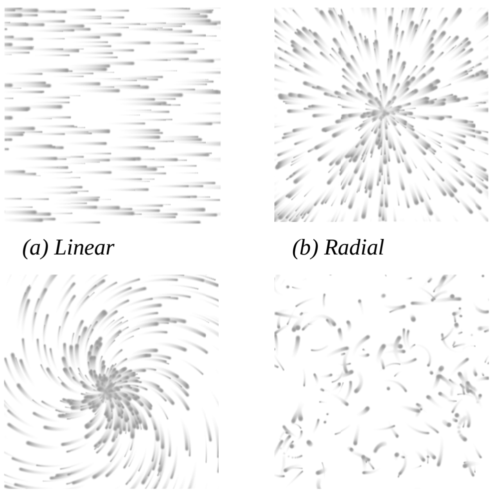
The *aMotion* toolkit uses a model of *brushes* and *surfaces*. It allows the user to create simple and compostable motion textures as brushes whose affects can be applied to a surface (an image or a video). Each brush has a number of *brushlets* (the individual hairs of a brush) that determine the visual appearance of the brush's interaction with the underlying surface. The user creates a brush by selecting one of a few texture shapes (linear, radial, spiral or random (Figure 1) and by adjusting the behaviour and appearance of the brushlets. Motion shapes can be combined in a single brush. We chose motion shapes and parameters that either proved affective in our previous studies [LBR11] or were requested by our expert designers [LB12]; the aMotion model, however, can accommodate extensive motion texture types, as will be discussed later.

Brushes

More formally, we define a motion brush as a single plane in a 2 dimensional space consisting of a number of amorphous objects which all move according to a shared motion texture *shape*. A user can control the look and feel of brushlet motions for a motion shape by manipulating parameters for speed, acceleration, direction and path deformation. There are also different options available to decide how the brushlets will repeat over the edges of the surface and to control their shape, opacity, *interpolation* (interaction with the underlying surface) and *lifespan* (the period over which the brushlet will exist).

Texture Shapes

The aMotion toolkit allows a user to work with the following motion shapes (linear, radial, spiral and smooth random (a kind of Perlin noise [P02]) (Figure 1d). Radial motions are simply a subset of spiral motions with no spiral property, so we will refer to these two motion shapes as simply spiral motions. These motions differ in how they depart from their origins and occupy the space. Each brushlet in a linear motion starts from its own origin and "travels" across the image; brushlets in spiral motions start from a common origin and are "anchored" to that origin. Anchored and traveling motions are perceptually highly distinctive [BWC02]: we believe this also contributes to affect.



(a) Linear *(b) Radial*

(c) Spiral *(d) Random*

Figure 1. Motion Texture Shapes

Linear motions follow a straight path as specified by the angle parameter. The linear motion texture is a travelling motion and as such offers options for dealing with the edges of the surface: *repeat over edges*, *die outside* (end life of object), or *bounce*. A user may specify two options for speed: constant or accelerating. With accelerating speed velocity increases from the start of the object life; this speed type can only be used with motions that have a lifespan. The maximum speed can be controlled via a separate slider parameter; this will also control the constant speed if no acceleration is specified. Some parameters controlling certain features carry over to other motions textures, and the linear controls are exposed if a linear motion textures is composited with another texture.

Spiral motion textures provide the user with parameters to control the extent and speeds of the spiral. This texture is a combination of our previous radial and spiral motion textures, taking the traditional radial controls of in/out toggle with a speed parameter and adding in a clockwise/counter clockwise toggle with a spiral speed parameter. Since these motions typically emit from a local origin in the texture, a more applicable option when dealing with edges is to reclaim the object when outside of the texture; the user accomplishes this via the *die outside* option detailed previously. The same acceleration and constant speed parameters from linear motions are applied to spiral motions. Finally, a user may specify a limiting radius to spiral motions specifying the maximum radius they can reach. Using this control, it is possible for the user to localize spiral motion textures to an area of a surface, painting with motion based affect, one of the goals of our research.

A smooth random motion texture uses Perlin noise [P02] to calculate the motion shape. The noise is 3-dimensional and has sliders to control the density and how the noise varies over time. Additionally, there are controls for the angle that the noise value is multiplied by in order to determine final motion direction and the overall force of this motion on the motion brush.

Brushlets

A motion brush is composed of a large number of brushlets. Brushlets have two main components: *object properties* and *path deformations*. *Object properties* are either set by a specific value or where necessary specified by a range to introduce random effects. The primary ones are lifespan, interpolation and opacity. Using brushlet controls for lifespan, interpolation and opacity a user can achieve subtle varying motion textures that are still faithful to the overall texture parameters. Lifespan can be faded in and out by a specified amount. A size range can be specified in addition to a choice of shape. The motion trail a brushlet creates is dependent on a global parameter and an individual opacity setting. Other brushlet parameters include additive colour blending with the sampled surface colour. Brushlets always sample the surface colour but the user may specify the interpolation level (see Section 0: Compositing).

Our previous research suggests *path deformation* is a powerful communicator of intensity, valence and threat. The aMotion toolkit allows the user to add these affective deformations to all motion shapes in the form of an additional wavy or angular path trajectory (Figure 2). For wavy deformations the user can specify an amplitude and period of a wave that will be perpendicular to the original overall motion shape trajectory. The resulting wave shape is also dependent on the motion shape's speed since this will stretch or compress the wave deformation. Angular deformations have the same controls but their shape is linearly perpendicular to the motion path resulting in a jagged, saw tooth pattern rather than a smooth curve.

Layout

For every texture shape the user can choose from three layouts: *random*, *grid*, and *point*. The user can utilize these layout options by specifying brushlets that have a lifespan and at some point need to be reseeded into the motion brush. A random layout is self-explanatory and there are many instances where this layout is the optimal choice for a motion texture, specifically linear motion shapes. However, spiral motions work best visually when reseeded at a local origin and therefore rely on the grid or point layouts to make this possible. The user may create a grid of origins with any number of rows and columns using sliders to control the parameters. The point layout allows a user to click where they would like seed points for the motion brush and the brush will immediately begin creating objects at these locations. Using the point layout with any motion type allows the user to localize their painting of affective motion brushes into still images or segments of video.

Surfaces

A *surface* in the aMotion toolkit is defined as any still image or video source. Each brushlet samples the colour of the surface in each frame and *interpolates* (blends) the surface colour with the current colour it has stored based on a parameter specified by the user. An alpha parameter to specify how much paint brushlet show allows for the creation of subtle motion under painting of a surface. This allows the user to finely tune the amount of streaking a brushlet will perform on the surface. Applying brushlets to surfaces fundamentally changes the qualitative impact of motion due to the introduction of a specific visual context. Applying different motion textures to the same surface, however, yields stark contrasts in visual representation (for example, the different impressions from linear and spiral brushes in Figure 7 and Figure 8).

(a) Straight *(b) Angular* *(c) Wavy*

Figure 2. Path deformations

Compositing

The aMotion toolkit allows additive layering of motion textures within a single motion brush. The user can create a brush that is composited from more than one basic texture shape, such as combining linear and radial. The composition of motion textures is additive; in the example of a spiral and linear composition, the spiral component vector for a motion object is added to the linear position vector. Linear and random motion shapes are built upon a force based model of acceleration. Compositing these motion types results in an additive acceleration force. Both methods of blending motion are visually accurate and do not impede the use of the brushlet path deformations. Layering motion shapes quickly increases complexity, which can make it hard to discern final motion properties.

Working with a single motion brush with one or more motion textures affords many possibilities for the creation of affect. One of the main concerns in our previous user study was the lack of ability to layer motion textures to composite basic 2 dimensional scenes. For the aMotion toolkit we have included the ability to create each motion texture on a separate layer and move them up and down the visual stack as necessary. A basic example composed of two linear motion brushes will turn a still image into a real-time cross hatching that will constantly iterate.

Implementation

Motion texture shapes are built upon a force based model of motion with added displacement vectors for path deformations. Linear motions add an acceleration vector (and optional constant speed vector) to the total acceleration of a brushlet. Spiral motions create additional displacement vectors added to ther brushlet position vector to incorporate sprial motion with an existing linear motion. Smooth random motion adds an additional force derived from Perlin noise to the acceleration vector of the brushlet. Path deformations (wavy/angular) create additional displacement vectors that are composited with the final brushlet position. The low level parameters governing the creation of these forces are all exposed through the controls available to the user of the aMotion toolkit.

User Interface

Controls for the aMotion toolkit are housed in a web based interface of tabs, sliders, and buttons. Tabs organise controls into 4 main sections: Brushes, Wash, Surfaces and Create. Brushes are listed, saved and loaded in the The Brushes panel. Wash controls post processing effects of the canvas, blur and various blending modes. The Surface controls manage the timing and cueing of video surfaces. Create is the starting point for creating a brush and allows a user to select from the three layout types and 3 motion types described previously. As mentioned before, all motion types can be utilized by a single motion brush, however only a single layout may be chosen for each brush.

Once a brush is created the webpage is refreshed automatically and there are two additional tabs created titled: Brush x and Brush x Settings, where x is the number of the brush. The first tab allows the user to hide/show the current motion brush and delete the brush when necessary. This main tab for the current motion brush also allows the user to save and annotate the brush providing authorship, a name for the brush, and a free form description. A set of sliders for 10 affective ratings selected from previous research [LB12] allows the user to characterise her motion according to these ratings. This supports two objectives: the user can organise and find motions she has previously described by affect, as well as provide rich data for our subsequent analysis of produced motions. We are collecting such data from our partners working with the aMotion toolkit in inform the design of higher-level affective controls for motion brushes.

The brush settings panel exposes all parameters to the user based on their choice of layout and motion texture. We have a number of low-level controls exposed at the moment in order to allow artists and designers to explore all possibilities in creating motion texture for their practice.

Finally, Web-based controls loosely decouple the user interface from the application, and allow multiple users the ability to create, view and edit motion brushes collaboratively in real-time, either face-to-face or using a screen-sharing application such as Skype™. The application runs the lightweight, open source, Mongoose webserver in order to serve web controls to any number of users. The web controls periodically ping the server via AJAX™ to obtain updated settings and display them accordingly.

Figure 3. original image

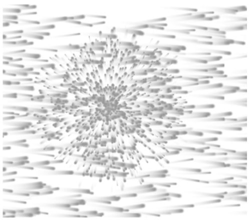


Figure 4. Linear + Radial brushes

Figure 5. Resulting image

Creative Use Cases

In our previous study with designers we sought to determine what a motion texture editor could afford them in their existing workflows, and they would like from a motion texture editor. Our eventual goal is to enable the embedding of motion textures into a wide variety of environments and applications: offer painting surfaces with motion textures is the first step in that direction, taking an image-based approach as a prelude to more complex, scene-based applications. We are currently engaged with an expanded group of artists and designers who are exploring and using motion texture creation with aMotion in a variety of creative endeavours. We discuss three such use cases here: theatrical stage lighting, visual art and video, and immersive performance installations. Key to this collaboration is an on-going and iterative study with these users in both the rich semantics of the motions they create, and utility, usability and domain requirements for the aMotion toolkit itself.

Theatre Lighting with Digital Video

We have been working closely with a team of professionals and students of lighting design from UBC. With Digital Video Illumination [G11], pioneered by UBC Professor Robert Gardiner, digital video projectors replace conventional stage lights. In this method, a relatively small number of video projectors are arranged so that they "cover" the performance area, and illumination, colour, shape, pattern, movement, and visual focus are created with light from these projectors, which are controlled using a personal computer. All projected images to cast light on the stage that are used by the team at UBC are static images or video sources with only the ability to translate the location of the image. The designers are now using aMotion to adding motion brushes to their palette of video effects, stating that they can quickly and easily create complex effects that previously required onerous hand video editing. They are extremely intrigued by the rich affective space - a new area of expression and atmosphere to mine. One comment from the lead designer after seeing the aMotion toolkit was, “I don’t know what this all means because I’ve never had motion lights before: it’s a whole new space”[priv Gardiner]. Their intent is to now develop a palette of motion light effects that can be both saved and streamed as well as dynamically mastered throughout the theatrical performance, similar to sound and in conjunction with existing lighting tools. They are actively developing motion-based video lights for their next production at UBC, scheduled for early summer 2012.

Visual Art and Video

We work with several video artists and editors, including Vidoe effects designer K. Rodriguez :an Adobe After Effects™ professional and owner of a small video production business. He is impressed by the expressive range of the tool and availability of all low level controls. In a single 2.5 hour session, he generated 25 motion textures across several surfaces used in addition to pure colour motion textures for ambient affect. The designer intends to use the tool for applications involving projection mapped surfaces of motion texture.

Immersive Performance

A team of theatre producers were intrigued by the expressive capacity of motion textures in a real-time immersive performance setting. We allowed the team to workshop the tool for a few hours using an actor from their upcoming performance. The surface used in the performance will be a live video stream of an offstage actor who is trapped inside a digital realm. The team is interested in the affordances of motion texture to convey the nuanced affect of several different disembodiment issues during the actor’s numerous monologues. Impressed by the affective

Figure 6. Original image

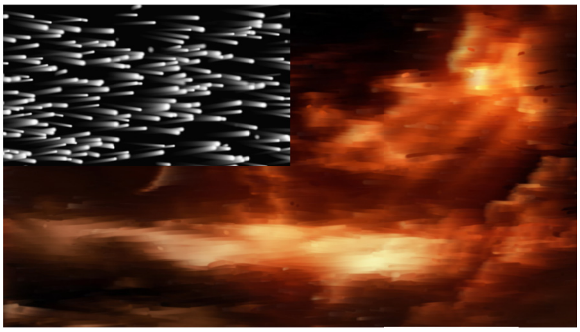


Figure 7. Wavy linear brush

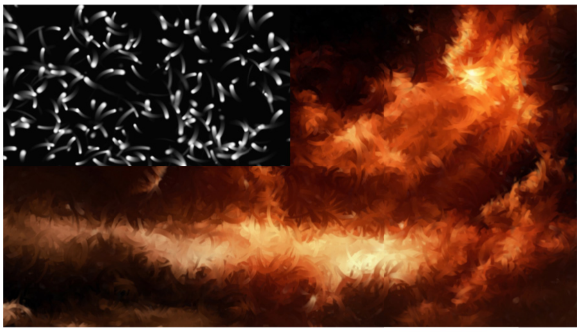


Figure 8. Gridded spiral angular brush

Images courtesy of K. Rodriguez.

textures that can be applied to a live video stream and con-controlled in real time through the wifi controls, the producers intend to use the toolkit in their upcoming production.

Discussion

Surface painting with motion textures and the wide range of low level controls available to users of the aMotion toolkit raises some interesting questions. Among them is how (and if) motion based affect carries from the abstract context when painted onto surfaces which may contain competing affective elements present in other mediums such as form and colour. How does painting motion texture onto surfaces alter the methodologies used to study motion based affect in this new context? We know that significant levels of motion affect are in the motion textures from previous work, but how significant is the affect in this new context? Has a specific affective response that is well known from prior research changed regardless of which surface is painted? Based on the current reaction from our partners using the aMotion toolkit, we feel the affective properties of motion texture from previous studies will be apparent in our current surface painting and future embedded contexts.

Usability

Collaboration is key in many creative environments and the lighting team from UBC in particular stressed the importance of the collaborative web based interface, stating this was a necessity for workshopping and eventually recording their own production ready motion textures. Our professional video effects designer made two important comments on the usability of the tool. First, that the modality of mouse and keyboard interaction is probably not best for control of the affective motion textures. The second comment is a comparison to prior experience using professional effects tools; the tool should provide a higher level interface without losing the expressive range currently available. The theatre producers had some difficulties using the tool specifically in the design process from ideation of affect to low level parameters.

Complexity vs. Simplicity

While the low level parameters are interesting and desirable, there is a steep learning curve in understanding exactly what a control is going to do and how much visual change will occur. With a myriad of settings, the target affective motion texture a user wishes to create can often take plenty of tweaking many settings individually. This is where our on-going research creating a palette of affective motion brushes will be important in moving forward. We do not wish to remove these low level controls, but rather augment the ideation process with higher-level affective parameters that will steer the underlying parameters.

All of these studies clearly point to a desire to have an expressive palette of brushes to paint affective motion textures on a number of varying media sources. Moving forward

Technical Challenges

Several architectures were piloted for the development of this toolkit and decisions were based on the following criteria as outlined by our previous work with motion designers. The tool must run at 60 Hz in full 1080p (1920x1080 pixels) so that it may be used in either a real-time context or for real-time ideation of motion brushes to be rendered and included as assets in existing workflows.

The amount of brushlets needed to create an overall texture of motion while still retaining the visual semblance of a surface is well over five thousand or more for our target resolution of 1080p depending on the detail of the subject painted and other brushlet parameters such as trail and opacity. Using video surfaces requires over ten or twenty thousand brushlets depending on the amount of detail in the video and the visual frame difference speed of a sequence.

There is an OpenGL issue with low opacity drawing that result in a burnt in layer of the colour on the texture surface being drawn to. Various techniques have been tried to alleviate this issue; however without breaking our real-time constraint there is currently no resolution.

Conclusions and Future work

Motion based affect is well established as a rich communicative medium situated in a dense design space with areas largely unexplored. The affect of motion perceived by articulated figures and human body movement has been explored heavily by past researchers. In contrast, the research space of pure motion-based affect with simple geometric figures and more abstract representations has moved comparatively slowly until recent research that has tied these abstract motions to areas of human computer interaction and visualization. Our work explores both an empirical understanding and the development of framework for ambient motion textures either in the abstract or applied contexts. We are interested in the potential of motion texture to imbue environments, media and performances with subtle overtones of affect. Based on an evolving and iterative series of empirical and design studies, we are pursuing two inter-related goals. The first is to deepen our understanding of the expressive capacity and semantic affordances of abstract motion effects. The second is to develop a set of creative tools that provide artists, designers and visualization practitioners means of exploring this expressive modality. These two avenues of approach inform and underpin each other.

We have developed the aMotion toolkit based on previous studies of motion affect, but we have not limited it to the restricted space of options that a controlled study necessarily uses. Instead, we consider it both as a prototypical tool for visual creators (a test bed) and as a blank slate where new insights into affective motion can be gleaned from its use by professionals.

Our on-going experience with professional artists and designers is currently providing rich datasets of motions created by individuals and teams that will be empirically analysed in order to determine critical attributes for more affective brushes. While the aMotion toolkit is founded on empirical studies of motion affect and represents a growing body of research we have only begun to scratch the surface of formalizing the expressive capacity of abstract motion. With the added functionality of saving and categorizing motions according to affect we are setting a course that aligns with the previously stated research objectives.

Additional future work includes the careful examination of a myriad of motion texture shapes in all dimensions not yet studied with respect to a rigorous approach developing understanding of motion properties relating to changes in affect and meaning. The expansion of an empirically grounded set of first principles for affective understanding of motion texture is valuable for all future applications of affective motion.

This work takes place concurrently with an abstract user study of 3-dimensional affective motion textures based in earlier work using the same motion textures in a 2-dimensional space. Our future research will examine emergent affect from behavioural motions consisting of several reactive artificial intelligence algorithms implemented in single and dual populations of brushlet agents. The trajectory of both studies will culminate in the development and application of a palette of affective motion brushes with high level affective parameters to create atmosphere, narrative and communicate nuanced meaning. Applications will be implemented and studied in game environments, visualization, architectural and CAD rendering, immersive performance and theatrical lighting.

Acknowledgments

This research is supported by a grant from the Natural Sciences and Engineering Research Council of Canada and the Canada Council for the Arts.

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