

## ScreenDress: a canvas for the moving image

Jonathan Hamilton

### Abstract

This paper explores the relationship between motion graphics and fashion garments for dance performance. For motion graphics the most important question is: what is the impact of using a non-rectangular canvas, such as that created by the fashion garment worn by a dancer? Previously there were two main approaches to incorporating moving images within a garment worn by a dancer. An often-used solution has been projection onto the moving body. This process could not be restricted to the moving garment and would project into the surrounding environment. Dark backgrounds or black environments were used to reduce the impact of this effect. A traditional approach is green and blue screen chroma keying: creating a garment out of green or blue felt. This required very flat lighting. ScreenDress creates a new approach of chroma keying using a medium weight fabric called 'Chromatte' created by the Reflecmmedia Company. ScreenDress is the first time Chromatte fabric has been used for a fashion garment for performance in conjunction with motion graphics. The process allows us to work with motion graphics entirely within the garment, is background independent and allows full creative control. We also have the ability to harmonise motion graphics and the detail of the fashion garment—from fashion silhouette with motion graphics to fashion garment detail features with partial motion graphics. Through demonstrations of short video footage of prototype work for ScreenDress created at the DAP Lab, the impact of the fashion garment being used as a canvas for the motion graphics will be shown. What type of motion graphics do you produce for a non-rectangular moving silhouette? How do you make a balance between motion graphics and the fashion garment detailing? How do you deal with multiple ScreenDress performers? ScreenDress is created at The DAP Lab (Design for

Keywords:  
motion graphics,  
screendress,  
chroma key

Performance): Lab Director Johannes Birringer. ScreenDress is a collaboration between Jon Hamilton (Motion Graphics), Michèle Danjoux (Fashion Garment Design), and Johannes Birringer (Choreography).



*ScreenDress Chromatte fabric before keying*



*Screen Dress with Kinetic Motion Graphics*



*ScreenDress with harmonised Motion Graphics*



*Early prototype ScreenDress used in a white environment*

## Introduction

ScreenDress is a collaboration between fashion, motion graphics, dance and choreography.

The ScreenDress garment is made out of a material called Chromatte, produced by a company called Reflecmedia. This fabric was traditionally used in the video industry for chroma keying backgrounds, but here we are using it as a garment fabric.

### **Chroma keying**

Chroma keying is the name for a technique where you select a colour in a piece of video footage and extract and remove it from the video, leaving a hole in the footage allowing you to put anything in the layer underneath. This can be other footage, still images or other visual information. The colour to extract could be any colour, but chroma-green or chroma-blue are normally selected, as these specific colours are not present in natural or human colour tones

### **Screendress summary**

The Chromatte fabric works in conjunction with a light-ring consisting of green or blue Light Emitting Diodes (LEDs). The light ring attaches onto a video camera, and the light from the green light ring reacts with the grey Chromatte fabric causing the fabric to glow green.

The fabric has very small lenses applied to its surface during manufacture by means of a dye. These lenses reflect the green light back directly to the camera lens creating a green glowing garment captured within the camera.

The light-ring has a simple controller attached that can vary the brightness and intensity of the light from the light-ring. As a result the amount of green light reflected from the garment into the camera can be controlled.

The Chromatte fabric we use is fairly pliable: it is not as fluid as chiffon but closer to a medium weight calico. The fabric and the dye contained on the surface is susceptible to damage by water but it can be ironed carefully and it can be pleated. It can be stitched and ribbed and eyelets can be incorporated.

Michèle Danjoux has created several garments made using Chromatte material exploring a variety of approaches. The fabric however is very expensive at £230 per metre.

We work with a mobile camera and light-ring with a dancer wearing the garment. The audience have two (simultaneous) views of the performance: one view of the performance on stage from their position in their seat, and secondly the image that the camera sees of the dancer which is projected, usually onto a large screen. In the projected image

the green glowing fabric can then be chroma-keyed out allowing us to insert Motion graphics inside the garment. The audience can then see on screen the garment and dancer combined with motion graphics on screen. These combined elements on screen create ScreenDress.

The projected images are the real performance in which the audience can experience the camera's cropped, framed and otherwise edited view of the events on stage. The camera moves around with the dancer. To the audience the fabric of the garment appears grey. The audience don't actually see the material glowing green unless they are directly in line with the camera.

The intensity or brightness of the light from the light ring can be varied from very subtle and weak to strong and intense by a controller attached to the light-ring. This is controlled by the camera operator. The brighter the light the more intense the key, and the weaker the light the more subtle or partial the key.

### **Chroma keying in use**

A typical example is a weather forecaster standing in front of a blue or green screen giving a weather forecast. On the viewer's television screen it appears the map – or often now an animated sequence – appears behind the forecaster with the clouds and weather elements moving.

Chroma keying is normally intended to cut out a background for a presenter or performer in the foreground. With ScreenDress we are doing the opposite: we are making the garment keyed out and leaving the background intact.

Chromatte is designed to be easily used by people new to video and without the technical expertise previously needed for blue or green screen. Chromatte has been used before as a very basic cape garment, but never within a fashion garment context or fashion garment and dance context. This is the first time according to the manufacturers of the Chromatte fabric, Reflecmedia, that any one has made a fashion garment using Chromatte fabric.

### **Films and chroma keying**

Chroma keying used to be a highly specialised practice only used in films for special sequences. Recently, though, substantial parts of films

have utilised chroma keying, and in some cases the entire film has used it: *Sky Captain and The World of Tomorrow* (2004) starring Jude Law and Gwyneth Paltrow, directed by Kerry Conran, was the first film to use green screen and keying for the entire film, using only virtual sets.

A year later *Sin City* (2005) directed by Frank Miller and Robert Rodriguez became the most famous example of this approach. Both these films were using chroma keying for backgrounds.

### **Reflective materials and garments**

The use of green screen for something other than background, e.g. as a garment, has been used in small amounts in film, most noticeably in *Harry Potter and the Sorcerer's Stone* (2001) directed by Chris Columbus. Chromatte fabric was used for the scene where Harry Potter uses his 'invisibility cape' putting it over his head and hiding inside. This was not truly a garment as it was simply fabric placed over an actor, but it was important as it used the shadows caused by the flow of the fabric rather than just using silhouette.

An earlier attempt at a reflective garment was explored by the production team for the James Bond movie *The World is Not Enough* (1999) starring Pierce Brosnan, and directed by Michael Apted. Motion graphic designer Mark Coleran attempted to make a reflective garment by using adhesive reflective tape to show two figures as if they were being seen by a spy satellite as moving silhouette figures. It was intended that the performers were head to toe covered in reflective scotch tape Scotchlite™ in a very simple body and head suit, but the production team could not get large enough pieces of the tape to complete the body suit. Eventually specialist thermal cameras were used instead to give the spy satellite style footage.

But nobody as yet has actually made a fashion garment from the Chromatte material. The approach we are using is new.

### **Fashion and garment design**

Viktor & Rolf

Fashion designers Viktor & Rolf produced a chroma key collection or the blue collection for their winter 2002/03 range. They were interested in using chroma key technologies to "go beyond clothes" and explore the moving image on a series of garments. They were also celebrating Yves

Klein quoting “long live the immaterial.” The winter 2002/03 range catwalk show had models wearing garments made from chroma key blue fabric with live screens near the runway showing images of nature within the surface of the garments. Here were uses of the virtual garment combined with moving images that only exist on screen.

### **Science research**

Professor Susumu Tachi, Ph.D.

In 2003 scientist Professor Susumu Tachi from Tokyo University developed a coat which makes those who wear it appear invisible: an ‘invisibility coat’ or a type of ‘optical camouflage’. Professor Tachi’s cloak works using a “retro reflective” material by projecting an image onto itself of what is behind the wearer. A computer generates the image that is projected so the viewer sees ‘through’ the cloak, sounding similar to Chromatte but using projection onto the garment rather than using a screen.

### **Motion graphics and the non-rectangular canvas**

One of the initial discoveries of working with the screen dress garment was the impact of working with a non-rectilinear canvas for motion graphics. Traditional format motion graphics designed for a 4x3 or 16x9 rectangular format were not going to be suitable for this screen (i.e. a garment format). Subtle, gentle animations that would work in a rectangular format do not necessarily work on a garment format.—especially when the garment is moving.

We also found early on that very strong graphic images or patterns consisting of strong graphical elements were successful: the work of animator Oskar Fischinger whose work from the 1920s with strong animated graphic pattern has been an influence. We have found repeated graphical units worked especially well, particularly when the Chromatte elements are fragmented within the garment design.

### **Colour and environment**

The second early discovery was that the ScreenDress worked well in both dark and bright or white environments. Initially we were using a white environment – a photo studio with an infinity curve. We found we could start positioning the motion graphics on the garment almost as a textile print designer would approach a piece of cloth.

Other discoveries for motion graphics concern the colour of the motion graphics and their relationship to the background and the environment: a garment colour that contrasts with the background allows the garment to be viewed clearly. When working within a dark background dance environment we need to work with generally lighter coloured motion graphics for the garment to be clearly seen, otherwise the shape of the ScreenDress garment becomes lost. Conversely, in a white environment having contrasting dark elements within the motion graphics will allow the audience to see the structure and shape of the garment fully.



*ScreenDress with kinetic motion graphics*



*Fragmented and single sided motion graphics*

Alternative approaches could have the background and the garment merging. Black background graphics changing to a light tone or colour can result in the garment emerging out from the background, leading us into interesting camouflage territory.

### **Camera movement**

#### Camera and light-ring

In our first initial tests we started positioning the camera on a tripod filming Chromatte fabric on a tailor's dummy, but we soon realised this was going to be too static when we started filming a dancer wearing a Chromatte garment.

Generally we are used to seeing shots on screen supplied from a camera that moves around a set. The use of steadycam and small cranes to give elevation is now the norm in filmed sequences. Recent developments no longer limit these approaches to big budget productions. Now low-

budget film makers are using these methods, as equipment becomes available through the increase in major independent productions using DV and HDV as a format.

We realised we needed movement with the camera. The light ring is designed to be mounted on a static camera on a tripod and connected to a mains supply, and we realised that to be free of mains cables it would be necessary to power the light ring with batteries.

To exploit movement of the camera we are using a hand-held camera and light ring. We have had a battery system designed to run the light ring, allowing us unrestricted movement and complete freedom for the camera operator to move, communicate and interact with the dancer.

Lighting and the light-ring in a dark environment

We have also found that we can be creative with the lighting. We can even work in very low light level conditions and even work with no lights on at all. When the light ring controller is set to its highest setting in an otherwise black set the light ring itself can become the light source for the performance. The ScreenDress garment becomes luminescent creating a subterranean and zero lux or night vision appearance.

If the light ring is close up both the garment and dancers become illuminated. On screen the dancers' features as well as the Chromatte garment are visible. If the light ring is far away from the dancer, all that appears on screen is the garment appearing to move on its own, with no visible figure, just the silhouette of the ScreenDress. The garment becomes a pure moving shape in its own right.

Surface experimentation

We have experimented with overlapping and overlaying fabrics over the Chromatte garment. We have overlaid fabric on top of the garment using chiffons and other semi-transparent fabrics: these worked very successfully from the very first tests. Having a piece of motion graphics on the garment, and having fabric working over the top create the appearance of the motion graphics truly being an integral part of the garment. This is an area for further exploration.

The Chromatte fabric is coated with the light reflecting dye on one side. Motion graphic elements on one side of the fabric and not on its reverse creates the appearance of their being attached to the one side of the



fabric. This really comes into its own during performance, and further enhances the illusion that the motion graphics are attached or embedded inside the garment and fabric.

### **Lighting**

Traditional approaches to chroma key would use felt as a fabric. To get a good strong key, the fabric needed to be very evenly and brightly lit, and the light illuminating the set would generally have to be simple and fairly flat. A common approach would be to have diffused non-directional lighting avoiding shadows. It would be especially important to avoid 'spill' onto the dancers' skin and face. The spill would cause green or blue to reflect from the garment onto the skin areas of the performer. When keying parts of the body this spill would start to key out where parts of the skin had become green, resulting in parts of the body disappearing on screen.

The advantage of our system is that we are lighting independent and can work with strong, harsh, soft or low to very low lighting conditions. Coloured light can also work successfully. Lighting is an area that we should spend time researching further: so far it appears that we may have full control to be creative with lighting and still be able to obtain a good key.

#### Lighting and the garment

We can use lights very harshly and at acute angles to create dramatic shadows on the garment, as a way of making more visible details such as pleats and surface texture details on the garment. We can also use shadows in a film noir or 1930s black and white photographic portrait style, or produce shadows over the performer similar to the photographic portraits by Alexandr Rodchenko's Russian constructivist photography, with strong graphic patterns.

Initially we were exploring the fashion garment as a silhouette, with the motion graphics taking the lead. But we have discovered that we can reduce the intensity of the key and have more of the fashion garment detailing to come through – appearing on screen in harmony with the motion graphics, or the motion graphics taking a more subtle or more minor role.

## **Collaboration and partnerships**

There are currently five team members: dancer, choreographer, camera-operator, fashion designer and motion graphic designer. Each member of the team is integral to the project, and the creative roles are heavily interlinked. In the future we anticipate the need to have additional partners as co-investigators, including lighting designers and set designers.

## **Camera and dancer**

Quite early during initial prototypes we realised that there was an important relationship between the camera, camera person and the dance performer, and this relationship was closer than we originally expected. The camera operator and the camera movement have to follow the performance and be choreographed like the dancer. The camera operator needs to focus on composition and framing, but also to consider the movement of the camera relative to the movement of the dancer.

## **Dancer-camera relationships**

The use of the close-up

One of the other main areas that has arisen through early prototypes is the importance of close-up camera work. Close-ups are really key to making the ScreenDress project work. Close-up allows the motion graphics and garment to become a large image on screen. It is preferable for a non-rectangular canvas to have a large image on-screen. Close-ups can be done with zoom, but it is very difficult to track a moving image using zoom: the dancers frequently move in and out of shot. Therefore being physically close with the camera is the only option for effective close up.

Wide angle close-up gives some good results. It exaggerates perspective as well as the movement of the garment and the dancer, and camera movements are enhanced. Wide angle can give very dynamic shots, especially low down on the floor close to the dancer and looking upwards.

But the main reason for using close-ups is because the Chromatte fabric occupies more of the screen whilst still showing the dancer and rest of the garment, giving a bigger canvas for the motion graphics to work.

Dancer, camera operator and sound

When using close-ups we have found that we can capture the sound of the ScreenDress as it moves. The Chromatte fabric has medium heavyweight properties with a degree of stiffness, which produces a noticeable sound when the garment is moving, and communicates the dancer's and garment's movement.

### **Dancer-camera relationships**

Music: the influence of music on the dancer performance relationship

We have been working with simple soundtracks for the dancer to perform with, and we have also worked without sound. We have found that soundtracks provide important cues for the dancer and camera operator, especially in early unscripted performances. As the music changes the camera person can have an indication of how the dancer will next move. This was important for the early test performances when we had unscripted performances and instinctive responsive approaches to choreography, where the dancer was learning how the garment felt and behaved as the dance performance progressed.

Soundtracks have also been useful in allowing both the camera operator and the dancer to respond to the music and focus on their common combined choreography that responds and reflects the pace and quality of the music, giving a common direction to both collaborators.

Working with more than one dancer

When we use more than one dancer wearing a ScreenDress garment, the camera view becomes a problem. It is difficult to decide what is to be in frame and what is to be outside the frame, in shot or out of shot. This is something we discovered during some of the early prototype workshops.

### **Camera work**

Working with two dancers, the camera operator instinctively tries to incorporate both the dancers in shot at any one time, but this is not always possible or is not always the most effective shot. Using this instinctive methodology the camera operator needs to decide to follow one of the performers.

## **Motion graphics for two dancers**

Making motion graphics for two dancers wearing Chromatte fabric has some interesting issues. In the edit they can either share the motion graphics inside each dancer's garment, or an alternative approach is to create two separate pieces of motion graphics (one for each dancer). The difficulty with this second approach is that as the dancers move within the camera frame in and out of shot, the motion graphics will need to move with them exactly. This has a disadvantage that it means that the motion graphics will need to move physically with the dancer at postproduction stage. To achieve this technically would mean having tracker markers on the dancer and running tracking software to position the motion graphics every time the dancer moves frame by frame. This could not be done live as it is too post-production heavy.

One solution is a hybrid approach using simple motion graphics that change from left to right. For example: having an orange colour on the left side and a blue on the right side of a motion graphics movie, these colours can then change into each other using a gradient. This would work well for two dancers, with one on the left of the screen and one on the right. When they interact with each other in the middle of the screen their colours will mix and make a secondary colour.

## **The camera**

### Camera movement

For the vast majority of cases camera movement needs to be smooth and flowing, although occasionally more aggressive camera movement is appropriate. Control of camera movements can be affected by many different factors, even to the point of wearing the right type of shoes. The cameraperson needs to have footwear with enough grip in order to be able to work smoothly and without slipping. Normal leather shoes can cause the camera operator to slip, and do not necessarily give the right type of support to move smoothly and move from a low position to a high one quickly and smoothly as the dancer moves.

## **Types of camera**

### Weight

The type of camera is important. The most significant characteristic of the camera we use is that it is lightweight, allowing us to make camera

movements that are not possible with larger, heavier cameras. We can hold the camera directly above the camera operator and dancer, then move in one smooth manoeuvre to a very low camera position. A lightweight camera allows us to move smoothly and gracefully.

#### Camera position

We use a lightweight Digital Video (DV) Camera that has a variety of carrying positions. This is particularly useful for smooth transitions from overhead shots to low shots, and for using the carry handle to follow a dancer by moving the camera close to the floor of stage in a steadycam style way. We have a variety of camera viewpoints and movements that we can utilise to integrate with the dance performance.

#### Image quality

It is important that we use a 3-chip DV camera because the image fidelity is three times greater than single-chip DV cameras. Single-chip cameras have one chip (CCD), with the image through the lens being split into three by three filters (red, green and blue). Footage shot using a single-chip camera has very limited potential for manipulation on a computer, as it is split in this way: footage will tend to break up quickly as it is being keyed out or manipulated. A 3-chip camera, instead of having filters has, 3 CCDs (one red, one blue and one green), and consequently this has three times the image quality of a single chip camera. Not only does this give better image fidelity, but it also allows the footage to be keyed out and manipulated and edited using other post production techniques without breaking up, and colour clarity is also better.

The camera we use also has a lens made from a special type of glass that has the ability to see detail in very low light conditions.

#### **Immediate plans for the future: live performance, live motion graphics**

Currently we have a time lag between the filming of the dancer and the keying out and insertion of the motion graphics. The footage is shot on tape and is downloaded onto disk in real time. A twenty-minute performance takes twenty minutes to download, and a five-minute performance takes five minutes to download. The footage is then quickly keyed out on a laptop, the pre-prepared motion graphics are inserted and scaled up or down for each scene, and assembled along the timeline of the dance performance.

## Live mixing

Currently there is a time lag for an audience to see the combined elements of dancer wearing the garment containing motion graphics. It is possible to do all of this live, and it is now less complicated and relatively inexpensive as technology has become more accessible. We will be able to show all the elements combined on screen at the same time as the dance performance. The audience will experience two versions of the performance at the same time. The live dance performance on stage and the virtual dance performance projected on screen combining the choreographed dancer the fashion garment and the motion graphics all combined, mixed and projected live before the audience.

For live mixing the motion graphics would be pre-prepared. The camera filming the dancer would send a live feed through to a Vision Mixer. This can be done with a camera connected with a fixed cable to the mixer, but we prefer to move freely with the dancer and therefore to be wire free by using a wireless video sender: a simple transmitter attached to the camera with a receiver attached to the mixer. A live keyer is attached to the vision mixer, allowing the live footage of the dancer to be keyed out live. Motion graphic sequences and elements can be mixed in straight away to work inside the keyed-out areas of the garment. This would be mixed live and shown live on the projection screen.

We are currently seeking funding to go to this stage. Our partners at Brunel University have put together a significant bid to the Arts Council of England (ACE). Included within the bid is the cost of the hardware to allow us to make the project fully live for an audience. We are awaiting a decision.

## ScreenDress, motion graphics and relationships with VJ-ing

Mixing live graphics and prepared motion graphics onto the ScreenDress garment and projected onto screens simultaneously as the performance is happening is where we start to cross over into different territory – into VJ-ing technologies, which have become increasingly popular in the last ten to fifteen years, and are now becoming the standard in clubs and dance venues. ScreenDress shares a lot of similarities with VJ-ing and is quite closely linked: the screen is the final output, the performance mixed live in front of an audience with the final experience appearing on screen

## Conclusion

With ScreenDress in its current form we have the ability to make short films, exploring the relationship between, dancer, choreography, fashion garment and motion graphics. From the very first few tests, in mid-2006, technically everything worked. There are many themes and subjects to explore and develop through dance performance experiments, and to develop into narrative performances. Some of the themes and subjects to explore are listed below.

Future projects

In early stages of production:

Suna no Onna

ScreenDress will form a part of a performance that choreographer Johannes Birringer, of Brunel University is leading, Suna no Onna. Suna no Onna will have a public premier in September/October 2007. ScreenDress will appear in scenes forming part of the performance alongside other garments designed by Michèle Danjoux from Nottingham Trent University. Suna no Onna will explore some of the capabilities of ScreenDress.

The issue of the relationship between camera and dancer and the role of the camera will be explored within the performance rehearsals and final performance, with questions of:

“What is the role of the camera in the performance”?

“Is the camera part of the performance or not”

“Is the audience to be aware of the camera or not?”

“Should the camera operator be a character in costume in the performance, or dressed in black similar to puppeteers, or a hybrid similar to a narrative assistant as used in many plays?”

We will also be exploring where within a set might the screen be located: inside the set or outside the set?

Within Suna no Onna we will be developing the Live capabilities of ScreenDress, with live motion graphics, and a live audience for the first time.

## Further future developments

### Audience

#### Audience participation

Once we have live capabilities we can explore the relationship between a live audience and performance: we will be able to explore audience participation. Members of the audience could become contributors to the motion graphics inside ScreenDress. The audience could send material to be incorporated into the garment as a dancer is performing. Using their mobile devices they could send text messages send photos and small movies taken with their phones or PDAs, and respond to the performance, again exploiting the real-time possibilities.

#### Audience as choreographer

The audience could even become the choreographer, asking the performer to move in particular ways, influencing the performance with their text messaging, and the dancer interpreting their messages which would also appear on the dress. The motion graphic elements created using the text message content could then be influencing the performance.

Further areas to explore: what will be the impact of exploring the following questions?

- Dancer and camera relationship?
- Sequences where each partner takes the lead?
- Dancer lead, choreography lead, camera lead, lighting lead, motion graphics lead?
- Backgrounds and emerging garment-motion graphic camouflage similar to a chameleon or squid?
- Fabrics overlaid on top of the Chromatte Fabric, semi-transparent overlays, opaque overlays?
- Single-sided motion graphics garment?
- Lighting – strong and harsh – exploiting the details of the garment – in particular Chromatte garment pleating?
- Using lighting to give strong patterned shadows over the top of the performer and garment in a Rodchenko way?
- Exploring visually simple or busy striped or patterned backgrounds?



- Designing motion graphics for more than one dancer/two dancers/multiples/groups of dancers wearing Chromatte?
- Telematic dancers and ScreenDress – dancers in different remote locations/different continents connected via the internet – a dancer in the USA or Japan dancing inside a dancer’s Chromatte garment in the UK?
- Exploration of black and white – filming in black and white, or black and white as the final image. Mixing colour footage with black and white motion graphics inside the colour footage of ScreenDress?
- Exploring the contrasts between background environment lighting and motion graphics inside the garment. High contrast and low contrast?
- Exploring short depth of field close-ups for use as motion graphics?
- Changing focus of filmed motion graphics?
- Exploring the impact of different types of lens – fully wide angle for exaggerating movement on screen or using extreme telephoto for flattening imagery?
- Could the garment show motion graphics representing internal functions of the body or internal thoughts or memories of the wearer?
- Lighting and garment?
- ScreenDress dance performance outside location environment at night, incorporating reflective street signs – will they react with the light ring and key out in the same way?
- Working with other dance environments, e.g. the Luminarium created by Architects of Air, the inflatable coloured sculptural vinyl enclosed dance and audience dance space?

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