Chapter 38

Bi-Manual 3D Painting:
An Interaction Paradigm for Augmented Reality Live Performance

Alexis Clay
ESTIA, Bidart, France

Jean-Christophe Lombardo
INRIA, Sophia Antipolis, France

Nadine Couture
LaBRI/ESTIA, Bidart, France

Julien Conan
ESTIA, Bidart, France

ABSTRACT

The rise of gestural interaction led artists to produce shows or installations based on this paradigm. The authors present the first stages of the “Sculpture Numérique” (Virtual Sculpture) project. This project was born from a collaboration with dancers. Its goal is to propose bi-manual interactions in a large augmented space, giving dancers the possibility to generate and manipulate virtual elements on stage using their hands. The first set of interactions presented in this chapter is 3D painting, where the user can generate 3D virtual matter from his hands. The movement of the hand defines a stroke, and shape is controlled by the shape of the hand. Changing the shape and orientation of the hand allows switching between three interaction modes to produce volumes, surfaces, or curves in space. The authors explore the applicative case of dance, with the goal of producing a plastic creation from choreography.

INTRODUCTION

The CARE project (Cultural Experience: Augmented Reality and Emotions), which ended in March 2011, aimed at setting up several design tools, interaction techniques and devices to augment a cultural event with emotions. With augmented ballet as one application case, our goal was to augment a ballet performance and to make a dancer interact with virtual elements on stage. This project ended in a staged demonstration that took the form of an augmented show, entitled “CARE: staging of a research project”.

The Virtual Sculpture project is in the continuity of the CARE project. Our goal is to give the dancer the ability to create 3D objects and shapes...
Bi-Manual 3D Painting

on stage. Those 3D elements should be visible by the audience. Our goal was hence twofold. First, we designed interactions to create 3D objects. As dance is our applicative case, we focused on body interaction and especially hand-based interaction. Natural interactions is much more understood by the audience and let a vast and free field of investigation for choreographers and dancers; enabling a technology better integration in the artistic proposal. As such, we focused on very direct interaction techniques. Second, we developed two prototypes, one in an immersive environment for training purposes and another one for a live show context.

In this chapter we describe the work achieved during the first interaction set up, part of the Virtual Sculpture project: 3D Painting, which provides matter creation from hands in a large space. That is how the user is capable of generating surfaces or volumes in a 3D space, which section is defined by his hand conformation, and which longitudinal draw is defined by his hand movement. Metaphor is direct: virtual matter seems to be generated right under the artist hand and stay fixed in space. Starting from there, space becomes a blank support where you can paint. Although we designed this interaction keeping our applicative case in mind, the metaphor uses natural aspects which makes this interaction extensible to other fields.

After a short state of the art, we describe the three interactions we suggest. Then we describe two prototypes creating 3D Painting, applying different technologies. Finally, we will discuss about future works before concluding.

STATE OF THE ART

The goal of our system is to allow the user to draw directly in a 3D space. We do not seek, however, to provide with some kind of modeling tool (like 3dsMax). Rather, we seek to give the user the ability to sketch in space. Several techniques already exist to draw directly in a 3D immersive environment. Deisinger et al. led a CAVE experimentation (CAVE Automatic Virtual Environment) on several modeling systems calling three different techniques (Deisinger, Blach, Wesche, Breining & Simon, 2000). The first one is matter creation by “substance” injection on a given point. In this approach, the artist adds volume to matter, and his movement creates the shape. In the same manner, the BLUISculpt system (Keefe, Feliz, Moscovitch, Laidlaw & LaViola, 2001) divides space into voxels, which the artist can paint. The second approach is surface generation. In the system being tested in (Deisinger, Blach, Wesche, Breining & Simon, 2000) the artist defines a flat polygon by points in space, and successively attaches created polygons to his sketch. Finally, the third technique, used by the third system in (Deisinger, Blach, Wesche, Breining & Simon, 2000) uses automatic surfaces generation from directives curves being drawn by the artist. This principle has been taken back from the FreeDrawer (Wesche & Seidel, 2001) system where the user traces B-splines in 3D space; lines defining a closed loop can be fulfilled with surfaces. Deisinger et al. noticed several recommendations for designing an immersive sketching tool from their experimentations. An ideal sketching tool should:

1. Be a conceptual phase tool towards a certain elaboration degree,
2. Hide its mathematical complexity,
3. Provides a real time and direct interaction,
4. Allow large scale and volume modeling, and
5. Be intuitive.

In this work we took a more artistic approach that led us to focus on the three last points. In particular, we inspired ourselves from two systems from the literature. Schkolne et al.’s SurfaceDrawing (Schkolne, Pruett & Schröder, 2001) allows the user to generate 3D surfaces directly from his hands, using data gloves. 3D display of the generated surfaces is performed by the responsive workbench, a horizontal screen able to track the