Frontiers of Mechanical Engineering and Materials Engineering III

Part 2

Edited by
Wen-Pei Sung and Jimmy (C.M.) Kao

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Frontiers of Mechanical Engineering and Materials Engineering III

PART 2

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(MEME 2014),
November 21-23, 2014, Xiamen, China

Edited by

Wen-Pei Sung and Jimmy (C.M.) Kao

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Preface

2014 the 3rd International Conference on Frontiers of Mechanical Engineering and Materials Engineering (MEME 2014) will be held in Xiamen, China during November 21-23, 2014. The aim is to provide a platform for researchers, engineers, academicians as well as industrial professionals from all over the world to present their research results and development activities in Mechanical Engineering, Materials Engineering and Control Engineering.

In this conference, we received more than 600 submissions from email and electronic submission system, which were reviewed by international experts, and about 227 papers have been selected for presentation, representing 10 national and international organizations. I think that MEME2014 will be the most comprehensive Conference focused on the Mechanical Engineering, Materials Engineering and Control Engineering. The conference will promote the development of Mechanical Engineering, Materials Engineering and Control Engineering, strengthening the international academic cooperation and communications, and exchanging research ideas.

We would like to thank the conference chairs, organization staff, the authors and the members of International Technological Committees for their hard work. Thanks are also given to Trans Tech Publications.

We hope that MEME 2014 will be successful and enjoyable to all participants. We look forward to seeing all of you next year at the MEME 2015.

November, 2014

Wen-Pei Sung
National Chin-Yi University of Technology
Jimmy (C.M.) Kao
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The Creative Application of Halftone Technology

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Keywords: Halftone, Stippling, Image processing, digital control

Abstract. This paper has designed several creative application of Halftone stippling for the convenience of digital processing. It processes images to gain stippling images with different effects by using AM and FM; it also produces 3D Halftone art based on pits effect and raised effect of Relief; Besides, the paper also analyzes the processing method of stippling with paper-cutting effect and the center point's homogenization treatment with Voronoi diagram. With easy and simple processing, the methods proposed in this paper can be used widely in such areas as landscape, wall decoration, product design, toy design and so on.

1. Intorduction

The technology Halftone has been used for more than a century in the field of printing. Even in the field of digital output devices, it has been applied for more than 40 years and is now more widely used. The name Halftone is given compared with continuous tone, which refers to all the methods that can convert the continuous tone images to physical binary representation.

Digital Halftone is a kind of technique based on human visual properties and image coloring features, which reproduces the images on binary and multicolor binary coloring equipment with the use of mathematics and computer. Digital Halftone relies on the low-pass characteristics of human eyes, which means that those close parts in the space of the images will be seen as a whole by the human eye at a certain distance. With this characteristic, the partial average greyscale of Halftone images is similar to the partial average greyscale value of the original images by the human eye, thus generating the effect of continuous tone on the whole.

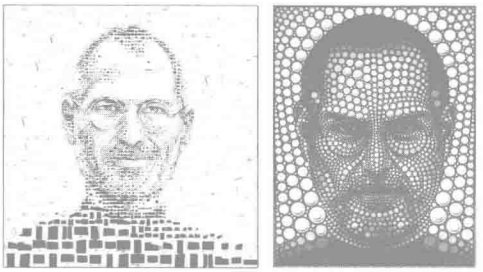
In order to simulate the visual experience of continuous tone imagery, Halftone generally will simulate changes in light and shadethrough the use of dots, varying either in size, in shape or in spacing. Stippling is a kind of application of Halftone technology.

Stippling is the creation of a pattern simulating varying degrees of solidity or shading with the use of small dots. It might occur in nature and these effects are simulated by lots of artists frequently.

In a drawing or painting, the dots are made of pigment of a single color, applied with a pen or brush; the denser the dots, the darker the apparent shade—or lighter, if the pigment is lighter than the surface. This is similar to—but different from—pointillism, which uses dots of different colors to simulate blended colors.

Images produced by Halftoning or dithering and computer printers operate on similar principles (varying the size and/or spacing of dots on paper), but do so through photographic or digital processes instead of manually. Though newer techniques can help to convert continuous-tone images into patterns that are suitable for printing, stippling may still be artists' first choice because of its simplicity and handmade appearance.

Nowadays, digital artists have created many fantastic halftone works using digital design tools. For example, Greek visual designer Charis Tsevis[1] illustrates Steve Jobs with all of Apple's white products, as is shown in Fig 1, a. Belgium artist Ben Heine[2] also makes Steve Jobs' portrait with flat circles on a black background. In the portrait, every circle has a single tone, a single color and a single size, as is shown in Fig 1, b. These fabulous and creative works are the fruits of the artists' strenuous efforts, which cannot be accomplished by common people. In view of this, we tend to develop applications of Halftone Stippling, helping common users manufacture related decorations easily.



(a) (b)

Fig. 1 Halftone portraits of Steve Jobs

This paper has proposed creative applications of Stippling based on the theories of Halftone along with the effect of relief and artistic paper-cutting. The experiment result shows the obvious decoration effect, which is convenient for the production of relief effect especially for the digital control and processing. It is widely used in real life.

2. Related studies

Halftone technology consists of Amplitude Modulation, Frequency Modulation and Hybrid Modulation. The frequency of AM is stable. AM shows the differences between light and shade with different sizes of stipples in unit area; The size of stipples of FM is stable. FM shows the changes of light and shade by changing the distance between stipples, i.e. changing the frequency; HM uses the stipples of FM in the areas of light and shade in images and the stipples of AM in midtones, thus achieving good effect.

In the field of the application of the art of Halftone, Victor [3] has designed a new image reproduction technique incorporating freely created artistic screen elements for generating halftones. Hung-Kuo Chu[4] applies Halftone to QR code. Stippling is a typical representation of Halftone and relative studies abound. Adrian Secord[5]proposes two non-interactive techniques for generating stippledrawings from grayscale images using weighted centroidal Voronoidiagrams. Stefan Hiller[6] present new efficient methods for stipple drawings by computer. SungYe Kim [7] regard stippling as an artistic style and consider their technique for capturing and reproducing stipple features uniqueto an individual artist. Li[8] presents a new fast, automatic method for structureaware stippling. Michael Balzer[9] put forward a new general-purpose method for optimizing existingpoint sets, whose resulting distributions possess high-quality bluenoise characteristics and adapt precisely to given density functions.

Raanan [10] proposes a new approach for generating point setswith high-quality blue noise properties that formulates the problem using a statistical mechanics interacting particle model. Xu [11] present an algorithm to efficiently generatethe sample point distributions possessing blue noise spectral characteristics in computergraphics. Fernando[12] present a fast, scalable algorithm to generate high-quality bluenoise point distributions of arbitrary density functions.

3. Stippling Application Based on Relief Effect

Relief, is a sculptural technique. The term relief is from the Latin verb relevo, to raise. To create a sculpture in relief is to give the impression that the sculpted material has been raised above the background plane. What is actually performed when a relief is cut in from a flat surface of stone (relief sculpture) or wood (relief carving) is a lowering of the field, leaving the unsculpted parts seemingly raised. The technique involves considerable chiselling away of the background, which is a time-consuming exercise with little artistic effect if the lowered background is left plain, as is often the case. On the other hand, a relief saves forming the rear of a subject, and is less fragile and more securely fixed than a sculpture in the round, especially one of a standing figure where the ankles are a potential weak point, especially in stone. In other materials such as metal, clay, plaster stucco,

ceramics or papier-mache the form can be just added to or raised up from the background, and monumental bronze reliefs are made by casting.

Producing a two-dimensional stippling painting with three-dimensional relief effect would be widely used in various areas because of its simple modeling and strong decorating effect. The application areas include landscape, decoration of walls and floors, furniture design, product design, etc. The size of stipples of halftone can vary. Stipples can be made into concave holes as well as raised small cylinders. Thanks to the support of bearers, these holes or small cylinders are mutually independent or overlapping.

3.1 Radius changed

The earliest halftone processing is to mark every small unit in images with black circles. The area of black circles is in proportion to the intensity of correspondingarea of the original image. Therefore, the output image is made up of black circles with different sizes. This is AM processing technique of Halftone.

The working unit of output devices of modern graphics is pixel, whose size and shape maintains the same and cannot be separated. Pixel cannot draw areas of different sizes, so that we cannot use the halftone processing mentioned above. However, if we choose from a group of $n \times n$ pixel, we can display only certain number of pixels instead of all the pixels and thus gain different levels of intensity. Different levels of intensity are shown with dots with different radius. The algorithm of the processing is as follows:

1) Divide the output image into several $n \times n$ areas;
2) Average the intensity of every area;
3) Select predefined dots according to different intensity values;
4) Put the selected dots in the center of the area;
5) Gain output image made up of dots of different sizes.

According to the size of the original object and the requirements of level of details, we can control the Halftone effect by choosing the dots' biggest radius. Take Steve Jobs' portrait as an example. Fig 2 shows the Halftone effect of stippling with different radius. The left one is the original image. Dots' radius of the four images becomes smaller from the left side to the right side.

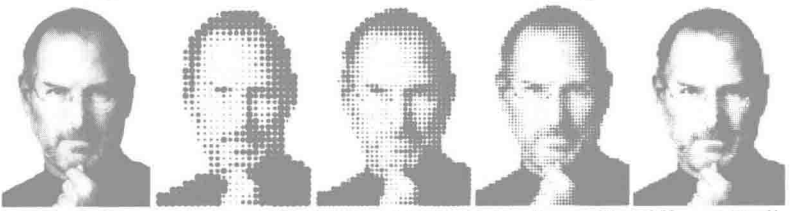


Fig 2 Demonstration of Halftone Effect of Stippling with Different Radius

3.2 Radius unchanged

For the convenience of processing, we can also use dots with the same size for stippling. This is FM technique of Halftone. The core of FM Halftone technique is the distribution of dots, which can be achieved through the dots' dispersed ordered dithering and random dithering, while the latter one gain halftone image of higher quality. Fig 3 shows the halftone effect of stippling with the same size. The left image is the original one and in the right image dots are replaced by small squares. Dots' Radius of the 3 images in the middle becomes smaller from the left side to the right side.

3.3 Processing method

During the processing of Halftone, we record the central position and the size of each dot, which is very convenient for digital processing. We get pits on a flat with CNC drilling machine. We use drills of the same or different sizes to achieve hole effect with changed or unchanged radius. We can also use a cone drill for processing to get tiny conical pits with different sizes, where we need to control the cutting varying depths into the flat.

Fig. 3 Demonstration of Halftone Effect of Stippling with the Same Radius

In addition to the pits effect, we can also produce raised effect. As is shown in Fig. 4, the left image is halftone pits effect, while the right one is halftone cylinder effect. When you look each piece up close, it just looks like an abstract pattern. But when you stand back, you see a fully-formed photographic image. The essence of this art is that it's not just flat, and you can actually feel the texture of each image. This unique new art form is called 3D Halftones. We can also use small cubes to replace small cylinders to accumulate and split to achieve 3D effect according to the specified location, which is suitable for making children's toys.

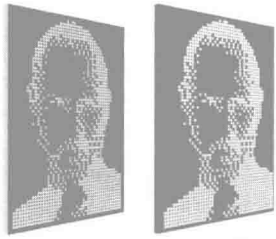


Fig. 4 3D Halftone Effect

Summary

This paper processes images to gain stippling images with different effects by using AM and FM; it also produces 3D Halftone art based on pits effect and raised effect of Relief. The methods proposed in this paper are quite suitable for digital processing and can be used widely in different areas. In the future, we will go on with the application studies on color Halftone by referring to Chromatography of Chinese woodblock new-year prints.

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The bionic anti-adhesion study of the clay on caterpillar surface

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Keyword: caterpillar surface, clay, anti-adhesive, bionic structure

Abstract: With analysis of the phenomenon that clay adsorb to the caterpillar surface, a new idea focused on improvement in the surface topography of caterpillar to decrease adhesion of clay is presented on the basis of inspiration from the biological hydrophobic phenomenon and perspective of bionics. The surface topography with papillary structure of caterpillar surface is designed on the basis of Lotus-leaf-likes surface with analysis of its microstructure in accordance with similarity principle. The new structure could effectively prevent clay from adhering to caterpillar surface. A model of the new structure is also built.

1. Introduction

The caterpillar has been widely used in the heavy vehicles. The surface of caterpillar is often sticking great clay in a humid environment or rain or snow and outdoor. It can affect the normal operation of the vehicles, reduce transportation productivity, and even lead to accidents. Therefore, it is important significance to prevent or mitigate the caterpillar surface adhesion from the clay. This article design a surface structure with convex hull on the caterpillar in view of the phenomenon of self-cleaning surfaces from the leaves and dung beetle head in order to reduce or eliminate the adhesion between the caterpillar surface and the clay and ensure the normal operation of the heavy vehicles.

The clay is generally not adhesive with the caterpillar surface. In this case, it does not affect the normal work of the caterpillar. However, in the wet or snow or outdoor environments, great number of clay powder are adhering to the surface of the caterpillar due to the adsorption of water and the belt surface. It is a key problem of solve the adhesion between clay and caterpillar in humid environment that how to achieve the anti-adhesive performance of the caterpillar surface.

Multiple factors affect the adhesive performance of the caterpillar surface. But, it is an important factor that the material of the caterpillar surface and the surface morphology and the working environment (Aqueous medium, air, soil, etc). Most of the caterpillar surface be machined in adult shaped grooves in order to increase the friction and the guide between the transported material and the surface. However, the caterpillar surface is nearly smooth in the microcosmic. If other conditions remain unchanged, it is just wet that makes the stick and adhesion between the caterpillar surface and the clay. It could be a feasible method to change the caterpillar surface microstructure morphology and reduce adhesion between the clay and the caterpillar.

2. The choice of biological prototype

Hydrophobic surfaces have considerable technological potential for various applications due to their water-repellent properties. A number of studies have been carried out to produce artificially