

# 筆墨夢 —— 數碼水墨畫展

## 引言

水墨畫源於古老的中國，至今已有上千年歷史。中國畫家「神重於形」之繪畫理念，很適宜以毛筆蘸墨於宣紙上表達。「筆墨意趣」乃成東方藝術的一大特色。

我們希望以科技發展水墨藝術。在過去五年，我們致力研究以電腦模擬毛筆與水墨的物理性能，並開發出一套嶄新的數碼水墨繪畫系統。畫家可手執筆型輸入裝置，以操控虛擬毛筆任意揮灑，且可即時看到虛擬墨彩在流動、滲化。是次展覽展示了以此系統製作之畫作，以及我們的模擬技術。望各界人士不吝賜教！

## 繼承·發展·推廣

我們相信傳統筆墨有其可取之處，不應只因其舊便摒棄之。在承傳的同時，我們還應該求新發展。近代水墨畫家積極尋求新手段，以豐富其繪畫詞彙及開拓新創作形式。手段取決於工具和材料。在探索中，有人棄用筆以求新效果，噴、撒、蝕、拓、吹——想得到的著墨方式幾乎也都試過。材料方面也有墨色催化劑、流淌劑等新產品面世，也有人從紙材處努力過。

電腦科技能否為水墨藝術發展另闢新途呢？我們的探索方向是先把一般可由毛筆與水墨在宣紙上做到的效果，透過模擬其物理在電腦上重現出來，然後再透過改變虛擬筆墨之物理來發展新效果，以及突破真媒材在物理上之限制。

在發展藝術語言的同時，我們也希望可憑科技推廣水墨藝術。除了欣賞以外，直接參與創作是推廣的重要一環。我們希望電腦之普及可使世人尤其年青一代，更容易對數碼水墨產生興趣及參與創作。

## 虛擬毛筆

中國書畫著重線的表現，而富有彈性的毛筆則是繪出多變、富節奏感線條的重要工具。若有效模擬毛筆剛柔並濟之特性，則必須考慮其物理。但如要把每一根毛也嚴謹地模擬出來，其運算量是大大超出現今家用電腦之負荷。所以，我們一方面要找出模擬筆毛物理的最有效方法，另一方面也要在仿真度與運算量之間求平衡。

我們用了物理學裡「最省能量」之原理來模擬筆頭如何受力彎曲。如筆鋒要散開，我們把整個筆頭模擬成數束小毛束，每一小毛束則以遮罩之方法做出末端披散的效果。我們可隨意更改虛擬毛筆之大小、彈性、含水量、與紙張之磨擦力等，以求不同的線條。技術詳情可參考以下文章：  
*Real-Time Painting with a Virtual Chinese Brush, IEEE Computer Graphics and Applications, vol. 24, no. 5, 2004.*

## 虛擬墨彩

水墨在宣紙上滲化，能造出流動、擴散、渲染等效果。我們選擇以流體力學裡的晶格波茲曼 (lattice Boltzmann) 方法來模擬水墨在紙纖維中之流動。一般紋理如分流、墨漬邊緣不規則、羽化等我們都可做到，且效果自然。我們也嘗試了加入一些現實難以做到的效果或操控，如用筆來

推在紙纖維中的墨流，和把紙的某些位置變成會浸出水份來的。我們也可以隨意更改紙質來做出不同的滲化效果。模擬技術之詳情可參考以下文章：MoXi: Real-Time Ink Dispersion in Absorbent Paper, *Proceedings of ACM SIGGRAPH 2005*.

## 展望

電腦作為繪畫工具，其長處主要在於模擬出來的媒材之可塑性，但因好的模擬往往需要頗大的運算量，以至目前製作大幅作品還比較困難。還有一個問題就是適合的輸入裝置能否普及。

現在所展出之結果只是一個開始，我們相信前面有待開墾的土地還闊得很，而開墾的過程也充滿挑戰，需要很多人的共同努力。我們希望是次展覽能引起各界人士之注意，並一同參與這方面之發展。

# New Brush and Ink: *an Exhibition of Digital Ink Painting*

## Introduction

For over a thousand years, the Chinese have been painting with brushes and ink on paper. Traditional Chinese aesthetics values the use of rhythmic lines created by deft brush manipulation to describe the painted subject. The use of spreading ink to create abstract shapes and patterns is also characteristic to the Eastern painting style.

In the past five years, we have been researching on computer simulation of this unique art medium. We developed a prototype paint system that allows artists to paint in the spontaneous style of Eastern ink painting digitally. Given a proper input device, an artist can manipulate our virtual brush just like in real life. Our simulated ink also flows like its real-world counterpart. In this exhibition, you will find works created with our system and the disclosure of our simulation techniques. We look forward to seeing you in the exhibition and your valuable comments!

## Further Development

Modern ink painters have been looking for new tools and materials in order to make breakthroughs in painting techniques. Can the computer be a new tool for ink painting? We attempt to answer this by first recreating the effects achievable with the traditional art tools and materials. We then explore the possibility to create new effects by tinkering the simulation.

Computers are becoming more and more powerfully and popular everyday. We therefore also hope that digital ink painting would be more accessible for the world, especially younger generations.

### **Virtual Chinese Brush**

Chinese brushes are designed for making eloquent lines. The key to their expressiveness is the flexibility of the brush bristles. Therefore, our focus is to effectively simulate the bristle physics. Since a strict physics simulation is still prohibitive with today's personal computer, finding a balance between realism and computation load is also important for us.

We apply a *minimal energy principle* recently proposed by physicists to simulate brush bending. The virtual brush can split into multiple tufts, each of which is masked to give a fine splitting effect. It is easy to change the attributes of the virtual brush, such as size, stiffness, and absorbency, for making lines of different quality. For more information on our simulation technique, please refer to the article: Real-Time Painting with a Virtual Chinese Brush, *IEEE Computer Graphics and Applications*, vol. 24, no. 5, 2004.

### **Virtual Chinese Ink**

Eastern ink painting often uses thin and highly absorbent paper, on which ink flows and spreads easily. We choose to simulate the ink flow using the *lattice Boltzmann* method from fluid mechanics. Common ink effects like branching patterns, feathery patterns, and boundary roughening are all possible in our simulation. We have also experimented with several special effects or controls such as pushing the ink with the virtual brush and setting certain parts of the paper as water sources. It is also possible to change paper parameters for different flow effects. More information can be found in the paper: MoXi: Real-Time Ink Dispersion in Absorbent Paper, *Proceedings of ACM SIGGRAPH 2005*.

### **The Next Step**

As a painting tool, the computer has the advantage of being able to create various interesting effects through simulations. This, however, also makes it not easy to produce large artwork because good simulations often require much computational power. Another concern in the development of digital ink painting is whether suitable input device can be made affordable to artists.

The results shown in this exhibition is only a beginning in the development of next-generation computer art tools. Much is still yet to be done. We hope that this exhibition can arouse public interest and draw forces for further development.