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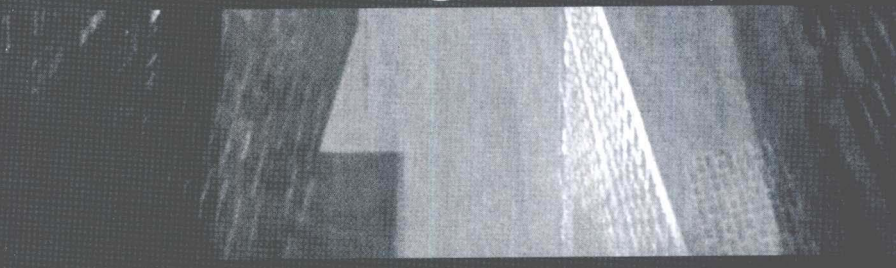
A Computational Approach to Digital Chinese Painting and Calligraphy



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For my parents and grandmother. —S.H. Xu

For Jimmy. —F. Lau

Preface

We are in the age of pervasive computing with computing permeating every facet of our living. In many cases we have access to a plenitude of excessive computing power which we do not know what to do with; the situation was exactly the opposite decades ago when computers were in their infancy. Since we are no longer constrained by computing resources, it is high time that computer science research should attempt to set foot in domains that are hitherto not so much charted. Art or certain forms of art are one such domain.

There is a long trace of efforts by talented artists to try unremittingly to transform the computer into a novel art creation tool, even at times when computers were outrageously expensive, clumsy and had very limited power. This is probably part of the "artist's nature"—to take advantage of anything on earth *for art's sake*. But until recently the limited amount of computing power available to any ordinary person had meant more hindrances than opportunities to the innovative artists who fancied using the computer to do art.

Seeing all the recent technical possibilities and the bilateral (that is, the technologists' and the artists') very strong desire to let the computer have a serious role in art, we feel that computer art will certainly be among the few topics being intensively pursued by many in the very near future as well as for many years to come. This book represents a possible contribution to these efforts.

We cannot wait to say that by committing to this book project we were not setting out, not at all, to try to replace the practice, method, habit and process of traditional art creation. Not at all, as that is already part of human nature, so to speak. Our ambition in our journey to explore digital art is to look for or perhaps fabricate computer-assisted means that can extend the bounds and enrich the experience of art creation, and we hope by so doing we may open up new exciting venues and genres for the aspiring artists, which were not feasible with the traditional approach. This book presents some of the preliminary and original work done by us during the past six years, which was sparked off by this vision.

The first piece of work reported in this book is the design and construction of an electronic hairy brush (e-brush for short) and its associated digital

painting system. As computing is so pervasive, we believe an e-brush could make painting and calligraphy more accessible to more people for more applications. We apply and develop computer science methods and algorithms, especially those falling in the categories of computer graphics and interactive techniques, for the basic e-brush as well as extended features for trying out new artistic effects by the painter that are not possible with a traditional brush. The basic e-brush targets a faithful emulation of the real brush, thus providing artists with a digital replica of their original creative environment, but with lots of added convenience. The success of the e-brush, or any e-brush for that matter, will represent an example of the positive impact technology can have on the practice of art creation. We hope to see more examples in the future of the computer and art being united in yet another innovative way to do art.

Other than serving for a human artist (who is in command) in interactive mode, the computer can produce meaningful artwork all by itself. We demonstrate that possibility by a prototype system for the automatic creation of beautiful calligraphy, and a system to turn Chinese paintings into animation. Taking advantage of some state-of-the-art algorithms and techniques in the field of artificial intelligence, the calligraphy system is bestowed with the ability to computationally appreciate and evaluate the quality of a piece of Chinese calligraphy; the ability also enables the system to produce facsimiles of artistic Chinese calligraphic art, or to synthesize new original ones automatically. The animation system can generate Chinese painting-styled animation of very high visual quality with a minimal amount of user involvement. These systems and their generated samples demonstrate how machine intelligence can be converted into "machine artistry", the manifestation of which may or may not need the participation of the human artist.

The more we engage ourselves in these projects, the more we realize that there in fact exist unlimited opportunities for the computer to influence art (and vice versa too). Unfortunately, relatively very little has been done so far. We hope this little book can bring out the awareness and help set off some keener interest among computer science researchers as well as art folks on the topic of "computational art".

Our work as you can see has a clear bent towards Chinese art forms. In fact the very long Chinese history has nurtured an extremely rich culture and system of Chinese traditional fine arts, which are increasingly becoming more mainstream, or on a par with Western arts, around the globe. We believe getting involved in the creation of Chinese fine arts with a computational approach presents many unique challenges. Just like the interest Chinese cuisine has enjoyed, we hope even more interest and effort will be accorded to the furtherance of Chinese arts, including possibly new ones in digital form. With the excitements of the 2008 Beijing Olympic Games still lingering on, we wish not just the spirit of sports but also that of arts will prevail.

We welcome your suggestions, comments and criticisms from any angle, and let's together make this interdisciplinary area of research as popular as the Louvre!

Target Audiences

This is a technical book on an interesting area in computer science—computer graphics and its application in fine arts. The book focuses on Oriental digital arts, in particular Chinese calligraphy and painting. It offers a multidisciplinary treatment, in particular from the angles of computer graphics, interactive techniques and artificial intelligence. It discusses the unique difficulties and challenges of using the computer to produce Oriental fine arts of paintings and calligraphy. It then presents some successful research results by the authors and the lessons and engineering experiences behind these efforts. The book serves as a good reference for computer science and information engineering researchers interested in this topic. For practicing artists the book offers a fresh view on the emerging medium of e-art. It can also be used as a reference text or supplementary reading material for a graduate course on digital arts and design or related disciplines.

A Quick Tour of the Contents

Part I discusses the general relationship between computer science and fine arts. It dwells on a few fundamental questions like whether the digital computer is indeed a tool well suited for art creation purposes. It then makes a brief survey of the popular forms of digital arts, and discusses why it is technically challenging to pursue digital arts.

We probe into the state-of-the-art research in digital painting and drawing in Part II. We delve into these existent research works and published works because they form the larger context enfolding our computational approach to Chinese painting and calligraphy. Since there is very limited research on digital painting or calligraphy studies, we dedicate the whole part to surveying digital painting work; we concentrate on those automatic approaches that rely heavily on machine intelligence and interactive techniques which are also our main tools in our expedition to explore computational Chinese painting and calligraphy.

In the next three parts (Parts III, IV, V) we expound our first-hand research and development in digital Chinese paintings and calligraphy. They form the main technical bulk of this book. Their contents bear on two broad areas in computer science respectively: computer graphics and interactive techniques being one and artificial intelligence being the other. The organization of the three parts are as follows, from the viewpoint of the "techniques" used:

(1) Part III discusses how to apply *computer graphics and interactive techniques* to implement a software system to support interactive digital painting and calligraphy;
(2) Part IV discusses how to deploy *artificial intelligence* algorithms and methods to automatically generate artistic Chinese calligraphy;

(3) Part V discusses how to use the *combination of computer graphics and interactive techniques and artificial intelligence* to create animations of Chinese paintings.

The three parts can also be considered from the angle of the digital art form(s) being treated:

(1) Part III discusses how to interactively create *Chinese paintings and calligraphy*;
(2) Part IV focuses on the problem of the intelligent generation of *Chinese calligraphy*;
(3) Part V is devoted to the intelligent animation of *Chinese paintings.*

The book concludes with a series of thoughts and perspectives on future work. The book should not really just end there as the list can go on and on. But space is at a premium.

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P.R. China
October 2008

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