



Southern Taiwan University

Ouyang Xun's Genuine Handwriting Restoration from Ancient Rubbings and Vectorized Shape Description

Chun-Tang Chao*, Shing-Yau Chiou, and Chien-Wei Tseng

**Department of Electrical Engineering,
Southern Taiwan University, Tainan, Taiwan, R.O.C.**



Outline

- I. Background
- II. Introduction
- III. Ouyang Xun and His Creations
- IV. Vectorized Shape Description of Handwriting
- V. Modern Image Processing Techniques
- VI. The proposed Matlab GUI-based system
- VII. Conclusions

I. Background (1/3)

Eastern Asian calligraphy

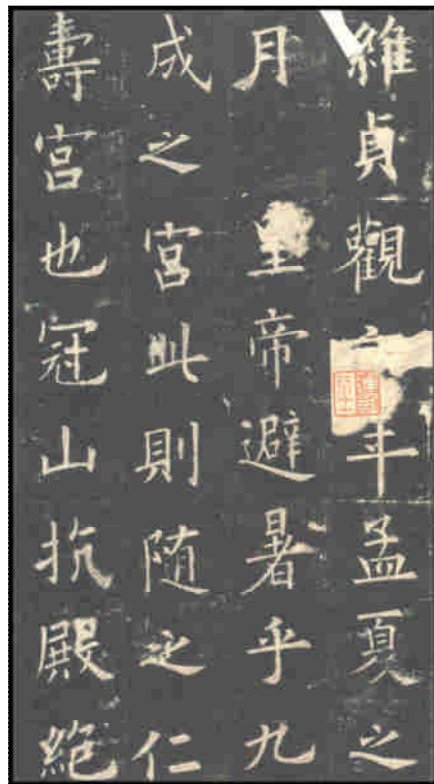
- The word "calligraphy" is transliterated from the Greek words meaning "beautiful writing."
- The art of calligraphy originated and developed from China, specifically the ink and brush writing of Chinese characters.
- Calligraphy is widely practiced and revered in the East Asian civilizations that use or used Chinese characters. These include China, Japan, Korea, and to a lesser extent, Vietnam.



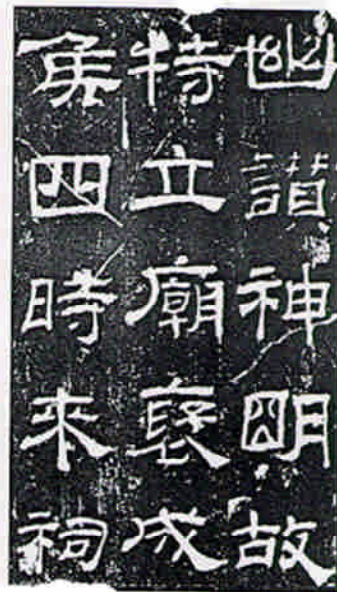
I. Background (2/3)

Major Chinese script styles

Regular



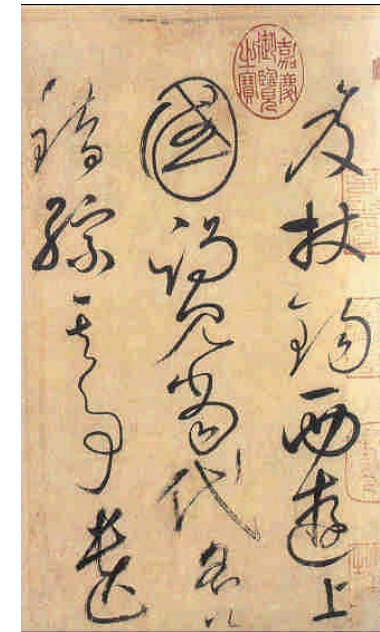
Clerical



Semi-cursive ("running")



Cursive (Grass)



I. Background (3/3)

Major Chinese script styles (cont.)

Regular



Clerical



Semi-cursive
("running")



Cursive
(Grass)



II. Introduction (1/5)

- Main ancient calligrapher of regular script

Yan Zhenqing



Liu Gongquan



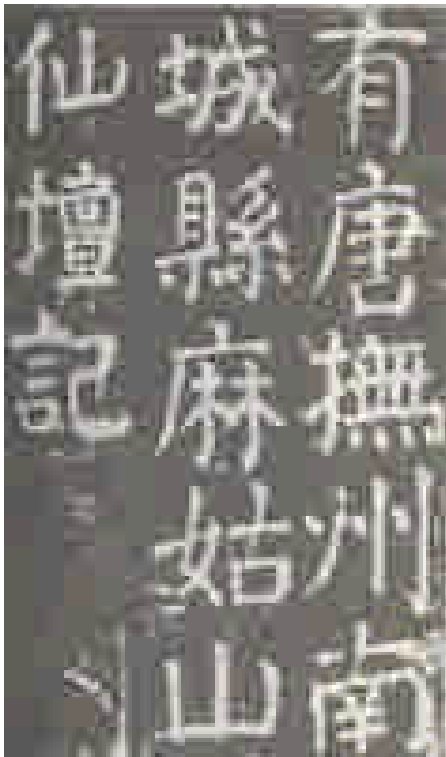
Ouyang Xun



II. Introduction (2/5)

- Some calligraphy documents are imitated by later generations

Calligrapher **Yan Zhenqing**,
(709–785) Tang Dynasty.



Tan Yankai (1880~1930)



II. Introduction (3/5)

- Some current computer fonts

7套Office常用字型

文鼎中楷體

文字傳情之美
文字傳情之美文字傳

文鼎新細體

文字傳情之美
文字傳情之美文字傳

文鼎粗體

文字傳情之美
文字傳情之美文字傳

文鼎君明體

文字傳情之美
文字傳情之美文字傳

文鼎精細體

文字傳情之美
文字傳情之美文字傳

文鼎君明體

文字傳情之美
文字傳情之美文字傳

文鼎中黑體

文字傳情之美
文字傳情之美文字傳

The header features a light green background with a white curved border at the bottom. In the upper left corner, there are three white silhouettes of birds in flight, moving towards the right.

II. Introduction (4/5)

- Some current computer fonts lack the value of calligraphy art

教 教
教 教

II. Introduction (5/5)

- The desired computer font of Ouyang Xun's regular script

| | |
|---|---|
| 散 | 淺 |
| 萬 | 深 |
| 取 | 聚 |

| | |
|---|---|
| 綠 | 沉 |
| 滿 | 浮 |
| 酒 | 如 |

| | |
|---|---|
| 著 | 含 |
| 一 | 蓄 |
| 字 | 不 |

III. Ouyang Xun and His Creations (1/9)

- Ouyang Xun's ancient rubbings in different periods.



Huangfu Dan Bei



*Jiuchenggong
Lichuan Ming*



*Yu Gong gong
Wen Yanbo bei*

III. Ouyang Xun and His Creations (2/9)

- Characters comparison of different periods.

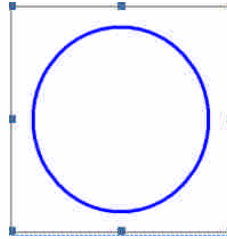


III. Ouyang Xun and His Creations (3/9)

➤ Structure classification of handwriting

- Type 1:

Inseparable type



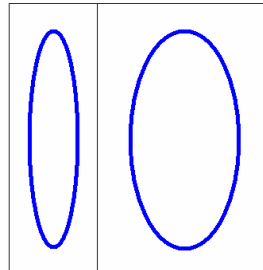
- Type 2: left to Right

➤ 1 : 1

➤ **1 : 2**

➤ 2 : 1

➤ 1:1:1



III. Ouyang Xun and His Creations (4/9)

➤ Structure classification of handwriting (cont.)

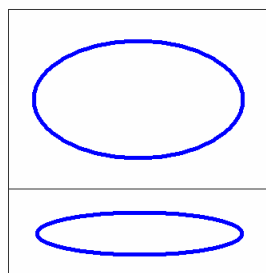
- Type 3: Top to Bottom

- 1 : 1

- 1 : 2

- **2 : 1**

- 1 : 1 : 1

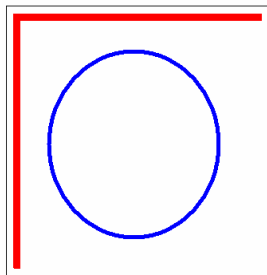


III. Ouyang Xun and His Creations (5/9)

➤ Structure classification of handwriting (cont.)

Type 4: Surrounded

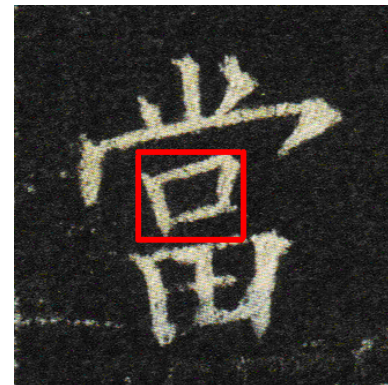
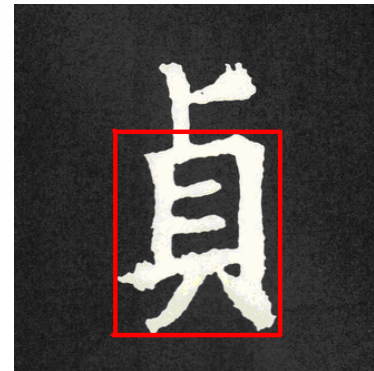
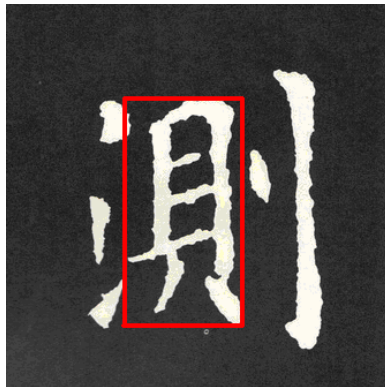
- Totally surrounded
- L-U-R surrounded 、 L-D-R surrounded
- U-L-D surrounded 、 **U-L surrounded**
- L-D surrounded 、 U-R surrounded



III. Ouyang Xun and His Creations (6/9)

➤ Radical Extraction

Some word parts in different structure type have different layout.



III. Ouyang Xun and His Creations (7/9)

➤ Radical Extraction

from 'Wen Yanbo bei'

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 儿 | 夕 | 尸 | 土 | 丶 | 巳 | 冫 | 白 |
| 火 | 示 | 日 | 卯 | 方 | 冫 | 田 | 山 |
| 山 | 四 | 次 | 目 | 宀 | 羽 | 卒 | 日 |
| 小 | 二 | 女 | 艸 | 巾 | 女 | 可 | 昌 |
| 子 | 歹 | 川 | 女 | 少 | 扌 | 木 | 扌 |
| 禾 | 口 | 台 | 彳 | 才 | 令 | 目 | 歹 |

III. Ouyang Xun and His Creations (8/9)

➤ Radical Extraction

from 'Wen Yanbo bei' (cont.)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 𠂇 | 𠂇 | 衤 | 木 | 貝 | 谷 | 半 | 反 |
| 正 | 古 | 文 | 王 | 禾 | 火 | 虫 | 工 |
| 良 | 且 | 糸 | 內 | 己 | 方 | 足 | 卩 |
| 衤 | 言 | 斤 | 卓 | 合 | 石 | 疋 | 食 |
| 馬 | 刀 | 欠 | 米 | 名 | 欠 | 立 | 巾 |
| 彳 | 才 | 丰 | 彳 | 彳 | 彳 | 彳 | 十 |

III. Ouyang Xun and His Creations (9/9)

➤ Character Combination



IV. Vectorized Shape Description of Handwriting (1/4)

- The zigzag phenomenon when a Bitmap image is enlarged



IV. Vectorized Shape Description of Handwriting (2/4)

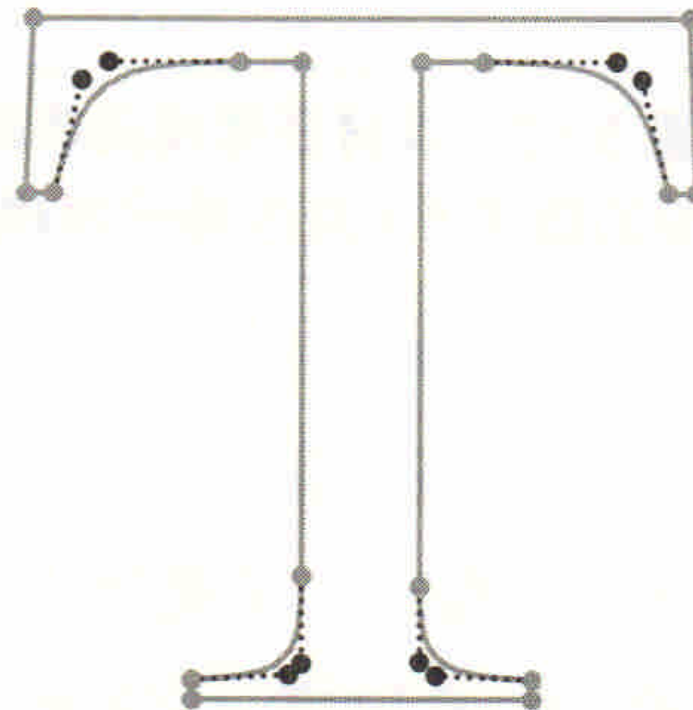
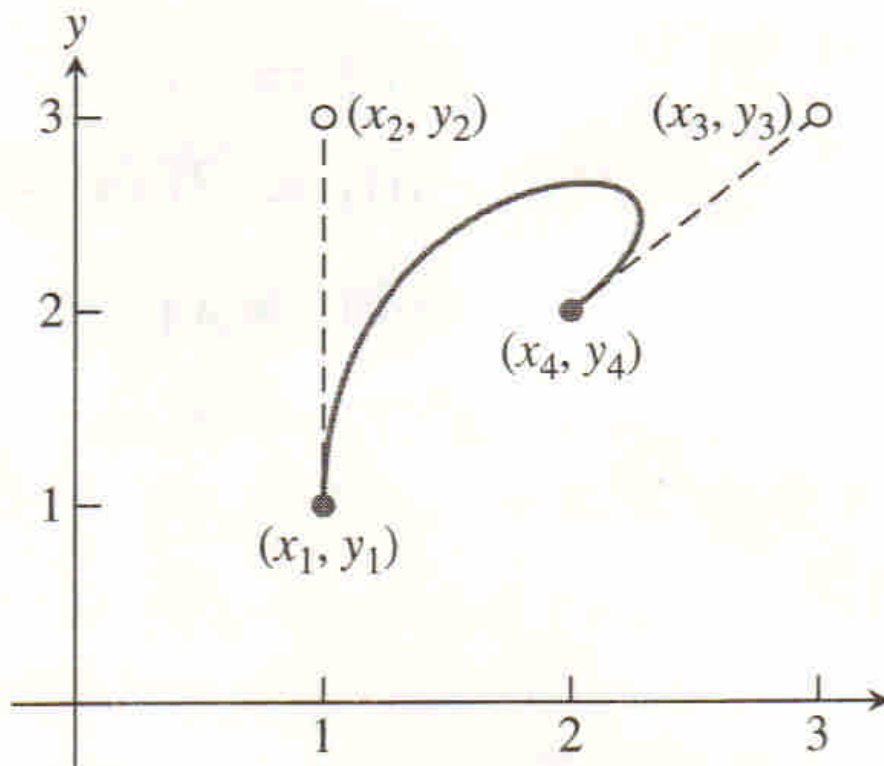
➤ Vectorized image will prevent the zigzag phenomenon

- Handwriting is recorded in mathematic equations
- The handwriting will keep in a smooth condition



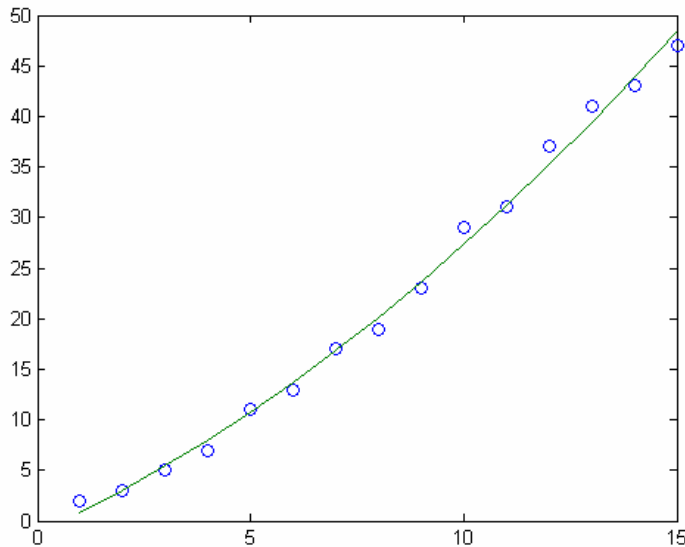
IV. Vectorized Shape Description of Handwriting (3/4)

➤ Bezier Curves

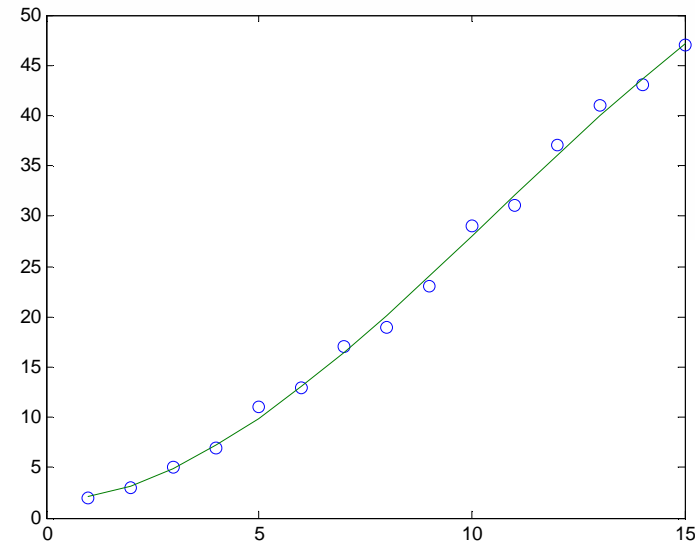


IV. Vectorized Shape Description of Handwriting (4/9)

➤ Polynomial Curve fitting



$$y = p_2x^2 + p_1x + p_0$$



$$y = p_3x^3 + p_2x^2 + p_1x + p_0$$

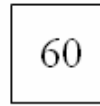
V. Modern Image Processing Techniques (1/2)

➤ Median filtering

| | | |
|----|-----|----|
| 50 | 65 | 52 |
| 63 | 255 | 58 |
| 61 | 60 | 57 |



50 52 57 58



61 63 65 255



60



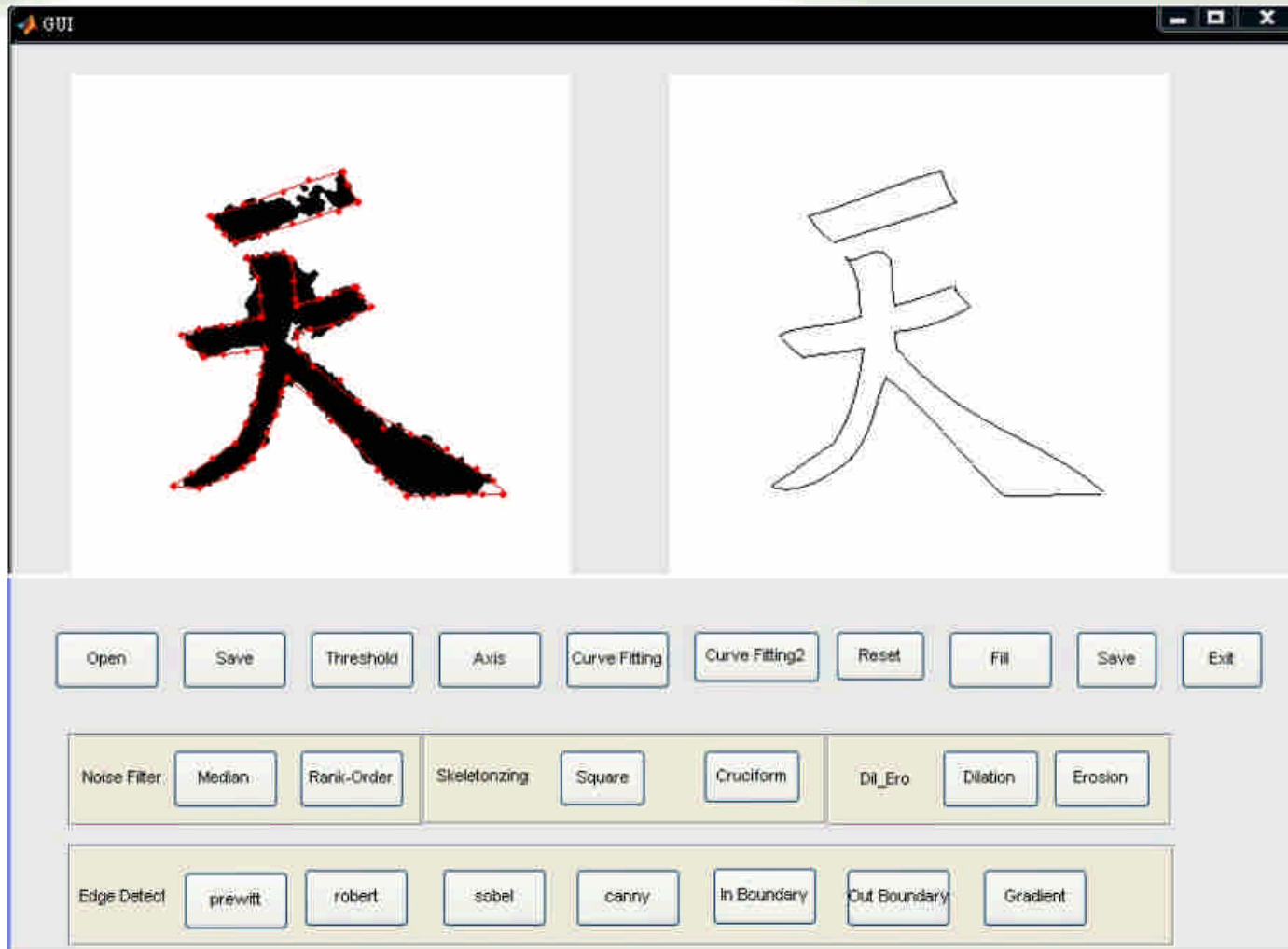
V. Modern Image Processing Techniques (2/5)

➤ Edge Detection

- Canny Method



VI. The proposed Matlab GUI-based system (1/2) -- for restoration and vectorization of Ouyang Xun's Genuine Handwriting



VI. The proposed Matlab GUI-based system (2/2)

➤ The interior file format example

lengthdata : 5 4 5 3

xxdata : 132 147 165 179 198.....

yydata : 107 105 101 95 91.....

5

(132,107) (147,105) (165,101) (179,95) (198,91)

4

(133,107) (135,111) (138,118) (142,124)

⋮

The header features a light green background with a white curved line at the bottom. Three white birds are flying in the upper left corner.

VII. Conclusions

- Computer fonts should improve its value of calligraphy art
- Ancient calligraphers' work should be restored and vectorized by modern techniques
- Structure classification and radical extraction can help the character combination
- A GUI-based system can help experts to finish the above work
- [Video Demo](#)

* A little cultural exchange event

<http://www.zennichishodou.com/cgi-bin//shodou/sitemaker.cgi?mode=page&page=page1&category=0>



Thank you for your attention !

佛所行處國邑丘聚靡不蒙化天下和順日
月清明風雨以時災厲不起國豐民安兵戈
無用崇德興仁務修禮讓國無盜賊無有
怨枉強不凌弱各得其所

一九九一年仲春恭錄大乘無量壽經

淨空

