

# Continuous Circular Scribble Arts

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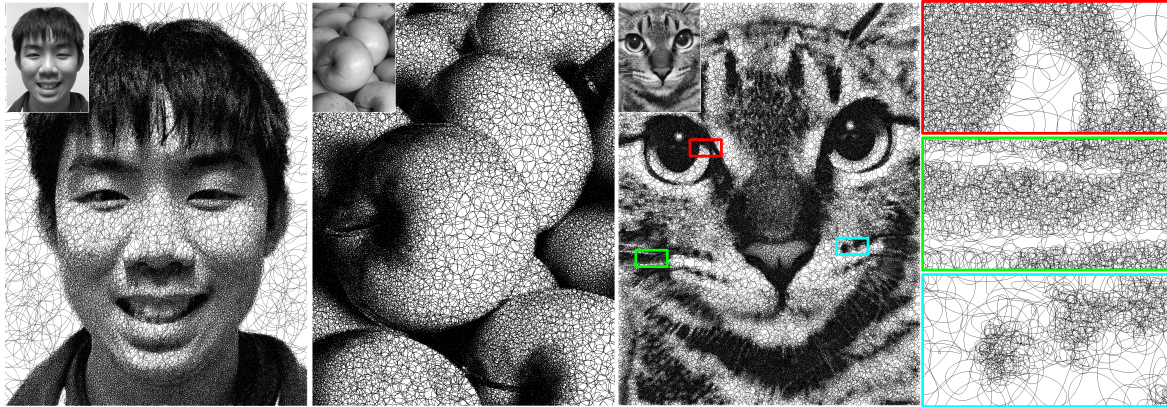
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**Figure 1:** Circular scribble images generated using our approach. Please zoom in properly to see the circular patterns in more details. Image of apples courtesy Dreamstime photographer Jamie Wilson.

## 1 Introduction

Scribble art is a kind of illustrative drawing. Artists use continuous lines to convey the impression of an image or concept of a design. Unlike conventional line drawings such as sketching and hatching that commonly comprise of short and straight line segments, scribble artists aim at depicting the image with long and continuous curves. In this work, we study a typical curve pattern, circular scribble that appears most frequently in the artworks. Circular lines are drawn in either clockwise or counter-clockwise direction with varying radius in the circular scribble arts. The artists delicately trace along a seemingly random path and control the size and orientation of circular line pattern to depict a subject of their artwork. The main challenges lie in producing smooth transition between grayscale levels and preserving dominant image features using continuous loops and intersections of a circular scribble. Thus, the creation of circular scribble art is skill-demanding and time-consuming. In order to facilitate such process, we introduce a systematic approach to automatically synthesize circular scribble arts from images by tracing along a virtual path using solely a single continuous circular scribble with varying radius and orientation. We have tested our approach using a wide range of images and generate visually pleasing circular scribble arts (see Figure 1).

Our work is closely related to the topic of artistic drawing style transformation. A typical approach is base on texture synthesis that learns the scribble patterns as texture patches from existing artworks and synthesize the image by overlapping and stitching the texture patches [Efros and Freeman 2001]. However, their approach will introduce fragmented scribbles instead of continuous loops. TSP art is a similar artwork where a single continuous path is traced to depict the original image [Kaplan and Bosch 2005]. In contrast to TSP art, our approach generates a virtual tracing path that accounts for constrains of preventing the path from crossing image features and self-intersection. A scribble generator is then proposed to synthesize the desired circular scribbles along the virtual tracing path.

## 2 Technical Approach

Our approach is briefly described as follows: The edge map and the grayscale luminance map of an input image are extracted first to help with the determination of sampling points and with the control of circular scribble synthesis. Based on the luminance map, segmentation to the input image is applied. Sample points are then generated for each image segment through the two maps. A local tracing path of each image segment is generated without feature crossing or self-intersection. In order to derive the final tracing path, an energy function minimization is designed to merge every local path into the final one. Finally, the scribble generator is applied to follow the tracing path. The scribble generator is similar to a rolling circle in 3D with its center tracing along a giving 2D path. The behavior is defined as a function of  $C:(r, n, \omega, \nu, cx, cy) \rightarrow (x, y)$  with radius  $r$ , orientation  $n$ , angular velocity  $\omega$ , center velocity  $\nu$ , center of the circle on the 2D tracing path  $(cx, cy)$ , and the generated circular scribble point projected to 2D at  $(x, y)$ . The radius  $r$  and orientation  $n$  are used to control the size and the shape of circular scribble, respectively. The angular velocity  $\omega$  is related to the smoothness of the shape, and the center velocity  $\nu$  is used to manage the drawing density of circular scribbles. By careful control of these parameters, with respect to the edge map and the luminance map of an input image, the circular scribble generator is able to synthesize the desired scribble art. While viewing from a distance, it resembles the grayscale input image. However, looking closely, the formation of continuous circular scribbles can be observed in the zoom-in image. The process is efficient and the quality is similar to the circular scribble artwork with well-preserved features.

## References

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