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THE USE OF RADON TRANSFORMATION AS A SARONG MOTIF

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Abstract: In this paper I will present the use of Radon transformation to design sarong motifs. The sarong is a large piece of cloth sewn at both ends to form a tube. Sarongs are made of a variety of materials: cotton, polyester, or silk. There are various kinds of sarong motifs, namely geometric, non geometric and a combination of geometric and non geometric. The concept of Radon transformation has spread across all fields of science, medicine and geophysics. This paper aims to provide an algorithm for making non-geometric patterns that can be used as sarong motifs. Algorithm consists of base, transformation and coloring. To help readers better understand the algorithm, I will present a computer program using Matlab. I describe an algorithm based on the Radon transformation that can fill a spatial region based on the Radon transformation of a base image with a random sampling area. With this algorithm, we can generate thousands of beautiful variations of patterns, of which I will show some examples.
Keywords : Sarong motif; radon transformation; algorithm; pattern; algorithm;

I. INTRODUCTION

The sarong is a wide piece of cloth that is sewn at both ends to form a tube [1]. In the sense of international clothing, sarong means a wide cloth that is worn around the waist to cover the lower part of the body (waist down). Sarongs are made of a variety of materials: cotton, polyester, or silk. The use of sarong is very wide, for relaxing at home, clothing for working as a farmer to official use such as worship or wedding ceremonies [2,3]. In general, the use of sarongs at related official events as a complement to certain regional clothes.

Like the 'Sari' in India [4], a piece of cloth with a shape that can be worn by both men and women in Asia, the Arabian Peninsula, and the African horn. Sarong is the garment of a seafaring community on the Malay Peninsula near Sumatra and Java (Indonesia). Sarong in Yemen is known as futah, izaar, wazaar or ma'awis. In Oman, the sarong is known as wizaar. The Saudis know him by the name Izaar. A common sarong motif is lines that cross each other (geometric). The philosophical value is that every step either to the right, left, up or down, there will be consequences. In accordance with the development of the era, the motif of the sarong has also changed so that now there are many non-geometric motifs. An example of a sarong motif can be seen in Figure 1.

Radon transformation is an integral transformation which takes the function *f* defined on the plane to be a function *R* (*f*) determined on the line space on that plane, whose value on a particular line is equal to the integral of the function line above that line. The transformation was introduced in 1917 by Johann Radon who also provided the formula for the inverse transformation [5]. Radon transformation can be widely applied to the tomography system, namely the creation of images from projection data related to cross-sectional scanning of an object [6-8].

Mathematically, the Radon transformation $R_\theta(t)$ of the Cartesian function *f* (*x, y*) is expressed as:

$$R_\theta(t) = \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} f(x,y)\delta(x\cos\theta + y\sin\theta - t)\,dx\,dy$$

Figure 1. Example of a sarong motif.
The left is an example of a geometric motif and the right is an example of a non-geometric motif.

This equation can be derived into a computer program (in this case using the Matlab programming language) as shown in the program below:

```
maxn = 1/2 * n;
r = sqrt (maxn ^ 2 + maxn ^ 2);
for line = 1:maxn;
 for column = 1:maxn;
   for i = 1:180;
    amp = sqrt((maxn-raw)^2 + (maxn-col)^2);
    psin = -1*round(amp*cos(i*pi/180+
          atan((maxn-raw)/(maxn-col))));
    t(r+psin,i) = t(r+psin,i)+p(raw,col);
    t(r+psin,181-i) = t(r +psin,181-i)+p(n-raw, col);
    t(r-psin,i) = t(r-psin,i)+p(raw,n-col);
    t(r-psin,181-i) = t(r-psin,181-i)+p(n-raw, n-col);
  end;
```

In the Matlab programming language, there is a Radon transformation function, namely **im2 = radon(im1)** where **im1** is the image of the object to be transformed and **im2** is the transformed sinogram image. The synogram of a point (for example 10,10) can be seen in Figure 2, and the synogram for a complex image can be seen in Figure 3.

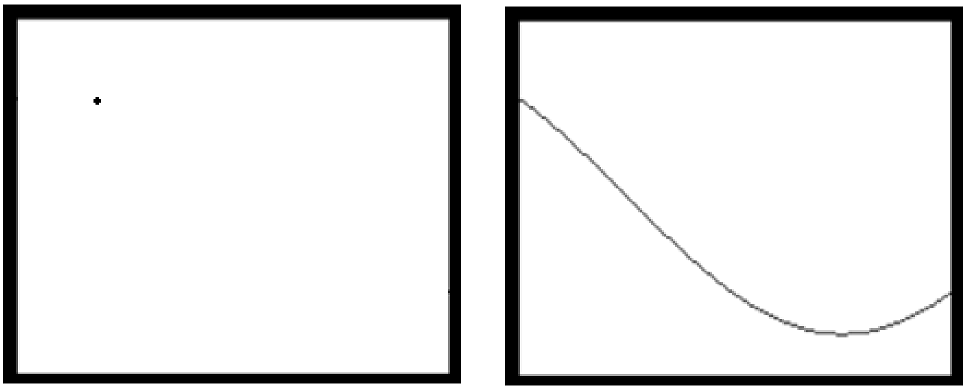

Figure 2. The point object and its sinogram.

From Figure 2 it can be seen that a point (at coordinates 10.10) when perform Radon transformation will produce a sine with an amplitude equal to the distance between the center of the plane and that point. If the object is a complex image, here is a Sheep-Logan phantom, it will produce a sinogram as shown in Figure 3, which in principle is the projection of all object points at an angle of 1 to 360 degrees.

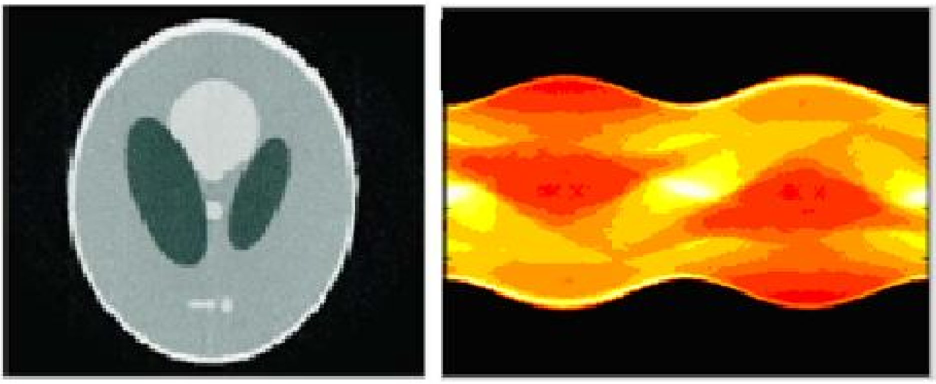

Figure 3. Complex object and its synogram

From these images and some literature on synograms and tomography, it can be concluded that the synogram has beautiful shapes [9-11]. From this background, I was drawn to use the radon transformation as a basis for creating the sarong motif.

II. ALGORITHM

In making a sarong motif based on the Radon transformation, first a base matrix is formed. The base is a simple circular object with high intensity on a black background. For complex motifs, the object can be in the form of two or three circles as shown in Figure 4

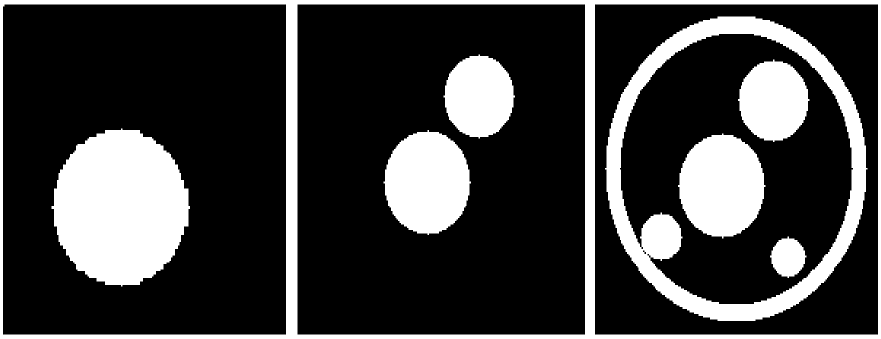

Figure 4. Basic object. The left image is a simple circle object, the middle image is a two-circle object and the rightmost image is a complex object.

After the base is formed, the first Radon transformation is carried out. This first Radon transformation was intended to obtain relatively continuous forms. This is the Matlab code for reading the image of the object and the first Radon transformation:

```
obj = imread ('circle1.bmp');
im = radon (obj, 1: 180);
```

The next step is the second Radon transformation. To get a varied pattern, we do not transform the object completely, but only partially. How much we transform depends on the random value. In this way we will get a different pattern for each execution. This is the matlab code for performing the second Radon transformation:

```
[ix, iy] = size (im);
m = round (rand * ix / 2);
n = round (rand * ix / 2);
for i = 1: n;
  for j = 1: 180;
    im2 (i, j) = im (m + i, j);
  end;
end;
im3 = radon (im2,1: 360);
```

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The most important phase is fill color. In principle, in matlab, we can create a colormap matrix according to our wishes with random Red, Green and Blue components. Black color can be obtained by the combination of RGB = 0.0,0. The brown color is obtained by a combination of RGB = 0.5,0.5,0. The yellow color is obtained by a combination of RGB = 1,1,0. And the white color with the combination RGB = 1,1,1. The green color is obtained by a combination of RGB = 0.1,0. The random number combinations RGB = (Random, Random, 0) can produce reddish, brownish or greenish colors. This is the matlab code for coloring with natural colors.

```
maxkolor = 16;
for i = 1: makskolor;
   kolor (i, 1) = rand;
   kolor (i, 2) = rand;
   kolor (i, 3) = rand;
end;
colormap (kolor)
pcolor (im3);
flat shading;
axis ('square', 'equal', 'off');
```

The last phase is duplicate. The pattern that results from the preceding phase is called a single cell. From that one cell it can be duplicated and then resized into a ribbon which is then added to the top left, top right, bottom left and bottom right. This phase can be done with the program or done manually using an image editor such as 'Paint'

III. RESULTS AND DISCUSSION

In this research, the execution of the programs that have been discussed previously has been carried out. By using random values, each execution produces a different pattern. From this computer program, we can produce thousands of different sarong motifs and varying colors.

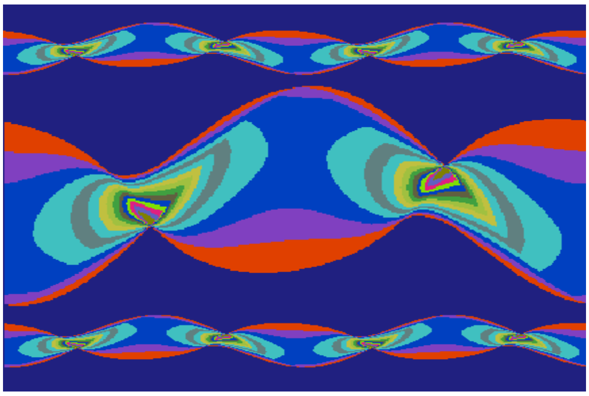

Figure 5. Sarong motif 1.

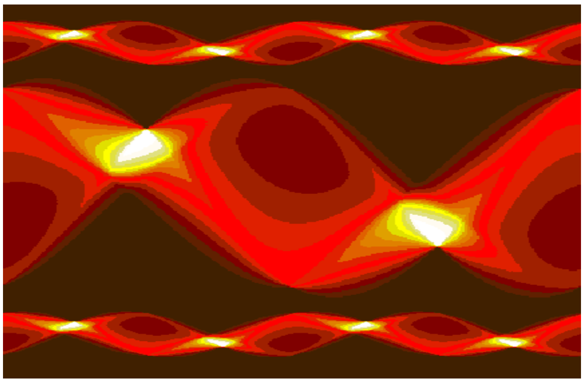

Figure 6. Sarong motif 2.

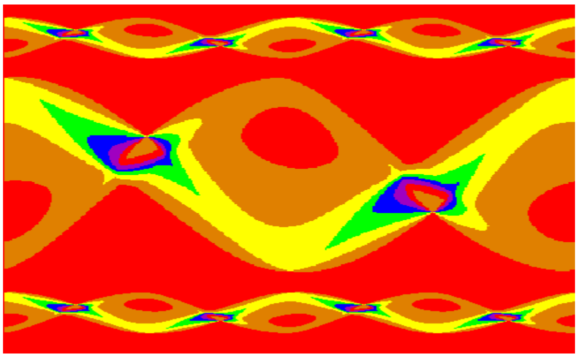

Figure 7. Sarong motif 3.

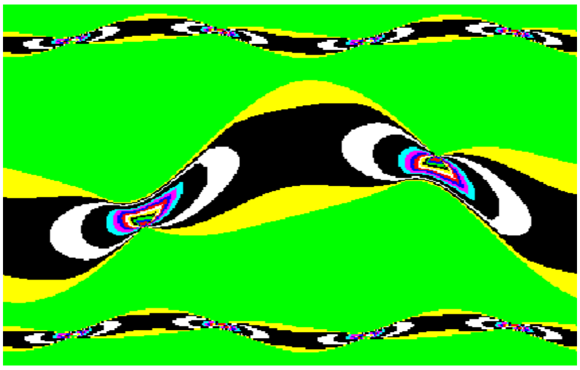

Figure 8. Sarong motif 4.

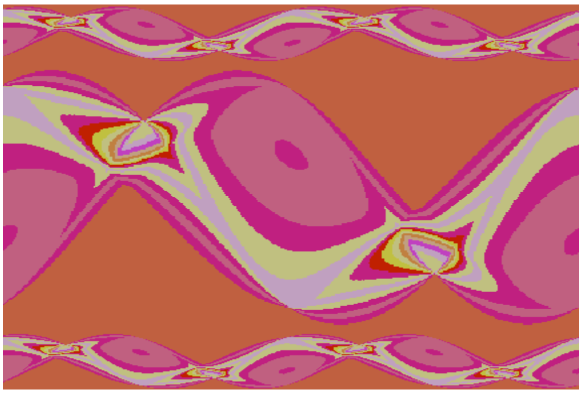

Figure 9. Sarong motif 5.

We just have to selectively select which motives we think are beautiful. The sample of the sarong motif that I produce can be seen in Figure 5, Figure 6, Figure 7, Figure 8 and Figure 9. From Figure 5, Figure 6, Figure 7, Figure 8 and Figure 9, we can get a variety of patterns with various colors. In Figure 5, we get a motif with a natural color. The natural color is obtained from the following coloring algorithm:

```
maxkolor = 32;
for i = 1: makskolor;
   kolor (i, 1) = rand;
   kolor (i, 2) = rand;
   kolor (i, 3) = rand;
end;
colormap (kolor)
```

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In Figure 6, we get a motif with the color 'Hot'. The color "Hot" is obtained by adding the command: Colormap (hot) at the end of the program.

In Figure 7, we get a motif with shades of red, brown, yellow, green, blue and purple called 'Prism'. The color 'Prism' is obtained by adding the command: Colormap (prism) at the end of the program. In Figure 8, we get a motif in black, white, primary colors and secondary colors.
The color is obtained with a Red-Gren-Blue combination with a value of 0 or 1. The random value of 0 or 1 can be obtained using the command: round (rand). Here is the algorithm for getting the coloring:

```
maxkolor = 16;
for i = 1: makskolor;
   kolor (i, 1) = round (rand);
   kolor (i, 2) = round (rand);
   kolor (i, 3) = round (rand);
end;
colormap (kolor)
```

In Figure 9, we get a motif with a predominantly red color. This color is obtained by a combination of Red = 1, Green = random and Blue = random. Here is the algorithm for getting the coloring:

```
maxkolor = 16;
for i = 1: makskolor;
   kolor (i, 1) = 1;
   kolor (i, 2) = round (rand);
   kolor (i, 3) = round (rand);
end;
colormap (kolor)
```

IV. CONCLUSION

Using the Radon transformation, we have the opportunity to automatically discover thousands of beautiful sarong motifs making it a lot of fun. The Radon transformation allows us to better understand non-geometric figures with beautiful structures and various colors. By using the Radon transformation, we can play with unlimited large simulations through digital systems. Thus, gradually we can involve science into art that will make the world a better place.

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