IMAGE PROCESSING FOR EFFICIENT MULTICORE OPTICAL FIBER TRANSMISSION

#**V.N.R.Aruna**[1],Email: arunavutukuri95@gmail.com
#**M.Priyanka** [2]Email: priyankamendi95@gmail.com
#**M.chiranjeevi Akesh**[3],Email:cjaasaki@gmail.com
#**T. Akshaya Kumar**[4],Email: akshaykumart.91@gmail.com
 # Electronics and communication engineering, Lendi institute of engineering and technology, vizianagaram INDIA

In this paper, geometric parameters of the multi core optical fiber are calculated by using the image processing technique. Geometric parameters mainly include the radius of the core through which we can further calculate the losses. A 43 core optical fiber is taken as input and we used MATLAB software to process the sectional view of the multi core fiber, and the algorithm mainly concludes the following steps: pre-processing, image segmentation, edge detection. We used an appropriate threshold value for boundary extraction. We used sobel edge detection operator. We got the relative geometric parameters of the MCF in pixels. We analyzed each result that is the radius of the core and calculated the losses in optical fibre.

KEYWORDS: **Multi core optical Fiber, sobel operator, losses, image processing, MATLAB software.**

---------------------------------------***********************************-------------------------------------

I.INTRODUCTION

Recently, several kinds of homogenous MCFs in which all the cores are identical to each other have been designed and fabricated in order to realize long distance transmission. It have attracted more and more attention. It has been widely used in many fields like light sensors,light detection, optical fiber transmission system. The connection between the fibre will directly impact on the performance of whole system, so it is important to connect the optical fibre without any connection loss. So, therefore it is necessary to understand the geometric parameters of the optical fiber cross section. Traditionally, there have some method to get geometry parameters of fiber cross section, including near-field image method, refractive near-field method, side-looking method. But these measuring methods are complex, and expensivenessof instrument.As it is expensive to measure directly and complexity is more, some of the methods of image processing techniques are used. The methods are image acquisition, image pre-processing, image segmentation, edge detection. We used 43 multi core optical fiber as the object. We applied the edge detection by calculating the threshold value by usingsobel operator. We used geometric fitting to reconstruct the geometric parameters of the fiber cross section. Initially we converted the RGB image into the gray image. Gray image means divided black to white into 256-order according to logarithmic relationship, and corresponding each pixel of the original RGB image to a gray scale. This is done to get accurate result and aims to improve image quality. By using the sobel operator through image recognition technique we can calculate the radius of the multi core optical fiber. And also we calculate the losses of the optical fiber by using appropriate formulae.

II.BLOCK DIAGRAM

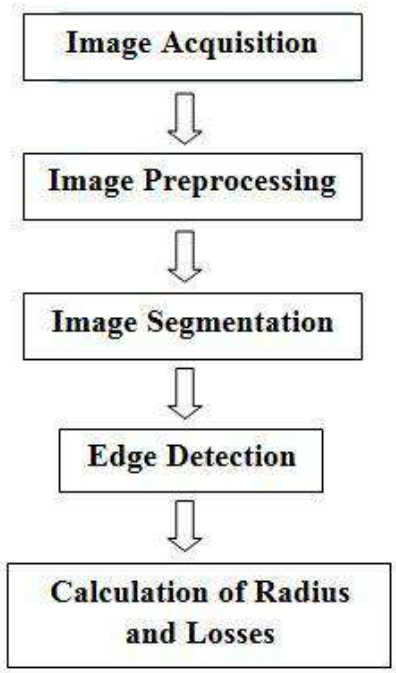


Fig.1. Principle Block Diagram

III.ANALYSIS

The basic block diagram is as shown in the Fig 1. The image acquisition is the first step in which it acquires or obtains the image of document in color, gray level or binary format.The image preprocessing is the second step where the basic enhancements like cropping, filtering, sharpening are made. But we have applied only cropping technique to the input image in this paper. The third step is thesegmentation of the image, it includesbinarization processing which converts the acquired image to binary format. Segmentation subdivides an image into its constituent regions or objects. That is, it partitions an image into distinct regions that are meant to correlate strongly with objects or features of interest in the image. Segmentation can also be regarded as a process of grouping together pixels that have similar attributes. It is to separate the target image from the background and by choosing a suitable threshold 'T'. The key aspect is the selection of the Threshold level 'T'. The image segmentation can be done by the formula shown below.

$$g(x,y) = \begin{cases} 1 & f(x,y) \geq T \\ 0 & f(x,y) < T \end{cases}$$

The important method during the process is edge detection. Edge detection is a fundamental tool for image segmentation. Edges are local changes in the image intensity. Edges typically occur on the boundary between two regions.The major property of the edge detection technique is its ability to extract the exact edge line with good orientation. The image will be smoothened and clear edges are formed by using the sobel operator. It precedes the edges at those points where the gradient is highest. The Sobel technique performs a 2-D spatial gradient quantity on an image and so highlights regions of high spatial frequency that correspond to edges.

Masks used bySobel Operator are given by

-1	0	+1
-2	0	+2
-1	0	+1

G_x

+1	+2	+1

Vol.9 Issue.1 Pages: 09-15
ISSN: 0975-5662, April, 2017 www.ijrct.org

0	0	0
-1	-2	-1

G_y

The X-direction Derivative is given by

$$G_x = (Z_7 + 2Z_8 + Z_9) - (Z_1 + 2Z_2 + Z_3)$$

The Y-direction Derivative is given by

$$G_Y = (Z_3 + 2Z_6 + Z_9) - (Z_1 + 2Z_4 + Z_7)$$

These can then be combined together to find the absolute magnitude of the gradient at each point and the orientation of that gradient. The gradient magnitude is given by

$$|G| = \sqrt{(G_x)^2 + \left(G_y\right)^2}$$

Typically, an approximate magnitude is computed using

$$|G| = |G_x| + \left|G_y\right|$$

which is much faster to compute.

In this detection algorithm threshold selection is very important. If the threshold is too small, it will detect some of the edges formed by the uneven brightness of the image . If the threshold is too large, it can only detect high contract edges, some part of the actual target edge will be lost. Finally we analyze and recognize the extraction image. The change of image gray scale can reflect by the gray gradient distribution. Classical edge detection method is to construct edge detection operator in a small area of the original image pixel. We have many different edge detection operators like canny, sobel, prewitt, log operator, roberts as shown in the figure below. In this paper we are considering the sobel operator to calculate the edge detection and radii values of the multi core optical fiber.

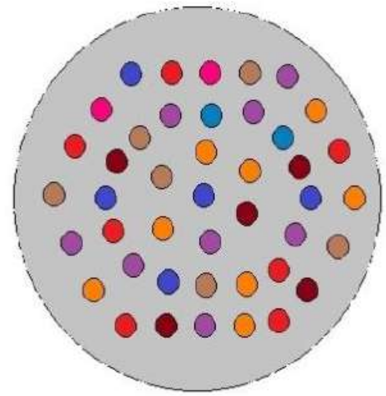


Fig.4.RGB image

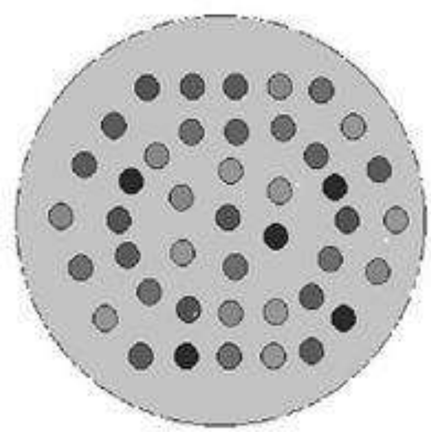


Fig.3. Gray image

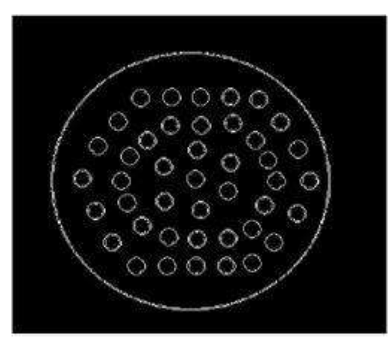


Fig.4. Sobel Image

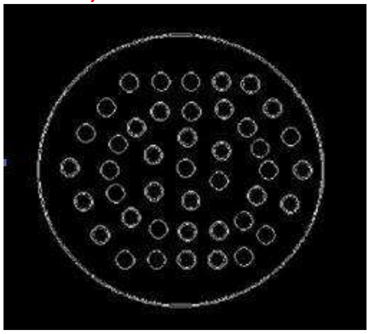


Fig.5. Prewitt Image

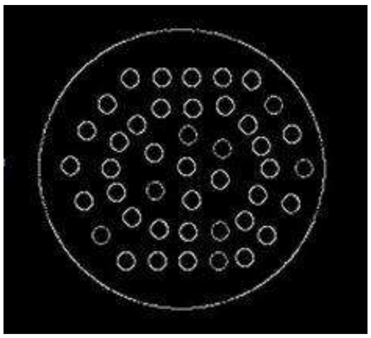


Fig.6. Roberts Image

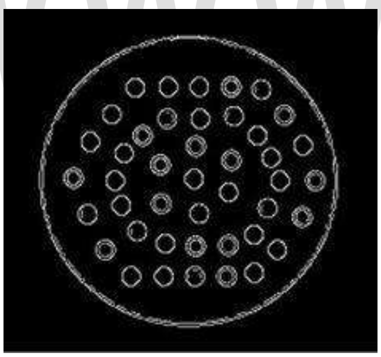


Fig.7. Canny Image

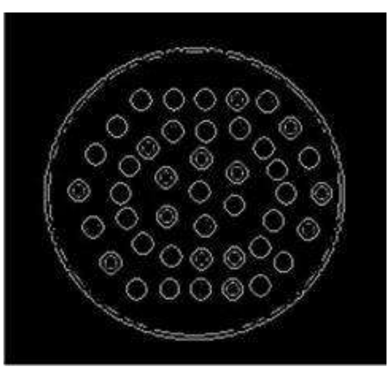


Fig.8. Log Image

IV.IMPLEMENTATION

The histogram is obtained from the gray image which is taken from the original RGB image. The gray scale image ranged from 0 to L-1 and the histogram for the image is as shown in Fig 9. The process involved in image segmentation is to read the gray image in order to get the smooth and clear edges information. Here we used the sobel operator for detection and it detects the circles in the entire image based on the contrast of background image.

The binary gradient mask shows if any lines of high contrast in the image compared to the original imageas shown in the fig 10. These linear gaps will disappear if the sobel image is dilated using linear structuring elements, which we can create with the 'strel' function. And to fill the holes in the circles which we want to find out the radius by using the 'imfill' function as shown in the fig 11. Any objects that are connected to the border of the image can be removed using'imclearborder' function and finally we smoothen the segmented image by eroding the image twice with a diamond structuring element using 'strel' function as shown in the fig 12. To find the radius of the circles in multi core optical fiber segmented image we use the function called 'imfindcircles'. Finally we get the values of the radii and centers of the circles.

When we connect two or more multi core optical fibres, we acquire some losses due to the variations of refractive index in core and cladding. The different type of losses in optical fibre are Fresnal loss, Angular loss, Lateral loss,

Vol.9 Issue.1 Pages: 09-15
ISSN: 0975-5662, April, 2017 www.ijrct.org

Longitudinal loss. In this paper we calculated the Fresnal loss and angular loss by using the formulae as shown below.

$$Fresnalloss, r = \left[\frac{n1 - n}{n1 + n}\right]^2$$

$$Fresnal_{lossindb} = -10\log_{10}(1 - r)$$

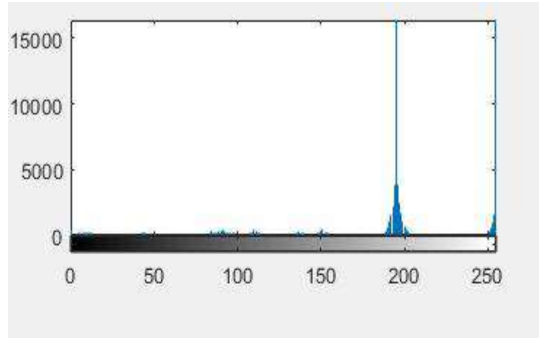
$$n_{ang} = \frac{16\left(\frac{n1}{n}\right)^2}{[1 + \left(\frac{n1}{n}\right)]^4}[1 - \left(\frac{n\theta}{\pi n1\sqrt{2\Delta}}\right)]$$

$$Angular_{lossindb} = -10\log_{10} n_{ang}$$

V. RESULTS AND DISCUSSION

The return parameters of the multi core optical fibre are obtained and some of the relative parameters are shown below. Calculation of the parameters is not unique value, this is because of the influence of the non uniformity geometric parameters of fibre core and other factors, there is a certain error. Also we find losses using the refractive index of air whose value is $1(a_0=1)$. The refractive index of the cladding is less than the refractive index of core. The variation of losses are observed for the different values of refractive index.

Fig.9.Histogram



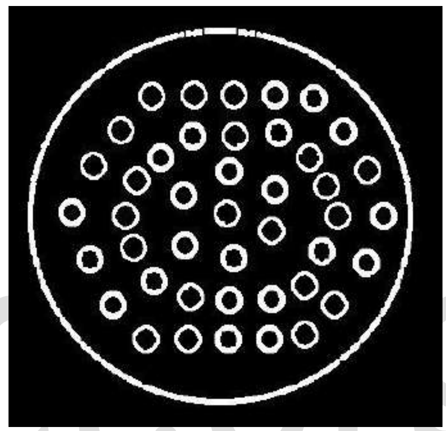


Fig.10.Dilated gradient mask

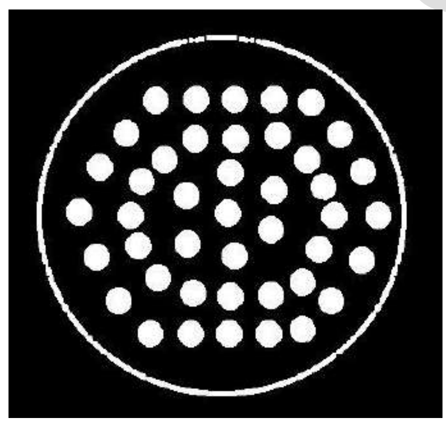


fig.11.Binary image with filled holes

Vol.9 Issue.1 *Pages: 09-15*
ISSN: 0975-5662, April, 2017 www.ijrct.org

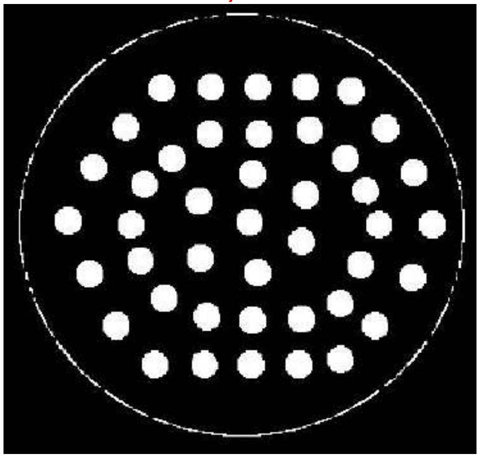


Fig.12.Segmented image

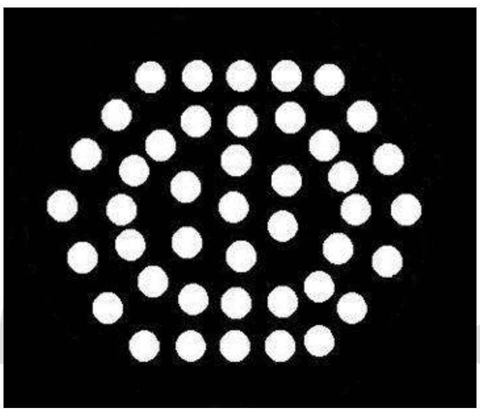


Fig.13.clear bordered image

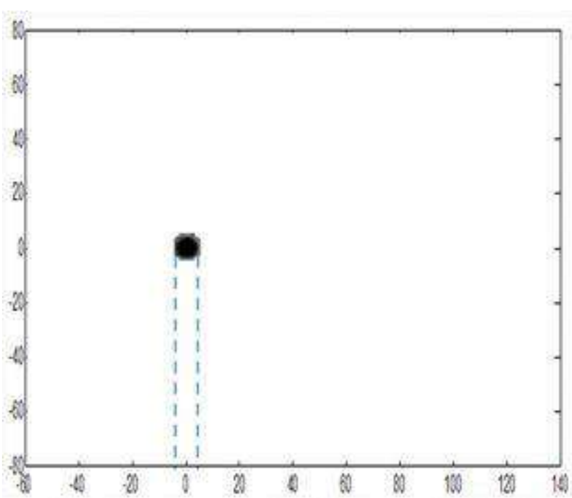


Fig.14. Separation of outline of core

Table 1:

The centers and radii for core are

Center	Radius
(241,17)	4.12
(261,17)	4.35
(307,17)	4.23
(330,17)	4.20
(366,17)	4.17
(275,17)	4.19
(298,17)	4.03
(91,427)	4.84
(459,288)	4.84
(391,229)	4.41
(250,91)	4.90
(144,232)	4.22
(387,311)	4.22
(258,403)	4.47
(379,208)	4.89
(404,221)	4.25

VI. CONCLUSION

We have described the calculation of geometric parameters for the multi core optical fibre by using the image processing techniques in the MATLAB software. In this edge detection process we used five different operators like sobel, canny, prewitt, log operator and roberts. In this paper we consideredsobel operator because it is efficient to detect the edges in the edge detection process. Also it is sufficient as we are working mainly on gray scale images, by which we can avoid other complex techniques. The losses occurred while connecting the two or more optical fibres can be determined by using relative formulae. Through this paper, the flaws in the connections of the multicore fibre can be easily identified and avoided which results in better transmission.

REFERENCES

[1] Chuanbiao Zhang, Tigang Ning, Jing Li Chao Li, Shaoshuo Ma, Image processing method for multicore fiber geometric parameters (2016), Institute of Light wave Technology, Beijing Jiaotong University, Beijing 100044, China.

[2] R.J. Essiambre, Capacity Limits of Fiber-Optic Communication Systems, OFC/NFOEC, 2009.

[3] R. Nagase, How to connect multicore and multimode fibers, OFC 2014 (2014).

[4] J.J. Tu, M. Koshiba, K. Takenaga, S. Matsuo, Design and analysis of largeeffective-area heterogeneous trench-assisted multi-core fiber, Adv. Photon.Congress Opt. Express 14 (2012) 15157–15170.

[5] T.L. Cheng, Z.C. Duan, W.Q. Gao, K. Asano, M.S. Liao, D.H. Deng, T. Suzuki, Y.Ohishi, A novel seven-core multicore tellurite fiber, J. Lightwave Technol. 11(2013) 1793–1796.

[6] Z.L. Ou, Y.Q. Yu, P.Y. Yan, J.S. Wang, Q.D. Huang, X. Chen, C.L. Du, H.F. Wei,Ambient refractive index-independent bending vector sensor based on sevencorephotonic crystal fiber using lateral offset splicing, Opt. Express 20 (2013)23812–23821.