Light source 3-D testing"- Most enabling NDT's Future

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Abstract: Creative and Innovative future in Non Destructive Testing (NDT) can be achieved by improvement in technology that gives better result. The technology that can reduce complex operations in getting result can be a revolution in Non Destructive Testing (NDT). This paper involves an innovative technique that can monitor the 3-dimensional image of the specimen with the cracks terminated on it. The concept that we propose is based on "white light". The known pattern of light (usually white) and sensors (typically CCD cameras) to capture images of the object with the patterns projected on it. In order to capture 3D information, multiple patterns and multiple sensors are used. As multiple sensors are use the known pattern and referencing between image angles to determine the 3D measurements. With observations of scattering rays due to cracks, the cracks are monitored. Our paper also shows the details about the working of this technology and proof that this system works. It would surely be the welcoming technology for better Non Destructive Testing (NDT).

Keywords: **white light, Sensor, Crack Identification**

I. INTRODUCTION

CCD camera (Sensor) is used in 3 dimensional image capture devices. Such devices have number of CCD cameras to observe the dimensions in all x direction, y direction and z direction. This technology is not very widely used in all fields because its application towards other fields is not very high. In our paper we propose such technique with number of CCD cameras arranged and advancement in the light source passing with its improved concentration out of which cracks are monitored.

Betterment in non destructing testing is required as there are various disadvantages in existing techniques. In liquid-penetrate method, it need relative smooth and nonporous surface; in Magnetic particle testing and eddy current testing only selecting material can be tested; for ultrasonic testing and radiography testing good experience is needed for operating it effectively. Where in light source 3-D testing technique there is no addition components added to the object that is to be tested and also accurate results are obtained. Much experience is not needed for operating it effectively.

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II. LIGHT SOURCE 3-D TESTING WORKING

The basic technique is to project a known pattern of light (usually white) and use sensors (typically CCD cameras) to capture images of the object with the patterns projected on it. In order to capture 3D information, multiple patterns and multiple sensors can be used. If multiple sensors are used the software uses the known pattern and referencing between image angles to determine the 3D measurements.

A. Light source:

Power is generated to the light source and it is made to focus on the object. Continuous light is passed for obtaining a perfect 3-dimensional image output with all cracks on its body.

B. Lens:

The Multi-Electrode Driving Liquid Crystal (MeD-LC) Lens can be used as it has the benefits of high focusing ability and realize the projecting the images to different directions to widen the viewing angle.

C. Mirror:

Mirror is set for focusing the light rays from various source and made to fall on the object.

D. Specimen:

The directed light rays fall on the specimen and if there is a crack then the rays that are reflected will be based on the shape of the crack.

E. Sensors:

All these reflected rays that travel on different direction based on the shape of the crack is observed using the number of sensors that are fixed with the focus on the specimen. CCD cameras can be used.

Fig 1: Light source 3-D testing Architecture diagram

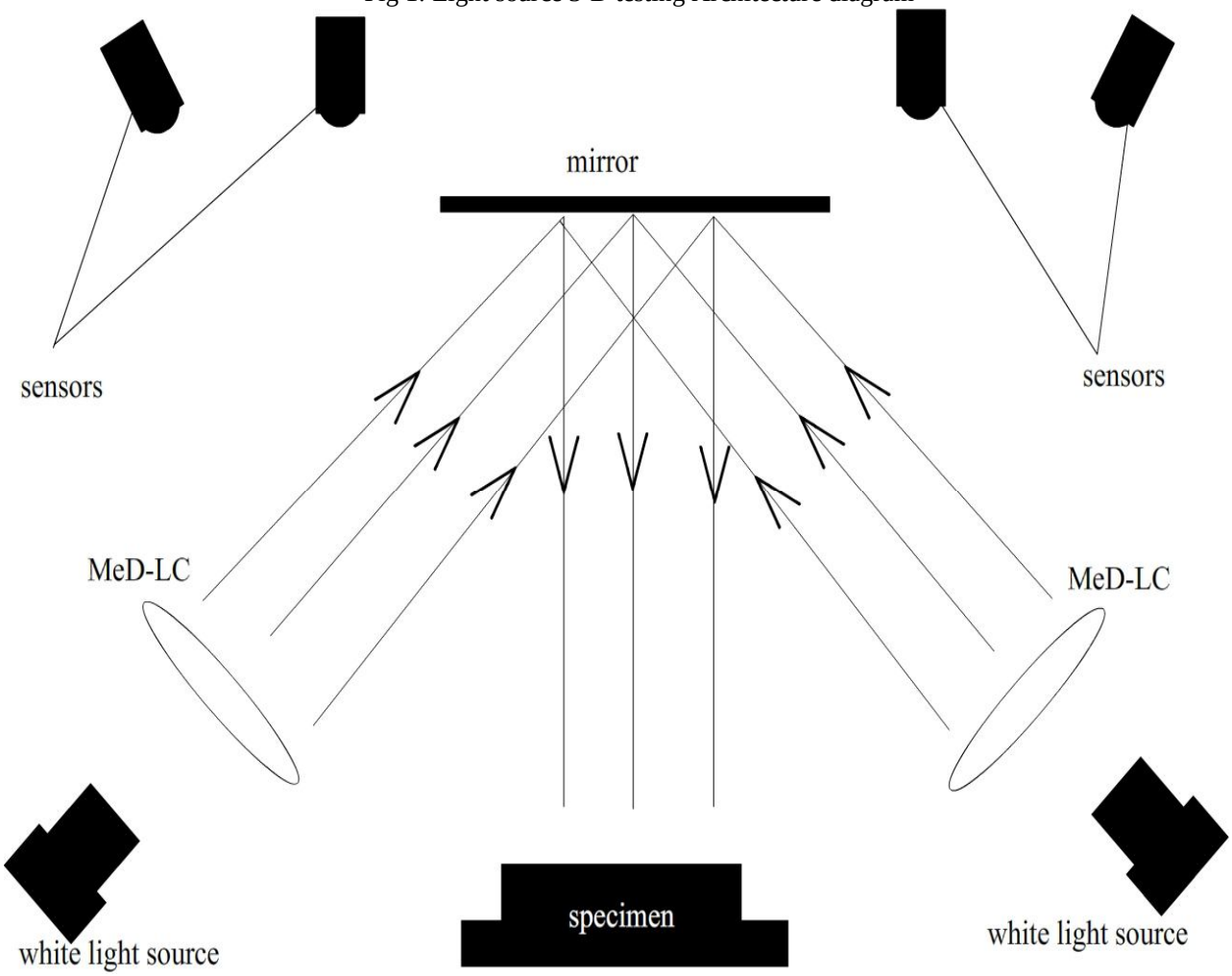
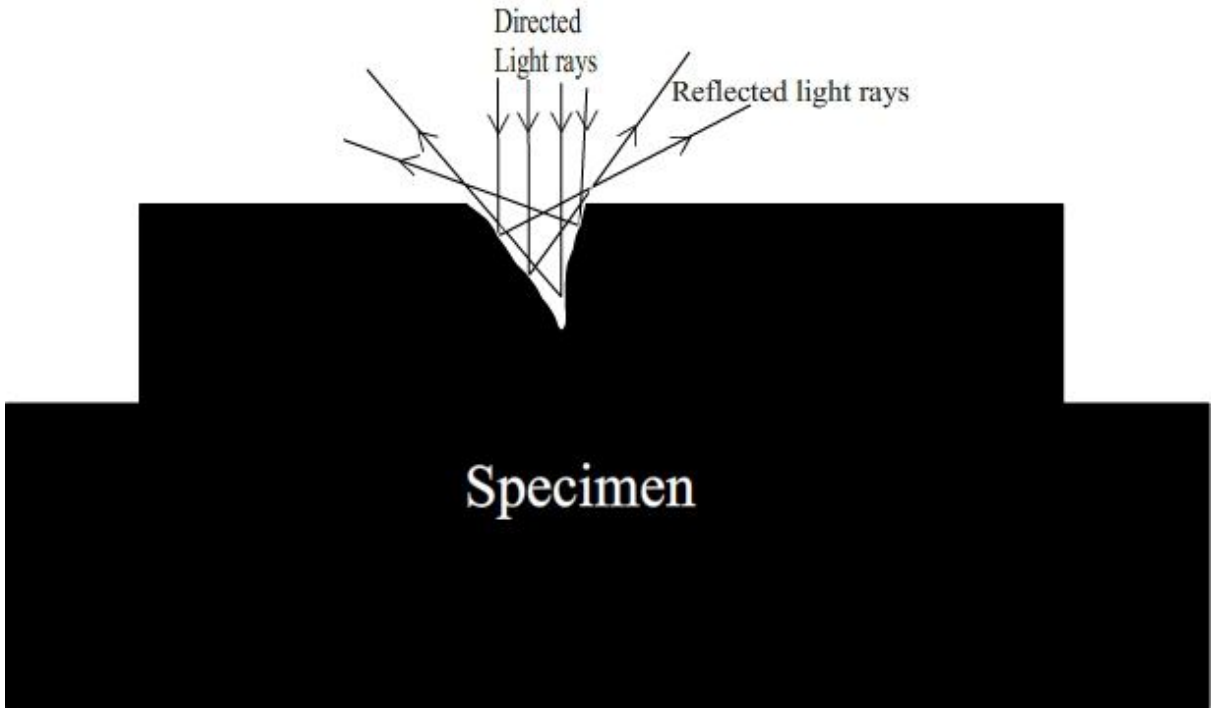


Fig 2: Reflecting of rays due to crack



III. CCD CAMERA OPERATION

In a CCD for capturing images, there is a photoactive region (an epitaxial layer of silicon), and a transmission region made out of a shift register (the CCD, properly speaking).

An image is projected through a lens onto the capacitor array (the photoactive region), causing each capacitor to accumulate an electric charge proportional to the light intensity at that location. A one-dimensional array, used in line-scan cameras, captures a single slice of the image, while a two-dimensional array, used in video and still cameras, captures a two-dimensional picture corresponding to the scene projected onto the focal plane of the sensor. Once the array has been exposed to the image, a control circuit causes each capacitor to transfer its contents to its neighbour (operating as a shift register). The last capacitor in the array dumps its charge into a charge amplifier, which converts the charge into a voltage. By repeating this process, the controlling circuit converts the entire contents of the array in the semiconductor to a sequence of voltages. In a digital device, these voltages are then sampled, digitized, and usually stored in memory; in an analogy device (such as an analogy video camera), they are processed into a continuous analogy signal (e.g. by feeding the output of the charge amplifier into a low-pass filter) which is then processed and fed out to other circuits for transmission, recording, or other processing.

IV. SELECTION OF SENSOR

3D DNR CCD camera
(Item Code: CP-BY60MW-E)
Features:-
1/3" SONY Super HAD II CCD
High Resolution (Colour: 600TV Lines, B/W: 700TV Lines)
True Day & Night (ICR Type)
WDR (Wide Dynamic Range)
3D DNR (Digital Noise Reduction)
Zero Defects
Sense -Up Function(x512)
Eclipse Function
Internal / Line lock Function
DIS (Digital Image Stabilization)
Motion Detection
Digital Zoom (x1 ~x10)
RS485 / PELCO-D
Privacy Mask (Polygonal Mosaic)

I. LENS PROPERTIES

The Multi-Electrode Driving Liquid Crystal (MeD-LC) Lens was utilized to realize the “active scanning film” for projecting the images to different directions to widen the viewing angle. By applying the operating voltage sequentially, MeD-LC lens could not only be switched on/off, but also horizontally moved to “scan” and project images without degrading the resolution. Additionally, the MeD-LC lens had the benefits of high focusing ability and low operation voltage. Consequently, the 3D crosstalk was lower by using MeD LC lens compare to that of conventional LC lens.

V. SUMMARY

Using this technology the exact 3d image of the object with all the cracks on it can be monitored. Based on the number of sensors, the effective result can be obtained. For better observation over the cracks formed, the process can be divided into two. In the first step the crack location can be spotted and in the followed step, that spotted portion can be zoomed and accurate results can be obtained on that portion alone.

VI. CONCLUSION

The technology that can reduce complex operations in getting result can be a revolution in Non Destructive Testing (NDT). Betterment in non destructing testing is required as there are various disadvantages in existing techniques. This would surely be the welcoming technology for better Non Destructive Testing (NDT).

REFERENCES

[1] Katsushi Lkeuchi (28 May–1 June 2001). "Modeling from Reality". 3rd International Conference on 3-D Digital Imaging and Modeling : proceedings, Quebec City, Canada. Los Alamitos, CA: IEEE Computer Society. pp. 117–124. ISBN 0-7695-0984-3.

[2] Raymond A. Morano, Cengizhan Ozturk, Robert Conn, Stephen Dubin, Stanley Zietz, Jonathan Nissanov " Structured Light Using Pseudorandom Codes" IEEE Transactions on Pattern Analysis and Machine Intelligence - TPAMI, vol. 20, no. 3, pp. 322–327, 1998

[3] James R. Janesick (2001). Scientific charge-coupled devices. SPIE Press. p. 4. ISBN 978-0-8194-3698-6.

[4] W. S. Boyle and G. E. Smith (April 1970). "Charge Coupled Semiconductor Devices". Bell Sys. Tech. J. 49 (4): 587–593.

[5] G. F. Amelio, M. F. Tompsett, and G. E. Smith (April 1970). "Experimental Verification of the Charge Coupled Device Concept". Bell Sys. Tech. J. 49 (4): 593–600.

[6] M. F. Tompsett, G. F. Amelio, and G. E. Smith (1 August 1970). "Charge Coupled 8-bit Shift Register". Applied Physics Lettersfrom 17: 111–115. Bibcode:1970ApPhL..17..111T. doi:10.1063/1.1653327

[7] Tompsett, M.F.; Amelio, G.F. ; Bertram, W.J., Jr.; Buckley, R.R.; McNamara, W.J.; Mikkelsen, J.C., Jr.; Sealer, D.A. (November 1971). "Charge-coupled imaging devices: Experimental results". IEEE Transactions on Electron Devices 18 (11): 992–996. doi:10.1109/T-ED.1971.17321. ISSN 0018-9383

[8] Dobbin, Ben. (2005-09-08) Kodak engineer had revolutionary idea: the first digital camera. seattlepi.com. Retrieved on 2011-11-15

[9] Albert J. P. Theuwissen (1995). Solid-State Imaging With Charge-Coupled Devices. Springer. pp. 177–180. ISBN 9780792334569

[10] Daigle, Olivier; Djazovski, Oleg; Laurin, Denis; Doyon, René; Artigau, Étienne (July 2012). Characterization results of EMCCDs for extreme low light imaging
[11] Brians, Paul (2003). Common Errors in English. Franklin, Beedle & Associates. p. 125. ISBN 1-887902-89-9. Retrieved 28 June 2009. Reports "lense" as listed in some dictionaries, but not generally considered acceptable
[12] Kriss, Timothy C.; Kriss, Vesna Martich (April 1998). "History of the Operating Microscope: From Magnifying Glass to Microneurosurgery". Neurosurgery 42 (4): 899–907. doi:10.1097/00006123-199804000-00116