International Journal of Mathematical Archive-3(5), 2012, 1899-1903
Available online through www.ijma.info ISSN 2229 – 5046

The Role of MOIRE Techniques in Precision Technical Applications

S. M. Krishna Ganesh*
**Department of Computer Science and Engineering, St. Joseph University in Tanzania, Tanzania*

(Received on: 01-05-12; Accepted on: 19-05-12)

ABSTRACT

The applications of the moiré patterns based on two gratings, methods were recently developed where circular, radial zone or other types of gratings are used. Moiré patterns formed by the interferences of circular gratings present the advantage of yielding, besides conventional information extracted from any moiré pattern formed by line gratings a complete information concerning the definition of the vector of the displacement of the one grating relative to the another. The moiré pattern formed consisted of parallel line fringes or family of circles. The moiré gauges created by the interference of either two circular gratings of a circular and line grating or radial moiré gauges, when fully developed may successfully compete with electric or photo electric strain gauges, All moiré techniques are easy and simple to apply. They do not necessitate elaborate equipment at the mose four photographs of moiré patterns after each loading suffice for a complete and accurate evaluation of the stress and strain in which the specimen is subjected

Keywords*: MOIRE fringes, gratings, interferences, wavelength.*

---

1. INTRODUCTION

Interference fringes between two beams of monochromatic light have been used for most refined measurement of length including the establishment of fundamental length standards in terms of wavelength of light. In all these measurements, the length is determined in terms of the wavelength used which is approximately one fifty thousandth of an inch. As the light path in the system employed is doubled by reflection, the passage of one fringe past a point is produced by a relative movement of half a wavelength, which is one hundred thousand of an inch. It is only that precision of this order is required in current laboratory work.

2. MOIRE Technique

The phenomenon of MOIRE fringes was first described by Lord Rayleigh in 1874,in a paper "On the manufacture and theory of diffraction gratings", he wrote if two photograph copies containing same number of lines to the inch be placed in contact film to film in such a manner that the lines are nearly parallel in the two gratings, a system of parallel bars develops itself, whose directions bisects the external angle between the direction of the original lines and whose distance increases as angle of inclination diminishes. When parallelism is closely approached the bars became irregular inconsequence of the imperfection of the rulings. This phenomenon might be made useful in a test. Therefore MOIRE technique is an optical method using two gratings, of line gratings or circular or radical or zone gratings which has many useful technical applications such as surface topology, dynamic problems, curved surfaces, MOIRE extensometers as well as even the detection and elimination of grating defects.

3. Different patterns of MOIRE Patterns

Ronchi in 1925 studied the case of moiré patterns created by the superposition of a line and circular grating. It was shown that form of moiré fringe formed by two overlapping gratings depended on the pitches of gratings and that the resulting fringes are hyperbolas, parabolas or ellipses. Raman and data treated the phenomenon gave the parametric equations of the fringes formed by the superposition of two zone gratings with different center-to-center distances. The moiré pattern formed consisted of parallel line fringes [Brewster bands] or family of circles. The phenomena observed by Foucault, Lord Rayleigh, Righi, Ronchi, Raman did not enjoy the consideration which they merited until quite recently, despite the many advantages which they offered in metrology. This was due to the many difficulties encountered in the reproduction of satisfactory gratings.

*Corresponding author: S. M. Krishna Ganesh**
**Department of Computer Science and Engineering, St. Joseph University in Tanzania, Tanzania*

In 1952, Koczer and Kroupa applied the properties of moiré fringes to determine the strain components in a two dimensional strain field. Meanwhile gratings of good quality were designed for metrological applications and produced at a moderate cost by applying a novel principle introduced by Sir Thomas Merton in England, for the manufacture of diffraction gratings by a reproduction from a turned master grating. The new method of manufacture of diffraction and coarse gratings of high quality made their use very efficient for measurement and created new fields of application of moiré fringes in measuring processes. Indeed the last two decades a great number of new measuring applications have been developed. These techniques may be classified into two categories such as techniques for measurement of rigid body translations, angular displacement which can find their way to applications in automatic control or monitoring of programmed machining operations and techniques for measurement of linear and angular displacements in different bodies.

4. MOIRE Patterns

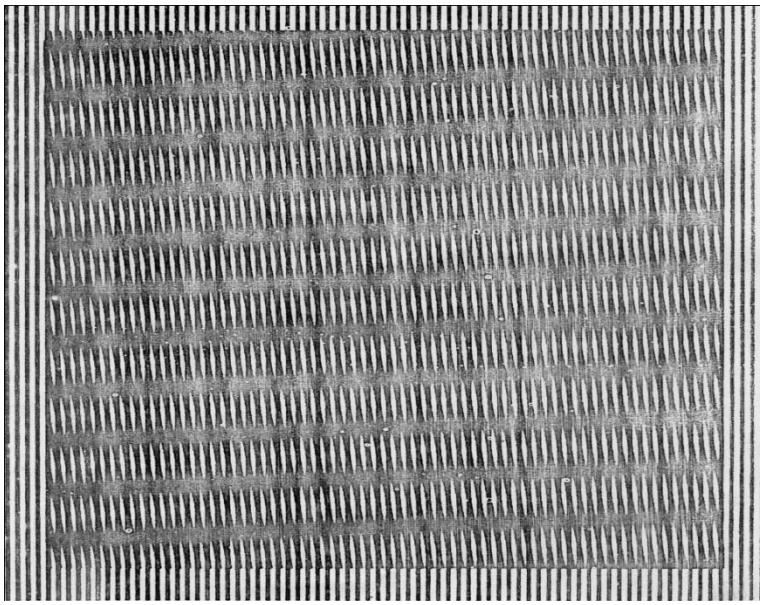


Figure 1: MOIRE pattern formed by two dimensional gratings angularly displaced by a small angle ∂ and illuminated by a diffuser

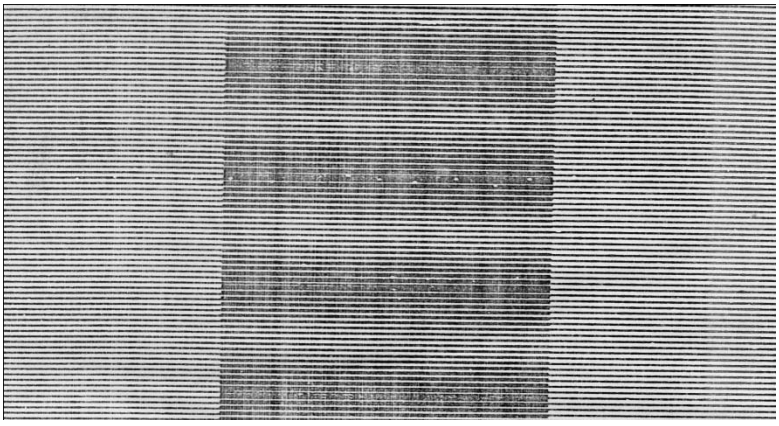


Figure 2: MOIRE fringes formed by parallel gratings of slightly different pitch.The fringes run parallel to the rulings of the gratings.

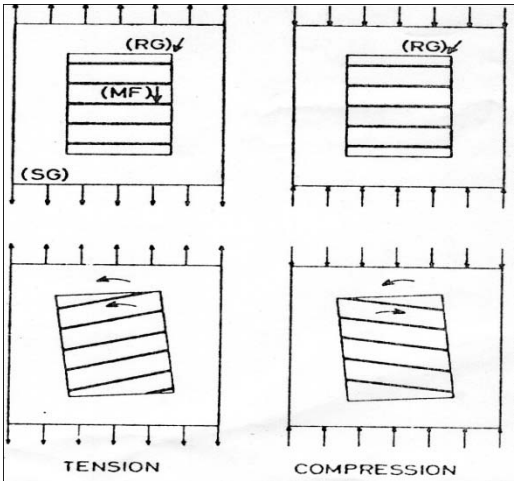
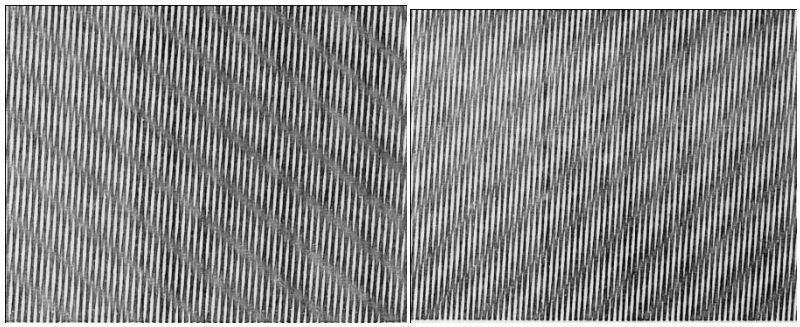
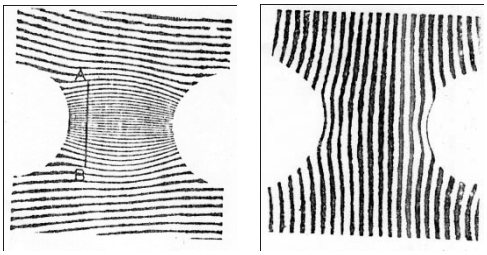


Figure 3: Schematic definition of the sign of strain component by a relative angular displacement of the reference grating.



(a) Specimen grating compressed (b) specimen grating extended

Figure 4: Moire patterns formed by two gratings of different pitch angularly displaced in same direction and showing the sign of strain component.



(a) (b)

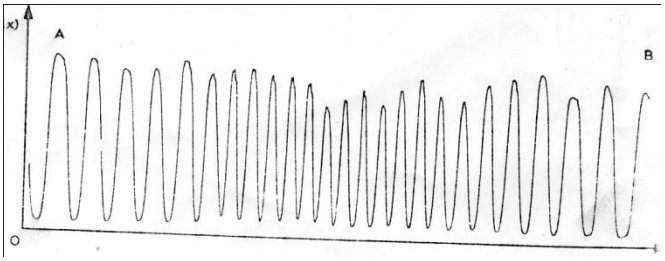


Figure 5: MOIRE patterns of the μ and ν displacement fields for symmetrically grooved aluminum specimen plastically formed by a longitudinal tension.

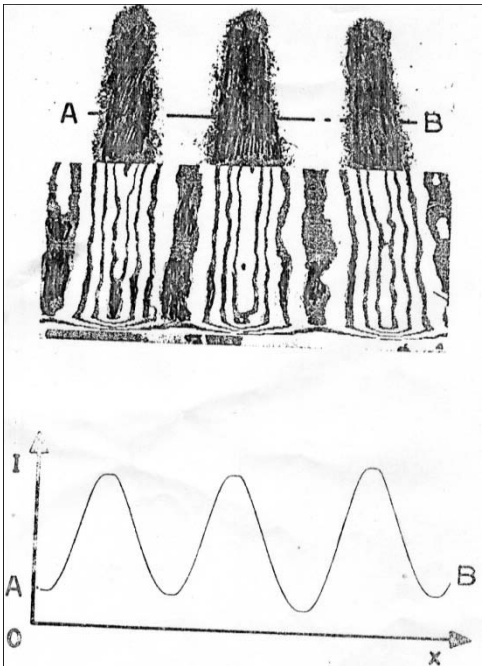


Figure 6: MOIRE pattern isodensitogram and a microdensitometer scan along the traverse *AB* of the pattern in an epoxy resin plant specimen subjected to uniaxial tension.

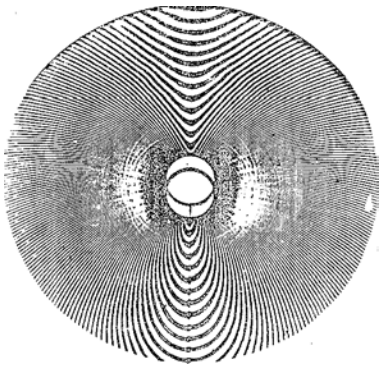


Figure 7: MOIRE pattern formed by a large relative displacement of two equispaced circular gratings of different pich.

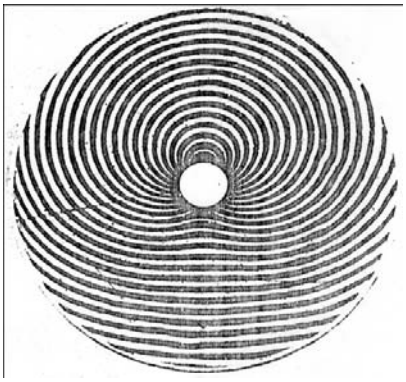


Figure 8: Moiré patterns formed by an infinitesimal displacement of two equi-spaced circular gratings of different pitch[moiré fringes are family of cardioids.

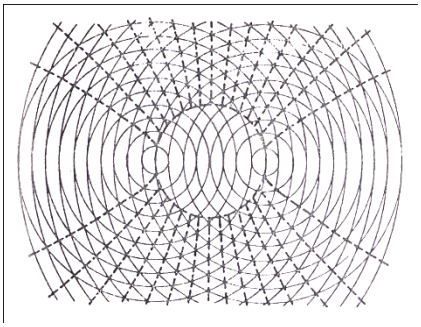


Figure 9: Schematic representation of the formation of moiré fringes by the interference of two circular gratings of equal pitch. The commutation boundary coincides with the circle passing through centers of two families of circles. Inside this boundary, moiré fringes constitute a family of ellipses, while outside the boundary they represent a family of hyperbolas.

5. CONCLUSION

Beside the applications of the moiré patterns based on two gratings, methods were recently developed where circular, radial zone or other types of gratings are used. Moire patterns formed by the interferences of circular gratings present the advantage of yielding, besides conventional information extracted from any moiré pattern formed by line gratings a complete information concerning the definition of the vector of the displacement of the one grating relative to the another. This information is important in the study of rigid body movements in various parts of a construction. The moiré gauges created by the interference of either two circular gratings[continue rosette] or of a circular and line grating or radial moiré gauges, when fully developed may successfully compete with electric or photo electric strain gauges, All moiré techniques are easy and simple to apply. They do not nexessiate elaborate equipment at the mose four photographs of moiré patterns after each loading suffice for a complete and accurate evaluation of the stress and strain in which the specimen is subjected.

10. REFERENCES

[1] Text Book [Research Level] ‘MOIRE FRINGES IN STRAIN ANALYSIS’ P.S.THEOCARIS, Pengamon Press, Oxford [1969].

Source of support: Nil, Conflict of interest: None Declared

