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Investigation of Stress Auto Separating Method in Digital Photo-elasticity and Its Application in Contact Problem

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Summary

The Stress distribution of contact area in engineering structure is complex. Automatic whole-field measurement of photo-elasticity is a feasibility method to solve the contact problem. However, the problem of isoclinic and isochromatic interaction is important in phase-shifting techniques in photo-elasticity. The technique named 8-step phase shifting technique is applied to solve the problem of isoclinic fringe pattern influenced by isochromatic fringe patterns in integer order and half-integer order. Isoclinic parameter in the range of [0,I?/2] is given by the method.

Based on the eight-step phase shifting technique, some methods to determine the first principal stress direction of the model are discussed. The Isoclinic angle in the range of [0,I?] is determined. Isoclinic angles are obtained by anti-tangent function. The first principal-stress direction in whole-field can be obtained by three principle. The feasibility of this method was proved by the experiments of disk and square under radial compression. The shearing stress would be obtained as the difference of principle stress and the direction of first principle stress are determined. Automatic technique of stress separation is discussed after obtaining the whole-field value of the shearing stress. The shearing stress difference method, automatic data processing and stress separation, is selected to separate the stress components of contact area.

Two dimensional contact stress of turbine between roots and rims are analyzed by the two-dimensional digital photo-elasticity. Three stress components and equivalent Von Mises stress of any point in the model are calculated and the contact area of roots and rims are discussed. Finally, the loading values of every tooth of rims are obtained. Efficacy and sensitivity of stress analysis will be greatly increased as the digital photo-elasticity method is applied in contact problem of engineering.

Keywords: two-dimensional digital photo-elasticity, eight-step phase shifting technique, isoclinic, isochromatic, roots and rims of turbine, stress auto separating, contact stress