Separation of the absolute retardation fringes using polarizaton holography

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The so called polarization holography is a holographic method of recording the state of polarization of the object wave by using two orthogonally polarized reference beams. Kubo[1] et al. reported the results of the application of double-exposure polarization holography to photoelasticity and the authors observed only Nisida's fringes, dark-field isochromatics and Fourney's fringes. Marwitz[2] reported that Nisida's fringes and two families of the absolute retardations fringes can be observed simultaneously from a double-exposure hologram by using a depolarizing object wave and two reference beams, but the two families of fringes can not be separated accurately. Ajovalasit[3] succeeded in separating the absolute retardation fringes accurately at any points in the whole model from a single hologram with the real time holography, but in this method the loaded model must be perserved. This paper presents a method with which only one single double-exposure polarization hologram is required. Nisida's fringes and two families of the absolute retardations can be obtained by direct observation of the hologram, while the absolute retardation fringes of different inclinic angles can be observed through a linear polarizer without the loaded model, thereby the two families of absolute retardations can be separated accurately, so this is much more simpler than Ajovalasit's method. The experssions for the light vector of the diffracted virtual image and its intensity are derived from a unified point of view by using Jones vector and matrix calculus, which show that when the double-exposure polarization hologram being illuminated with two reference beams, Nisida's fringes can be observed. On the other hand, when the same hologram being illuminated with one reference beam the corresponding absolute retardation fringes can be obtained. However, if the hologram is observed through a linear polarizer in front of it as in the real time method, the two families of absolute retardations can be separated accurately. Therefore, the presented method acquires the merits of the three above mentioned methods and contains all their results[4]. It is a new simple and convenient method for separating the absolute retardation fringes. Finally experimental results are presented.

References

[1] Kubo, H., et al., Optica Acta, 22, 59–70 (1975)
[2] Marwitz, H., Inegeneer-Archiv, 44, 359–369 (1975)
[3] Ajovalasit, A., J. Strain Analysis, 10, 148–152 (1975)
[4] 王季中等，山东工学院学报 No. 1, 8–16 (1980)

用偏振全息术分离绝对程差条纹

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所谓偏振全息术就是用偏振方向互相正交的两束参考光以记录物光偏振状态的全息术。Kubo[1] 等人发表过对两次曝光的偏振全息术用于光弹性的研究报告，他们只观察到了西田条纹和暗场等差与组合条纹。Marwitz[2] 报导了从一张用消偏的物光和两束参考光所拍的全息图上同时观察到西田条纹和两族绝对程差条纹，但不能精确地分离它们。Ajovalasit[3] 成功地用实时全息法在一张全息图上精确地分离了模型上各点的绝对程差条纹，但此法必须保留加载模型才能实时观察。本文所提出的方法只需一张两次曝光的全息图，直接观察可得西田条纹和两族绝对程差条纹，通过偏振镜观察又能得到不同倾角的绝对程差条纹，从而能够在整个模型上精确地分离这两族条纹，且无须保留加载模型，故较 Ajovalasit 的方法更为简便。文中从偏振全息术的统一观点，用 Jones 矢量和矩阵的运算，导出了被衍射虚象的光矢量和光强的表达式，证明了用本方法所拍的一张两次曝光的全息图，若用两束参考光同时照射可得西田条纹；若分别用一束参考光照射可得到相应的绝对程差条纹，而通过偏振镜观察又能象实时法那样精确地分离两族条纹。因此本方法具有上述三种方法的优点，并包括了三种方法的全部结果[4]，是一种简便的分离绝对程差条纹的新方法。最后提供了实验证明。