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Authors: Peng Huang, Chuanwang He, Bin Fan, Xiaochun Dong



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Dynamic patterns based on the superposition of micropattern array and microlens array

Peng Huang ^{a,b}, Chuanwang He ^{a,b}, Bin Fan ^c, Xiaochun Dong ^{a,*}

^a State Key Laboratory of Optical Technologies on Nano-Fabrication and Micro-Engineering, Institute of Optics and Electronics, Chinese Academy of Sciences, Chengdu, Sichuan, 610209, China

^b University of Chinese Academy of Sciences, Beijing, 100049, China

^c Institute of Optics and Electronics, Chinese Academy of Sciences, Chengdu, Sichuan, 610209, China

**dx468@126.com*

Abstract: Dynamic patterns have been studied theoretically and experimentally in this work. The microstructure consists of a base layer made up of micropattern array, and a superposed revealing layer made up of microlens array. Dynamic patterns will be observed directly on the revealing layer without visual facilities. When the viewing angle changes, displacement of dynamic patterns is produced. This technology is compared with traditional moiré techniques. In addition, analytical models to describe its structures are derived based on a vector method. There is a good agreement between the theoretical and experimental results, which indicates this study is helpful to design various kinds of dynamic patterns and dynamic effects, and this technology can be applied for many applications, especially in anti-counterfeiting field.

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Keywords: Moiré techniques; Dynamic; Microlens array; Pattern.

1. Introduction

Modern scientific research into the moiré technique and its application started only in the second half of the 19th century [1–3]. In development, a series of mathematical approaches have been proposed to study on the moiré. The best adapted approach for investigating moiré patterns is the spectral approach based on the Fourier theory [4,5]. Formulas of the period and orientation of moiré patterns are derived from the reciprocal vector approach [6].

In application, the moiré is supposed to be significant in many fields. On the one hand, a series of studies have been done on the merits of the moiré. A large number of studies indicate that the moiré has a potential to study dynamic phenomena such as atmospheric turbulence [7–9], wave-front sensing [10], vibrations [11] and velocity measurement [12]. Besides, the moiré in some nonconventional applications is also studied [13]. On the other hand, studies have been done to decrease the demerits that moiré brings as well, especially in autostereoscopic three-dimensional display. The image quality degrades in autostereoscopic three-dimensional display, because the moiré patterns form a patterned background which is effectively added to a displayed image [14–17].

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