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The Extension of the Electronic Speckle Photography to the Measurement of In-Plane Displacement

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Abstract: In this paper, a modified speckle photography technique is demonstrated for the measurement of a variable range of the in-plane displacement. The modification focuses on coupling the diode pump solid state laser DPSS with the conventional speckle photography technique. The DPSS laser emerges different wavelengths to provide speckle patterns of suitable size to measure the desired range of the in-plane displacement. The second harmonic generation in a nonlinear crystal of wavelength 532 nm and the principle diode laser wavelength 808 nm are employed in identifying the object positions within a lateral displacement made by a standard linear stage in the range from few microns up to 1.2 mm. The sensitivity and the correlation of the speckles formed by both wavelengths suit both small and large movements. A continues measurement by the modified technique can be achieved by identifying a scale factor in the uniform area in which both wavelengths are effective, and high correlation between the results obtained by 532 and 808 nm is maintained. The uncertainty in measuring 1.2 mm lateral movement by the modified speckle photography is found to be 26.8 lm.

Keywords: Speckle; DPSS laser; Photon correlation; Nonlinear effect; In-plane displacement