

Spatial filtering velocimetry for real-time out-of-plane displacement measurements - DTU Orbit (09/11/2017)

Spatial filtering velocimetry for real-time out-of-plane displacement measurements

We probe the dynamics of objective laser speckles as the axial distance between the object and the observation plane changes. With the purpose of measuring out-of-plane motion in real time, we apply optical spatial filtering velocimetry to the speckle dynamics. To achieve this, a rotationally symmetric spatial filter is designed. The spatial filter converts the speckle dynamics into a photocurrent with a quasi-sinusoidal response to the out-of-plane motion. The selectivity of the sensor relates directly to the uncertainty on sensor measurements. The selectivity must be derived from a temporal power spectrum of the photocurrent produced by this filter. This main contribution of this paper is a model, which describe the selectivity of the sensor, applied to speckle dynamics generated by an object moving out-of-plane. To motivate our interest in these filters we also present an all optical element which implements the spatial filter and experimentally demonstrate the ability of the technology to obtain displacement measurements of a vibrating object in real-time.

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