NTU MOLECULAR IMAGING SEMINAR

Investigation of traveling acoustic waves with digital holography

Pascal Picart
Université du Maine

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In the domains of acoustics, vibro-acoustics, vibrations of structures or flow-induced vibrations, Laser Doppler Vibrometer (LDV) is the most favorite instrument for dynamics measurements [1-4]. To get simultaneously a collection of data points at the surface of the inspected vibrating object, multipoint vibrometer were developed [5-9]. Full-field evaluation can be obtained with digital holography interferometry. Such an approach is well suited because of the high density of measuring points and the reduced measurement time. The use of time-averaging and quasi-time-averaging in digital Fresnel holography was proposed and discussed in the past [10]. However, the stationary regime is a particular case for investigating the structure vibration behavior (propagation of travelling waves), and the characterization of structures under operational or real functioning conditions requires analysis in the time domain. Then, providing a real-time follow-up of the vibration amplitude, whatever the excitation condition is a challenge for full-field optical metrology. As examples, problems that cannot be addressed by a stationary approach are: vibrations of panels induced by hydro or aero-acoustic sources, structural vibration induced by squeak and rattle noise. Performances of high power continuous wave lasers (>6W) and high-speed CMOS sensors (rate up to 1MHz) have been improved significantly these past years. Such technologies give opportunity of merging holographic interferometry and vibration analysis to develop an adapted approach for a real-time and multi-point recording of transient phenomena. Since the holograms are recorded with a high-speed matrix sensor, the real-time recording of transient phenomena, at their time-scale evolution, is made possible. The proposed approach is then not limited to stationary phenomena. So, this paper describes recent advances in high-speed holographic imaging; especially we focus on the use of such an approach to investigate traveling acoustic waves. Special attention considers the case of waves propagating after a shock and in an acoustic black hole (ABH).

主辦單位

分子生醫影像研究中心
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