High sensitivity non-contact method for dynamic quantification of elastic waves & strains in transparent media

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Short title: Quantification of elastic waves in solid media

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1 Abstract

This paper presents time resolved quantitative evaluation of elastic stress waves in solid media by utilising an adaptation of the well-established laser Doppler vibrometry method. We show that the introduction of elastic stress waves in a transparent medium gives rise to detectable and quantifiable changes in the refractive index, which is proportional to stress. The method is tested for mechanical excitation at frequencies from 10 to 25kHz in an acrylic bar. This refractometric quantification can measure internal strains as low as $1x10^{-11}$. Additionally, finite element analysis is conducted to gauge the validity of the results. In the presented work an acrylic bar is used, this method however should be applicable to any transparent solid.

Keywords:
1. Laser Doppler vibrometry
2. Refracto-vibrometry
3. Stress waves
4. Refractive index