A novel photomechanical approach to dynamic testing of materials

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The rapid development of fast and ultrafast imaging techniques will lead to major breakthroughs in the identification of material behaviour at high strain rates in the near future.
The objective of this paper is to give some ideas on how to take advantage of full-field measurements to overcome some major issues in the dynamic mechanical testing of materials, based on recent examples.

The first one concerns the vibration of thin plates. It will be shown that thanks to inertia effects, it is possible to identify a viscoelastic law (ie, stiffness and damping) without any force measurement and with a complete insensitivity to boundary conditions. In this case, the acceleration forces act as a distributed load cell over the volume (provided that the material density is known). This idea can be extended to high strain rate testing even though the current state of technology of ultra high speed cameras still hinders fully successful practical applications. Two practical examples will be shown. The first one consists in a polymer matrix composite specimen loaded in tension in a SHPB set-up. It will be shown how reliable stiffness identification was carried out from images taken with a Cordin 550-62 camera. The second deals with a spalling test on concrete. In this case, the transition between linear elastic behaviour and damage initiation is investigated from images recorded with a Shimadzu HPV-1 camera.

A broader perspective on the subject will be given at the end of the presentation