

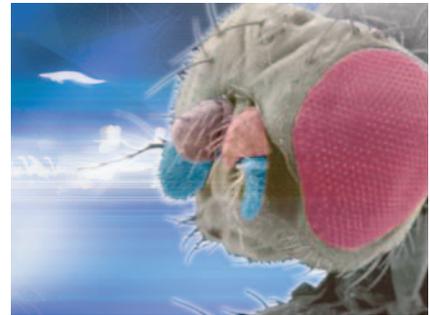
I Can Hear *the Grass Grow...*

Laser vibrometry can answer many questions: How do ears work? How do insects communicate? Where Is the vibration source?



In our world, vibrations are everywhere. Did you know about honeycomb vibrations, silo honking, bridge resonance failure and remote voice detection? Read on to learn more about vibrations in nature and in man-made products and processes. Discover how these vibrations are detected and studied using laser vibrometry.

To download previous issues of the LM INFO Special quoted in this article, please visit www.polytec.com/usa/LM-INFO



Biology

For every living species on our planet there are corresponding biological applications of laser vibrometry. One of the most prominent is insect communication. Some insect sounds are quite loud, such as the singing of the cicada; while others are supersonic and can't be heard. Some insects are so small that their songs are transmitted mainly through a plant rather than air. Entomologists can use vibrometers to record this unheard noise for later study. Consider honeycomb vibrations in beehives; these signals can only be measured with highly sophisticated equipment (see page 14).

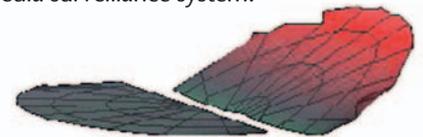
Other bio applications include measuring communication between elephants, fruit ripeness, spider web motion, and the hearing mechanism in frogs and fruit flies (see issue 1/2005, page 18).

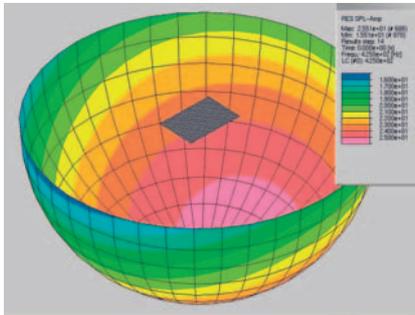


Medical and Health Care

In this issue you will learn how laser vibrometry can assist with eardrum diagnostics and research on the middle and inner ear. In addition, vibrometers have been used for vibration measurements on artificial heart valves, mechanical properties of tendons, analysis of vibrations while bone drilling or medical laser ablation, and detection of bone crack propagation. Medical, safety and health care devices like tooth brushes,

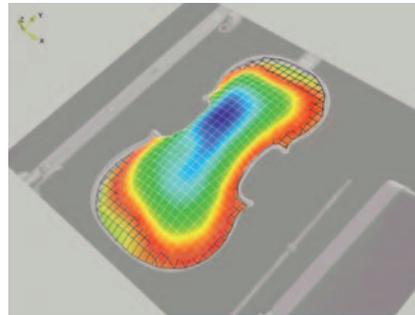
dental scalers (see page 16) and respirators have been investigated using Polytec vibrometers. The vibrometer can also function as a non-contact polygraph by measuring muscle vibrations, or as a remote voice detector as a part of a multi-media surveillance system.



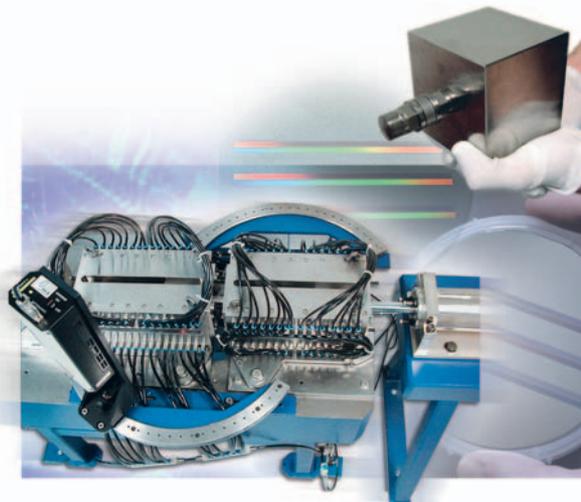


Acoustics

Musical instruments generate wonderful, inspiring sounds through their vibrations. Polytec vibrometers can help us understand how this happens with early work already done on violins, cembalos and dulcimers. Vibrometers are also indispensable tools for loud-speaker design, identifying diaphragm resonances that are deleterious to the sound quality. Vibrometer measurements provide an experimental basis for sophisticated acoustic investigations like structural-acoustic response (sound field) predictions, acoustic imaging and anti-sound research. Acoustics are also increasingly im-



portant in product design. The focus is on how and where are undesired noises generated and at which point or location can countermeasures be taken. Please read the article about the joint project between Polytec and HEAD acoustics on "Binaural Transfer Path Analysis" (See issue 1/2004, page 10).



Metrology and Calibration

Primary calibration of vibration and shock sensors by laser Interferometry has the unique advantage that measurements of surface acceleration, velocity or displacement are made with a precision that is traceable directly to the wavelength of laser light (see issue 1/2003, page 8). Also, laser vibrometric velocity measurements offer the possibility to perform traceable impulse calibrations of transducers subjected to known impulse loads (see issue 1/2004, page 16).

Industrial Research

There are many areas of industrial research where vibration issues are encountered. In the automotive and aerospace industry there are undesired vibrations of parts and bodies that must be eliminated.

Laser vibrometry gives the opportunity to optimize dynamic automotive FE models by matching the parameters derived from vibration measurements on prototypes to the FE model. Similarly, for small moving or vibrating components in electronic circuits, data storage devices, and microelectromechanical systems (MEMS), FE model verification is essential for rapid cost effective micro component designs. See issue 1/2004 for automotive applications, issue 2/2004 for data storage applications and issue 1/2005 for MEMS applications.

Materials Research, Mechanical and Civil Engineering

Laser vibrometry is an ideal tool for the measurement of structural dynamics and for non-destructive flaw detection (fracture, delamination, fatigue) in all kinds of materials, parts and components. For instance, we reported on non-linear scanning vibrometry for non-destructive testing (see issue 1/2004, p. 20) and on the investigation of ultrasonic wire bonding (see issue 1/2004, p.18). Regarding buildings and industrial plants, there are many applications for in-the-field structural health monitoring on wind turbines, building vibration and displacement, and cable-stayed bridges to prevent bridge resonance failure. Even curious effects like the loud

"honking" noise (up to 110 dB) that occurred while discharging grain from a silo could be resolved by using a Polytec vibrometer. Geological applications include detection of land mines, rock failures and earthquake-induced defects in concrete.



More interesting applications on www.polytec.com/usa/research