

# InFocus

Optical Measurement Solutions



New Applications in Hearing,  
Biomechanics, Medical Technology,  
and Biology

**Supplement**

Surface Measurement of  
Dynamic Stress Distribution  
on Turbine Blades

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Vibration and Acoustic  
Characteristics of Railroad  
Wheels

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**Vibrations, Sound, Stress & Strain:  
Revealing the Invisible**



Outgoing Managing Director:  
Dr. Helmut Selbach



New Managing Director:  
Dr. Hans-Lothar Pasch

## Dear Reader,

*I have had the pleasure of being employed at Polytec for 32 years now, and for the last 24 years I have been the managing director of the company. In July 2009, I decided that it was time for me to hand over the reins to a new managing director. Although I will not be directing the company on a daily basis, I am very pleased that I will continue to support and help the company as a member of Polytec's board.*

*My successor at Polytec, Dr. Hans-Lothar Pasch, has been managing director since July. Before joining Polytec he was head of development at a major automotive supplier. His extensive experience is invaluable and enables him to lead our high-technology company in a demanding market. All of us wish Dr. Pasch great success in his new position.*

*My years at Polytec have been very interesting and rewarding. The excellent relationship with our customers combined with the trustful cooperation and engagement of our employees has helped me to make the right decisions and has made Polytec the outstanding company that it is now. Please accept my sincere thanks for your support and your contribution to our success.*

*Polytec's reputation for innovation, quality and customer support has helped us to increase our business and make the investments that allow us to respond quickly to the present and future needs of our customers. Although we have been affected by the worldwide economic crisis, we believe our future is bright and continue to invest aggressively in product R&D.*

*You will find a series of new customer applications in this InFocus issue as well as the latest company and product news. The full articles can be conveniently viewed and downloaded from our homepage: [www.polytec.com/infocus](http://www.polytec.com/infocus).*

*Enjoy reading this magazine!*

Dr. Helmut Selbach

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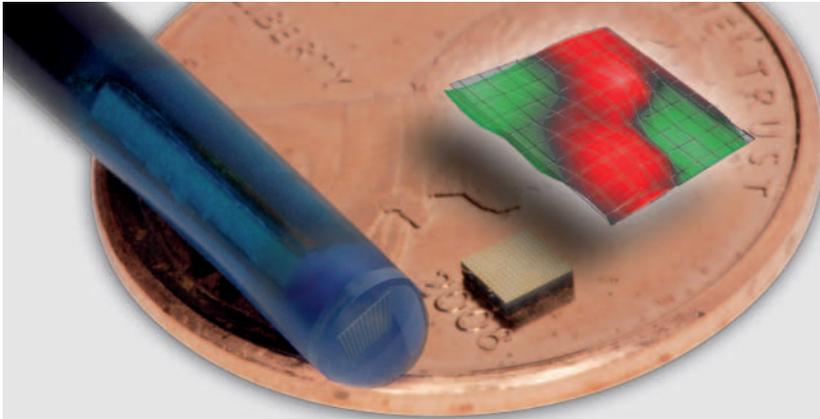
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### Events

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# Polytec Research News



## Polytec Partners with Top Level Researchers

Universities and research centers lead the way in the application of new, high-performance measurement technologies – supported by Polytec.

Polytec is an important partner by providing high-level measurement expertise to hundreds of institutes world-wide. Research teams characterizing structures such as MEMS, data storage devices, aircraft structures and biomechanics rely on optical vibration and surface metrology solutions from Polytec. For instance, piezoelectric micromachined ultrasonic transducers, like the one shown here, are being used to push the limits of real-time 3-D ultrasonic imaging in medical applications. The characterization of such devices while being developed at Duke University and RTI International in Durham, NC, presented unusual and demanding measurement requirements including the need for high speed and high resolution. These were easily met by the vibrometer incorporated into Polytec’s Micro System Analyzer. For more information see page 5 and [www.polytec.com/research](http://www.polytec.com/research)

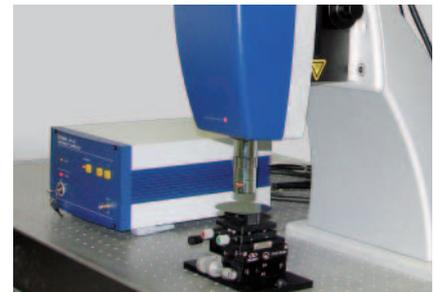
## IEEE Best Student Paper Award:

### Beyond 1 GHz with the New UHF-120 Ultra-High Frequency Vibrometer



Congratulations to Dr. Hengky Chandrahilim for winning the IEEE Ultrasonics, Ferroelectrics, and Frequency

Control Society 2009 Student Paper Competition Award for his publication about measurements above 1 GHz with Polytec’s UHF-120 Ultra High Frequency Vibrometer. Dr. Chandrahilim did his research work at Cornell University (Ithaca, NY) together with Polytec, Inc. and is now a post-doctoral researcher in the Micro and Nanosystems laboratory at ETH Zurich.



## Industry Award “Fibre de l’Innovation 2009”

For its new UHF-120 Ultra High Frequency Vibrometer, Polytec has received the “Fibre de l’Innovation 2009” award for Industrial Innovation from Opticsvalley, an important French society promoting photonic technology. The UHF-120 Vibrometer is designed to characterize mechanical motions at frequencies up to 1.2 GHz, enabling the precision examination of high frequency RF-MEMS. In addition, the capability to resolve high velocities permits the characterization of high-intensity, focused ultrasound transducers.

[www.polytec.com/uhf](http://www.polytec.com/uhf)

## Learn About Vibrations: Polytec’s New Vibrometer Education Kit

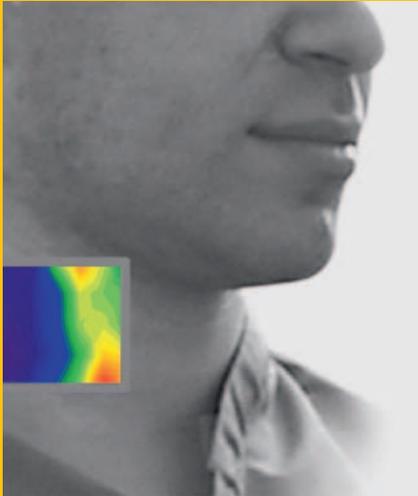


Polytec has tailored the PDV-100 Vibrometer Education Kit to the specific needs of universities and colleges. The kit includes the PDV-100 Sensor,

the VibSoft-20 data acquisition system and the data analysis software. It comes with all needed hardware and instructions to perform two fascinating educational experiments. A simple computer is the only item that must be added to start learning about the exciting field of vibration measurement. Priced for the University market, this educational package is ready to familiarize your students with the latest in optical vibration measurement.

[www.polytec.com/education](http://www.polytec.com/education)

# Polytec Research News



## A New Brochure: Applications in Biology, Medicine and Health Care

Vibration and 3-D surface profile measurements can reveal the details needed to understand biological and physiological structures and the mechanisms that interact with them. Polytec's laser vibrometers and optical surface metrology help improve our knowledge about living objects as well as medical processes and devices. The data can serve as an input for simulation models and the results can be beneficially transferred into bionic or therapeutic approaches. Please study the many application examples in the new brochure located in the center of the magazine. To find even more information visit [www.polytec.com/biomedical](http://www.polytec.com/biomedical)

## Surface Measurement of Dynamic Stress Distribution on Turbine Blades



To develop robust, high-performance turbines for industrial and commercial applications, engineers need to under-

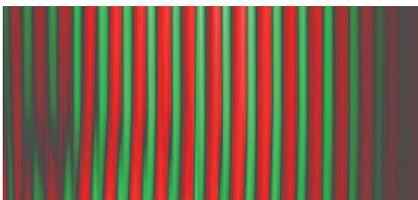
stand the dynamic stress distribution of their sub-components. Due to its very high sensitivity and ability to accurately measure the strains in all spatial directions, the non-contact PSV-400-3D Scanning Vibrometer is ideally suited to measuring the strain and stress distributions that occur in real components for comparison to simulation model results. In this article, laser vibrometer measurements of the dynamic strains and stresses in turbine blades are used to show how model verification can be carried out with considerably less effort and significantly

increased accuracy. Both qualitative and quantitative results for the strain and stress distributions show excellent agreement with the simulation. The entire measurement sequence can be completed quickly in a few hours.

### Authors

Dr. Ulrich Retze,  
MTU Aero Engines GmbH, Munich;  
Matthias Schüssler, Polytec GmbH

## Refracto-Vibrometry: Making Sound and Ultrasound Visible



Scanning laser vibrometers have been used successfully for years now to characterize both small and large amplitude ultrasonic vibrations in solid surfaces. Scanning laser vibrometers can also be used to visualize sound and ultrasonic waves in a medium such as water.

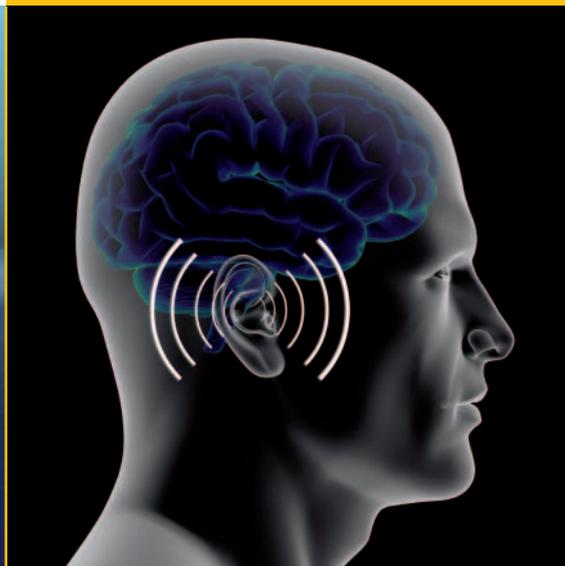
Applications include ultrasonic cleaning, ultrasonic flow measurement, sonar and echo sounding as well as sonographic applications in medical technology. Several applications will be discussed in the article.

### Author

Dr.-Ing. Walter Littmann,  
ATHENA GmbH, Paderborn, Germany

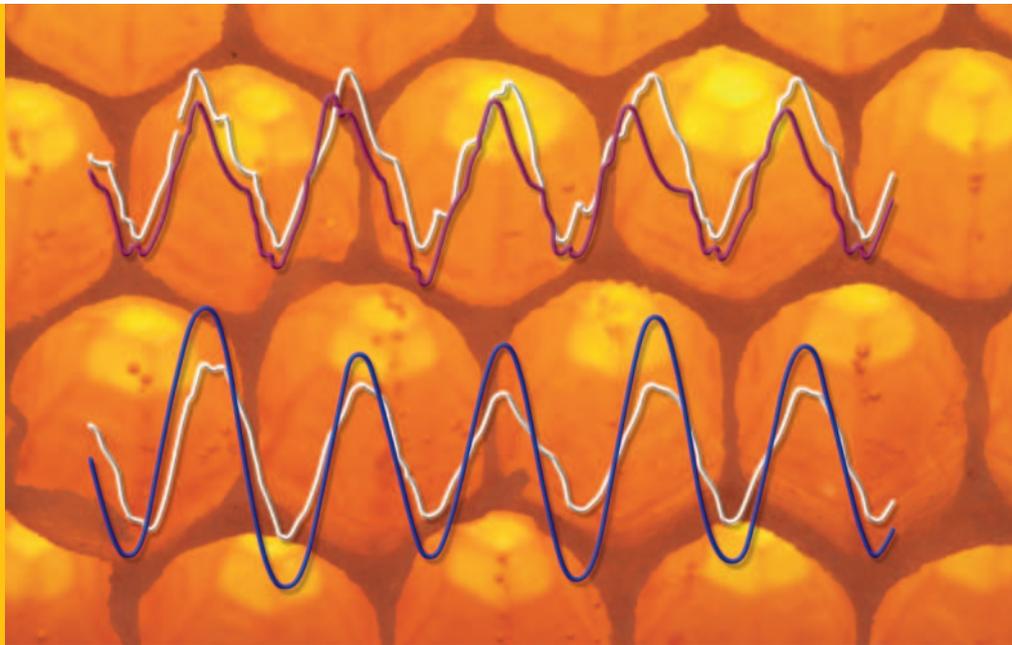
# Vibrations Everywhere in Nature

Applications of Optical Measurement Systems  
in Biology, Medicine and Health Care

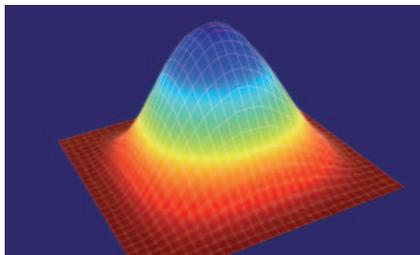


# Why Should We Measure Vibrations and Surface Topography?

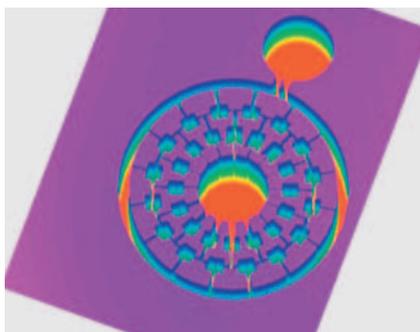
Perhaps the most important reason is to understand the biological and physiological structures and the mechanisms that interact with them. Polytec's laser vibrometers and optical surface metrology help improve our knowledge about living objects and medical devices. The data can be used for computer modelling, and the results used to enhance the design of bionic structures or therapeutic processes.



To get an idea about the scope of the medical applications that our customers are finding for Polytec vibrometers, please visit the National Institutes of Health Archive entering either "Polytec" or "vibrometer" as the search criteria. You will be amazed at what you find!  
[www.pubmedcentral.nih.gov](http://www.pubmedcentral.nih.gov)



Vibration shape of a membrane



3-D Surface profile of a lab-on-a-chip device

## What is Laser Vibrometry?

Laser vibrometry is a non-contact technology based on the Doppler effect – sensing the frequency shift of back scattered laser light from a moving surface. Laser Doppler Vibrometers can accurately measure vibrations without contact at frequencies up to 1.2 GHz. Alternative methods usually can't be used because they load or interact with the system, have limited bandwidth and spatial resolution or can't be scanned across a surface. The same is even more true for vibrations on the surface of liquid materials or in very small and light structures, such as can be found in many areas of biology and medicine.

[www.polytec.com/vib-university](http://www.polytec.com/vib-university)

## What is Surface Metrology?

Polytec's scanning white-light interferometers are based on the Twyman-Green interferometer principle. These non-contact optical instruments can measure surface heights on 3-D structures with profiles varying between a few micrometers to some centimeters. All surface features ranging from gradual slopes to vertical steps, with rough or smooth finishes, can be characterized with excellent precision. [www.topmap.info](http://www.topmap.info)

## Applications in Biology and Medicine

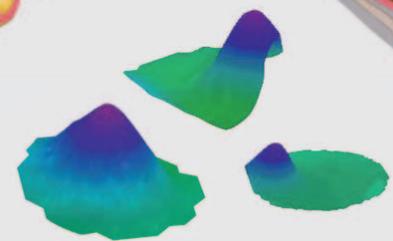
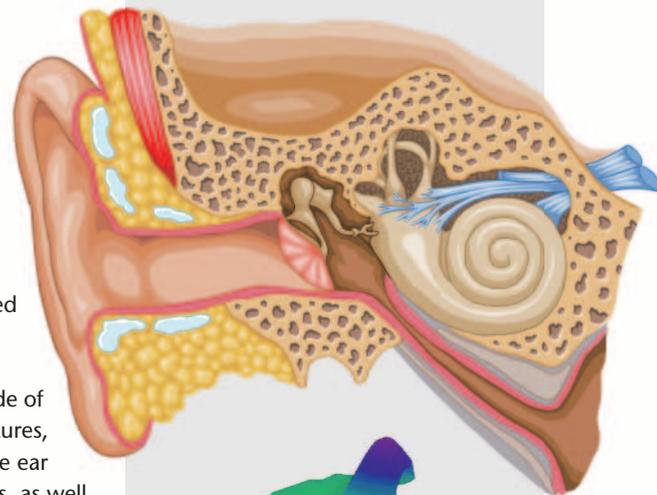
Laser vibrometers have proven to be indispensable instruments in hearing diagnostics and research, enabling the understanding of critical structural and functional relationships of the ear. Laser vibrometers have also been used for measurements on medical implants, for monitoring surgical procedures, for physiological measurements and other biomechanical research (pages 3 and 4). Further applications in medical technology for Polytec vibrometers or white-light interferometers include the development, proving and quality assessment of medical devices such as dental and surgical instruments, nebulizers and medical imaging systems, as well as many safety and health care devices (pages 5 and 6). In biology, Polytec vibrometers are prominent in insect communication and bio-mimicry studies. Other applications include measuring honeycomb vibrations in beehives (see image above), communication and orientation of mammals, fruit quality assessment and many others (page 7).  
**For more information please read further and visit [www.polytec.com/biomedical](http://www.polytec.com/biomedical).**



### Laser Tympanometry

Laser vibrometry is also used to acquire vibrational information about the response of the tympanic membrane in case of any pathologic changes in the middle ear. The technology gives access to full-field vibration down to microscopic detail and represents a standard in the research of the dynamics of the middle ear and the inner ear.

For more information about Scanning Vibrometers please see back page.



Full-field scanning measurements of the tympanic membrane. Left: normal; center: stapes fixation; right: perforation of tympanic membrane. (courtesy H. Mojallal, MHH Hannover, Germany)

## Applications in Hearing

State-of-the-art laser vibrometers are indispensable to those actively involved in the design, development, quality control, calibration and certification of middle-ear implants. They provide ease of use and unsurpassed accuracy and resolution, greatly advancing our understanding of hearing mechanics.



“Regarding our fundamental research on biophysical processes in the cochlea, there is no other measurement technology providing appropriate sensitivity and a resolution below 1 pm”

**Prof. Anthony W. Gummer**  
[www.uni-tuebingen.de/cochlea](http://www.uni-tuebingen.de/cochlea)



“Laser vibrometers are critical to understand structure/function relationships of the ear”

**Prof. Sunil Puria**  
[www.stanford.edu/people/puria](http://www.stanford.edu/people/puria)

Laser Vibrometry is an established technique used throughout the hearing research community. Dynamic measurements are made of temporal bones, cochlear structures, ear models, hearing aids, middle ear prostheses, implants and devices, as well as the monitoring of ear implant surgery.

### We Can “See” How the Patient Hears

Measurements on the eardrum allow us to investigate the micromechanical function of the inner ear. The active amplification process inside the cochlea, can be assessed non-invasively by the highly sensitive vibrometer. We can “see” how well or poorly the patient hears. This could have important applications in screening infants for dysfunctional hearing.

### Biomechanics of the Human Middle Ear

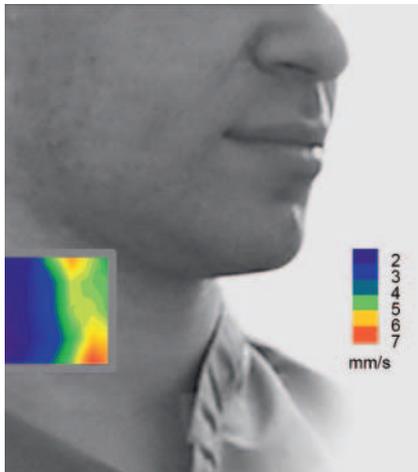
One reason for the enhanced understanding has been the use of non-contact laser vibrometers to measure motions of the middle ear both in-vitro and in-vivo. Measurements can be used to diagnose

pathologies, such as luxations of the ossicles, otosclerosis or dysfunctions of middle-ear implants and prostheses. Studies result in enhanced biocomputational models of the middle ear and the related sound transmission.

# Applications in Biomechanics



Biomechanics includes bioengineering, the research and analysis of the mechanics of living organisms and the application of engineering principles to and from biological systems. Vibrometers are an invaluable tool used for applications as diverse as physiological diagnostics, vibration measurements on artificial heart valves, mechanical properties of tendons, analysis of vibrations while bone drilling or medical laser ablation, detection of bone crack propagation, biodynamic response to hand tool vibration, for generating FE models of bones, and many more.



## Measuring Physiology and Biometrics from a Distance

Laser-Doppler vibrometers are widely used in industrial and engineering applications but their use for measuring system-level physiology is fairly recent. However, a large variety of internal sounds, pulses and vibrations can be detected simply by directing the laser beam at the body. Multiple investigators in the Washington University School of Medicine and School of Engineering have contributed to the development of a dedicated instrument that supports acquisition of vibrometer data on a

largely autonomous basis, with targeting, tracking and focusing of the instrument controlled using computer vision methods. Data are analyzed in near real time. Advanced measurements are supported in multiple response systems, especially cardio-respiratory and muscle activities.



“A large variety of internal sounds, pulses and vibrations can be detected”  
**Prof. John W. Rohrbaugh,**  
Washington University  
School of Medicine,  
St. Louis, MO



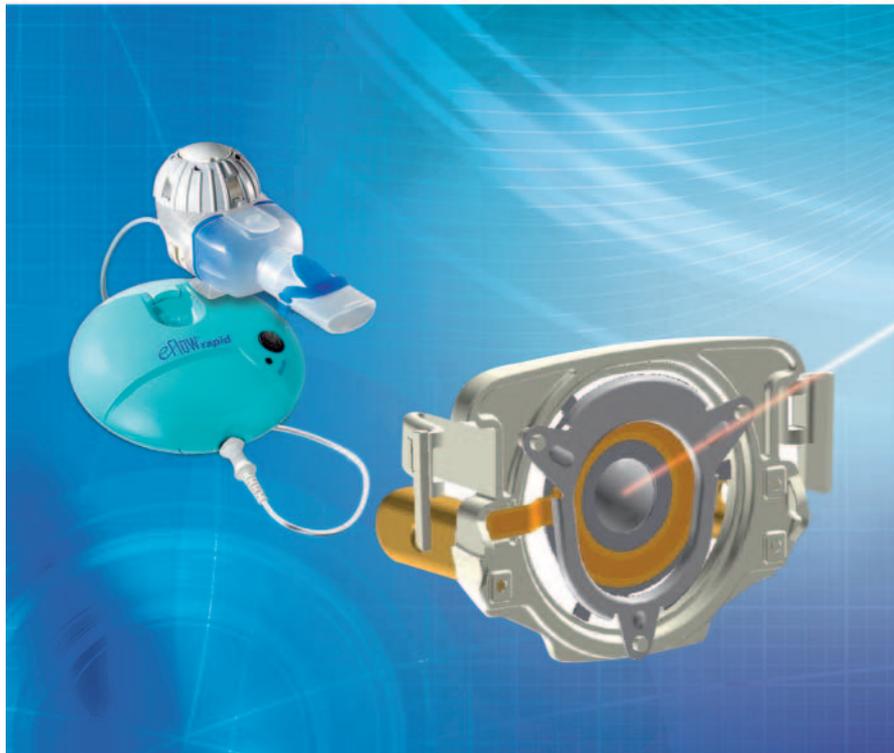
## Dynamic Analysis and Modeling of Bones

Recently, Finite Element Methods (FEM) have been used in biomechanics to investigate and model components for medical applications. For example, to assist with bone surgery, various approaches to generate realistic bone models from computer tomography data are being evaluated. The 3-D Scanning Vibrometer was used for the first time to determine

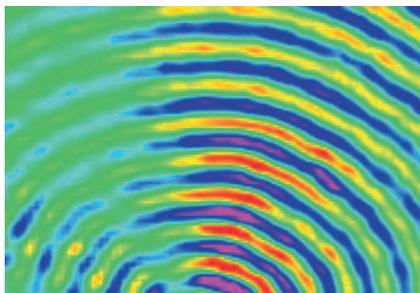
the modal parameters of a pelvic bone and provided spatial vibration modes with an accuracy and resolution that has not been available until now.

**Martin Quickert, Michael Werner, Sandra Scherer; Fraunhofer Institute for Machine Tools and Forming Technology IWU, Dresden, Germany**

# Medical Applications



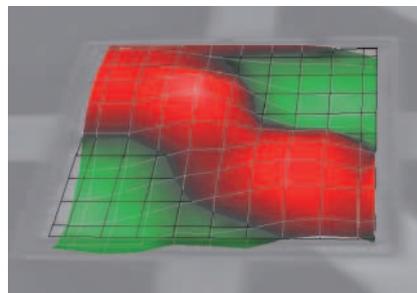
Applications in medical technology include development and quality assessment of medical instruments like micro fluidic devices, dental descalers, surgical instruments, and medical imaging devices. Further, there are many medical, safety and health care devices like inhalers, respirators and tooth brushes that have been investigated using Polytec vibrometers and white-light interferometers.



## High Frequency and High-Power Medical Ultrasound

Laser vibrometry is the ideal tool for characterizing and visualizing the behavior of ultrasonic transducers e.g. for use in lithotripsy, thrombolysis, sonography, disintegrators or nebulizers, or for high intensity focused ultrasound or low-power high resolution ultrasound imaging. Data for the verification of simulation models are quickly and easily created, enabling short development cycles. Polytec provides sophisticated tools for measuring high frequencies up to 1.2 GHz and velocity amplitudes of more than 100 m/s.

[www.polytec.com/uhf](http://www.polytec.com/uhf)



## Vibrational Analysis of Ultrasonic Transducers for Medical Imaging

Piezoelectric Micromachined Ultrasonic Transducers (pMUTs) are being used to push the limits of real-time 3-D medical ultrasonic imaging in areas such as intravascular ultrasound and intracardiac echocardiography. Measurement of these devices at high speed (~10 MHz frequency) and high resolution (<1  $\mu\text{m}$  displacement) were made possible by the Polytec's Micro System Analyzer and revealed a wealth of information about pMUT performance.

Derrick R. Chou, John B. Castellucci, Olaf T. von Ramm; Duke University; David E. Dausch, RTI International; Durham, NC

## 100 % Quality Control of Membrane Nebulizers

At PARI Pharma GmbH, a leading German manufacturer of aerosol generation systems, the quality of manufactured nebulizer systems is 100 % tested and affirmed using a Compact Laser Vibrometer to validate the vibration characteristics of the membrane generating the aerosol. This measurement system guarantees precise, reproducible delivery of the medication dose.

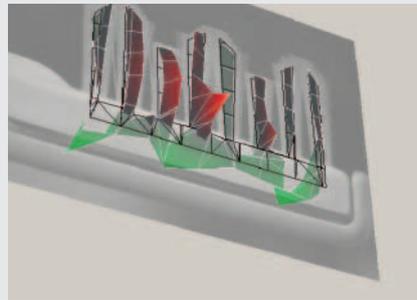
Philipp Holzmann, PARI Pharma GmbH, Gräfelfing, Germany





### Improving Efficacy in Dental Ultrasonics

Visualizing the motion of ultrasonic dental descalers is challenging due to their high frequency vibrations, small associated displacement amplitudes and multi-axis vibration. Laser vibrometry has made it possible to study, in detail, the vibration patterns of dental ultrasonic descaling



equipment, and to determine the most effective designs. The Scanning Vibrometer has found further application for measuring the response of endosonic files, ultrasonic retrograde tips and even powered toothbrushes.

Please read the full article at:

[www.polytec.com/infocus](http://www.polytec.com/infocus)

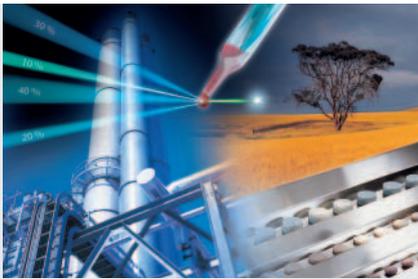
German: [www.polytec.de/infocus](http://www.polytec.de/infocus)



"Laser vibrometry has made it possible to determine the most effective designs"

**Dr. Simon Lea,**  
School of Dentistry,  
University of  
Birmingham, UK

[www.dentistry.bham.ac.uk/dentalultrasonics/](http://www.dentistry.bham.ac.uk/dentalultrasonics/)



### 100 % Quality Control of Tablets, Capsules and Pharmaceutical Substances

Near Infrared (NIR) spectroscopy is used for fast, reliable, and non-destructive measurements on pharmaceuticals to simultaneously control manufacturing processes and product quality, assuring that final product specifications and quality are met. Polytec spectrometers combine a high sampling rate with a flexible optical delivery method. Due to the extremely high measurement speed of these systems, each and every capsule or tablet produced can have its active ingredient content verified, thus, giving 100 % inspection and certification.

More Info · Contact:

[st@polytec.de](mailto:st@polytec.de) · [www.polytec.com/st](http://www.polytec.com/st)

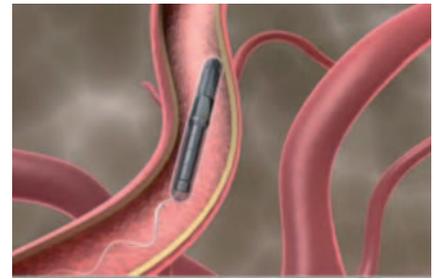
### Motors for Medical Nano-Robots

Remember the movie *Fantastic Voyage*? Now researchers are developing a motor for nanorobots with the help of Polytec's Micro System Analyzer. Its Australian creators hope their tiny motor will soon power medical nanorobots that can swim through tiny blood vessels into the brain. They made the microscopic motor using a piezoelectric material whose resonance frequencies and the associated mode shapes were determined by the use of a Micro System Analyzer.

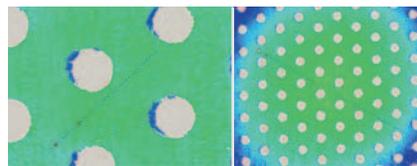
Please find more information on

<http://mnrl.monash.edu> and

[www.youtube.com/watch?v=VRMEtCCDR\\_E](http://www.youtube.com/watch?v=VRMEtCCDR_E)



"Simple can be made small"  
**Prof. James Friend,**  
MicroNanophysics Research  
Laboratory, Monash  
University, Melbourne



### Surface Metrology for Development and Quality Control of Medical Devices

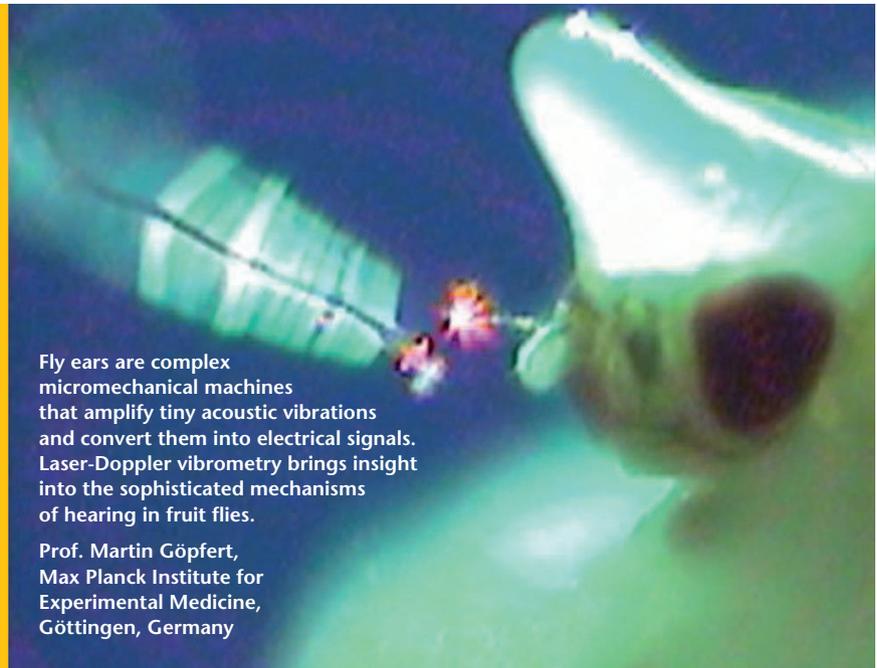
Polytec's White-Light Interferometers are well suited for non-contact 3-D surface characterization of medical devices.

For instance, the structure of tiny holes in the membrane of a drug nebulizer (see photo) can be monitored during production. 3-D topography and dimensions of cell clusters, dental implants, lab-on-a-chip systems and many other objects can be easily acquired. Polytec TopMap systems help determine critical parameters like flatness or waviness of various optical and mechanical parts of medical tools and machines.

More Info: [www.topmap.info](http://www.topmap.info)

# Applications in Biology

For nearly every living species on our planet there are corresponding biological applications of laser vibrometry. One of the most prominent is insect communication. Other bio applications include measuring echo location mechanics of mammals like bats or dolphins, communication between elephants, honeycomb vibrations in beehives, fruit quality, spider web motion, and the hearing mechanism in frogs, crickets, fruit flies, and other animals.



Fly ears are complex micromechanical machines that amplify tiny acoustic vibrations and convert them into electrical signals. Laser-Doppler vibrometry brings insight into the sophisticated mechanisms of hearing in fruit flies.

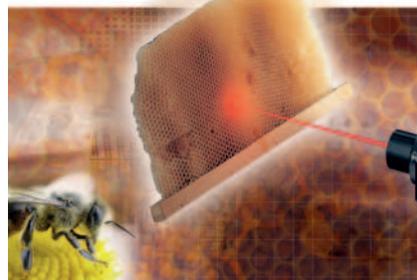
Prof. Martin Göpfert,  
Max Planck Institute for  
Experimental Medicine,  
Göttingen, Germany



## The Mechanics and Morphology of Hair-based Sensor Arrays

Crickets possess a hair array that can detect minute changes in air flow. It is one of the most sensitive sensory systems known in nature. By understanding how this highly sensitive biosensor works, we open the door to bio-mimicry, the manufacture of new sensors such as microelectromechanical systems (MEMS) technology, as substitutes for insect biology. The project already shows some very promising results.

Prof. George Jeronimidis,  
Dr. Emma Johnson,  
Centre for Biomimetics,  
University of Reading, Berkshire, UK



## Communication in Beehives

Social insects are excellent subjects for study. Understanding their mechanical systems and the evolution of differentiated, meaningful communication signals is important. The use of innovative laser vibrometry methods to measure signals and their transmission has shown how brilliantly the honeybees have utilized such signals to communicate.



“Vibrations of complex and lightweight structures like honeycombs can only be measured with non-contact equipment like laser vibrometers”

Prof. Jürgen Tautz,  
Biocenter, University of  
Wuerzburg, Germany



## The Origin of Sound-Processing Elements in Ensifera

The group of insects which include crickets is called Ensifera and produce sounds for communication. Their ears have evolved in their legs from the pre-existing vibratory organs. Through our study, we want to determine whether their auditory and vibratory senses share a common origin within their central nervous system. Non-contact laser vibrometry offers many advantages over contact methods of measuring vibrations.

Dr. Nataša Stritih, National Institute  
of Biology, Ljubljana, Slovenia

# Polytec Optical Measurement Systems

## Benefits for Bio-Medical Research and Testing

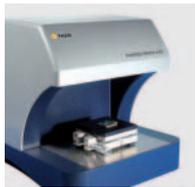
Laser vibrometry can sense the smallest of vibrations. It gathers data to display and characterize how mechanical motion takes place. It delivers a full picture either of single-point frequency responses or of full-field structural deflection shapes, by way of scanning vibrometry. Both Polytec's laser vibrometers and optical surface metrology help improve our knowledge about living objects as well as medical devices.



### MSA-500 Micro System Analyzer

Besides scanning vibrometry for measuring out-of-plane vibrations of microscopic structures, the MSA includes also stroboscopic video

microscopy for in-plane motion and white light interferometry for high resolution topography. [www.polytec.com/microsystems](http://www.polytec.com/microsystems)



### TopMap Surface Metrology

Polytec's TopMap Topography Measuring Systems allow for non-contact, high-precision surface profile measurements and 3-D image analysis of

both small and large surfaces and structures, including soft materials in research, development and quality control. [www.topmap.info](http://www.topmap.info)



### UHF-120 Ultra High Frequency Vibrometer

The UHF-120 Vibrometer is designed to characterize mechanical motions at frequencies up to 1.2 GHz, enabling the precision examination of high frequency RF-MEMS and other components. In addition, the capability to resolve high velocities permits the characterization of high-intensity, focused ultrasound transducers. [www.polytec.com/uhf](http://www.polytec.com/uhf)

Polytec is a global enterprise with corporate facilities in Europe, North America and Asia. Our market-leading position is built on innovative technology, high-quality products, engineering excellence, expert technical advice and thousands of satisfied customers worldwide.



### CLV-2543 Compact Laser Vibrometer

The CLV-2534 is the most versatile instrument for the audiologist and the otologist. Designed as an all-in-one system, it comprises the laser

sensor head with integrated optics and video camera. For beam steering and integration with the clinical microscope, the sensor head is mounted onto the Micro Manipulator. The head is fiber-coupled to the CLV control unit containing the laser source and the latest digital demodulation electronics for low-noise measurement. It can resolve nanometer displacements with ease. [www.polytec.com/vibrometers](http://www.polytec.com/vibrometers)



### OFV-5000 Modular Vibrometer Systems

The OFV-5000 Controller is the core of Polytec's state-of-the-art laser vibrometer systems and can be equipped with specialized sensor heads.

For fundamental research on biophysical processes, there is no other measurement technology providing such sensitivity with displacement resolution below 1 pm. [www.polytec.com/vibrometers](http://www.polytec.com/vibrometers)



### PSV-400 and PSV-400-3D Scanning Vibrometers

Polytec's Scanning Vibrometers provide cutting edge measurement technology for the analysis and visualization of structural vibrations up

to 24 MHz. Entire surfaces can be rapidly scanned and automatically probed, with no mass loading or added stiffness. [www.polytec.com/psv](http://www.polytec.com/psv)

The full articles can be viewed and downloaded from [www.polytec.com/infocus](http://www.polytec.com/infocus) (German: [www.polytec.de/infocus](http://www.polytec.de/infocus)). For more information and advice, please contact your local sales/application engineer.

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# New Applications

## Laser Surface Velocimeters for Non-destructive Testing of Steel Tubes

The Institut Dr. Foerster provides turnkey test lines consisting of Foerster testing systems and measurement equipment from other manufacturers.

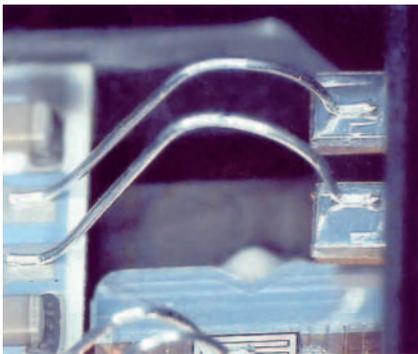


Currently a South American customer is testing seamless steel tubes. The test line includes two LSV-1000 Laser Surface Velocimeters from Polytec. Both the laser head and the electronics are now integrated into a single compact housing, facilitating a simple integration into the testing line. The first Laser Velocimeter provides a millimeter "clock", which is processed by the Foerster test electronics to determine the length of test pieces and the flaw position for logging and color marking. A second Velocimeter integrated downstream is used to recognize speed variation of test pieces due to the enormous extraction forces (more than 3000 N) caused by the flux leakage testing.

### Author

Michael Urban,  
Institut Dr. Foerster GmbH & Co. KG,  
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## Lifetime Testing and Assessment of Microelectronic Interconnects



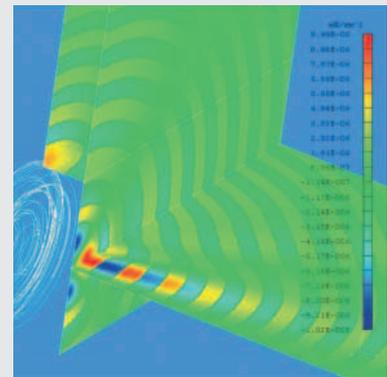
An accelerated test system for power and microelectronic interconnects is presented that offers reliability assessment and fast screening for product quality. This test system permits diverse loading modes to test various component geometries and

material combinations. Measurement of local velocities by differential Laser-Doppler vibrometry permits calculation of displacements and accelerations acting on the structure under test. Using this method, fatigue endurance curves were obtained and lifetime was modeled and compared with available lifetime measurements of similar micro-joints obtained in industrial power cycling tests.

### Authors

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Brigitte Weiss, Viktor Groeger,  
University of Vienna, Austria  
Thomas Licht, Infineon Technologies,  
Warstein, Germany

## Vibration and Acoustic Characteristics of Railroad Wheels



As cities become more crowded and congested, reducing rolling noise from railroad vehicles such as commuter and freight trains is an important priority in controlling urban noise pollution.

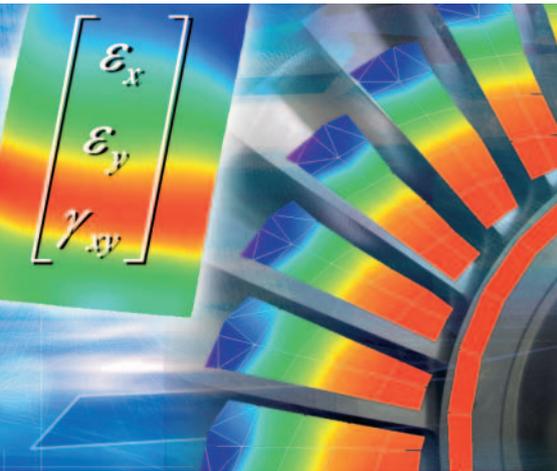
Rolling noise consists of both rail noise and wheel noise. A study at RTRI, Tokyo, focused on the wheel noise and its sources including the wheel web and associated parts. A 3-D experimental modal analysis was performed by using Polytec's PSV-400-3D Scanning Vibrometer to validate the mode shapes obtained by Finite Element Method (FEM) analysis and the predicted sound power from Boundary Element Method (BEM) analysis. Finally, the acoustic radiation from modified wheel geometries was calculated, showing that wheels with increased rim thickness produced the lowest sound level.

### Authors

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Institute (RTRI) Tokyo, Japan

# Product News

## PSV Software Version 8.7 Released with New Enhancements



Data processing software that is well written has several key features including powerful processing functions and a simple, easy-to-understand user interface. Our customers confirm that this has been accomplished with our PSV software. The new 8.7 version has further enhanced functionality while remaining a reliable tool for full-field vibration measurements. One key benefit included in the newest release is an autofocus function that is much quicker. The new release is designed to support the measurement of dynamic stress and strain in three dimensions by using the PSV-400-3D coupled with the PSV StrainProcessor. An optimized, fast

triangulation algorithm is available that enables the precise determination of a sample's geometry for ultrasonic applications and strain measurements. Also, additional improvements have been made to the tools for scan (measurement) grid construction. These tools permit the use of imported geometries, such as from FE models, for the definition of the scan grid. Version 8.7 runs also under Windows® Vista™ 64 which accelerates the throughput when working with huge data sets as can be the case for robot-assisted measurements with the RoboVib Structural Test Station.

[www.polytec.com/software](http://www.polytec.com/software)

## Keeping Cool when Measurements Get Hot:

### LSV-1000 Measures Length and Speed even under Harsh Conditions

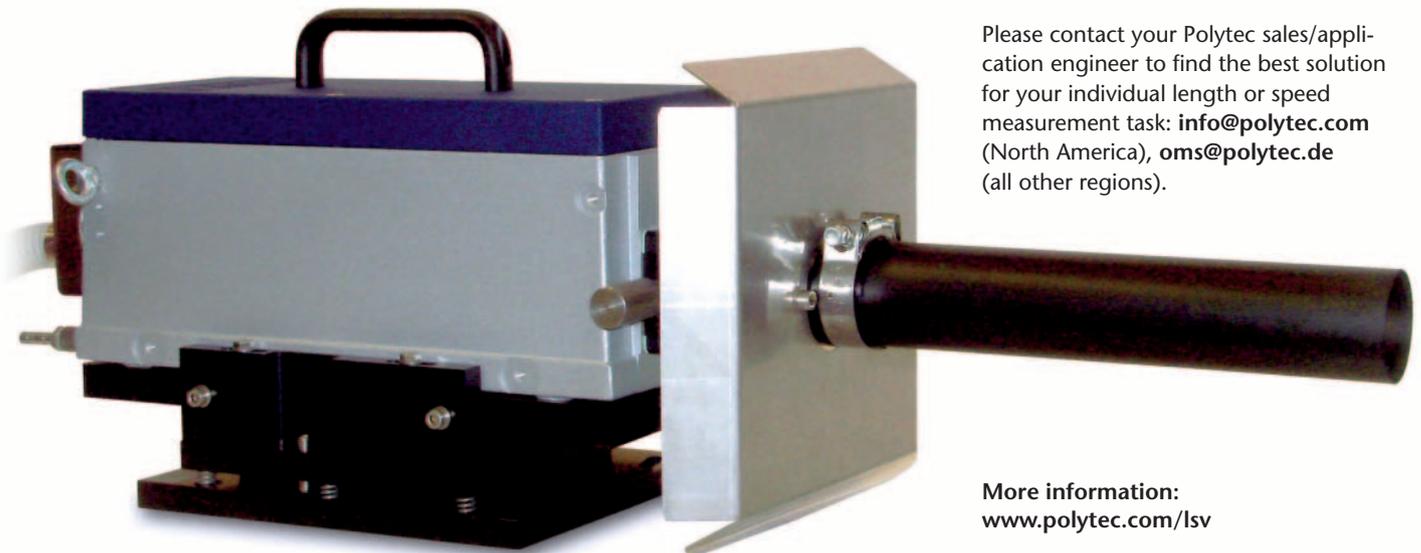
A new, comprehensive line of accessories enhances Polytec's industrial length and speed measurement systems. With the help of the new options, the LSV-1000 Compact Laser Surface Velocimeter can function in many different industrial environments ranging from dust-filled factories to high-temperature steel mills. A new cooling plate, an air wipe with quick exchange window and a cooled protective housing with a projecting tube/air wipe accessory (see photo) for

extreme operation conditions, minimize the environmental impact from heat, dust and vapor on the sensor head and optics. Various mounting and adjustment platforms as well as adapter plates and angular adapters are available for application-specific mounting and precise alignment to the object under test. To integrate the LSV-1000 into a radiometric gauge for mass-flow control, a special C-frame accessory kit provides all necessary components.



C-frame Accessory Kit

Please contact your Polytec sales/application engineer to find the best solution for your individual length or speed measurement task: [info@polytec.com](mailto:info@polytec.com) (North America), [oms@polytec.de](mailto:oms@polytec.de) (all other regions).

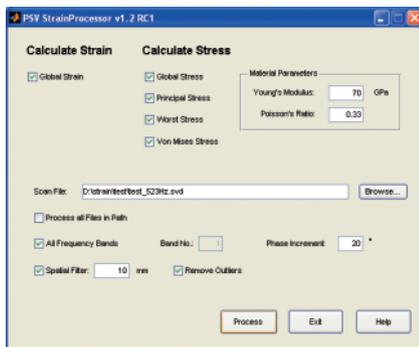


More information:  
[www.polytec.com/lsv](http://www.polytec.com/lsv)

## PSV StrainProcessor

Understanding the origin of the stress and strain distribution is crucial to increasing the durability of components under dynamic load. Numerical simulations based on finite element (FE) models help with this understanding but must be validated by real data from test structures.

Polytec's 3-D Scanning Vibrometer provides an advanced, non-contact optical test solution that provides accurate 3-D



vibration mapping, sets up quickly and interfaces with geometry models based on FE data. Polytec's StrainProcessor is a measurement extension developed to simplify finite element model (FEM) updating and for comparisons to calculated stress and strain distributions. It comprises a set of hardware and software components enabling a PSV-400-3D Scanning Vibrometer to measure and analyze the dynamic strain and stress distribution on surfaces with high resolution and low noise. Please find an application report on page V. For more detailed information visit [www.polytec.com/strain](http://www.polytec.com/strain)

### New Features:

## VibSoft Version 4.7

Good News for VibSoft-20 users: Using the appropriate USB video-in adapter, laptop support is now integrated for video-in from CLV-2534 and OFV-534 Sensor Heads with VIB-S-VIDEO. Also, a crosshair tool simplifies the beam positioning in the video window. The user interface has been redesigned to be much easier for repeated measurements with the same settings. A new autofocus control speeds up the refocusing process with compatible controllers. 3-D measurement capability has been enhanced to include high frequency measurements. VibSoft 4.7 operates also under Windows®Vista™ 64bit. [www.polytec.com/vibrometers](http://www.polytec.com/vibrometers)

## New NIR In-field Spectrometers and Accessories



Harvesting, agro business and other demanding in-field applications benefit from Polytec's continued advancement in the portability for their NIR Spectral measurement solutions. The new systems cover the 850 nm – 1650 nm (PSS-1721) and 1100 nm – 2100 nm spectral range (PSS-2121).

They come with convenient 12 V and 24 V power supplies and have been designed for mobile-vehicle applications, such as grain harvesters. For continuous sample testing, customers can choose from contact or non-contact heads, depending on their individual needs. The non-contact Conveyor Belt Sensor (see right photo) measures at distances from 150 to 500 mm. In contrast, the Contact Sensor head is best suited for situations in which contact with powders, fluids and bulk material occurs (photo above). The housing is made from stainless steel and both sensors meet the IP-64 industrial protection standards to work properly in highly demanding environments. PSS Process Software supports automated measure-

ments and the visualization of spectral results in both laboratory and production environments. A fully automatic proprietary matching system allows the transfer of calibration records from one system to another. Target value predictions are possible through use of modeling routines (SensoLogic and The Unscrambler®). Communication with process controllers is accomplished by Beckhoff TwinCAT® I/O. More Info: [www.polytec.com/st](http://www.polytec.com/st)





# Trade Shows and Conferences

Mar 09 – 10, 2010	Smart Structures and Materials/NDE	San Diego, CA, USA
Mar 23 – 26, 2010	ANALYTICA	Munich, Germany
Mar 24, 2010	MEMUNITY-Workshop auf der Smart System Integration	Como, Italy
Mar 30, 2010	Technology Seminar: Characterizing Micro and Macro Structural Dynamics Using Laser Vibrometry	Ontario, Canada
Apr 01, 2010	Technology Seminar: Characterizing Micro and Macro Structural Dynamics Using Laser Vibrometry	Montreal, Canada
Apr 12 – 16, 2010	TUBE 2010	Duesseldorf, Germany
Apr 19 – 23, 2010	Hannover Messe	Hannover, Germany
May 03 – 06, 2010	AISTech 2010 Iron & Steel Technology	Pittsburgh, PA, USA
May 04 – 07, 2010	Control 2010	Stuttgart, Germany
May 12 – 13, 2010	Wire Expo 2010	Milwaukee, WI, USA
May 18 – 20, 2010	Sensor & Test 2010	Nuremberg, Germany
May 26, 2010	Aspects of Noise and Vibration Measurement	London, UK
Jun 06 – 10, 2010	Hilton Head 2010 Workshop	Hilton Head, SC, USA
Jun 22 – 24, 2010	Automotive Testing Expo Europe	Stuttgart, Germany
Jul 12 – 15, 2010	17 <sup>th</sup> International Congress on Sound and Vibration (ICSV17)	Cairo, Egypt
Sep 20 – 22, 2010	ISMA 2010	Leuven, Belgium

Reference our web site [www.polytec.com](http://www.polytec.com) for the most up-to-date information and links on trade fairs, events and seminars!

## Polytec Online Seminars

Interested in special issues like brake testing, experimental modal analysis, rotational vibrations, ultrasonics, biological and medical applications? Just attend our free webinars in the web! Register for one or many seminars at the Polytec Web Academy at <http://polytec.webex.com>



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