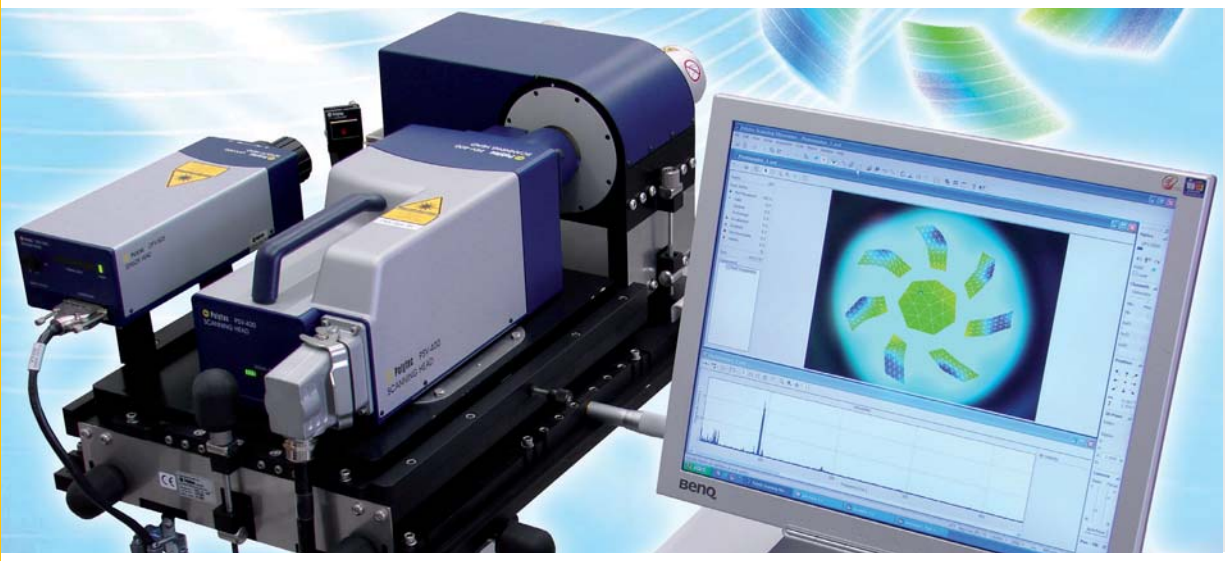
Polytec

PSV-A-440
Optical Derotator



Polytec Scanning Vibrometers

- PSV-400 Scanning Vibrometer
- PSV-400-3D Scanning Vibrometer
- MSA-500 Micro System Analyzer
- PSV Software
- **PSV-A-440 Optical Derotator**
- RoboVib Structural Test Station

Non-contact Vibration Measurement on Rotating Objects

The Optical Derotator makes it possible in a simple way to make non-contact vibration measurements on rotating parts with laser vibrometers. Order analyses and measurements of the operating deflection shapes at rotational speeds of up to 24,000 RPM can be realized in this way without the necessity of complex telemetry or the interference of sensor mass. The actual measurement is amazingly simple, as optics rotating at the same RPM freeze the motion of the object. This means that rotating objects, such as fan impellers for consumer products and vehicles, rotors, turbines or also tires can be measured as if at rest.

Optimization of Dynamic and Acoustic Properties in the Early Development Stage

The vibration behavior of rotating structures and components changes depending on the rotational speed. The PSV-A-440 Optical Derotator has been developed as an extension to the tried and trusted PSV-400 Scanning Vibrometer to examine real behavior under operating conditions and to get information on the operating state. This information is already available when designing the component, thus allowing you to avoid undesirable acoustic effects or mechanical weaknesses in operation later on.

Key Features and Benefits

- **Safe input data for the calculation through measurements made under real operating conditions**
- **Operating deflection shapes**
- **Run-up and coast-down measurements**
- **No telemetry necessary**
- **Compatible with all PSV-400 Scanning Vibrometers**
- **Simple synchronization with standard encoder signals**

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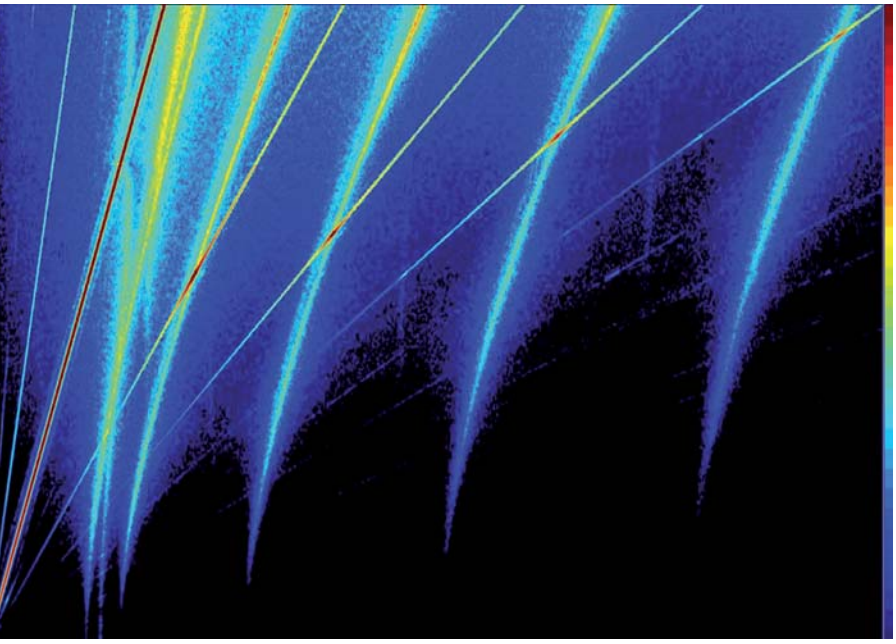
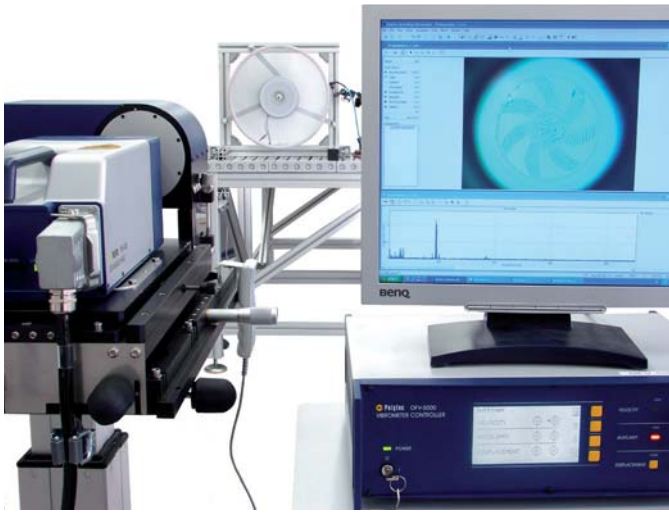
New Insight

User-friendly and non-contact measurement of deflection shapes are the specialty of Polytec Scanning Vibrometers. They have already made it possible to take measurements on continuously rotating parts, such as brake discs or shafts.

The Optical Derotator now expands the area of application to axial measurements on any geometry. Using special rotating optics, the object under test appears to be standing still. Particularly on segmented parts, the results derotated in this way give an insight into the actual behavior of a specimen dynamically stressed by the rotational movement. Especially with plastic parts, the stiffness changes and thus also at high rotational speeds the stiffness changes and thus also the eigen-frequency. Changes to stiffness are immediately apparent in the order analysis. The derotator measurement exposes undesirable resonance excitations and directly supplies vibration amplitudes that can be used to estimate service life, for example.



Changed natural resonances due to the change in stiffness at an increased rotational speed.



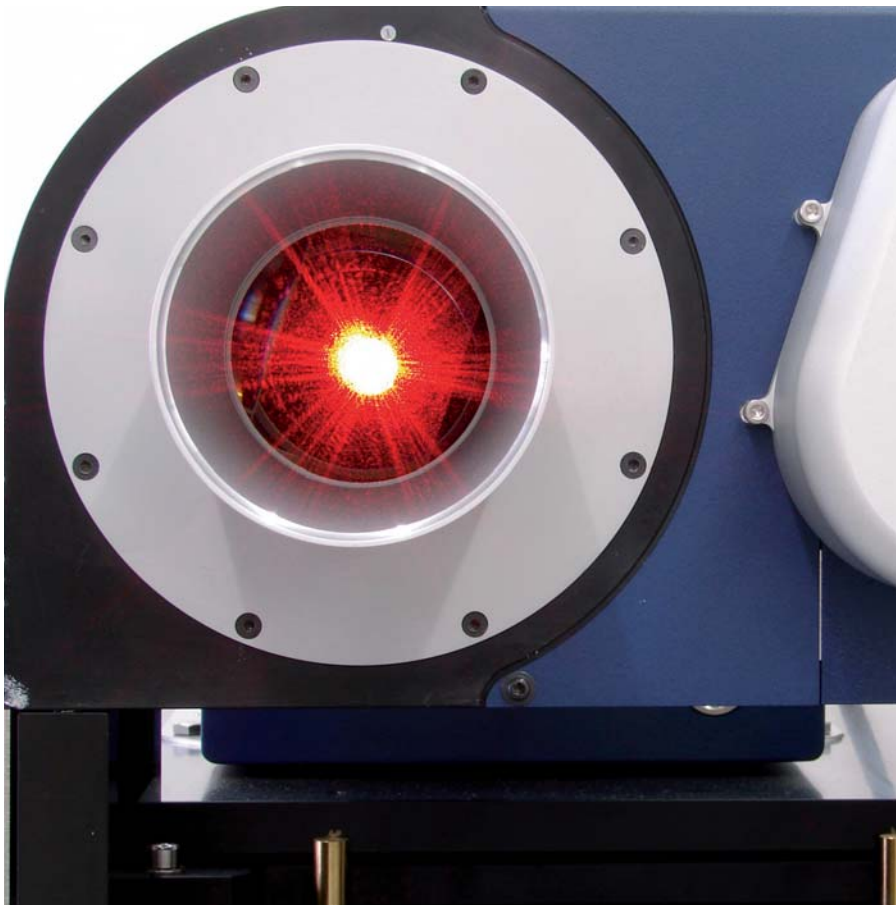
Perfect Interaction

With the PSV-A-400 Optical Derotator, a precisely controlled optical rotation unit guides the laser beam to follow the rotating object. Flexible control for fixed rotational speeds or run-ups links the derotator to an encoder signal that comes from the sample. Once synchronization has been achieved, the object appears to be at a standstill in the video image of the Scanning Vibrometer and making the actual measurement is as easy as with an object that is not moving. The definition of the measurement grid and the scanning process are carried out in the customary simple way with a Polytec Scanning Vibrometer. A second laser vibrometer, whose laser beam also runs through the derotator, is used as the phase reference for presenting the deflection shape.

Two Dynamic Measurement Variants

In single point mode, run-up and run-down tests can be carried out for an order analysis. In doing so, the measurement laser is pointed at a fixed point. In parallel to that, the RPM signal is recorded. With this data, an order analysis is then carried out, which identifies excess resonance increases depending on the RPM.

In scanning operation, a defined surface, for example the blades of a turbine or fan are scanned at a fixed RPM. The scanning process runs automatically. After a short time, the operating deflection shape is available, which can then be compared to simulation calculations and modal tests at rest.



All-in-One System

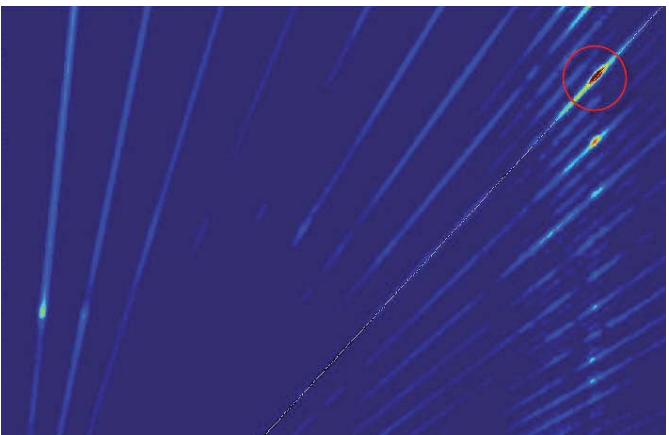
The complete system for measuring deflection shapes on rotating parts is made up of the PSV-A-440 Optical Derotator with the rotation unit, the control and a base frame for aligning the rotation axis of the object with that of the derotator. The sensor technology is made up of the PSV-400 Scanning Vibrometer and an OFV-505 reference laser vibrometer with an OFV-5000 controller. All systems are controlled by a common computer.

Applications: When Everything is Turning

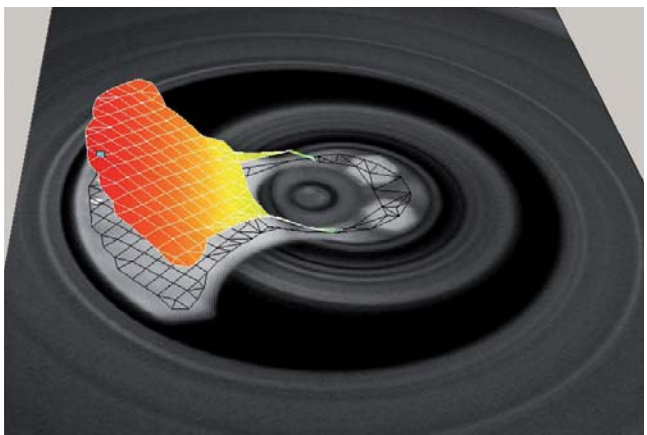
The Derotator provides its valuable services anywhere that real behavior cannot be measured because of rotation.
Using an undesirable excited bending natural mode of a component at risk as an example, the possibilities opened up by direct measurement can be shown.

It was possible to measure and quantify the excitation measures with the derotator. This provided suitable data for an estimation of service life.

Run-up: Increased amplitude due to resonace on a counterweight.



The associated deflection shape of the counterweight measured at 3000 RPM.



Technical Data

Delivery Contents

PSV-O-440 Rotation unit	Prism unit with drive and protective guard SUB-D jack for encoder signals
PSV-A-410-DER Co-axial unit	Attachment for PSV-I-400 scanning head. Brings camera image and laser beam onto a common optical axis. Additional beam splitter for reference beam.
PSV-E-440 Controller	Control electronics for Rotation unit
PSV-S-DER Control software	Software for setting the parameters of the control electronics and to adjust to the reference encoder. Software is installed on the PSV-400 Data Management System. Operating system Windows XP
PSV-A-P44 Adjustable Base Frame	Allows close-up adjustability of the derotator to the axis of rotation of the object and adjustment of the reference laser beam.
PSV-A-T44 Base frame	To move the entire derotator slightly and to hold the controller.

Derotator Specifications

Max. RPM object	24,000 RPM
Max. RPM change speed	700 RPM/s
Scanning angle	±4°; measurement distance approx. 7x object diameter
Phase jitter at rotational speed of object (in master/ slave operation)	■ 6,000 RPM: ±0.2° ■ 12,000 RPM: ±0.2° ■ 24,000 RPM: ±0.4°
Encoder (internal)	500 Imp/rev
Reference encoder (on object under investigation)	■ Recommended ≥500 Imp/rev (not included in delivery) ■ Master Encoder mode output TTL A/B or A, /A, B, /B (recommended) ■ Step Direction Mode: TTL Pulse signal
Adjustment device	■ Adjustment range height 300 mm ■ tip angle ±3° ■ Adjustment range side ±18 mm ■ Tilt angle ±1.5°

Compatible Sensor Heads

Scanning sensor head	PSV-I-400 Sensor Head with PSV-A-420 Distance Sensor, optics sensor head: LR (long range; recommended) or MR (mid range)
Reference sensor	■ Recommended: OFV-505 or OFV-503 with LR- (long range; recommended) or MR (mid range) optics ■ IVS-300 or IVS-400 with VF lens ■ PDV-100 Portable Digital Vibrometer

General Features

Dimensions	L x W x H_{min} ... H_{max}: 105 cm x 60 cm x 110...140 cm
Weight	145 kg (without sensor heads)
Mains supply	100 V ... 230 V, 50/60 Hz

Please find more detailed information on the PSV-A-440 Optical Derotator, on the PSV-400 Polytec Scanning Vibrometer and on the reference sensors in separate data sheets or at **www.polytec.com/derotator**

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