VSM 3D-SCAN-(EXT)

VSM 3D-SCAN-UW2 (EXT)
3D SCANNING LASER VIBROMETER

- *Scanning Vibrometer for Full-Field 3D Vibration Measurement on Large Objects*
- *Class 2 Laser*
- *Fast Autofocus*
- *Self-Mixing Interferometric Configuration*
- *3x Laser Telemeters for 3D Geometry Measurement*
- *Works Through-Water and on submerged Targets*
- *Frequency Range from DC to 50 kHz (option: 20 kHz - 3 MHz)*
- *Easy and Automatic Alignment of the Three Optical Heads*

3D Scanning Laser Vibrometer

Julight VSM-3D-SCAN Laser Vibrometer **combines three individual 2D scanning laser vibrometer heads**, each equipped with a state-of-the-art two-axis galvanometer mirror system for deflection and scanning of the laser beam. The VSM-3D-SCAN allows to perform the full-field 3D vibration and modal analysis of a large object without contact. Operating distance is up to 5m. For distance larger than 2m, the use of retroreflective tape is recommended.

The system is managed by a proprietary PC software that simultaneously controls the three scanning heads, so that the three laser beams hit the same point of the target.

A dedicated, high-precision fully-analog electronic circuit board calculates in real time the exact vibration components along the X, Y, and Z directions, starting from the raw vibration signals A, B, and C measured by the three lasers. Thus, the electrical output signals are a replica of the target displacement or velocity components along the X, Y, and Z axes, in a frequency range from DC to 100 kHz (or from DC to 3 MHz with "-EXT, extended frequency" option).

Applications

- Full-field 3D non-contact vibrations measurement
- Automotive, aerospace, and mechanical industry
- Modal analysis

Principle of Operation

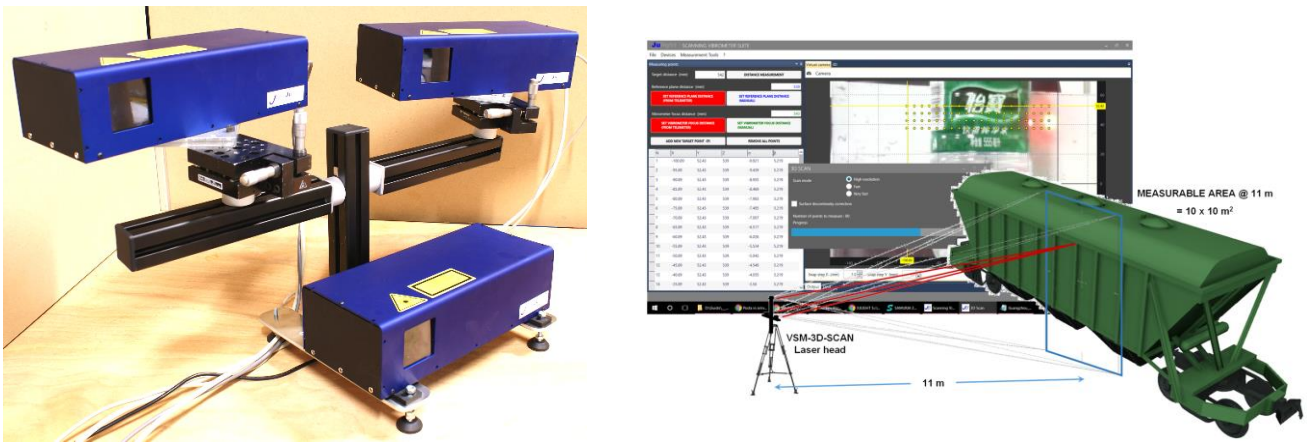
Julight Laser Vibrometers use state-of-the-art diode semiconductor lasers, and are based on the novel self–mixing interferometric scheme, that exploits the coherent interference of the backscattered light directly into the laser, allowing for greatly simplified optical design and the smallest, most lightweight, optical heads on the market.

Features for 2D/3D Scan System

- **HD Video Camera** – The object under test can be viewed on the PC through a HD color camera integrated into each optical head. The user can select the measuring points on the image of the object.
- **Geometry 3D Scan** – A scanning laser telemeter is integrated in each optical head, to acquire the 3D profile of the object under test. This feature greatly simplifies the alignment of the three laser beams for 3D vibration measurements, for which the user must not do any manual alignment.

Each of the three scanning vibrometer units can also be used independently as a 2D scanning system.

An external data acquisition system is required to store and analyse vibration time series.



VSM-3D-SCAN optical heads with mechanical mount (left). PC software and measurable area (right)

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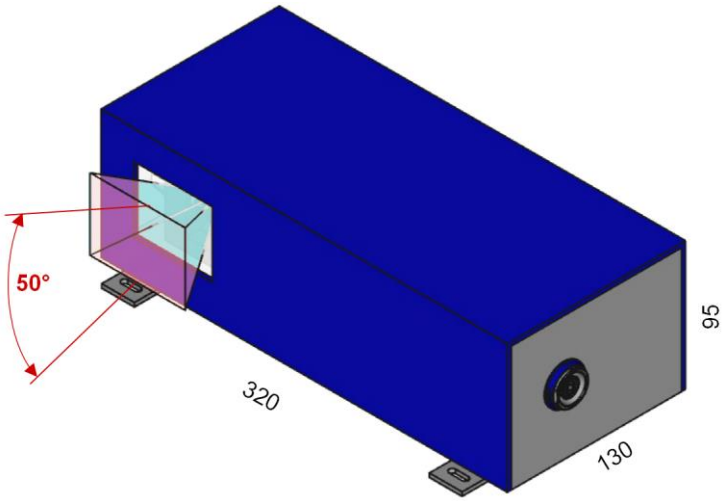
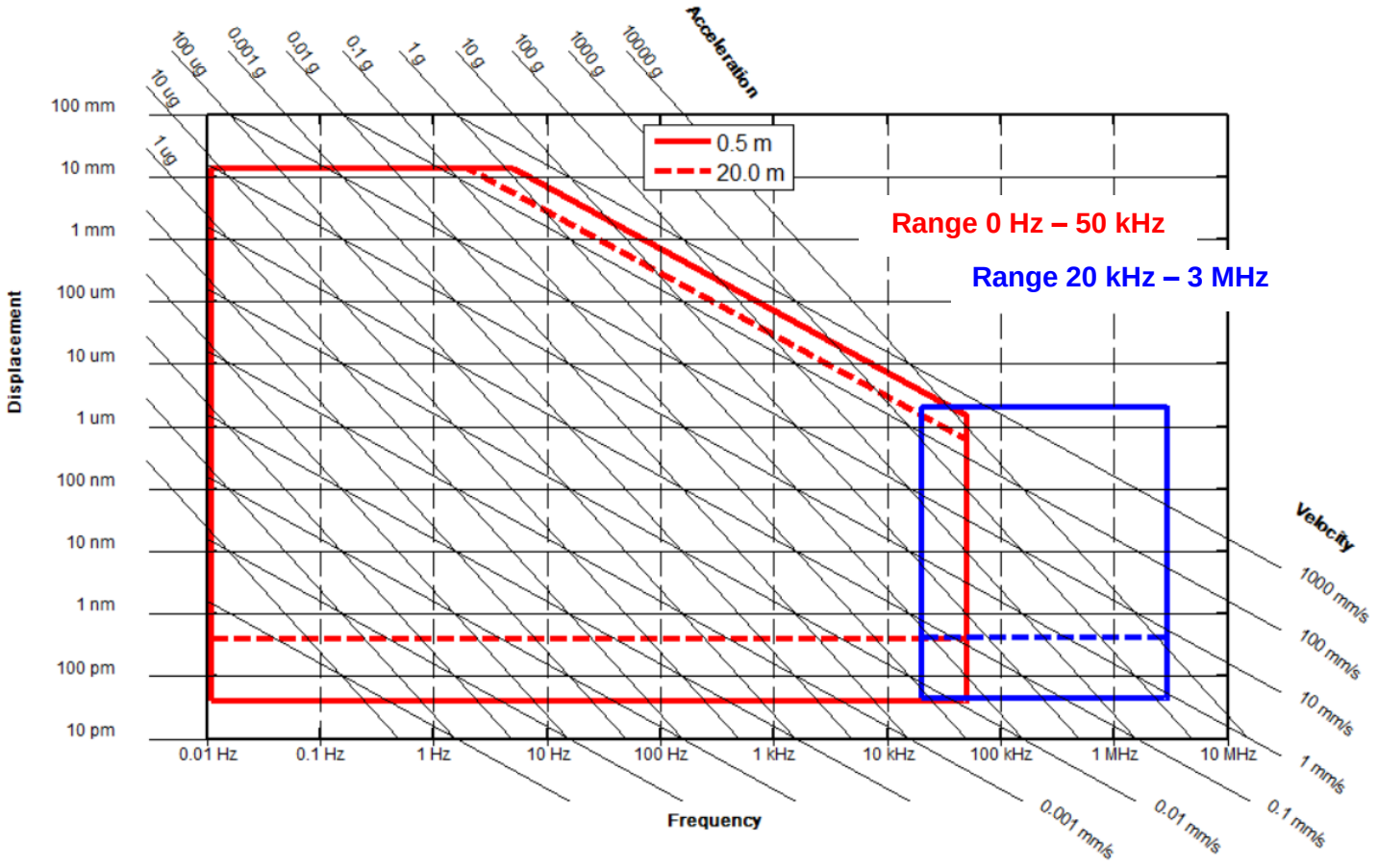
VISIBLE AND INVISIBLE
LASER RADIATION
DO NOT STARE INTO THE BEAM
CLASS 2 LASER PRODUCT
λ = 650 ± 10 nm ; P max. < 1 mW
λ = 1310 ± 10 nm ; P max. < 15 mW
(according to IEC 60825-1:2007)

SINGLE LASER HEAD DIMENSIONS
(in mm)



MEASURABLE VIBRATIONS



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FULL MODAL ANALYSIS CAPABILITY

Julight VSM-3D-SCAN Laser Vibrometer allows to execute complete Modal Analysis tests, yielding as output the 3D ODS (Operational Deflection Shapes).

For laboratory experiments where the vibration of the object under test is forced by the user, the three lasers of the VSM-3D-SCAN allow to obtain the 3D EMA (Experimental Modal Analysis).

Instead, for in-the-field experiments, where the vibration of the object under test is not forced and is intrinsic or naturally generated, an additional single-point Laser Vibrometer head (OH-1000-(L)-(EXT)) must be used as reference channel for the three lasers of the VSM-3D-SCAN. In this way the OMA (Operational Modal Analysis) can be obtained.

OPTIONAL 2D/3D ROTATION TRACKING

Julight Scanning Laser Vibrometers (both 2D and 3D) can be equipped with the Rotation-Tracking option (-TRACK) for the measurement of the vibration of rotating targets, such as discs, wheels, fans, turbines.

The tracking of a point of the rotating object is obtained by driving the mirrors of the two-axis galvanometer scanner in real-time, in such a way that the laser beam(s) always aim at the same identical point on the rotating surface.

Since the rotation-tracking does not require a complex and expensive rotating prism (optical de-rotator), the rotation-tracking can be efficiently done also for 3D vibration measurements, with the three lasers aiming at the same point of the rotating surface, from three different angles of incidence.

PRINCIPLE OF ROTATION-TRACKING

This is obtained through a combination of the PC software and a dedicated electronic hardware. The system receives as input a signal from an encoder or a tachometer (an optical non-contact tachometer, SNS-1000-TACHO, is also available from Julight), and it accurately synchronizes the movement of the laser beams in-phase with the rotating object. The user can change the relative phase of the point to be tracked, from 0° to 360°, i.e. all the points of the rotating object be tracked, one at a time, thus obtaining a scanning vibration measurement result similar to the case when the rotating object is at rest.

The principle of the rotation-tracking is based on a circular trajectory for the scanned laser beams, implemented automatically by the software according to the rotational speed of the object under test (deducted from the Tacho or Encoder signal), and the circle drawn by the user in the camera window of the Julight software that controls the Scanning system. For cases where the rotating plane is not perpendicular to the optical head(s), the user can finely adjust the ellipticity of the circular trajectory. A pre-run test function allows the user to check that the projected beam(s) is(are) correctly positioned onto the object under test.

The system is auto-aligning and it does not require difficult alignment procedures from the user.

For experiments where the instantaneous rotational speed of the rotating target object is not constant, the Julight system can even track rotational speed variations within a single turn, by synchronizing to the angle signal from an encoder.

The Rotation Tracking option can equip one of the three 2D scanning optical heads, or all the three of them. In the latter case, the system acts as a full 3D-scanning rotation-tracking laser vibrometer.

An optional DSLR (Digital, Single-Lens Reflex) camera with speedlight (by Nikon or Canon, specific model to be defined at the time of purchase) can be also included in the system, with the goal of taking a snapshot at the rotation object, thus enabling the user to see where exactly the beam(s) of the laser(s) head(s) is(are) aiming at onto the rotating target. The camera takes snapshots with 1/8000 s exposure time or shorter, synchronized with the tacho signal from the rotating object, thus allowing to identify the angular and radial position of the laser beam(s), with an angular accuracy of 2° @10000 rpm.

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Performance	0-100 kHz	20 kHz - 3 MHz
Maximum measurable vibration (peak-to-peak)	43 mm (theoretical) 15 mm (practical)	4 µm
Maximum measurable velocity	0.5 m/s @ 0.5 m 0.2 m/s @ 5.0 m	40 m/s
Output signals	• Raw (A, B, C) and X, Y, Z Displacement and Velocity (analog) • Scan Sync (digital) • 3x Monitor (3.5mm jack): - Optical Signal Level (analog) - Speckle-Tracking active (digital)	
Output signal responsivity	• Displ.: 0.5, 50, 5000 V/mm • Vel.: 5, 500, 50000 V/(m/s)	5 V/µm
High-Pass filter	None (DC response) , 0.1 Hz, 5 Hz, 100 Hz	20 kHz
Low-Pass filter	100kHz, 10kHz, 3kHz, 1kHz, 0.3kHz	3 MHz
Resolution	Noise-limited	
Noise Equivalent Displacement	0.04 nm/√Hz @ 0.5 m 0.4 nm/√Hz @ 5.0 m	
Output signal accuracy	1 % (@0.5m)	<5 %
Spatial transverse resolution	100 µm @ 0.5 m 500 µm @ 5.0 m	
Target surface	Diffusive or retro-reflective.	
Working distance	from 0.1 to 5.0 m	
Autofocus	Fast, assisted by laser telemeter	
Telemeter resolution	±0.5 mm	
Scan angle	50° × 50° (2D scanning, single head) 40° × 40° (3D scanning, 3x heads)	
Scanned area	from 10cm x 10cm, to 4.5m x 4.5m	
Maximum scan rate[1]	up to 5 pts/s (with Windows SW control) up to 400 pts/s (with direct Galvanometer programming)	
Angular resolution	0.002°	
Angular stability	0.001°/h	

Rotation-Tracking option	
Input signals	Tachometer (TTL) Encoder pulse angle (TTL) Sync polarity positive or negative
Maximum rotational speed	10000 rpm
Maximum rotational speed change	500 rpm/s
Allowed scanning angle	50° x 50° (2D scanning, single head) 40° × 40° (3D scanning, 3x heads)
Phase tracking error	<0.5° (with tachometer signal) <0.2° (with encoder signal)

Physical and Interface	
Laser radiation	• Pout < 1 mW @ 633 nm (visible)
Laser safety class	• Class 2 @ 633 nm (EN 60825-1:2008, CFR 1040.10, CFR 1040.11)
Camera (for each head)	HD 5MP (2592 x 1944 pixels), autofocus, variable exposure, with digital zoom
Optical head dimensions (single)	95 mm × 130 mm × 320 mm
Electronic unit dimensions (single)	24.6 cm × 15.5 cm × 32.0 cm
Optical head cable length	3 m (5 m option)
I/O	USB 2.0
Host PC (included)	• Processor: Intel Core i7 • RAM: 8 GB • OS: Windows 10
Software functionality	Alignment; Distance setting; Autofocus; Laser control; Camera pan and zoom; Measuring point selection (mouse-click, automatic array, import from .csv); 3D profile measurement (3D view, data export); Vibration measurement set-up; Rotation-Tracking
Power supply	• 110-120 VAC / 60 Hz • 220-240 VAC / 50 Hz
Power consumption	< 120 W
Weight	• main units: 3x 4 kg • optical heads: 3x 4 kg • mechanical mount: 5 kg
Temperature (operating)	Optical head: +10 °C to +60 °C Main unit: +10 °C to +50 °C

One main unit and optical scanning head

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