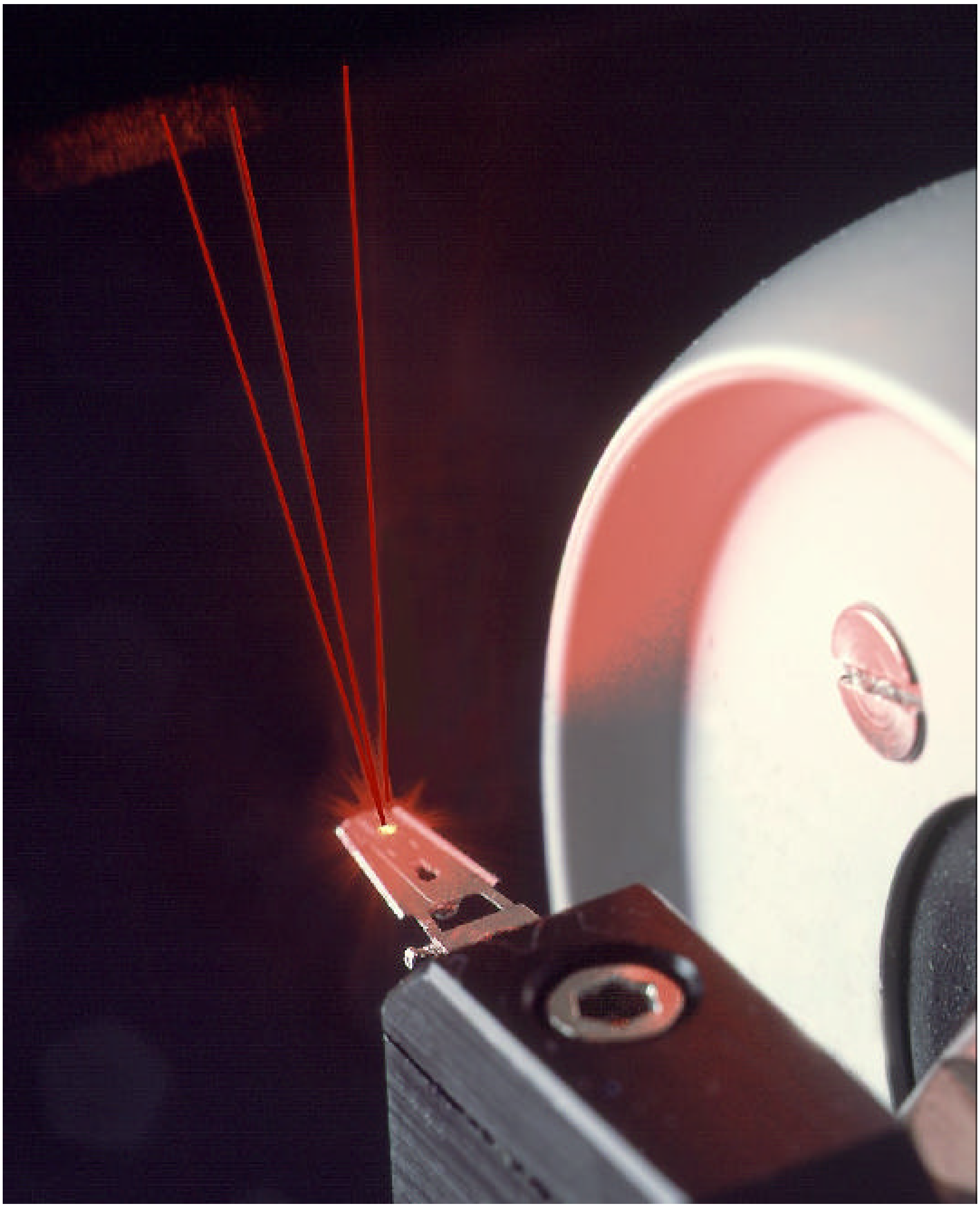
3D-LV Application for Drive Suspension Modal Test



Background

The task of performing a full modal test of disk drive suspensions has historically presented a number of obstacles. Mainly, the lack of three-dimensional information and the resulting amount of time required to test have made this a cost intensive procedure. One that is indispensable as well in an industry with ever increasing pressure to improve performance while slashing costs. By using the innovative 3D-LV vibrometer from Polytec PI, measurement of the complete motion of a suspension or actuator arm can be accomplished and the results obtained provide three-dimensional characterization over the entire structure. Further test time reduction is achieved with an integrated 3D-LV scanning system employing Polytec PI's positioning products and expertise. The result is a system with unparalleled capability. Furthermore, the scanning portion of the system can easily adapted for use with the large number of fiber LDV sensors so prevalent in the disk drive test field.

System Overview

A comprehensive solution was put together by Polytec PI. It consists of:

- 3D-LV sensor and controller to acquire three-dimensional velocity measurements.
- Modified CLV-T-031-NZ test stand including a beam splitter and camera with beam positioning adjustment.
- VIBSOFT-84 4-channel data acquisition system with internal generator.
- Coreco™ video board and software for camera image display.
- C-844 motor controller and M-511.DDB 100mm linear motorized stages for positioning of device under test (DUT).
- Polytec PI's DC Move and WinTerm programs for automated and interactive positioning of DUT.
- ME'scope VES™ software for modal analysis.

Figure 1 3D-LV Scan System arrangement

Principle of Operation

The 3D-LV optical sensor contains the optical components of three independent CLV-700 sensors. Each output laser beam is inclined at a 12° angle (f=160 mm lens version) with respect to the surface, but from three slightly different directions. A 12° angle is small enough to allow the sensors to collect enough back-reflected light to make a high-quality measurement, but still large enough for good sensitivity to the in-plane vibration components. Furthermore, the narrow cone angle allows the beams to pass through small holes or windows in wind tunnels or environmental test chambers. For even narrower cone angle applications, a f=310mm front lens may be fitted in combination with a 310mm version of the geometry module.

The 3D-LV sensor generates three laser beams: top, left and right, which measure components V_t, V_t and V_r, respectively. When the sensor is pointed at a surface vibrating in three directions V_x, V_y, and V_z, the true x, y and z components can be calculated using the following relationships:

$$V_r = V_z \cdot \cos q + V_x \cdot \sin q$$
$$V_l = V_z \cdot \cos q - V_x \cdot \sin q$$
$$V_t = V_z \cdot \cos q + V_y \cdot \sin q$$

Solving simultaneously,

$$V_x = (V_r - V_l) / 2 \cdot \sin q$$
$$V_y = (V_t - V_z \cdot \cos q) / \sin q$$
$$V_z = (V_r + V_l) / 2 \cdot \cos q$$

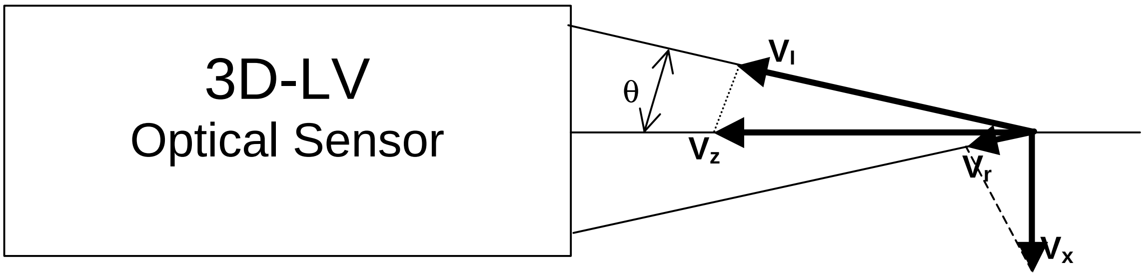


Figure 2 Top view of the probe beams and the coordinate system. The plane of this diagram is defined by the l-beam and the sensor axis.

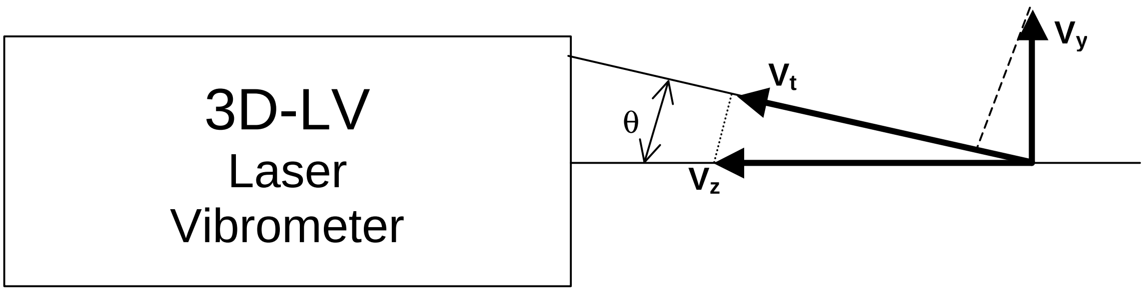


Figure 3 A different side view of the sensor. The plane of this diagram is defined by the t-beam and the sensor axis.

Measurement Description

Measurement of the DUT is carried out in the following steps:

- DUT, and shaker if applicable, is mounted onto linear X and Y stages. A Z stage can be easily added if necessary.
- 3D-LV sensor and CLV-T-031-NZ are set up so as to place beam coincident point on DUT.
- Image is captured and displayed using Coreco™ Bandit software or similar.
- Geometry to be scanned can be entered interactively with WinTerm, or a macro can be created for automated scanning using DC-Move.
- Data acquisition of X, Y and Z velocities and reference signal (load cell or accelerometer) is done with VIBSOFT-84 4-channel system. The software includes
- Excitation of DUT can be done with VIBSOFT-84 internal generator. A variety of excitation waveforms can be specified.
- Data can be exported using UFF format from VIBSOFT-84.
- Modal analysis can then be carried out in ME'scope™.

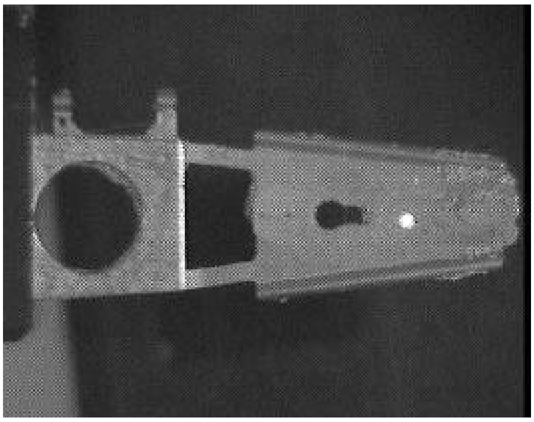


Figure 4 Suspension under test.

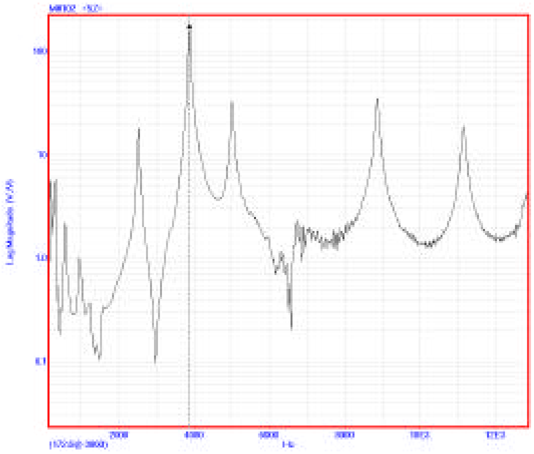


Figure 5 Frequency response function exported to ME'scope.

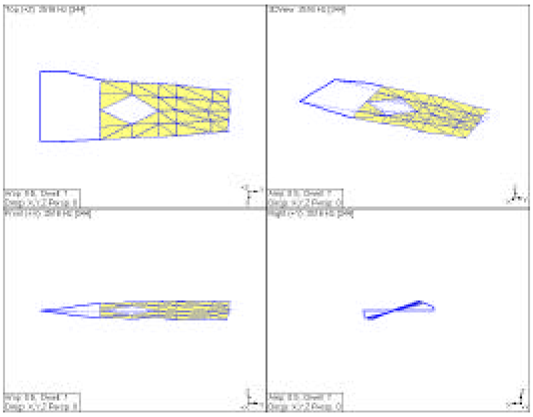


Figure 6 1st torsion mode.

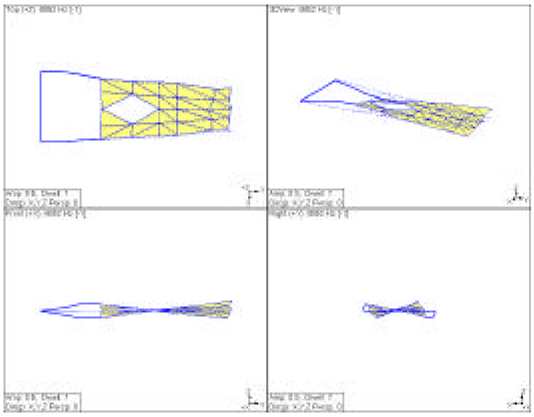


Figure 9 2nd Torsion mode.

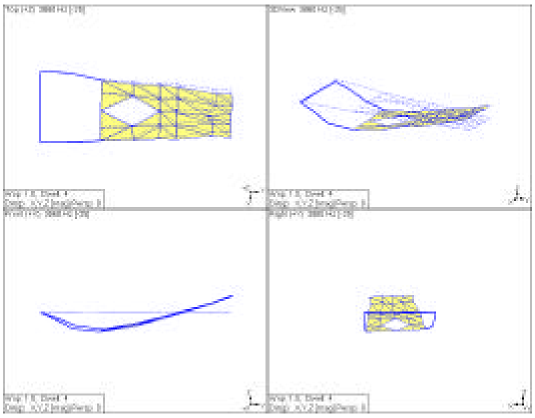


Figure 7 1st bending mode.

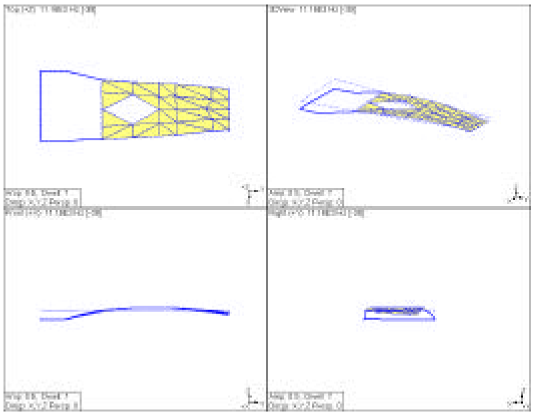


Figure 10 2nd Bending mode.

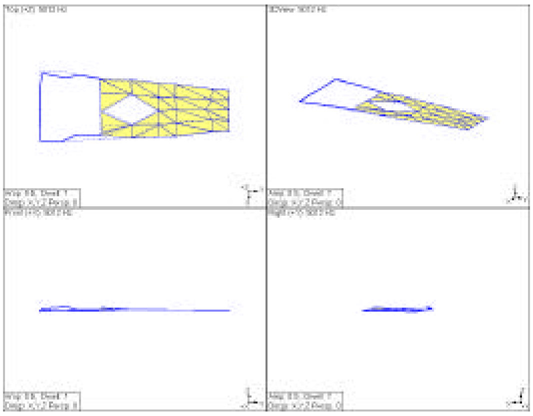


Figure 8 1st Swaying mode.

Figure 11 Overlaid FRF's (Real part).`

US Sales Offices

West
Polytec PI, Inc.
1342 Bell Avenue, Suite 3A
Tustin, CA 92780
tel: (714) 850-1835
fax: (714) 850-18

East:
Polytec PI, Inc.
23 Midstate Drive, Suite 212
Auburn, MA 01501
tel: (508) 832-3456
fax: (508) 832-0506

www.polytec.com