www.xsight.eu info@xsight.eu

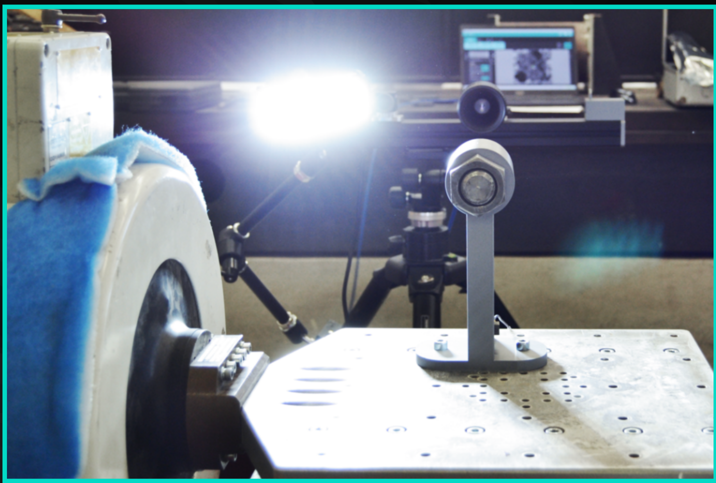
XSIGHT

APPLICATION REPORT

VIBRATION MEASUREMENT USING STANDARD CAMERAS

APPLICATION INFO

Two possible approaches exist to measure high-speed phenomena with standard cameras. The first one, described in this report, increases the camera's FPS (frames per second) by decreasing the ROI (region of interest) and shutter time. The second method uses random scans of the tested specimen movement for a sufficient period. Afterwards, under the presumption of periodicity or quasiperiodicity of the measured system behaviour, the measured signal is reconstructed to determine frequencies, amplitudes and to visualize the mode shape. The second approach is currently undergoing research.



Experimental set-up for vibration measurement

FLIR Blackfly S 9 MPx (low-speed) global shutter camera was used to measure the vibrations of a plastic sample on a shaker. The specimen is a simple 3D-printed console supporting additional weight. Initially, the system was placed in front of the specimen and calibrated with a calibration grid. Initially, the measurement system was positioned in front of the sample at the correct distance and calibrated using a corresponding calibration grid. The specimen surface was marked with a speckle pattern.

KEYWORDS

- Vibration measurement
- Shaker test
- Vibration frequency
- Vibration amplitude
- Low-FPS camera

TEST SETUP

- CS Mono measuring system
- Alpha: Axial & Transversal Strain Module
- Measurement probes:
  - Point probe
  - Line probe
- 3D-printed polymer specimen

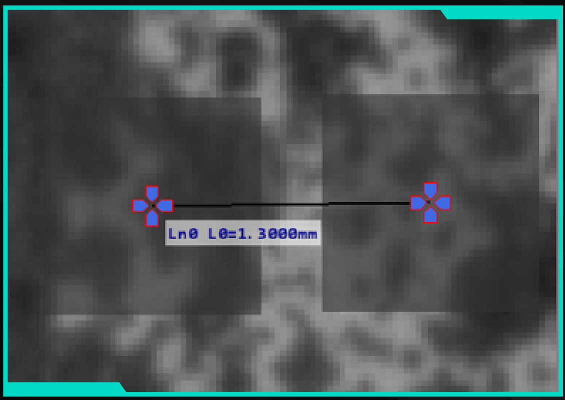
OUTPUT

- Frequency spectrum
- Power spectrum
- Vibration amplitude

WHY CHOOSE X-SIGHT?

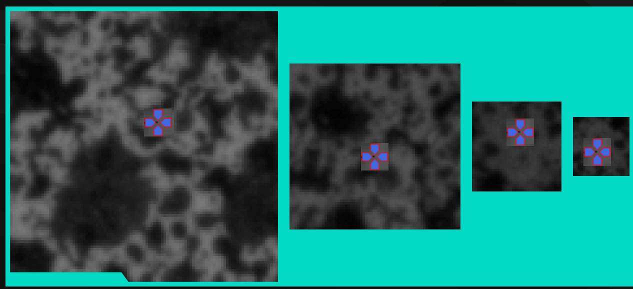
- For a wide range of applications, an expensive high-speed camera is not required for vibration measurement. The frequency spectrum and vibration amplitudes needed for vibrographic analysis can be determined using a standard camera.

MEASUREMENT PROCESS AND TOOLS

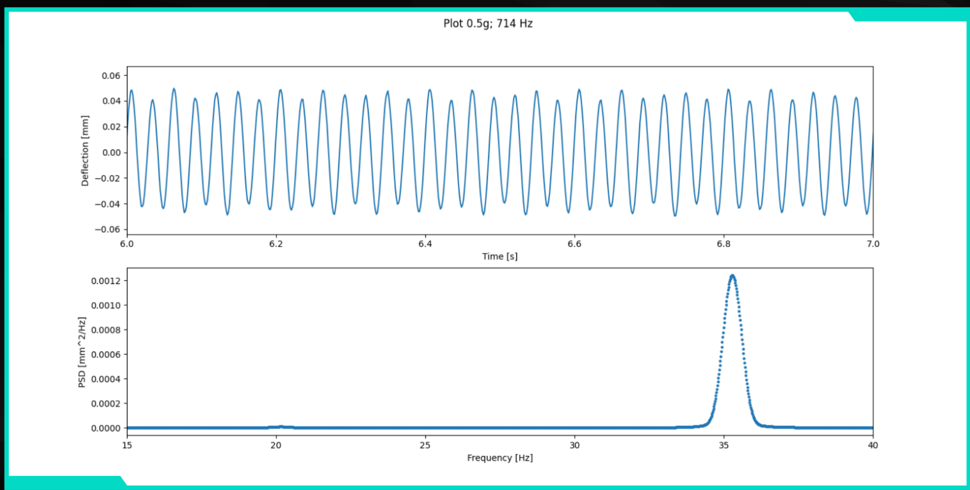


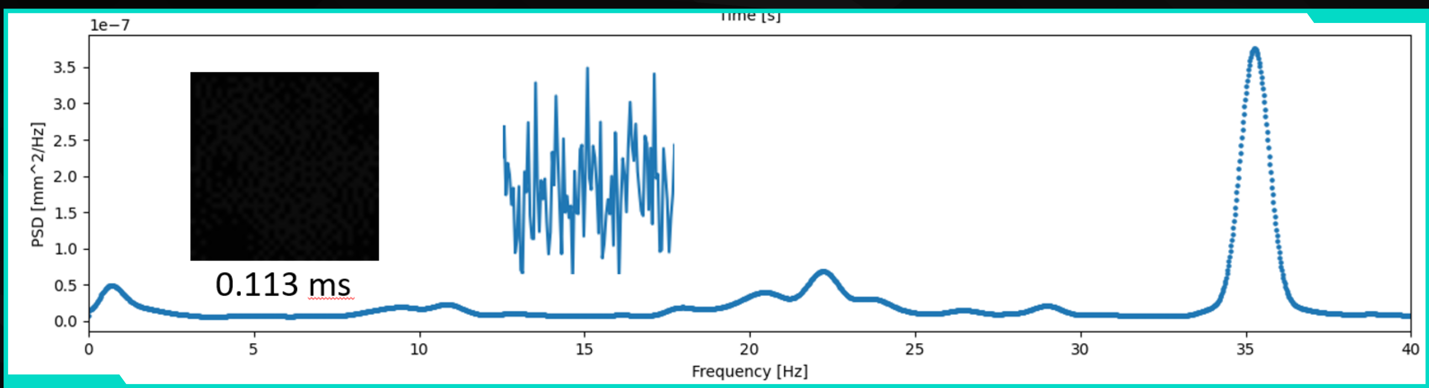
The system was excited just in one direction – the plane parallel to the lens – so it was sufficient to measure only the displacements of individual points. In the case of vibrations occurring in the direction perpendicular to the objective, line length change can be measured because it relates to the rigid body motion in this direction on an appropriately small and stiff area of the sample. The Alfa strain-analysis software was used to measure and post-process the recorded data.

Square ROI with a side length of 105, 67, 36, and 23 Px was measured up to 987 FPS with a suitable shutter speed setting. It means that it was possible to describe the signal in the frequency domain up to 493 Hz (considering Nyquist criterion) and up to 100 Hz in the time domain (considering ten samples per period as the rule of thumb).



714 FPS, 23 x 23 Px area, 1 ms shutter measurement of 35 Hz 0.5 g specimen excitation. The signal is well described in the time domain, and excitation frequency is easily detected by performing PSD analysis. Also, the signal amplitude can be estimated by performing FFT analysis using proper signal length and windowing.





866 FPS, 36 x 36 Px area, 0.11 ms shutter measurement of 35 Hz 0.005g specimen excitation. The excitation frequency is distinctly identified, although the image is very dark (approx. 11 gray levels) due to the high shutter speed, and the signal is considerably noisy due to the low vibration amplitude (approx 0.001 mm).