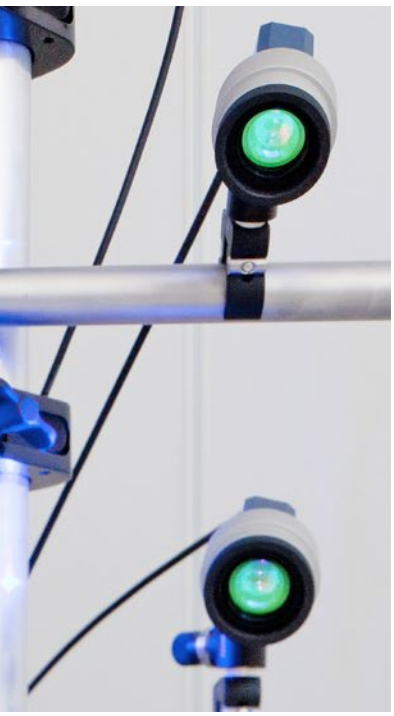
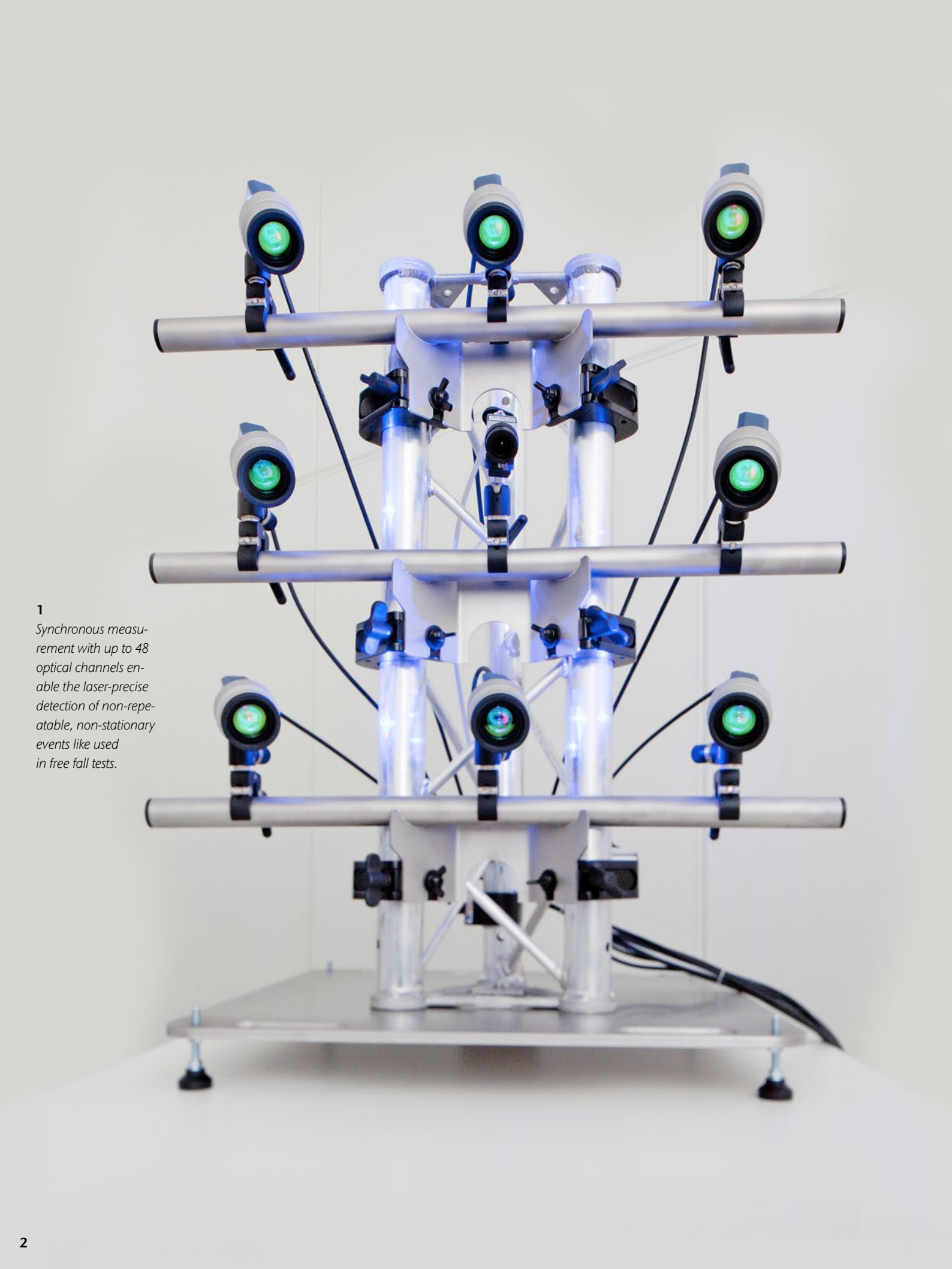
Polytec



Drop test of precision mechanics

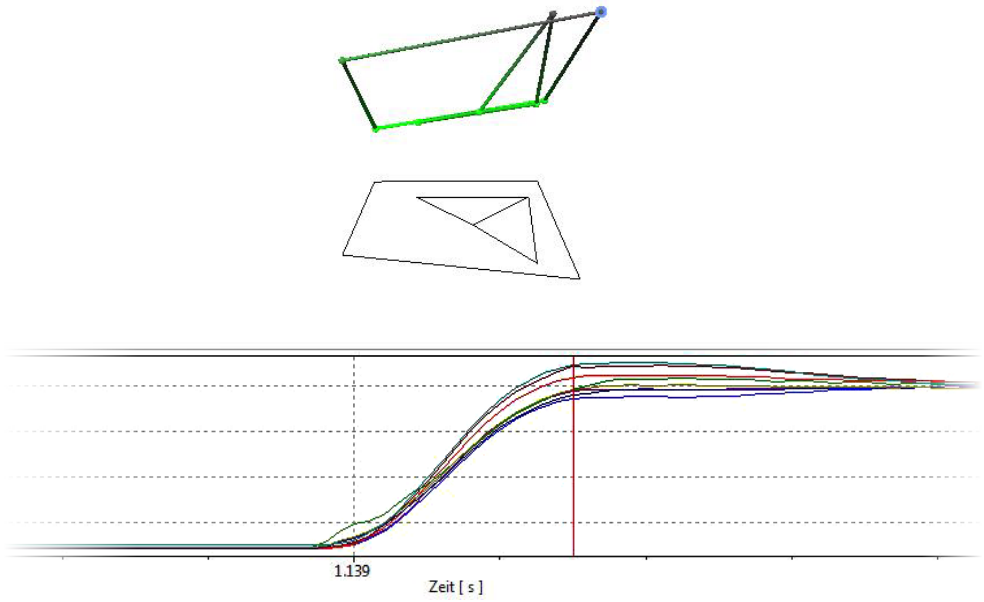
Synchronous measurement with a Multipoint Vibrometer

Application note

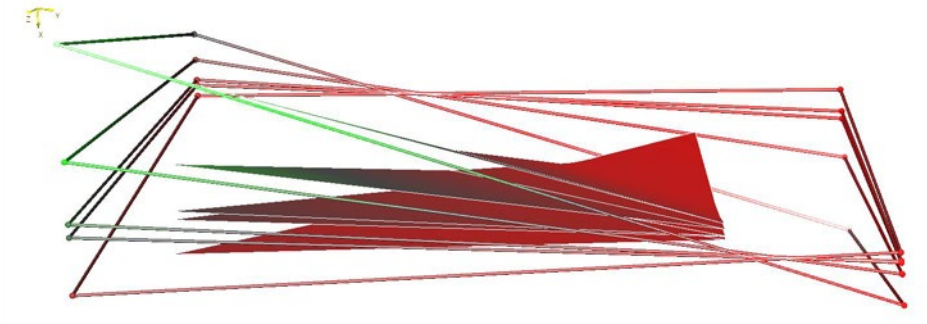


1
Synchronous measurement with up to 48 optical channels enable the laser-precise detection of non-repeatable, non-stationary events like used in free fall tests.

Drop test with a MPV-800 Multipoint Vibrometer for non-contact and synchronous measurement.

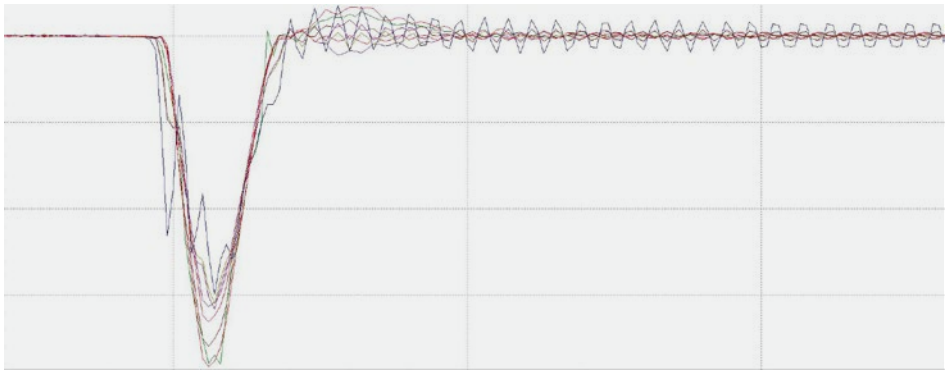


2
Visualization of the motion of the watch case (velocity)



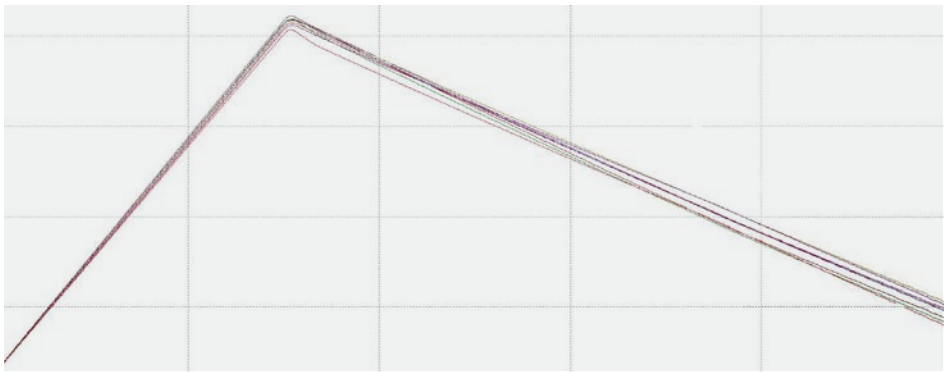
3
Combined view of 5 measurement times

Acceleration



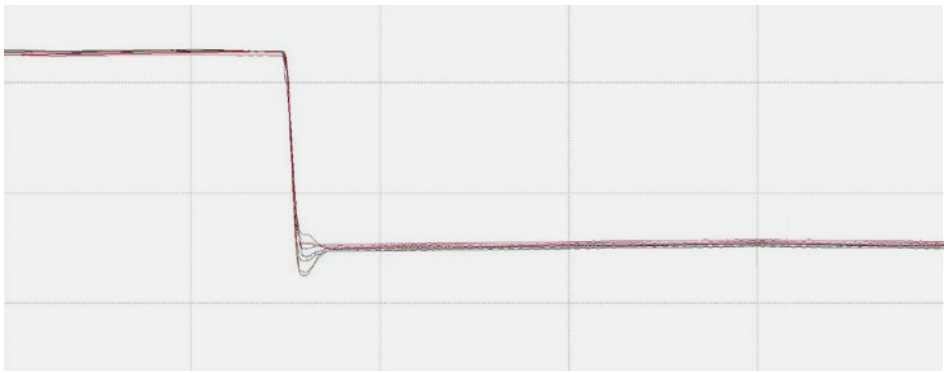
4
Acceleration time traces

Displacement



5
Displacement time traces

Velocity



6
Velocity time traces

Measurement of the resulting shock of a watch case free fall on the ground with the Multipoint Vibrometer

The main objective of this experiment is to analyze the behavior of the watch case (watch without its bracelet) during and just after the resulting shock of its free-fall on the ground. In particular, the goal is to obtain the displacement, velocity and acceleration profiles of different points from different parts of the case.

7
Fiber head arrangement for the 8 measurement points on the watch case

Experimental set up

Eight points of the case were measured in term of velocity just before, during and after the shock. To ensure a specific impact location during the fall of the watch a test an experimental bench was developed and used in this experiment. As it is not possible to repeat the fall experiment consistently, the 8 measurement points have to be measured simultaneously. Therefore, the MPV-800 Multipoint Vibrometer was used. With the laser-based MPV-800 Multipoint Vibrometer from Polytec, it is possible to carry out time-synchronous measurements with up to 48 channels and represent both

8
View of the complete setup with the MPV-800, the mechanical system for the free fall of the watch case

9
Individual fiber head with signal level indicator for noise minimization

frequency-dependent and time-dependent deflection shapes. A video camera also allows to visualize the position of the measurement points. See figure 7 and figure 8

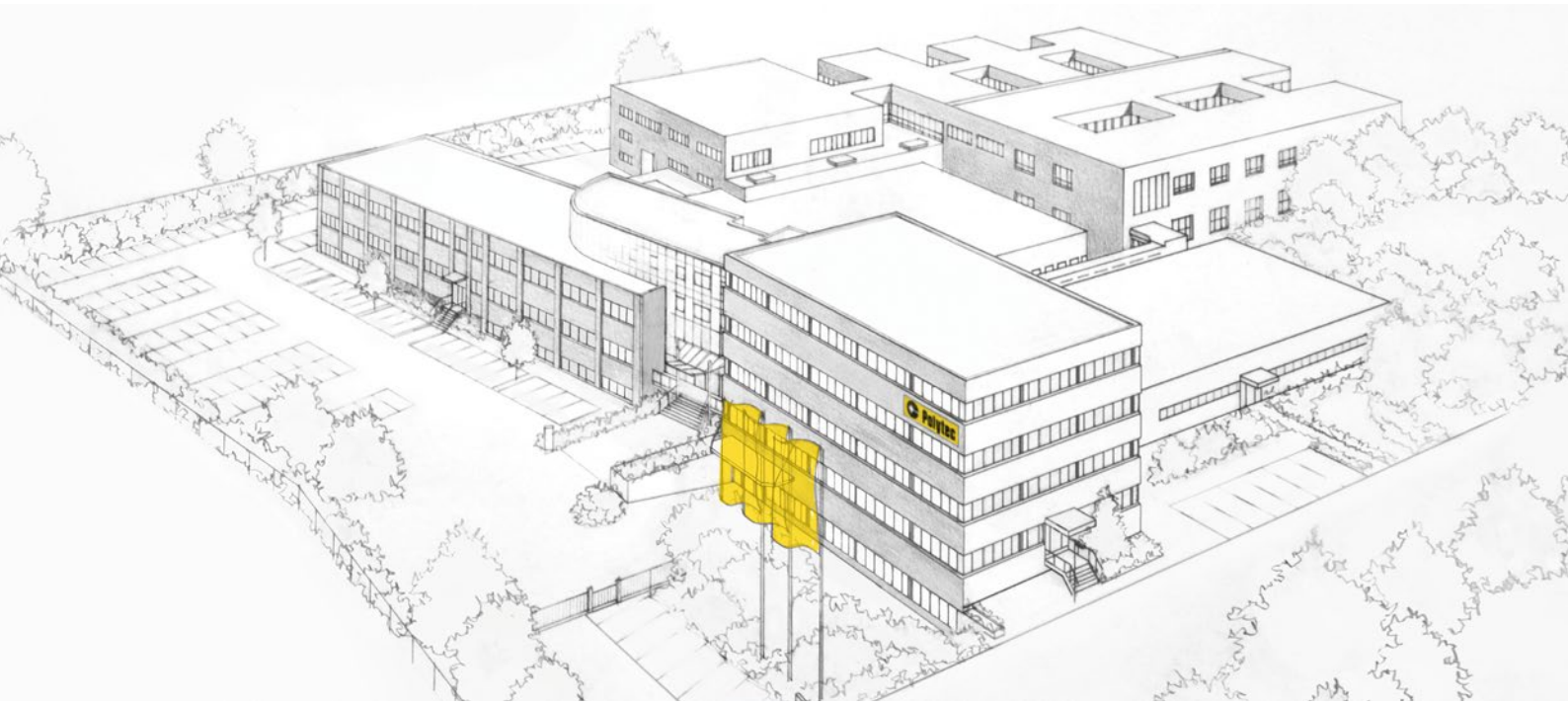
Measurement results
During the measurement the velocity was recorded as a function of the time. It was possible to record the velocity of the case for 8 points during approximatively 8 ms; 3ms before the impact and 5 ms after the impact.
An overlay of the velocity traces allows for a comparison of the different measurement points and can be seen in figure 5. It is possible to see different behavior during the impact.

With the help of the MPV software it is possible to visualize in 3D the motion of the watch case like in figure 2. From this 3D visualization, we can also see how the case rotates after the impact. For a better visualization some post-processing was done. The MPV Software was used to differentiate and integrate the velocity to get access to the acceleration and to the displacement. A comparison of the displacement before, during and after the impact can be seen in figure 5. From the time domain deflection shapes in displacement 5 views with a time difference / offset of 50µs where combined into one picture. The result of this post processing can be seen in figure 3 where the rotation of the watch case after the impact can be clearly identified. The acceleration time traces (figure 4) delivered additional information: the individual components have different post-pulse oscillations.

Conclusion
The synchronous non-contact measurement capabilities of the MPV-800 Multipoint Vibrometer is a valuable tool to assess impact responses during a drop test. MPV-800 uses independent sensors which can be positioned arbitrarily around the object and –if required – and can be combined to 3D channels. A sampling frequency of up to 250,000 samples per second allows to resolve also very short time events with a very high precision and the resolution. Such clearly resolved results allow for unambiguous post-processing and model updating.

Author

Mélanie Gérard
Polytec GmbH
Applications
m.gerard@polytec.de



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