attoSENSORICS
Ultra Precision Sensors

Long distance and high-speed displacement measurements using the FPS3010

pioneers of precision

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attocube's fiber-optic based Fabry-Pérot sensor (FPS) interferometer allows the user to measure a target's relative displacement with sub-nm resolution and real-time position output at 10 MHz bandwidth. Various applications in industry as well as in science and research and development require the precise detection of a target's position at high velocities as well as long distances. As shown below, the FPS3010 is now able to measure displacements at distances of up to 3 m and velocities of up to 2 m/s.

In these tests, an FPS3010 interferometer was equipped with attocube's M12-type sensor head and a retroreflector as target. Figure 1 illustrates the setup including sensor head and reflector. To realize reproducible displacement measurements of the target a commercial linear motor stage was utilized. Moreover, by using a retroreflector instead of a plane mirror the alignment process was very fast: the reflector can be tilted by more than 4 degrees with respect to the detection direction without losing the signal. This is due to the geometrical construction of the reflector, which is based on three perpendicular mirrors. The high stability of the signal guarantees that the FPS3010 can be calibrated at any position along the full length, making it extremely user-friendly and easy to use.

For the first test measurement, the target was set at 1.0 m distance from the sensor head. This first measurement consisted of an oscillation of the target with 0.9 m displacement amplitude and velocities of up to 1.0 m/s. Figure 2(a) shows the position measurement and the derived speed of the target during this oscillatory movement.

Figure 2(b) depicts the measurement during a high-speed movement over a distance of 0.5 m with a velocity of up to 2.0 m/s. As can be seen from the red curve, the maximum stage acceleration is limited: it needs more than 10 milliseconds to realize the speed of 2 m/s as well as another 10 ms to slow down before the programmed end position B is reached. Moreover, the inlay in Figure 2(b) points out that the FPS3010 also tracked the positional inaccuracy of the linear stage when approaching the end position B, indicated by a position overshoot by more than 5 microns.

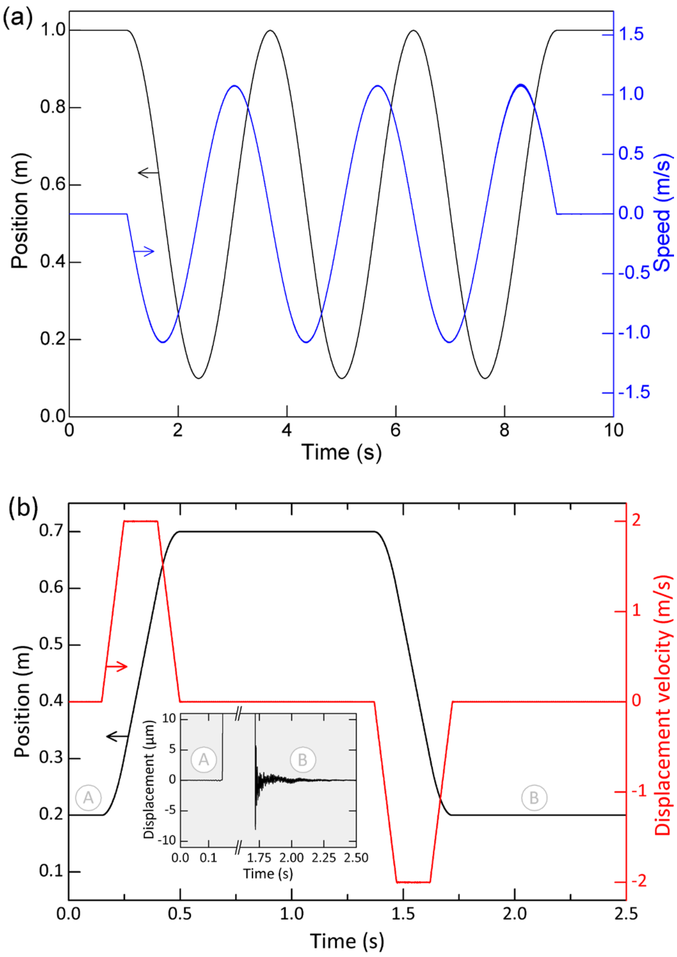

Figure 2: *(a) Displacement measurement of an oscillating target. The resulting speed was calculated from the position data. (b) Displacement measurement while moving the target with a maximum velocity of up to 2 m/s to different positions. In addition, the inlay in (b) shows the displacement differences on the start position A and end position B.*

This Application Note demonstrates the capability of the attocube's FPS3010 interferometer to measure displacements at large distances of up to 3 m with sub-nanometer resolution even at a target's velocity of up to 2.0 m/s.

For more information on the FPS3010, please visit our website: www.attocube.com.

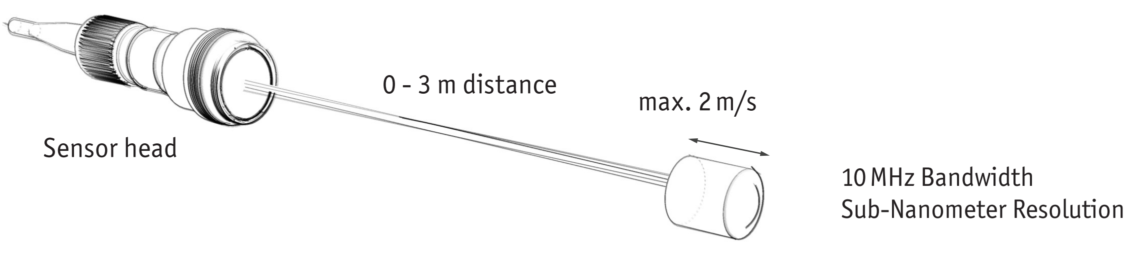

Figure 1: *Sketch showing the setup including attocube's M12 sensor head together with the retroreflector, which can be displaced with 2 m/s velocity over a distance of up to 3 m.*

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