



Powerful Electromagnetic Linear Stage with Interferometric Closed-Loop Control

WITTENSTEIN cyber® linear motor together with attocube's IDS3010 interferometer

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system can realize high dynamic movements with high-speed, high-acceleration and high-load capacity. The combination of both devices leads to a compact system with low maintenance needs that can easily meet the requirements for modern production processes.

Introduction

Requirements for precision manufacturing continue to increase as technology keeps evolving. This means faster production cycles, smaller components, and larger batches. To achieve these goals, production machinery must become more precise without compromising its speed. Laser interferometers play a key role because the technology has various advantages in comparison to e.g. the classical glass scale: fast machine integration, available for micrometer (μm) ranges and ranges up to tens of meters with a flexible scaling possibility, nanometer (nm) accuracy close to the Point of Interest (POI), adjustable resolution and sampling rate, and compatibility to extreme environments.

In this Application Note, we highlight several advantages of attocube's interferometer (IDS3010) as a closed loop encoder system. We build an electromagnetic linear stage with a travel range of 400 mm based on a WITTENSTEIN cyber® linear motor [1], which is controlled by a cyber® simco® drive 2 [2] using the displacement data from the IDS3010. Figure 1 shows this linear stage. The WITTENSTEIN electromagnetic linear

Closed-Loop Motion System

The electromagnetic linear stage shown in Figure 1 consists of standard WITTENSTEIN and attocube components. The stage has a stiff moving element guided by two rails with a movement range of 400 mm. A single rail is also possible.

The motion range is defined by the length of the rails and can be extended to multiple meters by using longer rails and adding magnet carriers. The advantage of the IDS lies in the contactless measurement of the interferometer with the corner cube (see Figure 1, left zoom-in picture) and the compact M12/C7.6 sensor head (see Figure 1, right zoom-in picture). The corner cube and M12/C7.6 sensor head easily enable working ranges up to 5 meters and both offer the possibility to operate in other environments as, for example, ultra-high vacuum (UHV) and high magnetic fields. For applications at ambient conditions the IDS3010 uses an Environmental Compensation Unit (ECU) to compensate changes of the refractive index, which is influenced by air temperature, pressure, and humidity [3]. The ECU is also shown in the right zoom-in picture of Figure 1. The moving element of the stage reaches a maximum velocity of 2 m/s.

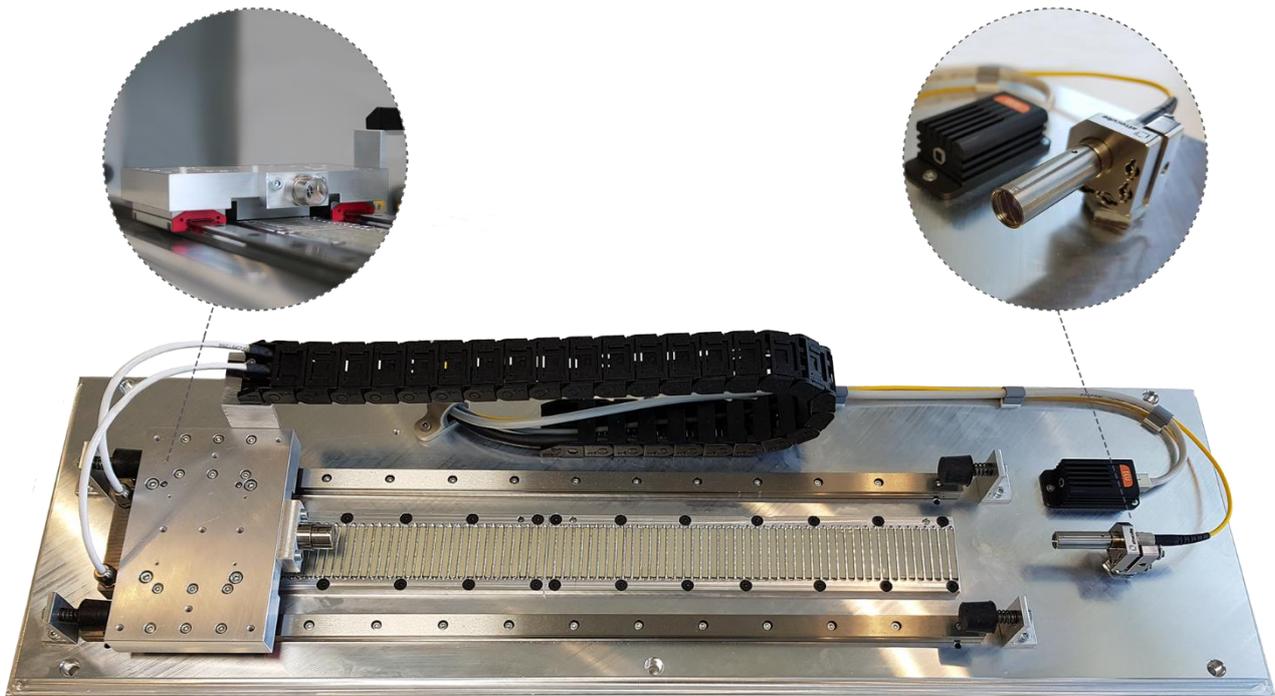


Figure 1: The electromagnetic linear stage with the main components from attocube and WITTENSTEIN is shown. The WITTENSTEIN parts are the following: cyber® linear motor with the magnet elements and controlled by the cyber® simco® drive 2. The attocube parts are the following: corner cube on the moving element (left minor picture), sensor head (M12/C7.6) as well as the ECU (right minor picture) and the IDS3010.



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The position feedback of the cyber® simco® drive 2 in this application is realized by the Sin/Cos real-time output-signal. With the possibility to adjust the Sin/Cos bandwidth as well as resolution, the IDS3010 offers the possibility to tune its communication with the controller based on the specific requirements. The IDS3010 also provides other industry standard real-time protocols like HSSL, AquadB, Linear-Analog, and BiSS-C with bandwidths up to 10 MHz.

References

- [1] WITTENSTEIN, cyber® linear motor.
- [2] WITTENSTEIN, cyber® simco® drive 2 – servo drive.
- [3] National Metrology Institute of Germany (PTB) calibration certificate, Calibration mark: 54012 PTB 15, 2016.

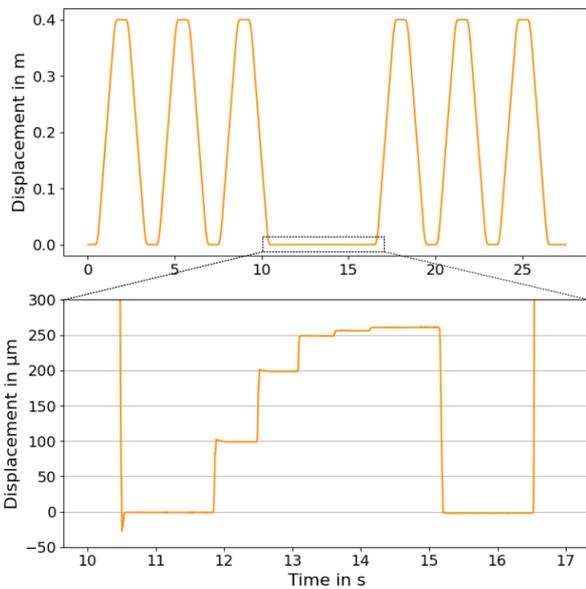


Figure 2: Exemplary movements of the electromagnetic stage using the IDS3010 as closed loop encoder. The upper graph highlights 400 mm movements with velocities of 0.4 m/s. The bottom zoom-in graph shows μm -movements.

Figure 2 shows exemplary movements of the electromagnetic stage using the IDS3010 as closed loop encoder. The upper graph shows strokes of 400 mm, while the bottom zoom-in graph highlights strokes over several μm . The movement was controlled with command lines of the cyber® simco® drive 2. The stage was moved with a velocity of 0.4 m/s. The cyber® simco® drive 2 has various settings to regulate the moving behaviors as for example the acceleration and feedback loop.

Conclusion

This Application Note highlights that a WITTENSTEIN cyber® linear motor can be closed loop controlled by the attocube IDS3010. This type of motion system can be highly beneficial for many industrial applications in different industries where both speed and accuracy are required. Its flexibility in size, working range, and environment enables the system to be perfectly adapted to the customer requirements.