

TwinCAT optimally supports the multi-mover systems XTS and XPlanar

With XTS and XPlanar, Beckhoff has two multi-mover systems in its portfolio that are not only very complex electronically and mechanically, but also place high demands on the software. These mechatronic systems are completely controlled by a standard Industrial PC and TwinCAT, including the position control and the motion or path planning of the individual movers.

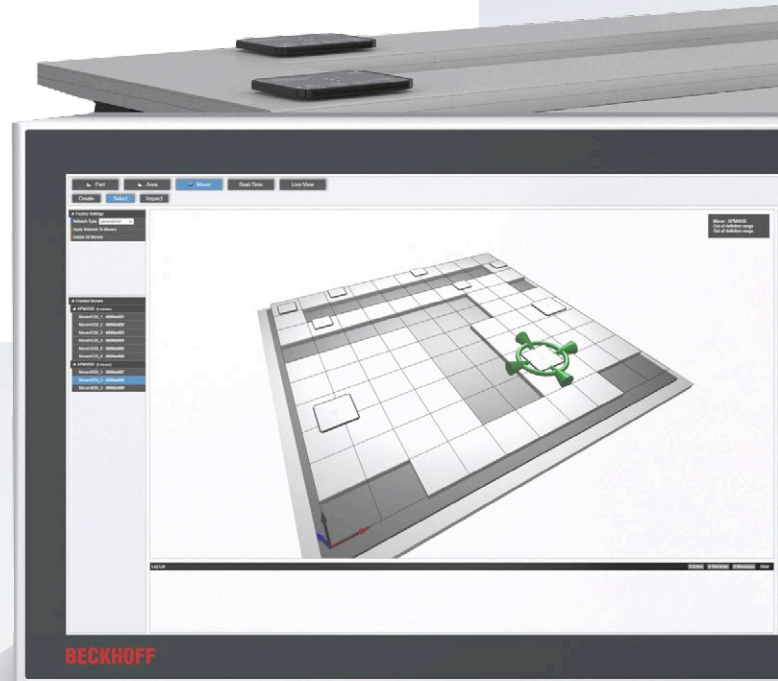
The XTS and XPlanar drivers – TwinCAT 3 XTS Extension (TF5850) and TwinCAT 3 XPlanar (TF5890) respectively – are comparable in their basic function to conventional drives, e.g., for servomotors. The positions of the movers must be determined from the encoder signals, the control of the axes has to be calculated and then the electrical current values are computed and sent back to the hardware. The fundamental difference, however, is that XTS and XPlanar do not require dedicated hardware for position control.

XTS systems can have a track length of over 100 m long and XPlanar systems can consist of over 100 tiles forming the floor area, with the respective movers moving from module to module over the entire distance or area. With decentralized drives that only control a few modules at a time, large systems would become incredibly complicated. For a module transition, the individual drives would have to communicate with each other, transfer data for the respective mover, take over the mover from the other drive at exactly the right time, and much more. Instead, the obvious solution is to feed the process data of all XTS modules or XPlanar tiles to a central control system so that it is informed about every single coil and sensor in the system. This centralized control system is possible with the Beckhoff system architecture:

- A high-performance fieldbus is available in the form of EtherCAT, which can communicate all process data from the field to the Industrial PC and back again in just a few microseconds.
- The Beckhoff portfolio offers real-time capable Industrial PCs with powerful computer hardware for motion control.
- TwinCAT is used as the central control software with all its versatile functions that enable the position control of a large number of movers to be calculated on the Industrial PC in sub-millisecond cycles.

Many-core support, additional functions and synchronization benefits

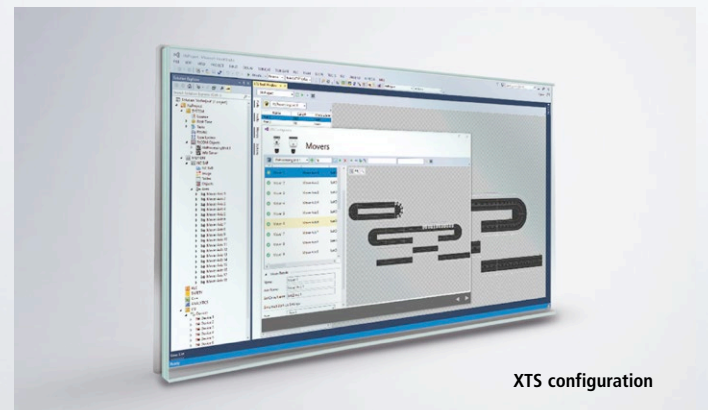
Many-core support with TwinCAT software allows both the I/O images and all calculations to be distributed across multiple CPU cores. This means that even



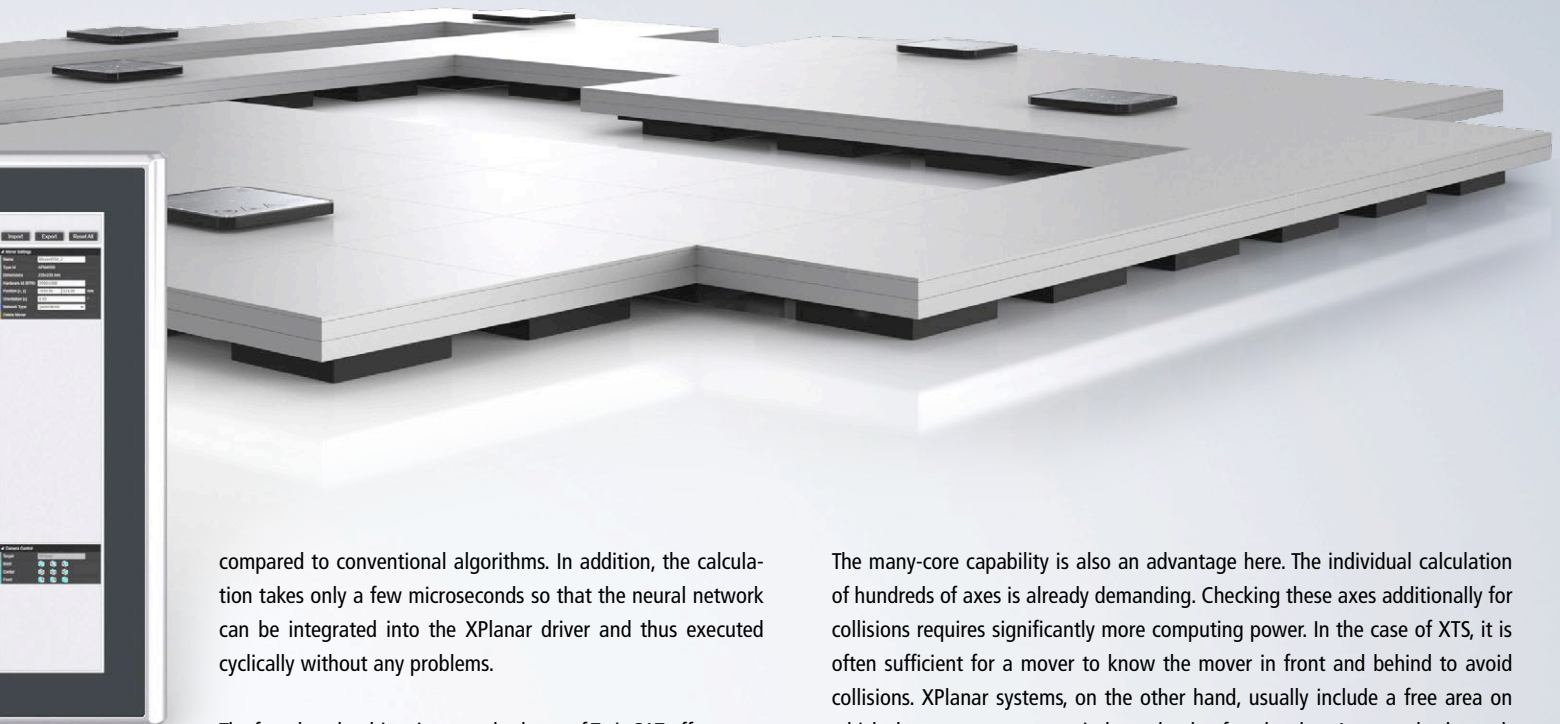
XPlanar configurator

very large systems can be implemented, and the maximum possible system size grows with advancing CPU technology.

The complete process image of the XTS or XPlanar system is available in TwinCAT and can therefore be processed with the wide range of TwinCAT functions. For example, in the XPlanar driver a real-time neural network inference is used to determine the position of the movers. The neural network manages to determine the 6D mover position much more accurately from the sensor values



XTS configuration



compared to conventional algorithms. In addition, the calculation takes only a few microseconds so that the neural network can be integrated into the XPlanar driver and thus executed cyclically without any problems.

The fact that the driver is a standard part of TwinCAT offers even more advantages: All other control processes – e.g. additional motion axes, machine vision, HMI, analytics or the PLC program – run in parallel in the same software application and can be precisely synchronized with XTS and XPlanar. Furthermore, since the XTS or XPlanar driver calculates the physics of the system, all important and physical parameters of the system can be conveniently accessed:

- How much force does Mover 23 generate in the x-direction?
- How warm is tile 12?
- How much power is currently being consumed by the system?

All this makes the handling and the overview much easier for the user. Additionally, system updates are reduced to a minimum: The exchange of a single file is all it takes to bring completely new features to XPlanar, such as the 360°-rotation of an XPlanar mover.

Comprehensive motion control functionality

In addition to the XTS or XPlanar driver software, fully-integrated motion control software from Beckhoff, which runs as independent TwinCAT modules, is available for both systems. This motion control calculates the setpoint dynamics from the motion commands for the movers and communicates these to the respective driver. The particular challenge here lies in the multi-mover systems: On the one hand, a very large number of axes have to be controlled simultaneously – for example, up to six axes per mover in the case of XPlanar. On the other hand, it is not enough to control each mover individually. For comfortable operation from the user's point of view, the movers should "look out" for each other and automatically avoid collisions. And this is exactly what TwinCAT, with all its motion control advantages, achieves.

The many-core capability is also an advantage here. The individual calculation of hundreds of axes is already demanding. Checking these axes additionally for collisions requires significantly more computing power. In the case of XTS, it is often sufficient for a mover to know the mover in front and behind to avoid collisions. XPlanar systems, on the other hand, usually include a free area on which the movers can move independently of each other. As a result, the path of nearly every mover must be tested against the trajectories of every other mover in up to three axes, increasing the complexity with each mover. To provide sufficient computing capacity, it helps, just as with the driver, if the individual movers are distributed over several cores and thus a large number of movers can be controlled simultaneously. In addition, neural networks can also help here to calculate "schedules" for the movers that even humans could not create.



Johannes Beckhoff,
R&D

More information:

XTS: www.beckhoff.com/tf5850

XPlanar: www.beckhoff.com/tf5890