Interview with Uwe Prüßmeier on the new drive system: "flying motion" with free-floating planar movers

XPlanar: Maximum positioning flexibility with six degrees of freedom

With planar movers that float freely positionable over floors of planar tiles that can be arranged in any kind of pattern, the ground-breaking XPlanar system from Beckhoff offers boundless potential for streamlining production machine and plant design. In this interview, Uwe Prüßmeier, Senior Product Manager Drive Technology, discusses the unique value proposition of a system that can position movers precisely, dynamically and with exceptional flexibility.

Flying motion: XPlanar is a contact- and wear-free
solution for the transportation of products.

– 6 degrees of freedom
– x, y, z movements
– α, ß, γ orientation
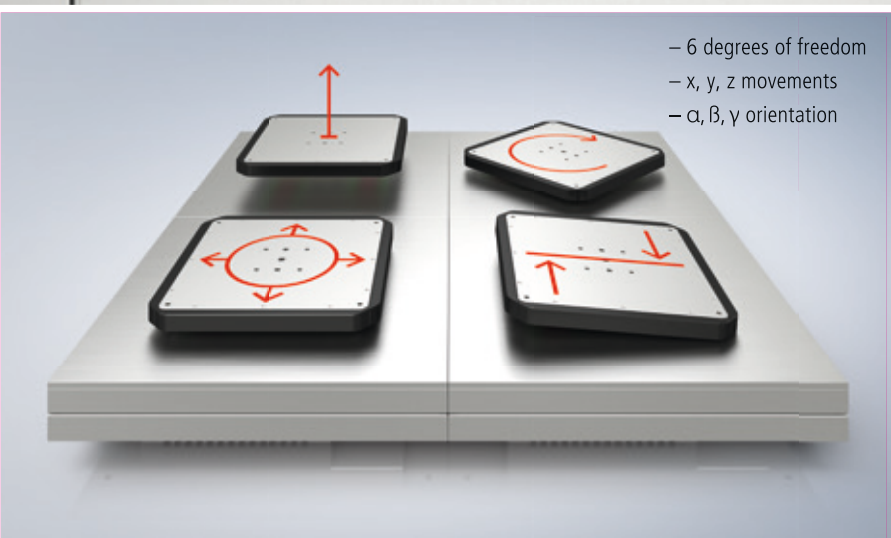
With the XPlanar system, planar
movers float freely over planar tiles
that can be arranged in any layout.

Uwe Prüßmeier, Senior Product Manager Drive Technology: "XPlanar opens up entirely new avenues in machine building with its combination of capabilities – contactless product transportation, two-dimensional positioning and additional movements in the third dimension."

What characterizes the new XPlanar drive system based on the principle of flying motion?

Uwe Prüßmeier: Like the XTS linear transport system, XPlanar is much more than just a drive system – it's a comprehensive solution designed to make product transport extremely flexible. Compared to XTS, XPlanar adds movement in a second dimension and allows the movers floating over floor tiles to overtake one another, and to be held in buffer zones or to bypass them. The free-floating planar movers also have a further important advantage: because of the contactless drive principle, they are silent and completely wear-free.

What kind of functionality does this system provide for implementing transport tasks?

Uwe Prüßmeier: Basically, a transport system simply moves products from one processing station to the next – from A to B, then from B to C, from C to D, and so on. With XPlanar, these stations need neither to be in a linear arrangement nor visited in a fixed sequence. This means that a given product need only travel to those stations that are essential for processing it. By incorporating

the second dimension, XPlanar opens up several other options, too, including the ability to discharge individual movers from the production flow or to create special waiting zones in order to optimize processing sequences. Enabling faster movers to overtake slower movers is also important as it allows sub-processes to be executed swiftly, in parallel. Not only is each planar mover controlled individually, as a single servo axis, it can also be synchronized precisely with other movers if necessary.

The movers can travel with six degrees of freedom. What are the benefits, particularly at processing stations?

Uwe Prüßmeier: The movers not only travel to processing stations, they can also move into them. They can turn, too, rotating the payload they're carrying through all three axes so that it can be processed or inspected easily from any side. The movers can also be raised or lowered slightly and even tilted. A little tilt, for example, can be useful to prevent spills when accelerating quickly while carrying a container full of liquid.

In spite of all the complex motion options that XPlanar supports, the system is simple to set up and deploy from user standpoint. What are the key factors here?

Uwe Prüßmeier: Right at the start of the development process, we decided it was important that the system should be highly integrated and that users would only have to plug in two cables – one for data communication over EtherCAT G and another for power supply. As a result, all other functionality has been fully incorporated into the modules. Design-wise, they are also extremely compact: The distance between the working surface of each planar tile and the carrier frame beneath it is just 4 cm.

And choosing individual XPlanar components is just as simple?

Uwe Prüßmeier: Yes. The system builds on one basic component, a planar tile measuring 24 x 24 cm. The tiles can be arranged in any floor or track layout. In addition to this standard tile, there will be another version in the future, identical in shape and size, over which planar movers can rotate through a full 360° – that is to say, infinitely. The movers available differ only in terms of their size and therefore their load-carrying capacity. They currently range from 95 x 95 mm, for payloads up to 0.4 kg, through to 275 x 275 mm, for a maximum payload of 6 kg.

The TwinCAT software also plays a key part in the system's ease of use. What is the primary focus here?

Uwe Prüßmeier: Our main objective is to make sure that users find the planar motor system easy to manage. In TwinCAT, the planar movers appear as simple servo axes, capable, in principle, of supporting all six degrees of freedom. However, given that the degree of flexibility available with six axes is not always needed from a practical perspective – or, at least, not throughout the XPlanar system – TwinCAT provides a way to reduce this complexity. It does this by representing each mover as a one-dimensional axis capable of optional additional movements in other dimensions – lifting, tilting and turning, for instance – that are available when it reaches a processing station. This means it's enough, initially, to just set the desired route, or track, across the XPlanar floor; this simplifies operation significantly.

How important is TwinCAT Track Management when implementing complex motion sequences?

Uwe Prüßmeier: A key factor in XPlanar's exceptional flexibility is that its ability to transport products is not confined to the aforementioned single tracks. You can define additional tracks, and movers can switch between them. To keep things simple for users, even when operating multiple tracks, TwinCAT offers Track Management, an extremely user-friendly tool designed to support complex motion sequences, including the ability to overtake slower movers on the same track or to accumulate movers in waiting zones. To do this, it allows users to define parallel lanes, bypasses, or tracks to other plant areas on the XPlanar floor. Track Management lets movers switch smoothly from one track to another via a short parallel segment. All this takes is a "switch track" command, without users having to deal with the specifics of merging in and out of the flow or avoiding collisions. Movers can also be positioned with complete freedom, without having to follow any preset tracks. Using Track Management, they are simply sent to specific coordinates within the defined XPlanar floor space – again, without any risk of colliding with other movers.

From a user's perspective, what are the advantages of building the XPlanar floor from individual tiles?

Uwe Prüßmeier: Here, too, we put flexibility front and center. The tiles can be arranged in any shape – and even wall- or ceiling-mounted – so the XPlanar sys-

tem can be configured to perfectly suit a given application's requirements. For instance, you can leave gaps within the tiled floor to accommodate processing stations or lay tracks around plant components. This means users can set up a transport system in a cost-optimized fashion and, at the same, reduce machine size to a minimum. In addition, it's easy to modify the planar motor system subsequently, just by adding more tiles when necessary – e.g., to accommodate new processing stations or gain extra space to optimize motion through curves.

How can users best exploit this immense innovation potential?

Uwe Prüßmeier: XPlanar opens up new avenues in machine and system design. Users need, literally, to experience the system's new possibilities hands-on in order to grasp them, so at market launch we're offering easy-to-use starter kits, just as we did with XTS. These consist of six or twelve planar tiles installed on a carrier frame, along with four movers and a small control cabinet with an Industrial PC, complete with pre-installed software, and the requisite electrical components. This offers machine builders an ideal basic kit on which to trial XPlanar in their own environments and then go on to use later in real-life applications. In addition, offering this kind of preconfigured system makes it a lot easier for the Beckhoff support staff to answer any questions that might arise.

Which mechanical engineering sectors or use cases does XPlanar suit best?

The immense flexibility of the XPlanar system makes it ideal for a wide range of transport tasks in the most diverse areas of application, including the pharma and food industry.

Uwe Prüßmeier: There are almost no limits on using it with production plants and machines. The only requirement is that a product's weight and volume are within the limits of what the planar movers can carry. Where this applies, users can benefit from all the system's highly flexible positioning capabilities. These are particularly interesting in sectors with special requirements in terms of hygiene and cleanability, zero emissions or low noise. This is the case in the food and pharmaceuticals industry as well as in laboratory environments or processes that require a vacuum (in semiconductor production, for instance). The latter two sectors in particular can benefit from the fact that products are carried on floating movers, abrasion- and contamination-free. Depending on the needs of a given application, users can also apply plastic, stainless steel foil or glass plates to the XPlanar surfaces to make them easy to clean without residue.

XPlanar was first exhibited at the SPS IPC Drives show in Nuremberg in November 2018. What kind of feedback have you had from show visitors in response to this innovation?

Uwe Prüßmeier: The exhibit attracted considerable interest among visitors; it also spawned lots of ideas for possible applications, because many users have been looking for a flexible solution to solve specific transport problems in their production facilities for years now. Here's an example from food processing: In the production of high-quality confectionery, there are always minor deviations in the color of chocolate coatings. This is not a problem as such provided there's

no variance within individual boxes of chocolates. However, at a production rate of 100 chocolates per minute, selecting ten individual chocolates with the same color for each pack is difficult using conventional means. It would require using several pick-and-place robots to check and sort all the chocolates, which would be costly in terms of time, floor space and throughput rate. The problem can be solved much more efficiently using individually controlled planar movers operating on a single floor. Movers transporting individual chocolates could easily sort themselves at the end of the production line according to the chocolates' particular shade of color. Or, if movers were designed to carry an entire box at once, each mover could automatically travel to the system ejection point for the appropriate color of chocolate to pick up the products. Both of these approaches could be implemented much faster and, importantly, with lower space requirements than, for example, the robot solution I mentioned.

Are there other current examples where the high flexibility of XPlanar is crucial?

Uwe Prüßmeier: We already received specific inquiries from the laboratory automation sector, where there's considerable interest in maximizing the flexibility of analyses. For the most part, samples are tested for the same substance content, but less common analyses also need to be carried out for the purpose of individualized diagnostics. Even with mass analysis methods, XPlanar offers a great way to extract individual samples; it also creates additional quality assurance advantages by making it easy to discharge or exchange particular

The planar tiles can be laid out in rectangular floor areas (right)
or in free application-specific configurations (left).
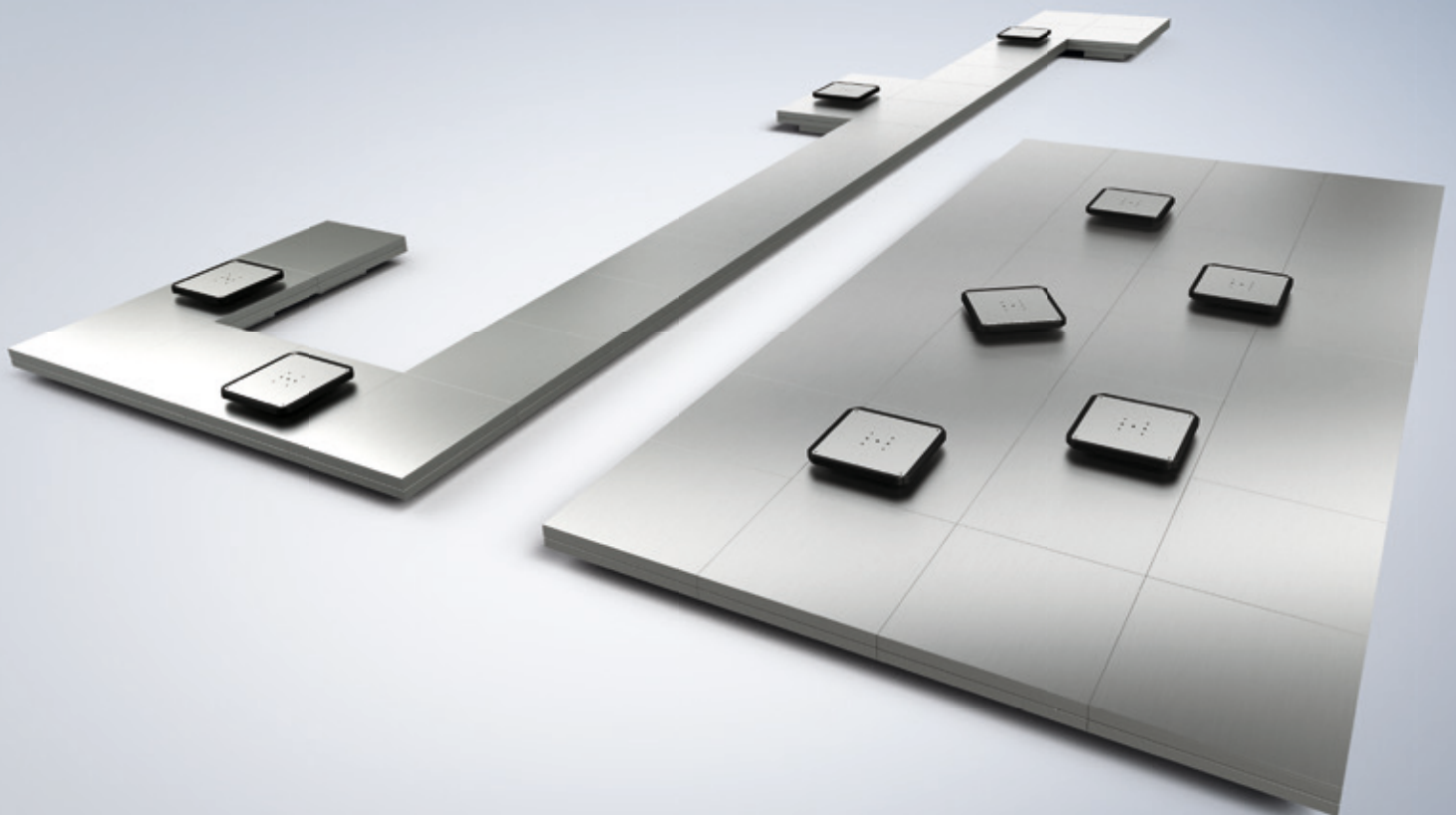
samples. There's similar demand in the cosmetics industry, too. For example, in one particular case, fragrances need to be filled into selectable, customer-specific bottles that are individually labeled and packaged.

How do the XPlanar and XTS transport systems differ in terms of use?

Uwe Prüßmeier: The main difference is that the XPlanar movers don't need a mechanical guide rail so, as already mentioned, the system offers greater flexibility in terms of movement. At the same time, though, the mechanical guidance in XTS can be an advantage: Compared to the magnetic counterforce of the planar movers, a guide rail allows significantly better dynamics and higher speeds in curves, especially in very tight curves, and even when carrying a payload. The specifics of a given application will ultimately determine which of the two systems is the better option. The bottom line is that XPlanar and XTS complement each other perfectly.

The interview was conducted by Stefan Ziegler, Editorial Management PR, Beckhoff

XPlanar: Planar mover technical specifications

- – max. speed: 4 m/s
- – max. acceleration: 20 m/s^2 (without payload)
- – four available sizes: 95 x 95 mm, 155 x 155 mm, 155 x 275 mm and 275 x 275 mm
- – mover thickness: 12 mm
- – max. payload (largest mover): 6 kg (at low speed)
- – max. levitation height without payload: 5 mm
- – max. levitation height with 1 kg payload: 1 mm
- – max. angle of rotation (±): 360°, ±15°
- – max. angle of inclination: 5°

Further information:
www.beckhoff.com/xplanar

Planar movers can follow a variety of tracks across the XPlanar floor; they can also switch from track to track.