Path Control – Easy to Handle

Handling Technology and Robotics
Product handling forms an important step in the process chain in factory automation. Loading and unloading directly make up the machine’s cycle time, and it is for this reason that the motion profile must be fast and, at the same time, gentle on the product and the mechanical system.

The loading drive moves in one dimension if it is positioning a workpiece facing forwards or backwards. It is easy to optimize the positioning time and the process. Multidimensional movement of the workpiece is possible with at least two drives. Here, it is difficult to determine the ideal motion profile so that items can be handed as quickly and yet as reliably as possible. Different points in space often vary and can be reached using different paths. Typical applications are, for instance, pick and place applications, palletizing, transfer handling, secondary packaging, or stacking.

Similar demands are posed by applications where products are processed and refined further, for example, when decorating food items or for on-the-fly processing. The process is stable if material processing can be reproduced with a high level of accuracy.

We have developed kinematic modules for CCU and MOVI-PLC® for exactly these application areas. They form the ideal solutions platform that enables easy and optimized path movements on par with individual axis movements.

Driving the world – with innovative drive solutions for all branches of industry and for every application. Our products and systems can be used in any application – worldwide. Be it in the packaging, automotive, building materials, food and beverage, or metal-processing industry – the decision to use drive technology “made by SEW-EURODRIVE” stands for reliability for both functionality and investment.
If machine sequences are controlled centrally at a higher-level, you can simply use our lower-level motion module for performing path movements. This is where our CCU (Configurable Control Unit) with the directly executable HandlingKinematics application module comes into play.

During startup, you only need to enter the mechanical data and configure the motion parameters once. During production, it is then only necessary to transfer the trajectory positions at the start of the movement to the CCU. The application module coordinates the required path movement in real time. If you define wait points in the trajectory, the CCU continues the movement only when permitted. During palletizing and stacking, it is often necessary to immediately adapt the target position during runtime. The integrated touch probe function in the CCU is able to make the necessary changes independently and in real time without higher-level controller intervention.

The HandlingKinematics application module in detail

- The CCU takes over the drive operating modes; the higher-level controller coordinates the process sequence and defines the product data.
- Complete interface to the higher-level controller with up to 20 path points.
- Possibility to simulate sequences and diagnostics without real machines.
- Choose from four programs to select the perfect motion profile for your case: axis/cartesian interpolation, linear interpolation with coordinated/synchronized rotation.
- Choose a mechanical system with up to four degrees of freedom, XYZ and rotation around Z.
- Reproducible path fidelity with BACK-TO-PATH, even after disruption.
- Suitable for static objects and combinable with up to eight further application modules, e.g. for conveyor belts, lifting axes, grippers.
- Wait points can be defined for each path segment.
- Touch probe measurement function and sensor-based positioning.
Easy parameterization and connection to the higher-level controller

Configurable Control Unit (CCU)

- **Fieldbus interface**
- **HandlingKinematics**
- **Single-axis modules**

Parameterizable path control with standardized fieldbus interface.

Reliable, quick and easy

- Performance guarantee due to encapsulated path control that has been tested and has proven itself time and time again.
- Extremely quick and easy startup of the entire kinematic model using graphical software that is intuitive to use and features a clear diagnostics and monitoring function.
- The cycle time is significantly reduced due to synchronous path control with look-ahead and by-passing of interfering edges while maintaining contour accuracy.

Requirements for the CCU

HandlingKinematics application module

- DHF41B (PROFIBUS, DeviceNet) or DHR41B (PROFINET, EtherNet/IP, Modbus/TCP) controller with OMC41B memory card.
- TS technology (T4 for Cartesian gantry).
If the CCU HandlingKinematics application module covers all of your functional requirements, but your application requires greater flexibility, you can choose the HandlingKinematics technology module for the freely programmable MOVI-PLC®. It provides exactly the same functionality, the configuration is completely reusable, and even the hardware remains the same. You only require a different memory card to utilize programmable MultiMotion software. Unlimited consistency is our guiding concept because it makes everyday work easier.

Additional options offered by the HandlingKinematics technology module

- All functions of the HandlingKinematics CCU application module.
- Interpret and scale the resolution of the path points according to your needs.
- Practically any robot can be operated: Select a mechanical system with up to six degrees of freedom XYZA\textsuperscript{B}C.
- Amend and modify the fieldbus interface according to your needs: Control the technology module directly or using signals in your MOVI-PLC® program.
Benefit from the MOVI-PLC® as a freely programmable controller

- Increase your efficiency due to the modular machine design. Relocate all sensors and actuators that are relevant for motion to our MOVI-PLC®. Light barriers, proximity switches, vision systems, pneumatic axes are coordinated directly by us.
- Reduce data exchange at runtime to only what is necessary: Place the recipe data for path planning on the MOVI-PLC® in advance.
- Use our MOVI-PLC® “power” controller to monitor the interaction of multiple kinematic chains and a total of 64 drives in a practical manner.
- One software package for everything: Using MultiMotion, operate the master machine, e.g. the packaging machine, and the kinematic module on the same controller.

### Requirements for the MOVI-PLC®

**HandlingKinematics technology module**
- DHE41B, DHF41B, DHR41B MOVI-PLC® “advanced” controller with OMH41B memory card or UHX71B MOVI-PLC® “power” controller with OMH71B memory card.
- T5 technology (T4 for Cartesian gantry) per instance of the technology module.
- Two additional technology points per controller when using the “MultiMotion” motion control platform instead of “MultiMotion Light” (not necessary for pure path control operations).

### Additional functional adjustments

**MOVI-PLC®**

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<td>Freely programmable IEC application</td>
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<tr>
<td>HandlingKinematics</td>
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<td>“MultiMotion” motion control platform</td>
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HandlingKinematics technology module with adaptable fieldbus interface and freely programmable MOVI-PLC®.
If your functional requirements go beyond those offered by the encapsulated HandlingKinematics module, then go one step further and use the Kinematics technology module at its core. In this case, individual motion segments are programmed explicitly. Example motion sequences are included in program templates and can be tested straightaway.

The Kinematics technology module in detail

- Fine-tuned access to all motion parameters in each path segment.
- Extensive options for entering circle segments.
- All coordinate systems can be used for control (also axis/world/piece coordinate systems) and it is possible to toggle between them even during motion.
- Multiple kinematic instances can be synchronized on the same workpiece.
- Master/slave relations can be implemented, e.g. motion of the robot along the CAM profile or path progression as a function of a MultiMotion axis.
- Basic G-code import for motion control along the CAD contour.
Maximum functionality and flexibility

**MOVI-PLC®**

**Fieldbus interface**

**Freely programmable IEC application**

**HandlingKinematics**

**Kinematics technology module**

**“MultiMotion” motion control platform**

Freely programmable Kinematics technology module with maximum range of functions that can be flexibly combined with other modules

**Requirements for the MOVI-PLC® Kinematics technology module**

- DHE41B, DHF41B, DHR41B MOVI-PLC® “advanced” controller with OMH41B memory card or UHX71B MOVI-PLC® “power” controller with OMH71B memory card.
- Technology per instance of the technology module:
  - T2 Homing, jog, target operating modes
  - T3 Additional 2D linear/circular interpolation
  - T4 Additional 3D linear/circular interpolation
  - 1T Use of world/workpiece coordinate system, e.g. for variable pallet positions or tracking.
  - 1T Mechanical system is not a Cartesian gantry
- Two additional technology points per controller when using the “MultiMotion” motion control platform instead of “MultiMotion Light” (not necessary for pure path control operations).

**Benefit from high-end motion control and automation**

- Solve complex tasks quickly and easily: For example, one command suffices if you want to completely move or rotate a palletizing template. Our MOVI-PLC® does it fully automatically.
- You do not have to wait until objects are stationary but can instead pick them while the system is running at full speed, and place them on moving conveyor belts using TRACKING. The workpiece position follows the signal of an external encoder or a camera for instance.
- Process and refine your products further while moving at full speed using freely shapeable movement paths. Use our path control for plotting, cutting, painting, and more.
- Effortlessly move large workpieces using several synchronized robots with sensor-guided path correction.
- One software with numerous possibilities: material processing, packaging, stacking and complete machine automation with unlimited flexibility and consistency with only one controller.
You know which axis arrangement in your machine is best for the application at hand.

We make sure that graphic configuration and control of your mechanical system is child’s play.

There are several dozen different kinematic models available in numerous variants for you to choose from:

- Cartesian gantry
- Roller gantry
- SCARA
- Delta
- Tripod
- Quadropod
- Hexapod
- Articulated
- Mixed
- User
The integrated MotionStudio 3D simulation shows you your exact configuration without you having to make any other entries. It is a crucial tool because path control can only correctly navigate through space when dimensions, zero points and directions of movement correspond with the real machine. You will never want to miss this function again if you have already used the simulation function during programming at the office (with or without real axes). Virtual startup helps to prevent collisions and machine damage, and can speed up real startup considerably.

Requirements for 3D simulation:

- MotionStudio
- OMC41B/OMH41B/OMH71B memory card for development/startup with 10 additional technology points for all instances carried out on the controller.
- 30 minute test duration without additional technology points.

You can’t find exactly the right model for your mechanical system?
No problem. If you can sketch it, we can move it. SEW-EURODRIVE creates the right modules – or you can implement your special kinematic models in specially designed modules. Based on the dynamic modeling of your mechanical system, we also offer support on request in the selection of suitable drive technology.
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How we’re driving the world

Fast. Up-to-date. Online: www.driveworld.de/en
Path control –
Easy introduction guide

CCU HandlingKinematics
(see pages 4-5)

Which application requires a solution?
☐ Handling  ☐ Stacking  ☐ ____________

How are the trajectories defined?
Number of path points: _____ (start + max. 20)
Wait points ☐ Yes
Touch probe ☐ Yes
Stationary pick and place ☐ Yes

What degree of freedom do the kinematic models require?
☐ X ☐ Y ☐ Z
☐ Tool rotation around the Z-axis

MOVI-PLC® HandlingKinematics
(see pages 6-7)

What data is exchanged between the higher-level PLC and the MOVI-PLC®?
☐ High-resolution positions (>1 WORD per coordinate)
☐ ____________

Which automation tasks will the MOVI-PLC® be performing?
☐ Recipe management (e.g. path points)
☐ ____________

Which sensor technology will be connected to the MOVI-PLC®?
☐ Light barrier  ☐ Camera  ☐ ____________

MOVI-PLC® Kinematics
(see pages 8-9)

Which transformations are variable during the runtime?
__________________________________________

In which coordinate systems should path control take place?
__________________________________________

Is synchronized movement of several kinematic models or, for example, CAM required?
__________________________________________

Mechanical system and kinematics selection
(see pages 10-11)

How many drives are there in the mechanical system?
☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8

How are the drives and joints arranged?
(sketch on the rear)
__________________________________________

Which kinematic model (page 10) matches your mechanical system?
Line no. ____________
Column no. ____________
Your application solution requirements
Using path control from SEW-EURODRIVE

<table>
<thead>
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<th>Department / function</th>
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<tbody>
<tr>
<td>Company</td>
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<td>Email</td>
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Your sketch of the mechanical system/application

Please send this page by fax to the Technical Office near you.
You can find contact addresses on the rear page of the folder or on the Internet at www.sew-eurodrive.com.