Multi-Axis Systems — Combining Linear Axes

This page explains how to combine NILAB linear axes into **multi-axis systems** (2D, 3D, gantry, pick-and-place) and how to coordinate them. Use it when your machine needs motion on more than one axis, or when you want a compact, high-dynamics system built from integrated motors.

Multi-axis configurations

Configuration	Description	Typical NILAB axes
2D (X-Y)	Two axes, coordinated motion in a plane	GDM, LM, ULCO, NLi
3D (X-Y-Z)	Two planar axes plus a vertical Z axis	GDM + LM + LMA/NELA, or NLi
Gantry	Two parallel axes carrying a cross-carriage (off-axis payload)	GDM (multi-carriage), LM
Pick-and-place (2D)	Parallel kinematic robot for fast handling of small parts	NLiP

Which axes for a multi-axis system

GDM — the module version of the Green Drive motor with a carriage and an integrated linear guide. It is available in a **multi-carriage** configuration and is designed for **off-axis payload** and multi-axis systems. Ideal for gantry and 2D systems.

LM — long-stroke, high-force axis on an aluminium profile. Suitable for the long-travel axis (X) of a gantry, with a wide choice of encoders and fieldbuses.

ULCO — modular belt-driven linear units with unified T-slots. Easy to combine into **self-supporting multi-axis** systems for small to medium power.

NLiP — a 2D pick-and-place robot based on two miniature integrated-drive linear motors using **parallel kinematics**. Handles parts up to 2 kg with high acceleration in a small space; it is programmed with NILAB Starter.

NLi / NLi-EtherCAT — integrated motors with a very compact form factor and low cabling effort; suitable for daisy-chain connection.

How to coordinate the axes

Option	Description	Link
NILAB Starter Software	Configures the motion parameters of the integrated drives, offers application GUIs and auto-teach for single and parallel motion	NILAB Starter
EtherCAT (integrated)	NLi-EtherCAT combines the integrated drive with an EtherCAT interface for interpolated motion	NLi-EtherCAT
EtherCAT (gateway)	The NILAB EtherCAT Bus Interface connects up to 10 NLi motors (CANopen profile positioning, or Modbus RTU) to the EtherCAT fieldbus	EtherCAT Bus Interface

Fieldbuses on LM axes	LM axes are delivered ready for EtherCAT, ProfiNET or CANopen and common servo drives	LM Linear Axis

System design considerations

- **Mechanical structure** — keep the moved mass low and the rigidity high; see the Machine design requirements (mass reduction, stiffness, natural frequencies ≥ ~200 Hz). - **Off-axis payload** — use GDM (or a dedicated cross-carriage) when the load is off the axis centreline. - **Environment** — choose the bellows version (GDM) or IP-rated axes for washdown / dust / food-grade applications. - **Cabling** — integrated motors (NLi, NLi-EtherCAT) reduce cabling effort; use daisy-chain where supported.

How to proceed

1. **Define the motion task** — 2D, 3D, gantry, pick-and-place; stroke, speed, acceleration, payload. 2. **Select the axes** — use the Axis selection page. 3. **Select the coordination** — NILAB Starter, EtherCAT, or a fieldbus. 4. **Design the machine** — see the Machine design requirements. 5. **Commission** — use NILAB Starter (single and parallel motion, auto-teach, diagnostics).

Related pages

* Linear axes selection * GDM Tubular Linear Axis * LM Linear Axis * ULCO Belt-driven linear units * NLiP Parallel Kinematic Robot * NILAB Starter Software * NLi-EtherCAT integrated linear motors * NILAB EtherCAT Bus Interface * Machine design

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