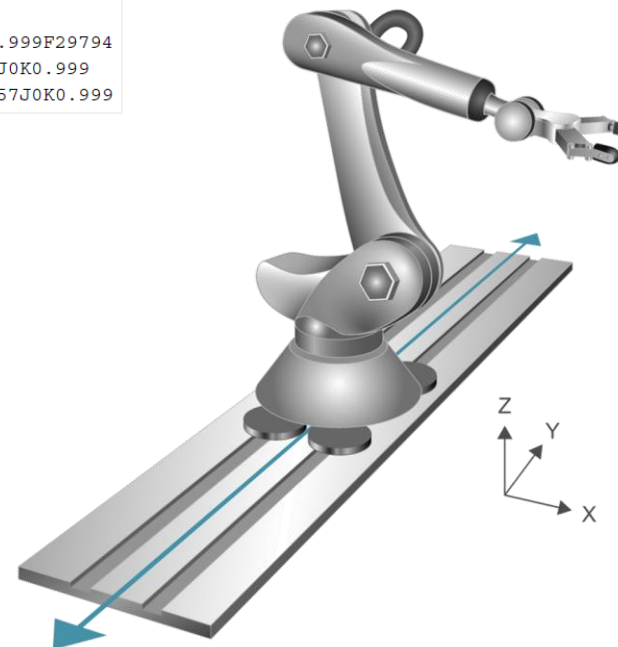


```
#ORI MODE [VECTOR_IJK FIXED_AX_IDX=5]
#TRAFO ON
X50 Y50 I50J0K0
X75Y150Z180I0J0K1
X149.316Y150Z180I-0.0457J0K0.999F29794
X149.316Y150Z165.012I-0.0457J0K0.999
X150.0018Y150Z150.0279I-0.0457J0K0.999
```



VIRTUAL COMMISSIONING IN ROBOTICS – FROM PLANNING TO CONTROL

Dr.-Ing. Christian Scheifele

Stuttgart, den 11. November 2025

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ISG INDUSTRIELLE STEUERUNGSTECHNIK GMBH



SUCCESSFUL CUSTOMERS

35+ years of experience in control and simulation technology



INNOVATIVE EXPERTS

65+ engineers in the field of control, simulation, mathematics and physics



SHAPING THE FUTURE

Developing solutions for tomorrow's production in research networks and partner projects





CNC / RC / MC

The software for controlling machines and systems in the fields of CNC, robotics as well as motion control



ONE CONTROL CORE FOR ALL TECHNOLOGIES



LONGSTANDING PARTNERSHIPS



1987

MACHINE TOOLS	PANEL PROCESSING	ROBOTICS & AUTOMATION
HSC Engraving Penduling Online Tool Correction Face and Shell Milling 5-Axis-Machining Die-Sinking EDM Wire EDM Disc erosion Machining Cycles Multi-Spindle Technology Optics	Laser Cutting Waterjet Cutting Plasma Cutting Punching & Needling Blade Cutting & Fixed Knives Welding	Serial Kinematics Tripod/ Hexapod Open Kinematics Interface Flexpicker Milling Handling
	ADDITIVE MANUFACTURING	WOOD PROCESSING
	Wall Printing 3D Filament Printing Concrete Printing Dispensing	Milling Drilling Edge gluing



ISG-KERNEL FOR ROBOTICS

DIRECT CONTROL OF BENDING ROBOT KINEMATICS WITH 6-CHANNEL TWINCAT CNC AT WAFIOS



REQUIREMENTS

All 6 bending robot kinematics must be moved in synchronisation with the cycle.



BL 10-6

CNC-Mehrkopf-Rohrbiegemaschine

zur Herstellung von komplexen dreidimensionalen Biegeteilen

CNC Multiple-Head Tube Bending Machine

for the Production of Complex, Three-Dimensionally Bent Parts

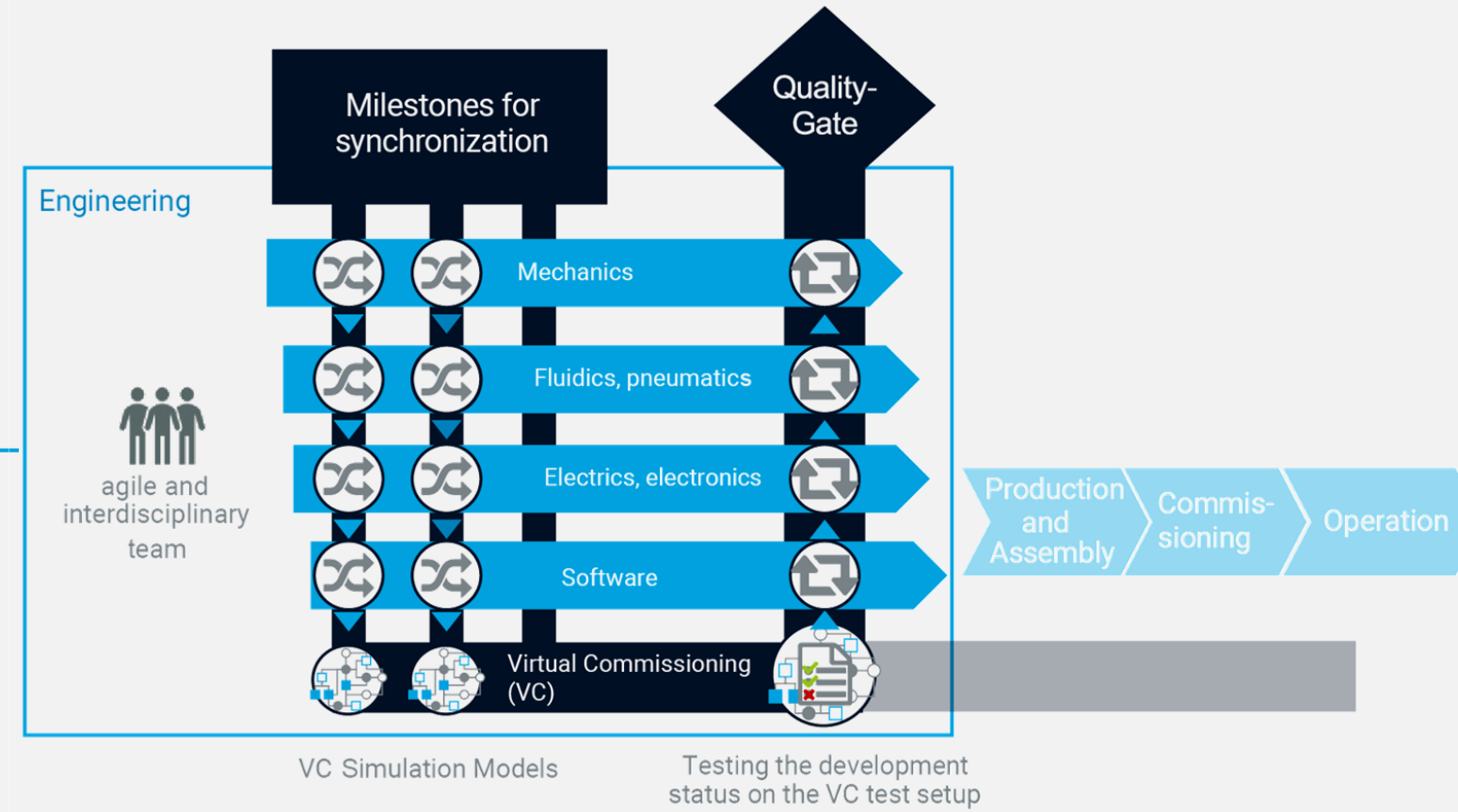
Copyright by WAFIOS AG 2016



REALTIME SIMULATION

From early engineering to virtual commissioning

2005





VIRTUAL COMMISSIONING

- + Verification of control code and robot programs with real hardware
- + Ensuring system functionality long before production starts

Early Engineering

Virtual commissioning (VC)

Retrofit & Maintenance

Trainings

THE ONLINE STORE FOR PREBUILT 4D-MODELS

Directly from the manufacturer and for all forms of simulation

- + ORIGINAL FIRMWARE
+ STANDARDIZED FORMAT**
- + REAL-TIME-CAPABLE
4D-SIMULATION MODELS**

2020



INNOVATIVE SOLUTIONS

OUR SOLUTIONS FOR THE FIELD OF AUTOMATION



CNC / RC / MC

The software for controlling machines and systems in the fields of CNC, robotics as well as motion control



REALTIME SIMULATION

From early engineering to virtual commissioning



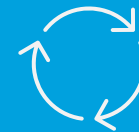
PREBUILT 4D-MODELS FOR SIMULATION

Directly from the manufacturer and for all forms of simulation

1987

2005

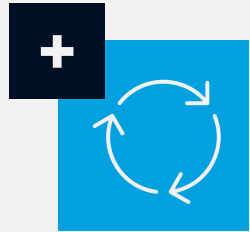
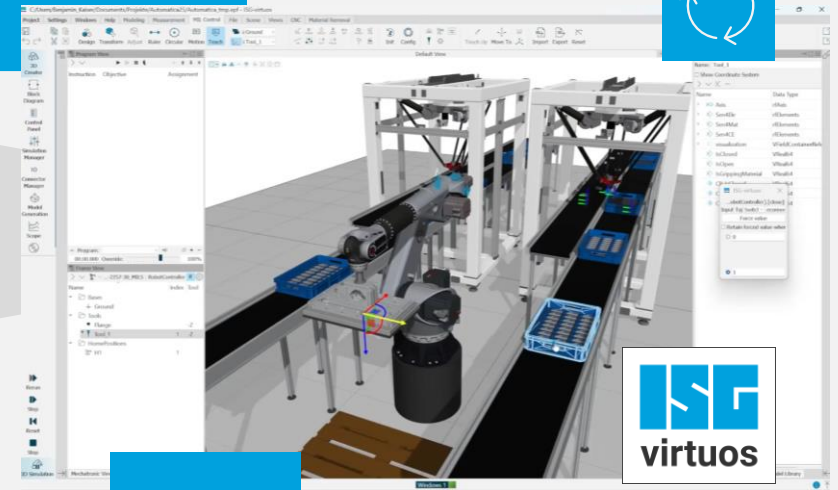
2020



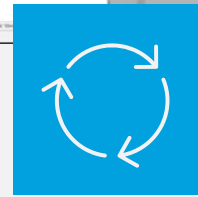
COMBINATION OF TECHNOLOGIES



LET'S TAKE THE NEXT STEP TOGETHER!



seamless
COMBINATION
OF high-end **TECHNOLOGIES**



EFFICIENT PROGRAMMING WITH DIGITAL TWINS & REAL CONTROL ALGORITHMS



1

The screenshot displays the Virtuos software interface. The main window shows a 3D perspective view of a mechanical assembly, likely a conveyor system, with a transparent blue component highlighted. The interface includes a top menu bar with options like Project, Settings, Windows, Help, Modeling, Measurement, ML Control, File, Scene, Views, and Material Removal. A toolbar below the menu contains various icons for editing and simulation. On the left, a vertical toolbar lists functions such as 3D Creator, Block Diagram, Control Panel, Simulation Manager, IO Connector Manager, Model Generation, Scope, Record, and Dashboard. The bottom left corner features a simulation control panel with buttons for Run, Ramp Up, Reset, Stop, and 3D Simulation. On the right, a 'Model Library' panel is open, showing a list of components under 'User defined' with 'KOCH_Beckhoff_XTS' selected. The bottom of the interface shows a Windows taskbar with a search bar and system tray icons. At the bottom of the slide, a table summarizes the benefits of the software.

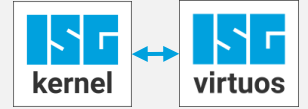
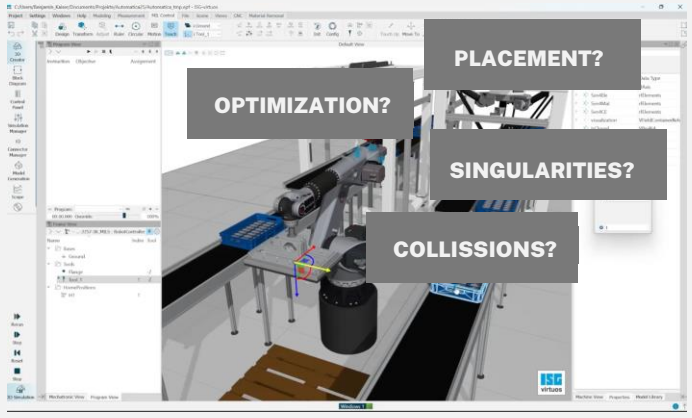
MODEL FROM LIBRARY	MODEL FROM PREBUILT COMPONENTS	AUTOMATED MODEL GENERATION	EARLY REALISTIC MOVEMENTS
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COMBINATION OF CONTROL AND SIMULATION



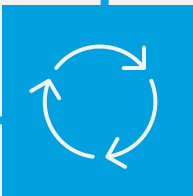
1

TRY



- Virtual CNC/RC/MC core
- 3D Simulation-Environment

„ONE CLICK“



ONLINE DEPLOYMENT

EXECUTE



■ ROBOTS FOR MACHINING

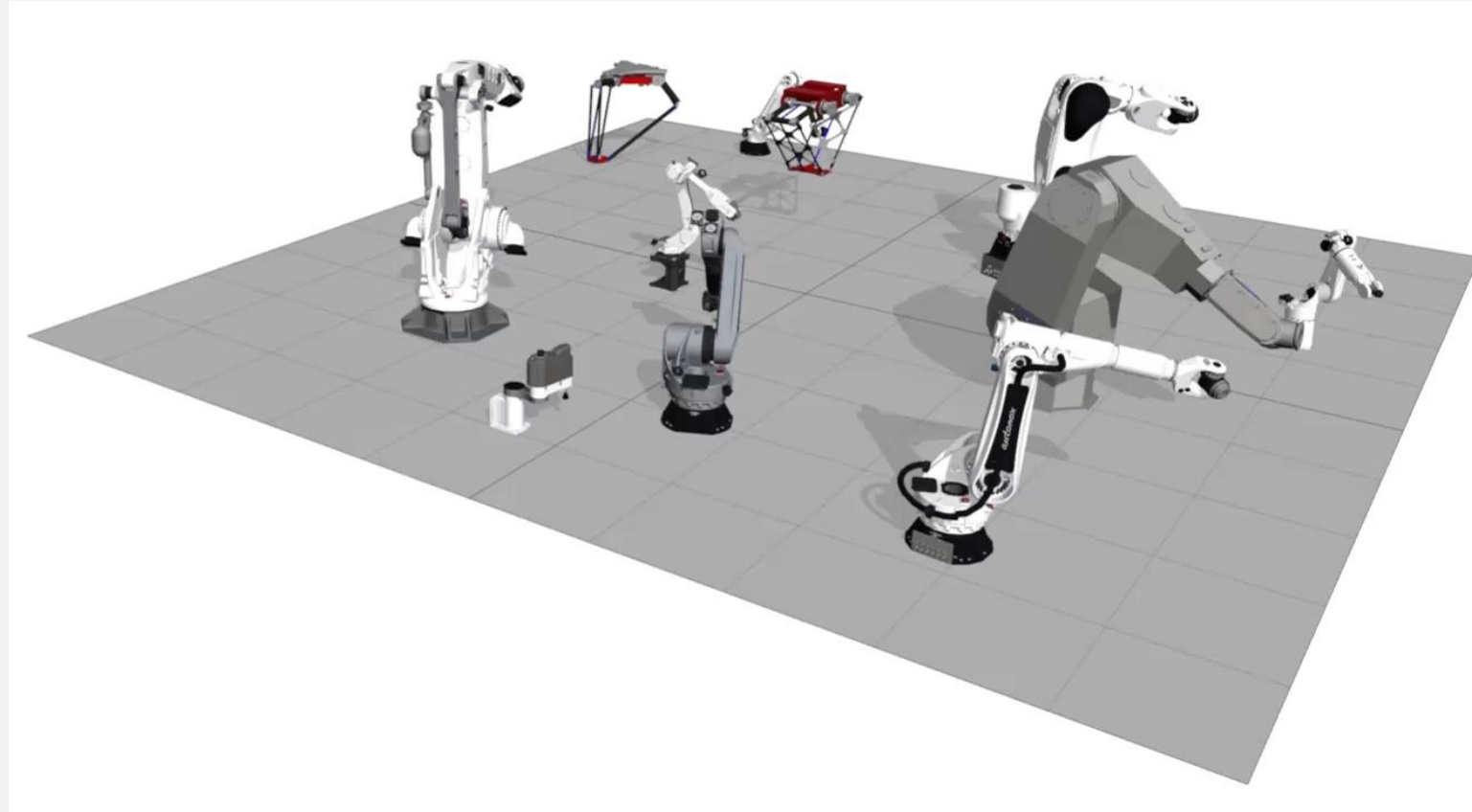
- Highly accurate, path-accurate motion control
- Constant path speed
- Programming via CAD/CAM

■ ROBOTS FOR HANDLING

- Loading/unloading machines
- Handling in packaging technology
- Simple programming of robots
- Fastest possible movements for short cycle times

■ OBJECTIVES

- Move robots faster
- Program robots more easily
- Smooth transition from simulation to real robot cell
- Shorter cycle times
- Faster commissioning



Offline programming (MiLS)

bases

programme

CAD-based path planning

- Along edges (e.g. welding, deburring, etc.)
- Filling of planes and curved surfaces (e.g. painting, sandblasting, scanning, etc.)

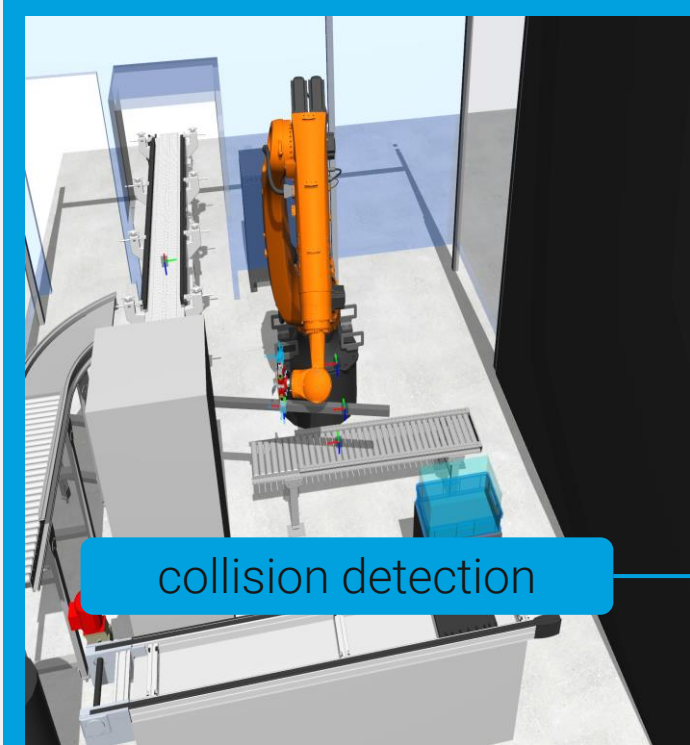
Programming cycles

- Palletising
- Handling
- Assembly
- Measuring
- ...

CAD-based path planning and robotic cycles



AUTOMATIC PATH PLANNING

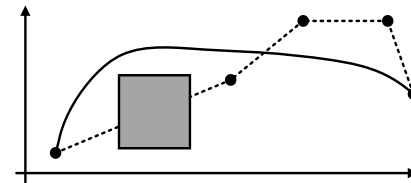


Offline programming (MiLS)

bases

programme

- Collision avoidance
- Singularity avoidance
- Path optimisation (time, distance, energy, stiffness, etc.)



collision detection

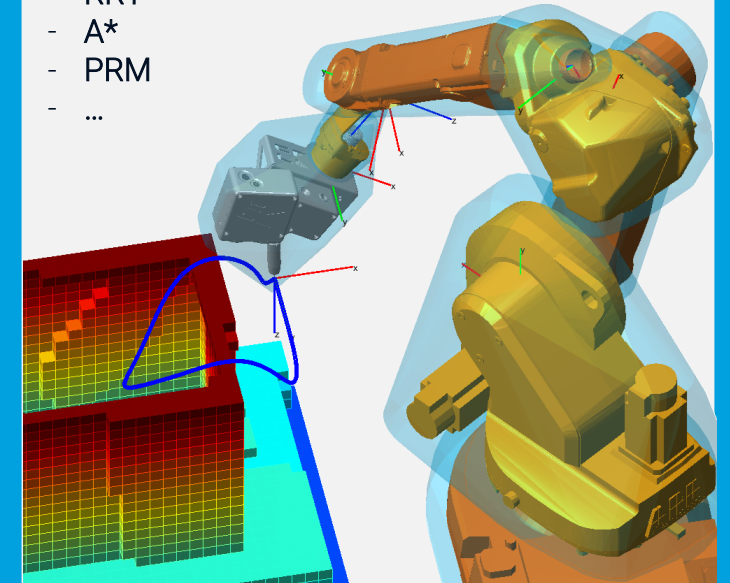
path planning

ISG-kernel

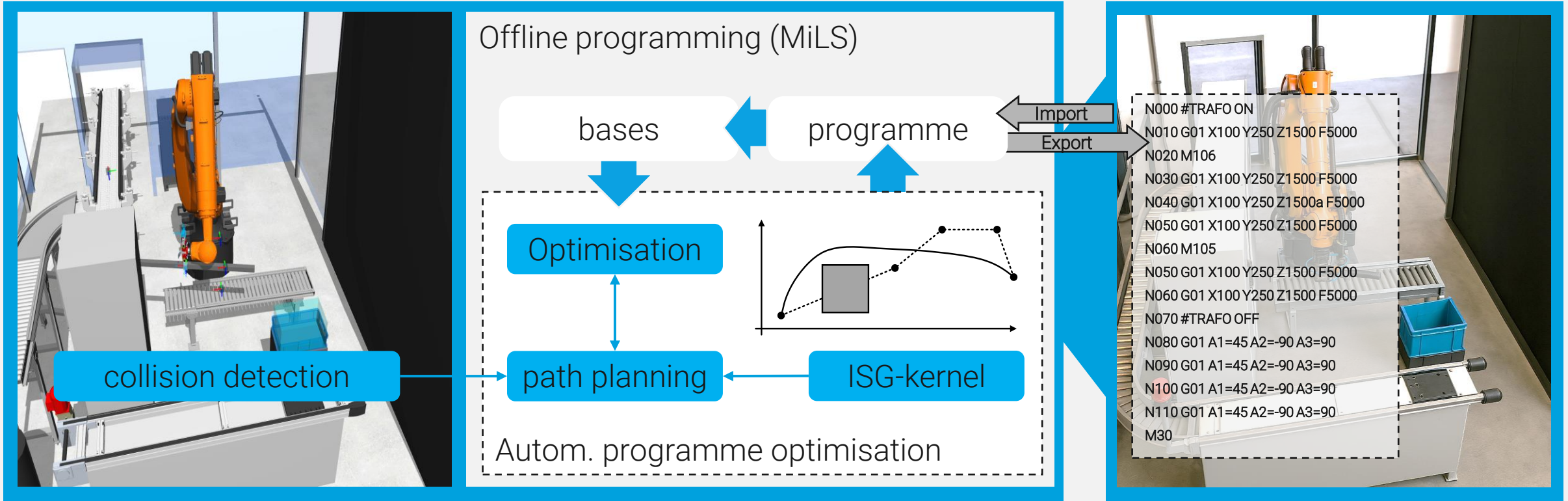
Constraint-based planning

Aut. path planning

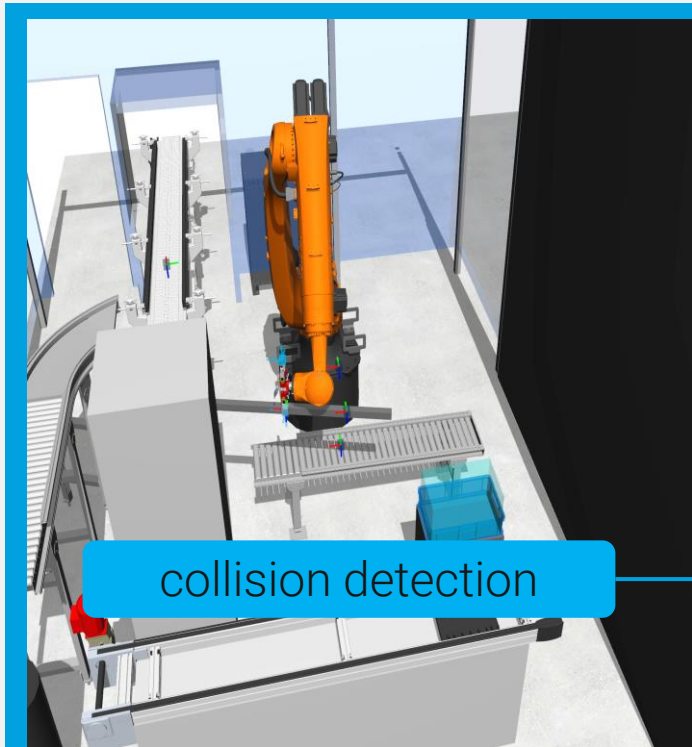
- RRT
- A*
- PRM
- ...



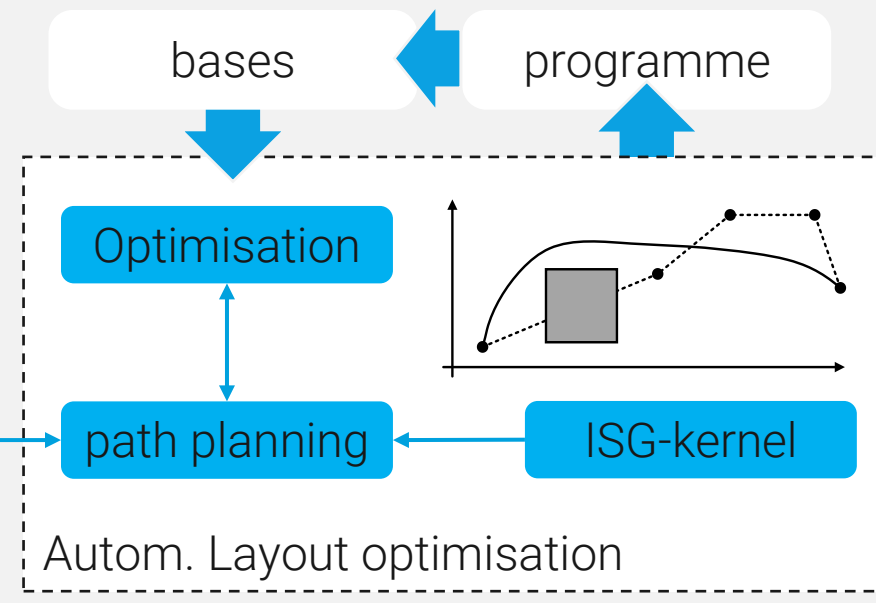
PATH OPTIMISATION



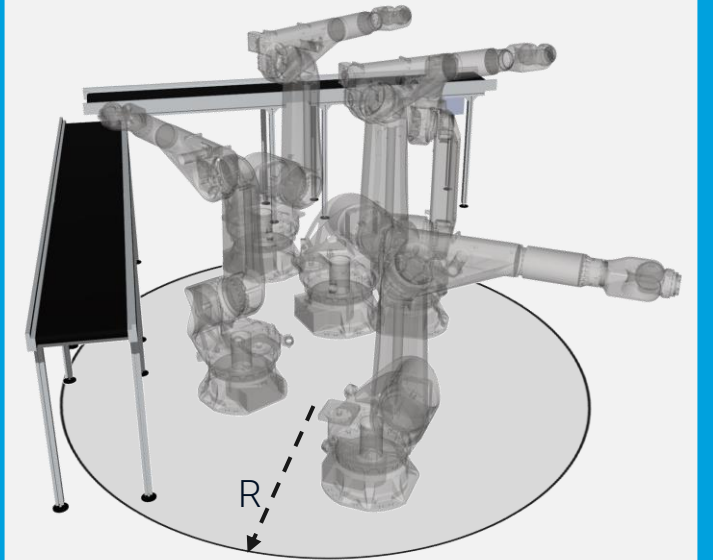
LAYOUT OPTIMISATION



Offline programming (MiLS)



cell optimisation



THANK YOU FOR YOUR ATTENTION. QUESTIONS?



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christian.scheifele@isg-stuttgart.de