



Complex automation systems increase the amount of programming needed – until now (figures: KraussMaffei)

Smart Control Over Complex Production Cells

Robot Programming. Time and qualified personnel are often in short supply when it comes to programming the automated workflows in molding shops. The use of interactive, intuitive programming and user interfaces that simplify the interaction between man and machine can remove this bottleneck.

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Advances in injection molding continually unlock new possibilities for adding extra functions to parts as they are being produced. However, while this not only enhances the value, it also increases production line complexity. Converters are increasingly turning to automation to demold and process high-quality parts after the injection molding process. Thus, over 10,000 new industrial robots were installed in the plastics and rubber industry worldwide in 2011, according to the International Federation of Robotics (IFR). After the electrical/

electronics industry and the automotive sector, plastics processing is the third most important field of application for industrial robots.

While linear robots can be programmed relatively easily by employees with some basic knowledge, six-axis industrial robots are a more difficult and time-consuming proposition. Molding shops can find themselves in a quandary. True, the more complex the products made by a manufacturing cell, the greater is the value added during production. At the same time, however, more time is needed to program the automation equipment and to train personnel. Yet, in practice, short product life cycles mean that production startup must occur as quickly as possible and so time is at a premium. An easy-to-use programmable robot can therefore bestow a decisive competitive advantage.

Efficient Working with the Machine Controller

An equally important factor governing production quality and versatility is the harmonious interaction between injection molding machine and automation components. KraussMaffei's newly developed MC6 machine controller and WizardX, VisuX and ProgTechX programming and operating wizards offer integrated control systems that greatly simplify the operation of automated manufacturing cells (**Fig. 1**).

The MC6 controller is clearly and intuitively designed so that the operator can work more efficiently and faster than ever before. It employs split-screen technology that can display different content independently. The operator therefore always has an overview of the most important production processes. For example,



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Fig. 1. The MC6 controller platform for complex production cells allows mutual operation, e.g., of the injection molding machine from the robot handheld

the current cycle statuses and the injection process can be displayed simultaneously. The MC6's built-in ProcessDesigner provides an uncluttered view of all running processes. These can be modified as needed through simple touch operation or intuitive swiping.

To render the controller as user-friendly as possible, navigation within the MC6 has been kept flat, with very few hierarchical levels. The uncluttered format, featuring customizable favorites bars, quickly guides the operator to his or her objective. For greater clarity, only those keys are displayed which are relevant to the instantaneous operating conditions of the machine. A special panel for line selection makes it possible to select all the components of the manufacturing cell directly. In keeping with the overall energy-efficient design of KraussMaffei injection molding machines, the MC6 controller also features a so-called eco button, which allows the operator to optimize the machine's energy settings at the touch of a button.

Predefined role profiles for machine operators, machine setters or production manager enable different permissions to be assigned quickly and easily. Furthermore, additional hierarchical levels can be added and individual rights assigned to specific users. The MC6 is equipped with a resistive touch screen – which means that the screen responds to pressure and can therefore be operated with gloves. Its dual-touch function allows two-fingered operation familiar to many users of smartphones. All these properties are available not only on the machine display, but also on the handheld device for the robots (Fig. 2).

Intuitive Programming in Four Steps

The WizardX graphical programming assistant serves in tandem with the MC6 controller to program the linear robots used in injection molding.

Even beginners can program basic demolding processes in the shortest possible time. This is done in four steps (Fig. 3). In the first, the elements that make up the cycle are defined. The individual stations in the program flow, such as demolding, sprue separation and scrap deposition, are inserted simply via touch controls into the desired location in the program workflow. When all the various stations have been created, the user configures them individually in the second step. An interactive series of questions and answers helps him or her to fully enter the configuration data.

The third step consists in “teaching” the various approach points of a molding cycle. From the starting position, the programmer initially moves the robot to the first desired position, e.g. to the point



Fig. 2. Robot handheld for LRX linear devices with the WizardX programming and operating assistant

at which the part is demolded. The coordinates of this point are saved. This procedure is then repeated until the entire molding cycle has been executed once and all the positions have been stored. Every position that has already been taught is marked in green. This visual highlighting helps the user to keep track of and identify missing stages during teaching.

This completes the manual programming work, because in the fourth and final step WizardX automatically generates the error-free basic program from the entered data. The proven 5-button design ensures that the entire automation can be easily operated and ensures smooth production startup.

Thus, linear robots can be programmed faster than before. Even where the operator has no programming knowl-



Fig. 3. Graphical sequence programming with WizardX is divided into four steps

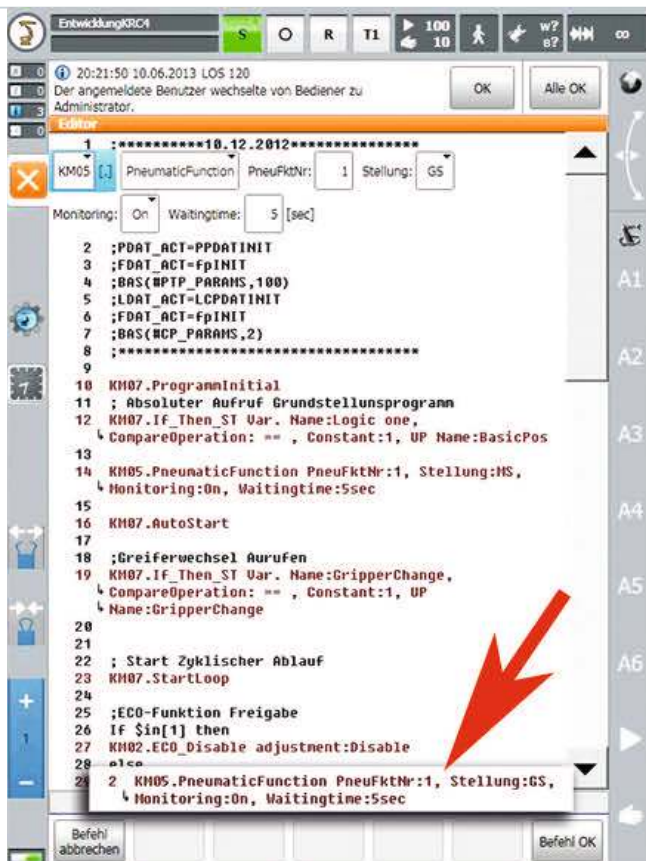


Fig. 4. The ProgTechX programming assistant for industrial robots automatically opens the inline form (gray) after a function has been selected so that the command can be configured accordingly. The small window (red arrow) shows the automatically generated code for a fully parameterized pneumatic function

edge, the programming wizard gives him or her the capability to generate error-free code. This automatic program creation eliminates laborious and time-consuming debugging. The expert mode additionally offers the option to modify and customize the automatically generated code where appropriate programming skills are available.

These simplifications to the programming and operation of the linear robots reduce the need for personnel training. Faster programming leads to earlier production startup. WizardX avoids programming errors and so saves time and costs.

Reducing Complexity to the Essentials

The programming of industrial robots is complex and extensive due to their kinematics. The code for the molding cycle of an industrial robot can quickly reach 1,000 lines and more. Until now, the programmer had to code these programs one character at a time. That requires studious concentration on syntax and commands. Accordingly, coding and debugging are time-consuming.

ProgTechX from KraussMaffei simplifies the interaction between humans and robots, allowing attention to focus fully

on the process. ProgTechX is a programming interface that reduces the complexity of the robot functions to the essentials. It boasts a range of command libraries and inline forms that make it possible to create error-free programs for industrial robots faster than before. With its graphical interface, a command library simplifies the finding and usage of specific functions. Clicking the corresponding button causes the respective command and inline forms to be inserted into the program. Typos cannot occur here (Fig. 4).

Once the industrial robot has been programmed, it should also be easy to operate under daily production conditions. VisuX from KraussMaffei is a user interface that provides the operator with the necessary information on the industrial robot (e.g., program selection, counters, timers, current axis positions) in a convenient format. VisuX groups and clearly displays all the information over seven pages. At all times, the operator is therefore able to diagnose the current manufacturing process, and adjust it if necessary.

A particular advantage is that it is integrated into the MC6 interface. This enables the robot to be operated and programmed from the panel of the injection molding machine. Conversely, the machine can also be operated and programmed from the robot handheld (Fig. 5). Because the user interfaces have the same look and feel, it is very easy for an operator who is already familiar with the machine controller to navigate the VisuX user interface and quickly access the relevant information.

Conclusion

The new developments in control systems that have been described here greatly simplify the programming and operation of automated manufacturing cells. The interactive and intuitive solutions facilitate interaction between man and machine and help to prevent programming and operating errors. ■

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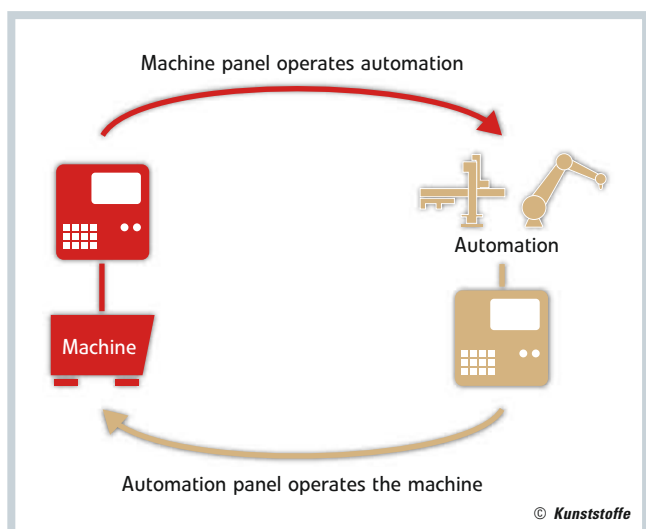


Fig. 5. The control panel of both injection molding machines and robots can be accessed from each other