

PowerMILL Robot Interface launched

JAN WILLEM GUNNINK

Jan Willem Gunnink (jwg@delcam.com), Delcam, UK

How to cite: J.W. Gunnink. PowerMILL Robot Interface launched. *Advanced Technologies in Mechanics*, Vol 1, No 1 (1) 2014, p. 41–46. DOI: [http://dx.doi.org/10.17814/atim.y2014.iss1\(1\).art11](http://dx.doi.org/10.17814/atim.y2014.iss1(1).art11)

Abstract

Delcam was the Co-ordinating Partner on the thirty-month COMET project, which was part-funded by the European Commission under the Factories of the Future umbrella, aimed to overcome the challenges facing European manufacturing industries by developing innovative, robot-based machining systems. One of the key outcomes of the project was new software PowerMILL Robot Interface which makes it easy to program a robot for machining. The core functionality of PowerMILL Robot consists of three main steps: programming, simulation (including analysis) and creation of the robot programs in native language, eliminating any need for third-party translation software.

KEYWORDS: Delcam, robot, milling, innovation, simulation

The PowerMILL Robot Interface (PRI) has been launched formally after being rewritten and fully embedded inside PowerMILL as a plug-in. This approach makes it fully associated application inside PowerMILL, with data stored as PowerMILL projects.

Support from the COMET project

The development of the PowerMILL Robot

Interface has benefited from Delcam's participation in the COMET project. Delcam is co-ordinating the project, which is focused on improving the accuracy of machining with industrial robots. Partially funded by the European Commission, the project aims to develop innovative robotic machining systems that are flexible, reliable and predictable, with an average of 30% cost-efficiency savings in comparison to machine tools.

In order to achieve this, the COMET project is addressing the following critical limitations of machining with industrial robots:

- A Lack of absolute positioning accuracy

- An inability to cope with disturbances in terms of process forces
- A lack of reliable programming and simulation tools that ensure „right first time” machining

More details on the COMET project can be found on the project website www.cometproject.eu

As a result of working with numerous robotics experts in the COMET project, Delcam has been able to implement the latest robot machining technologies into the PowerMILL Robot Interface to make it easier than ever to program industrial robots (fig. 1). With unlimited access to PowerMILL’s renowned toolpath strategies, the user can easily program and simulate robot paths and post the output in native robot language to a range of robots, including KUKA, ABB, Fanuc, Yaskawa Motoman and Stäubli. Within the project, seven different robot machining cells have been established, which have all been used in extensive testing of both the software and the project’s research goal: achieving more accurate milling results from robots. Feedback has been used to simplify offline programming as much as possible.

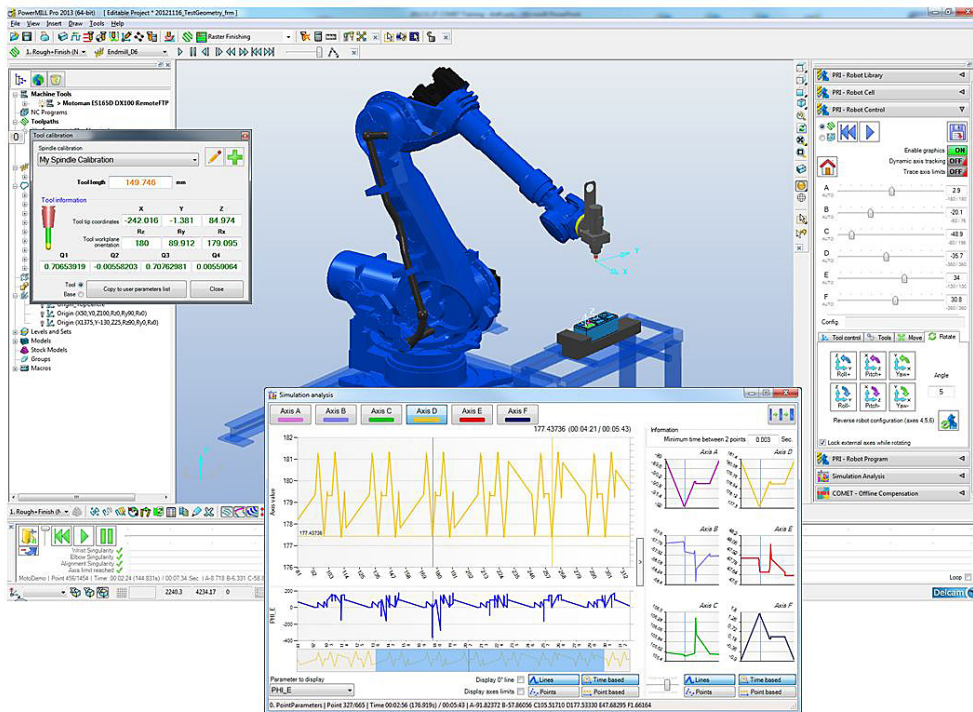


Fig. 1. The new PowerMILL Robot Interface makes programming a robot as easy as programming a five-axis machine

For example, several dedicated forms have been created within the PowerMILL Robot Interface to make the cell set-up and cell calibration as simple as possible.

Core functionality

The core functionality of the PowerMILL Robot Interface consists of three main steps: programming, simulation (including analysis) and creation of the robot programs.

Robots can be programmed for tool-to-part applications, making them ideal for machining large parts, or for part-to-tool applications, such as grinding or finishing. The working area can be extended with linear tracks and rotary tables for even greater flexibility over the size and types of parts that can be manufactured.

A solver strategy can be defined to achieve the desired robot simulation and to control the robot's movements through different variables, such as axis limits, axis priorities and workplane constraints. Robot cell configurations, such as axis limits, tool constraints and home position, can be defined, and the robot simulated within those constraints.

The robot's working envelope can be displayed to optimise the part position and to give maximum access to the part. The maximum range of movements required of each axis can be viewed to analyse the robot's behaviour and movements throughout the operation.

Any issues that may prevent toolpaths from being completed are detailed, with notifications of the robot potentially reaching axis limits, singularities and collisions. Graphs display the axis limits, wrist singularity and axis reversals to give a better understanding of how the robot will move. Similarly, the acceleration and deceleration of the robot's axes are shown on time-based graphs.

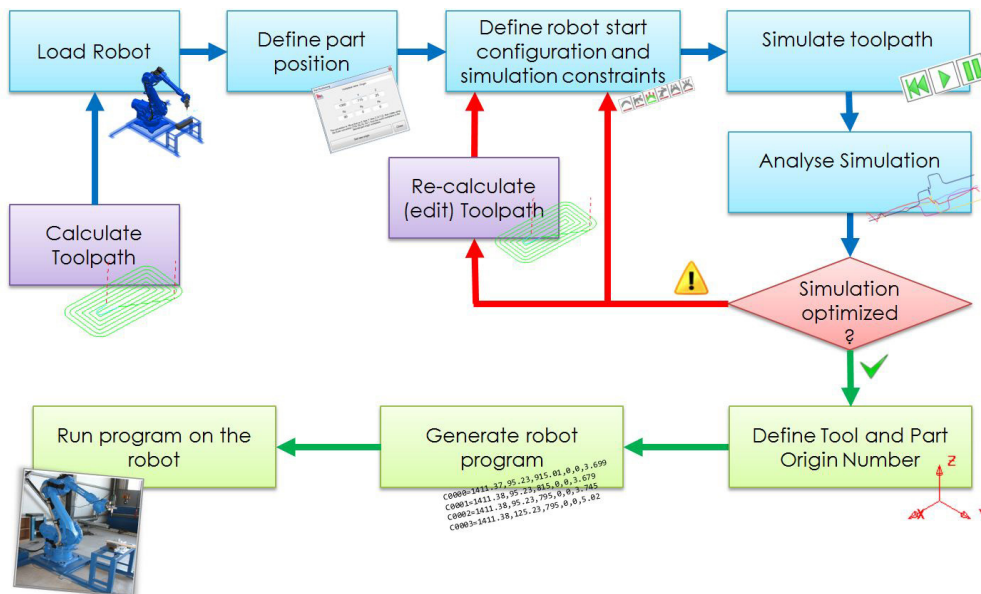


Fig. 2. The workflow used when programming robots

Once the results of the simulation have been reviewed, the program can be output in the appropriate robot native language, for example for KUKA, ABB, Fanuc, Yaskawa Motoman and Stäubli, eliminating any need for third-party translation software.

Acceleration, smoothing values and other robot -specific parameters can be defined within the output. Full support for external axes, such as rotary tables and linear tracks, can be included, as well as dedicated tools for spindle calibration.

Overall, the PowerMILL Robot Interface helps users to get the most out of their robotic platform in the shortest possible time. A simplified workflow makes it easy to program, simulate, review and refine toolpaths, whilst enabling the robots to achieve levels of accuracy similar to many CNC milling machines (fig. 2).

Addressing accuracy

One of the key aspects of the COMET project is to address the lack of accuracy when machining with robots (fig. 3). The project separates this into two main aspects: offline compensation and online compensation. The online compensation uses optical measurement equipment from Nikon Metrology to correct the robot position during machining operations. The offline compensation identifies the key error sources of the robot and compensation routines are then developed for the most relevant ones. The offline compensation is also available as a plug-in inside PowerMILL and works seamlessly together with the PowerMILL Robot Interface. Kinematic offline compensation is able to compensate for slight alignment errors and manufacturing tolerances within the robot structure. Each robot cell is measured with an optical tracker and the result is used inside the offline compensation to adjust for the kinematic errors.



Fig. 3. Robot machining was demonstrated by Delcam at the recent JEC exhibition

Compensation also needs to be considered for joint effects. Each joint within the robot arm has errors such as backlash (the main error source in robotics), compliance and friction effects. An embedded simulation model of the joint dynamics allows for emulation and compensation of these joint errors, which depend on the load on the robot and on the estimated cutting forces. In this way, the actual robot -joint effects can be foreseen at the engineering stage. In the project, machining tests have shown the effects of the identified errors when machining aluminium and steel with industrial robots. The offline compensation has been proved to be able to compensate for a significant amount of the error. However, while the PowerMILL Robot Interface is now available for Delcam's customers, the different COMET solutions to compensate for robot errors are still under development and are currently only available to the consortium partners as prototype components (fig. 4).



Fig.4. Extensive trials of the new Interface have been undertaken within the COMET project

Acknowledgement

The Comet project is co-funded by the European Commission as part of the European Economic Recovery Plan (EERP) adopted in 2008. The EERP proposes the launch of Public-Private Partnerships (PPP) in three sectors, one of them being Factories of the Future (FoF). Factories of the Future is a EUR 1.2 billion program in which the European Commission and industry are collaborating in research to support the development and innovation of new enabling technologies for the EU manufacturing sector.

For further Information, please visit

http://ec.europa.eu/research/industrial_technologies/factories-of-the-future_en.html

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