

Experience with Work in Simulation Software Cosimir[®] Professional

MIHALÍKOVÁ, Jana¹ & LÍŠKA, Ondrej²

¹ Ing., ✉ Katedra automatizácie a riadenia, Sjf - TU Košice, Park Komenského 9, Košice, 042 00,
💻 jana.mihalikova@tuke.sk, 🌐 <http://www.sjf.tuke.sk/kaar>

² doc. Ing., 💻 ondrej.liska@tuke.sk

Abstract: *simulation is well-recognized among its expert practitioners as a manufacturing productivity improvement tool. However, within many companies, simulation is used only in unusual situations and when the need for efficiency improvements has reached a high level of urgency and visibility among managers. Company Festo Didactic has much software for modelling and simulation manufacturing process.*

We worked with software COSIMIR[®] PLC and COSIMIR[®] Professional. COSIMIR[®] Professional is the industrially tried and tested, extremely high performance development software for creating 3D simulation systems for automation technology. It combines three tools under one common interface 3D simulation, 3D modelling and Robot programming.

The contribution describes defects and problems that come into being existence on import file, modelling and simulation. We imported 3D model from software Inventor 11. In finish they are inscription advantages and disadvantage making with software.

Keywords: *simulation, modelling, COSIMIR[®] Professional*

1 Introduction

Simulation is appropriate toll for effective assimilation system. Because of simulation is possible employed different programs than the DELMIA, Arena, Simple ++, COSIMIR[®] and lot software. We're been using programs from advice the Cosimir[®]. This programs is lot software, which are using for simulation, projection, programming and for virtual reality. I am working with programs the COSIMIR[®] PLC, the COSIMIR[®] Robotic and the COSIMIR[®] Professional.

COSIMIR[®] PLC is a PC-based graphical 3D simulation system that offers a virtual learning environment for the mechatronic training system MPS[®]. It is specifying to train in PLC programming and testing of the PLC program. Simulate can real also imaginary PLC.

COSIMIR[®] Robotic is a virtual learning environment for industrial robotics offering a comprehensive online tutorial on robotics and numerous predesigned robot cells.

COSIMIR[®] Professional is the industrially tried and tested, extremely high-performance development software for creating 3D simulation systems for automation technology. It combines three tools under one common interface 3D simulation, 3D modelling and robot programming. [1]

2 COSIMIR[®] Professional

COSIMIR[®] Professional is the "Crown Jewel" for today's robot technology, with professional 3D software for modeling, simulation and programming of various industrial robot systems, and a new "learning environment" developed by COSIMIR[®] Educational. Graphics are Open-GL standard, providing the capability to produce simple wireframes or shaded representations, including cosmetic controls [3].



Figure 1: Program COSIMIR® Professional

Modelling is possible by basic CAD functions and importing of numerous CAD formats. Modelling through parameterisation of the geometry, the kinematics, the material and physical properties.

It takes libraries with industrial robot systems, numerous automation components and powerful automation mechanisms. All 3D objects are controlled by an integrated virtual PLC via mechanical or electrical interfaces. This permits real-time experiments and analyses.

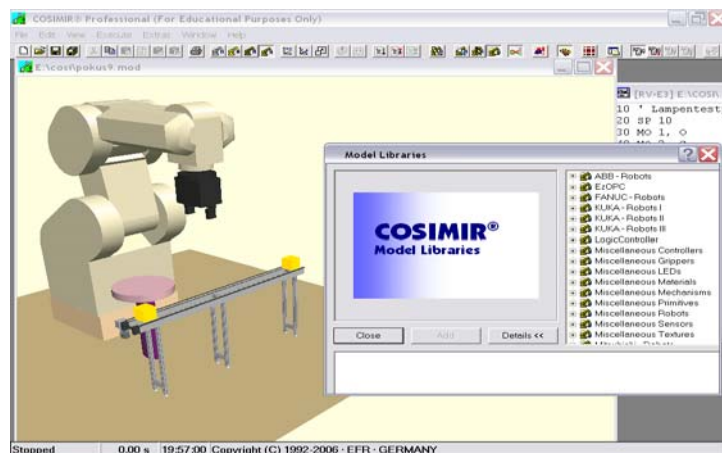


Figure 2: Model Libraries in COSIMIR® Professional

Program wear a powerful mechanism for flexible movement of workpieces for transport simulation. Collision detection is make through colour changes or warning messages with/without acknowledgement. Easy selection of the objects to be checked for collision. Almost all sensors, from the inductive sensor to the camera, can be reproduced with their physical properties. This permits realistic analyses of interactions with the periphery. Surface finishing processes such as painting or welding are respresented graphically in detail. This permits efficient preparation for your on-site optimisations.

Process models can be controlled in parallel by a number of robots and/or PLC controllers (either S5 or S7). Creation of user interfaces for configuring error scenarios and troubleshooting. With configuration menu for communication with OPC servers.

Use COSIMIR® to plan robot-based workcells, to check the reachability of all positions, to develop programs for robots and controllers, and to optimize the workcell layout. All movements

and handling operations can be simulated to avoid collisions and to optimize cycle times. The direct download of tested programs and positions into the robot controller is completely supported.

The modeling extensions for COSIMIR[®] support the composition of robot-based workcells. Efficient modeling is provided by using component libraries containing machinery, robots, tools, conveyor belts, part feeders, etc. Free 3D modeling and import from CAD systems (e. g. AutoCAD[™]) are also possible. Additionally, COSIMIR[®] supports user defined libraries and project documentation [2].

3 Modelling

For modelling realistic, three-dimensional workcells a special three-dimensional editor is required. The three dimensions of a workcell in a 3D-editor however are mapped on a two dimensional output device, your screen. With this kind of workcell display some objects or parts of the space may be covered by other objects. To edit these hidden objects and to easily place objects at any place, at least two different views of the workcell are required. In order to avoid complex interdependencies between these views, it is recommended to choose perpendicular views. COSIMIR[®] supports the protection of the simulation model that is currently loaded into the simulation system to prevent the concurrent change of the model [2].

I had been importing from program Inventor 11 independent accessories from assembly mobile mechanism. First step was to installing program for making filename extension .VRL to a program Inventor 11. Program Inventor 11 non comprise translator for extension .VRL. We have to buy WRLM translator and to install him.



Figure 3: Mobile mechanism a program Inventor 11

VRLM translator

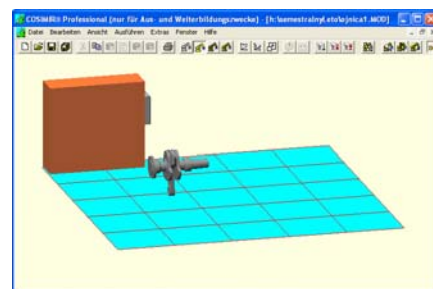


Figure 4: Importing to a program in COSIMIR[®] Professional

The elements to modify with a single command execution have to be marked for this purpose. This can be done with the use of the model explorer or by selecting the elements with the mouse.

Scaling is used to change the size and proportions of elements. The size and proportion of all subordinated elements are also affected by the scaling.

In order to connect peripheral devices (objects) to a robot controller it is necessary to make an input-output connection. Before connecting the inputs of an object to the outputs of another, the inputs and outputs must be named. It is advisable to assign intuitively understandable names.

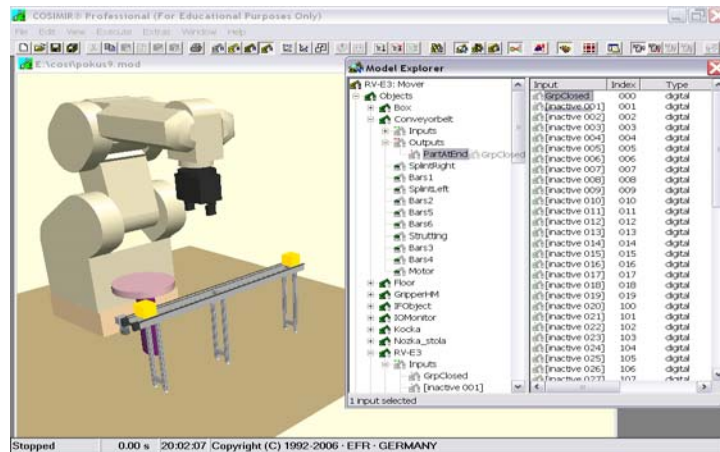


Figure 5: Input-output connection

For having interaction between objects in a workcell, there must be an exchange of information. Objects are communicating via Inputs and Outputs. So you have to connect the Inputs to the appropriate Outputs. In this connection the robot controller plays a special part, because it is the only programmable object controller in COSIMIR®. So all processes are controlled or synchronised by this special controller.

In COSIMIR® the simulation of so called base mechanisms is a powerful feature for simulation of workcells. A mechanism is assigned to an object using the object's type. Depending on the mechanism the object structure (concerning number of I/Os, number and configuration of sections and joints) is given. The mechanism can only be simulated correctly if the given object structure exists.

To model a mechanism, use the model libraries. Add an object with a mechanism to the workcell to guarantee that the object structure is correct. Afterwards, change the shape as well as the dynamics and I/O names of the object to model your own mechanism.

To control any of the mechanisms the input values have to change from low to high to start the mechanism. More over the output values containing the state of the mechanisms are only updated if the outputs are connected to an input [2].

4 Programming

Programming of the Mitsubishi robots, KUKA robots, ABB robots, Adept and Stäubli robots can be done in COSIMIR® Professional in their native programming languages:

- Movemaster Command or Melfa Basic IV,
- KRL,
- RAPID and
- Vplus.

Optionally, you are also program the robots using the universal robot programming language IRL (Industrial Robot Language). IRDATA is a standardized low level code needed to download robot programs created in different programming languages. COSIMIR® processes IRDATA code created by compilers for different high level programming languages. IRDATA files created by COSIMIR® may be only used inside COSIMIR®. Do not use IRDATA files created by COSIMIR® with robot controllers [4].

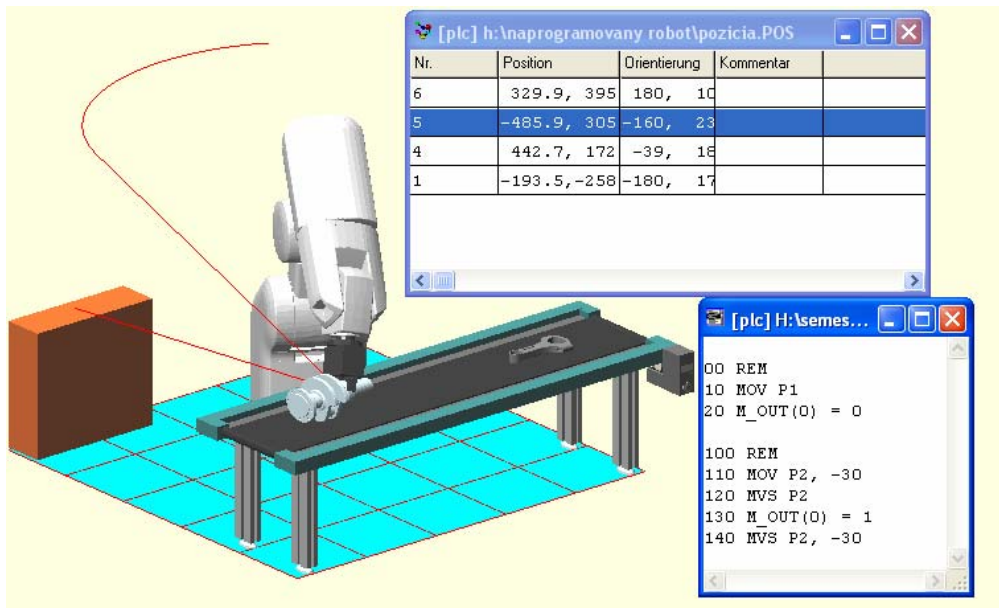


Figure 6: Programming language and position list

Programming paths of an industrial robot is characterized by a variety of positions and their sequence. Each position is defined by three cartesian coordinates and an orientation. A given set of positions and their corresponding sequence is called a trajectory.

If the robot processes a workpiece surface, the robot has to move a tool along a surface on a predefined trajectory. Every tool needs a tool center point. Every movement command reverts to the TPC. Every process needs a special tool, for example a cutter, a milling tool, a pulsed laser or a painting tool.

The representation of a workpiece surface has to consider simple basic geometric primitives and analytical not describable form (free form surface). The generation of a trajectory for a special task depends on several parameters.

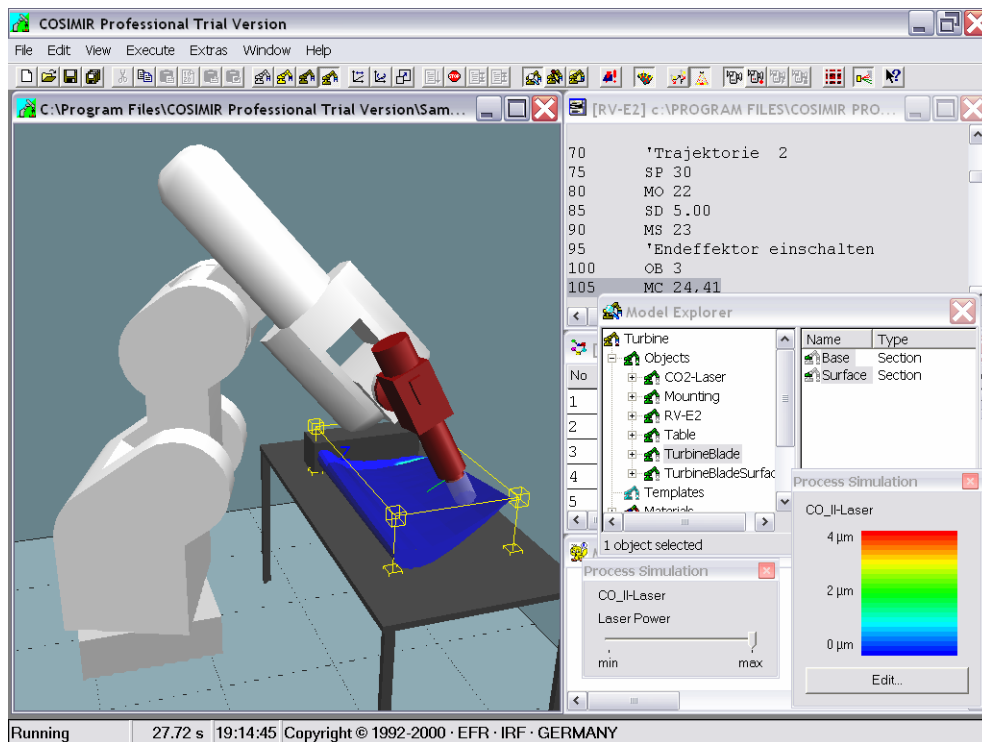


Figure 7: Device trajectory

All calculated interpolation points describe their position relative to the robot basis. They devone the position and orientation of the TCP to get an optima process result. The determination of the interpolation points is independent of the working modus. If the robot moves the tool, no further adaptions are needed. If the robot moves the workpiece all position have to be transformed [4].

5 Simulation

The difference of simulation time between the graphical updates of the workcell Windows is called simulation cycle. The shorter you choose the time for a simulation cycle, the smoother but also slower is the animation. The controller cycle is the time used to update the internal system values like interpolation steps of robots or I/O update cycle of PLCs. The Simulation Cycle mentioned above is always a multiple of this controller cycle.

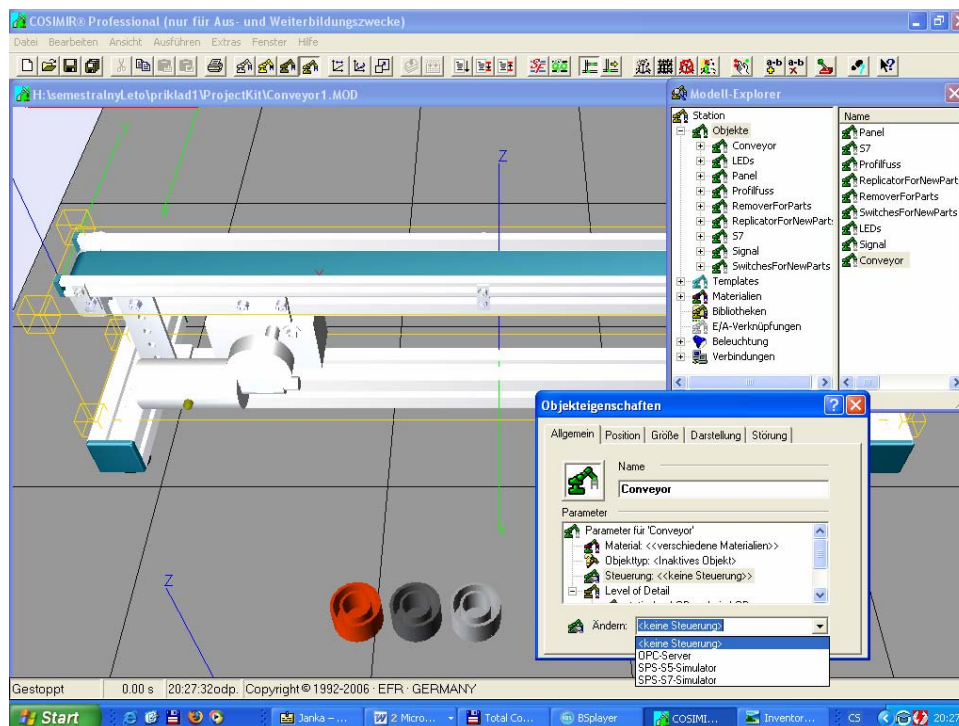


Figure 8: Selection wherebe controller

The selection Model Update switches the update of model calculations like belts or process simulation from the very small cycle Controller Cycle to Simulation Cycle. The setting Controller Cycle my lead to decreasing performance for some models, on the other hand Simulation Cycle may evaluace to some inaccuracies.

Choose Realtime to start a simulation with a dynamic simulation cycle that is controlled respectively to the real time to reach a synchronizaition between the simulation time and the real clock. Configure a Maximum Simulation Cycle to limit the simulation cycle.

The sensor simulation extense the capability of COSIMIR[®] simulate complete workcells. Many sensors used in production automation can be parameterized and simulated realistically. Moreover the visualization of measuring ranges helps to prevent errors in the planning stage. This cannot be done in realy.

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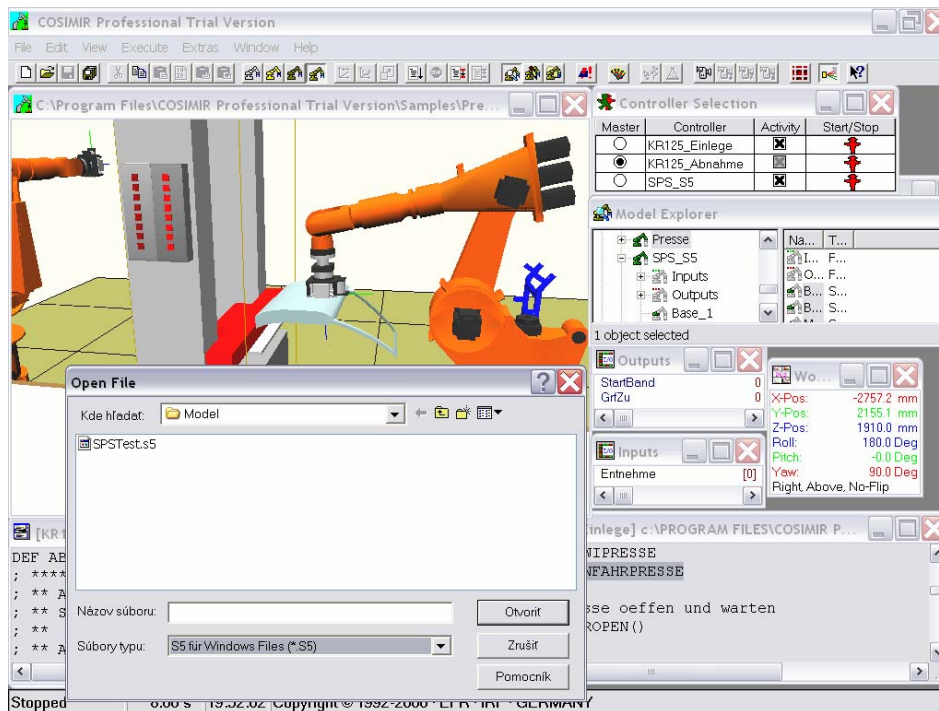


Figure 9: Import STEP 5 for PLC

The OPC coupling of COSIMIR[®] enables you to connect external controllers to the simulation kind: controllers that perform basic logica and arithmetic calculations or controllers that control one or several kinematice. Programmable logic controllers (PLC) belong to the first group and robot controllers to the second.

The communication interface used for the coupling of the controller and the simulations systém is OPC (OLE for Process Control). OPC is a standardized software interface definition that facilitates and standardizes the data access of PC-based applications within the automation engineering field. For a controller that is to be coupled to COSIMIR[®] an OPC server must be dispoable that provides controller internal information to communication partners. The OPC coupling of COSIMIR[®] is realized as an OPC client which retrieves the necessary information from the server and passes them to the COSIMIR[®] kernel.

The coupling is realized as an extension module and is fully integrated into the user interface of COSIMIR[®]. Since the coupling also has an adequate controller interface to COSIMIR[®] an external controller shows exactly the sme behavior as a controller that is integrated in COSIMIR[®] and that emulates the program processing and the kinematic functions [4].

OPC is based upon the DCOM (Distributed Component Object Model) technology developed by Microsoft for distributed applications. Hence, the features of DCOM are used, when COSIMIR[®] and the OPC server of the external controller are running on different computer systems.

DCOM uses several security mechanisms that control the access to local applications over network. Numerous system settings that are dependent on the network environment are necessary for the establishment of a network connection.

The COSIMIR[®] OPC coupling addresses OPC server over DCOM classes that are registered in the Windows registry. In order to perform a remote access, the desired DCOM classes must be registered in the local registry of the COSIMIR[®] computer. Therefore, register the OPC server on the COSIMIR[®] computer using a registration program provided by the vendor of the OPC server or

install the server also on the COSIMIR[®] computer. With the installation of the server all necessary DCOM classes are entered into the registry [4].

6 My yet experience of program COSIMIR[®] Professional

According to my experience, program have benefit how's it:

- integration 3D modelling by means of functions CAD, import 3D object, selection completed component from libraries,
- integration programming by means of programming language for robots, PLC or OPC server,
- monitoring collision at object time modelling,
- integration 3D simulation.

Disadvantage program is:

- that you have to buy WRLM translator at imports CAD programs,
- complicated setting kinematics for import mechanisms,
- for writing program robot you have command programming language corresponding robot (for Mitsubishi robots Movemaster Command and Melfa Basic languages, for Stäubly and Adept languages V+, KRL for KUKA, etc .),
- you have command STEP 5 Manager or STEP 7 for programming PLC,
- you have to know operation object for correct assignment input and output.

7 Concluding remarks

Simulation is well-recognized among its expert practitioners as a manufacturing productivity improvement tool. However, within many companies, simulation is used only in unusual situations and when the need for efficiency improvements has reached a high level of urgency and visibility among managers.

Program COSIMIR[®] Professional is very advantageous tool on education modelling, programming and simulation, but also for simulation real system in praxis.

8 References

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