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Modelling and simulation tooling controlled by the PLC in the robot cell in NX

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Abstract. Many CAD programs allows the simulation of machines. Often, before creating the real machine can simulate the operation and see how it works. In these cases, set values of the forces acting on an element or displacement of the element. It is very easy for simple machines. Programming in this way PLC controlled system is very complicated because have to save the the entire PLC logic in the simulation program. It would be good simply connect the PLC or PLC simulation program to a CAD program enabling the simulation. There are many possibilities for sending information between the PLC and CAD. PLC to control most of the actuators using the digital outputs 0 or 1. Actuators often have two states but the transition from one to the other takes some time. By setting additional parameters may be the behaviour of the simulation as in real life. Setting these parameters is usually held in the testing phase before running it means that the system is assembled and can be damaged. Often this is the only opportunity to verify the PLC program. It is worth noting that such testing and running takes place on the production line and needs to be stopped.

1. Introduction

Offline programming of industrial robots is already very popular [1,2]. At the design stage, you can simulate and test robotic production line consisting of even several robots [6]. This allows you to take correct and another test. Such programs reduce the cost of construction of the production line, they allow you to adjust the core material.

For PLCs, there are many programs that simulate their work. They allow you to validate the operation of the PLC and not the entire system. You can easily do the visualization of any process, but it also does not show how the system will work.

So why is there any software to simulate operation and programming of complex systems such as robots or CNC [11, 12] machine and it is difficult to find a simulator of a mechanical system controlled by the PLC?

The answer to this question is difficult but analysing software simulation of robots should pay attention to the moving parts of the robot cell. In contrast to the work they perform movement 0, 1 (open, closed) without any intermediate states. Grapples close immediately, and in fact it takes a while, and it is necessary to set the waiting time for closing.

The main problem lies in the diversity and modularity of solutions powertrain simple mechanisms. Most of these systems is widely used for decades so they are used based on the experience of PLC programmers. The parameters of these systems are selected after the completion of testing [4, 5].

The question is whether such software is needed and as it might look like it?

Now the software engineering especially CAD [5, 7] is becoming increasingly complex accompanied by the other modules in the simulation module. Another very important element is the addition of the module control via PLC. To do this it is necessary not only virtual but also PLC system executive pneumatic electro-pneumatic or electric [8]. The purpose of this system will call the corresponding displacement (rotation) or forces (moments).

2. The analysis of the signals between the PLC and the Machine

Communication between the PLC and CAD simulation must be carried out in two directions figure 1. For this reason, it is necessary to modelling the sensors because the analysis of the signals between the

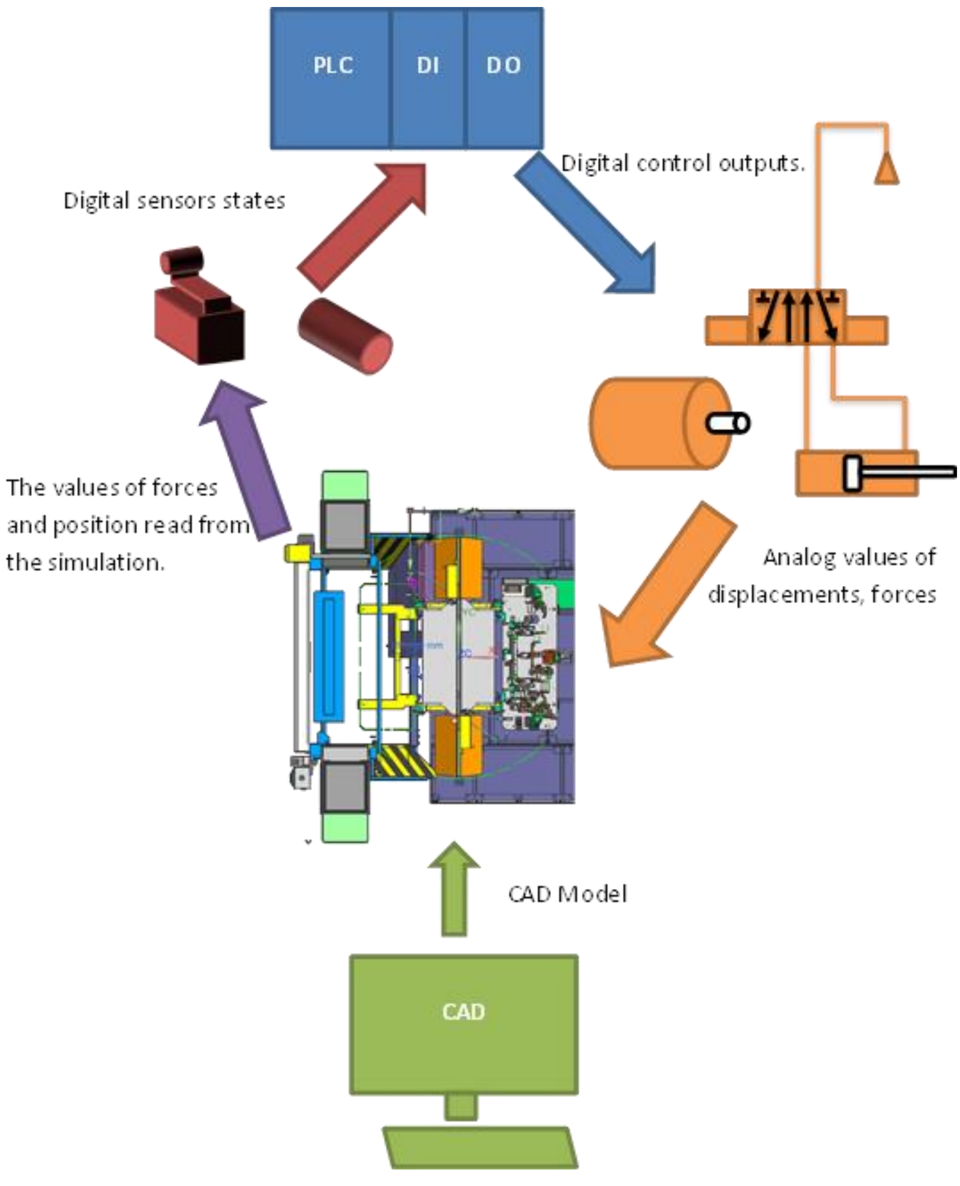

Figure 1. Flow diagram of signals in the circuit of the PLC.

PLC and the Machinery give information on the state model. In most cases the conditions are also binary. It is easy to read the distance between the surfaces in the simulation. It could've been models of analog sensors [10], but more often binary sensors are used.
Such a tool is very useful and allow you to integrate with each virtual CAD model and PLC system. This integration simplifies the design and programming of systems based on PLC and simple cylinders.

3. Components of the system.

The main element of the system is the PLC. For the tests, the controller B & R x20 series of input modules output was selected. PLC programming is done using Automation Studio figure 2. This is a program where you can program any PLC or Power Panel B & R. It is good that the same program can be used on manydefferent platforms B & R.

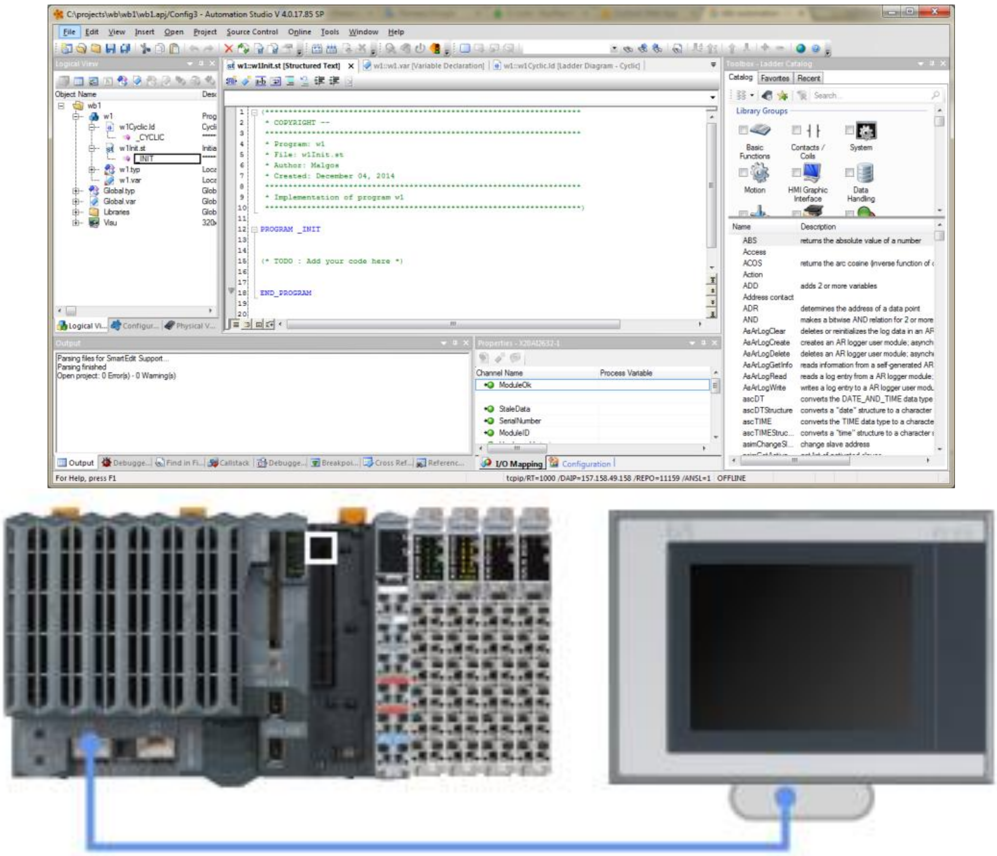

Figure 2. Program Automation Studio, and X20 series PLC.

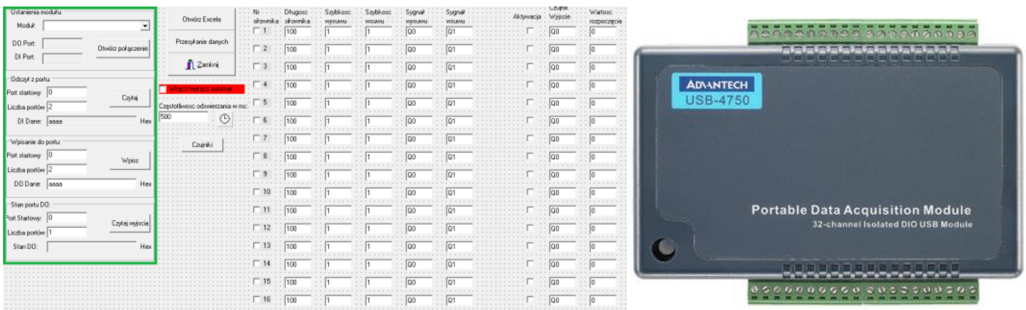

Figure 3. The program module Advantech USB - 4750. Advantech USB – 4750.

Module Advantech USB - 4750 figure 3 can check the outputs of the PLC and the proper settings PLC inputs. Using wires are connected to PLC inputs to the outputs module and the PLC outputs with the inputs of the module. The module sends the information to a computer via USB. The module manufacturer provides libraries for writing their own software. Figure 4 shows a sample program window that allows transmission of data (check the inputs and outputs of the module setting).

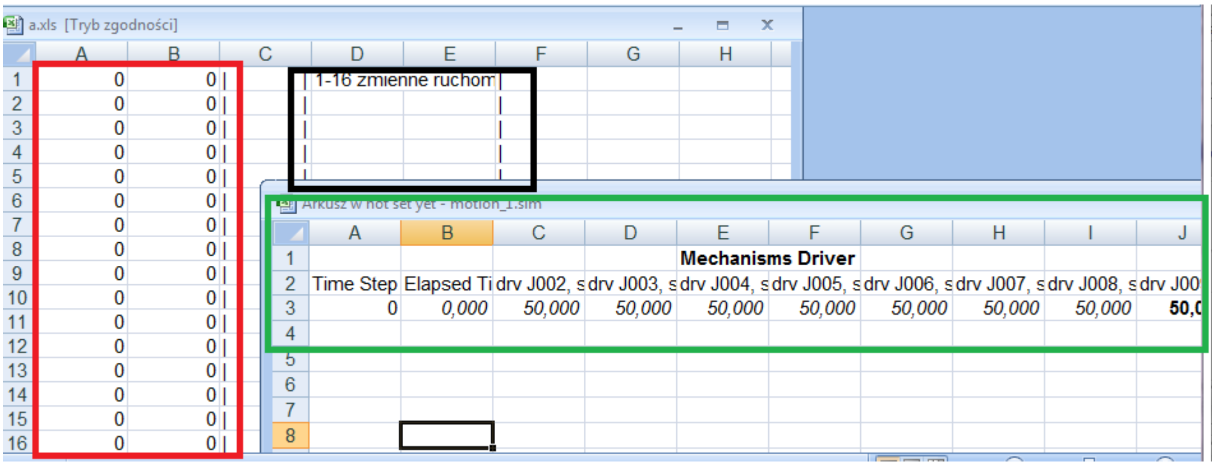

Figure 4. Exchange of data in Excel.

Another program is Microsoft Excel. It is used to exchange data with CAD. So the program in figure. 4 must be read and written to the Excel file.

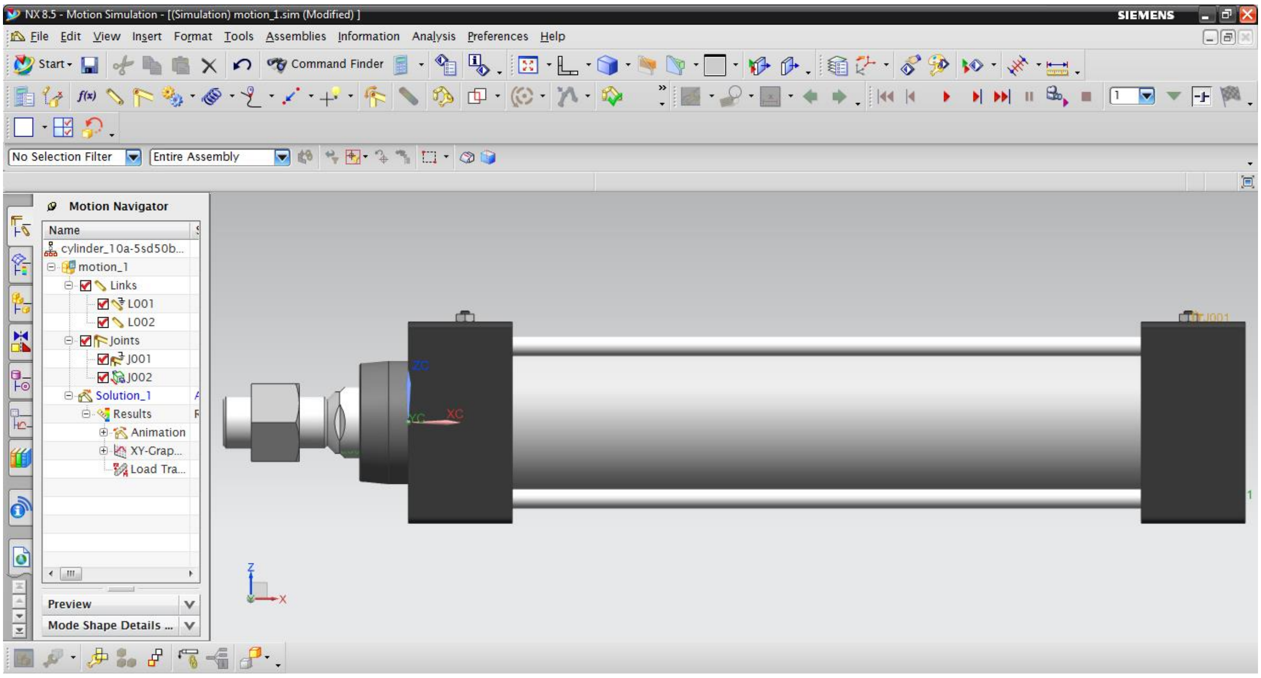

Figure 5. Example in CAD program.

The last element is a CAD program. In this program it is possible to modelling any system. As an example, figure 5 is shown only a pneumatic cylinder [9].

4. Testing.

During the testing of the entire system could be ejected from the driver of dignity enshrined in the PLC program. it was necessary to adjust the speed of movement. set it in the program shown in figure 3. It is possible to also control more complex systems are formed but not a big delay. This system is sufficient for modeling and simulation of pneumatic systems but may lose very fast signals.
This problem can be solved by replacing module Advantech USB - 4750 by OPC server. At this time last is build new softwar the.

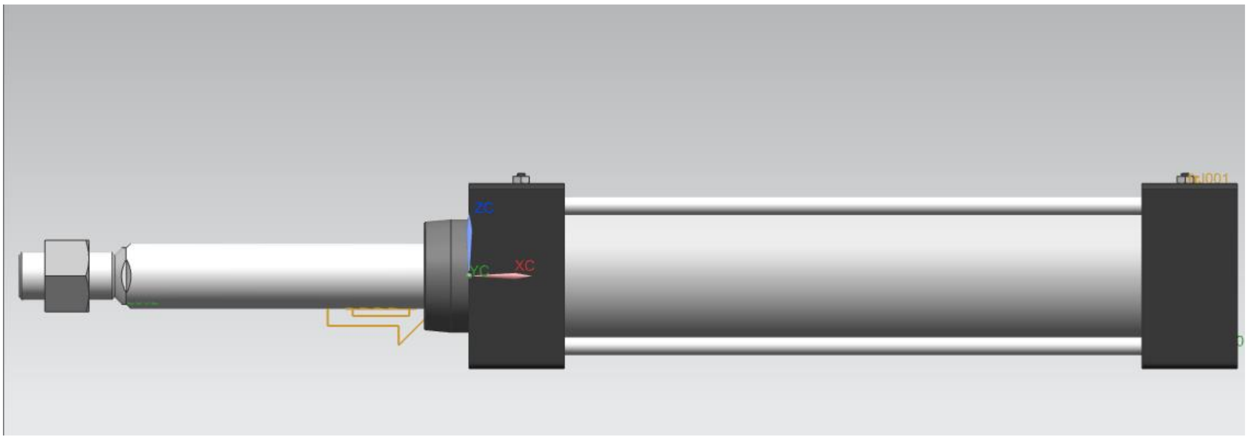

Figure 6. Virtual pneumatic cylinder controlled by PLC.

Another problem is that the set is a constant rate of extension of the actuator and does not depend on the forces acting on the system. The solution may be to set the force does not velocity, or a combination of velocity and strength figure 6.
In this case omitted is the interaction of the air, or rather reduced to a minimum. Each actuator is connected to an electronic PLC-controlled valve, any flow control is set to velocity.

5. Conclusion

The combination of modeling systems and PLC controlled robot allows for better testing and use of the means of production [13, 14, 15].

Using the CAD is very convenient because it is easy to apply fixes in the model and test again. Unfortunately, in the CAD program it is possible only visualization. Conducting a simulation requires calculations. Solutions are performed for certain input parameters, which are known before the start of calculation. It is not possible to perform dynamic calculations and change the parameters of the system.

In most cases it is sufficient especially in the design phase. It is possible to perform tests of the system. When the system is operated sequentially and actuators take specific locations, it is for example pneumatic cylinders this method is good. Designed pneumatic systems operate in this way, so they can be tested by this method. Systems with electric motors also operate in this way so they can be tested by this method. Pay attention to the selection of actuators because in the course of these tests is not possible to check the forces acting in the system.

Execution of the dynamic test is possible in the method presented in [3] but the modeling of the system, implementation of corrections is more complex.

These methods do not allow to verify the effect of damage or corrosion [16, 17] on the tested system.

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