Modeling an Automatic Processing Station Using Fluidsim Software

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Abstract: *Computer-aided design of modern industrial systems contributes to increasing the quality of these systems and reducing the time to obtain the final results.*
The paper presents the results of the modeling of an automated electro-pneumatic processing station using the Festo FluidSIM Pneumatics application. For the chosen operating protocol, both the power part and the electrical and control part were modelled, being generated as well, the state diagram of the processing station cylinders, in a working cycle.

Keywords: *modeling, pneumatic, processing station, FluidSim*

1. Introduction

Modern industrial systems can be designed, modelled, simulated and tested in virtual computer assisted environments, thus increasing the quality of the processes mentioned and shortening development time [1].
We propose to use these new methods in this work for the pneumatic drive system of a piece processing station. The pneumatic drive is modelled and simulated on a personal computer using the Festo FluidSim Pneumatics application [2].

2. Structure of processing station

The processing station consists of a machine tool (MT) with a stock of raw input pieces and a stock of output semi-finished products (Fig.1) and a manipulating robot (MR) transferring the work pieces from the stock Input to the machine tool [3].

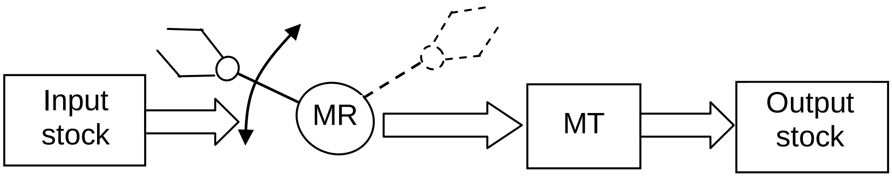

Fig. 1. Structure of processing station

It is considered that the MT performs a single operation (for example, pressing, stamping, drilling, threading, etc.) on a single ingots. It is also considered that both input and output stocks have a limited capacity at a semi-finished product.
The entire structure is integrated in an electro-pneumatic drive system with linear actuators (pneumatic cylinder) and rotary (rotary pneumatic motors), controlled by monostable and bistable valves [4].
Thus, the manipulator robot- MR comprises four modules and machine tool- MT comprises a main processing module and the outlet module machined semi-finished products (Fig. 2).
A complete working cycle of pneumatic drive involves following sequences:

1. Advance C4→ Advance C1→Retraction C4→ Retraction C1;
2. Advance C3→ Left rotation MP2→ Advance C1→ Advance C4;
3. Retraction C1→ Retraction C4→Right rotation MP2→ Retraction C3;
4. Advance C5→ Retraction C5→ Advance C6→ Retraction C6

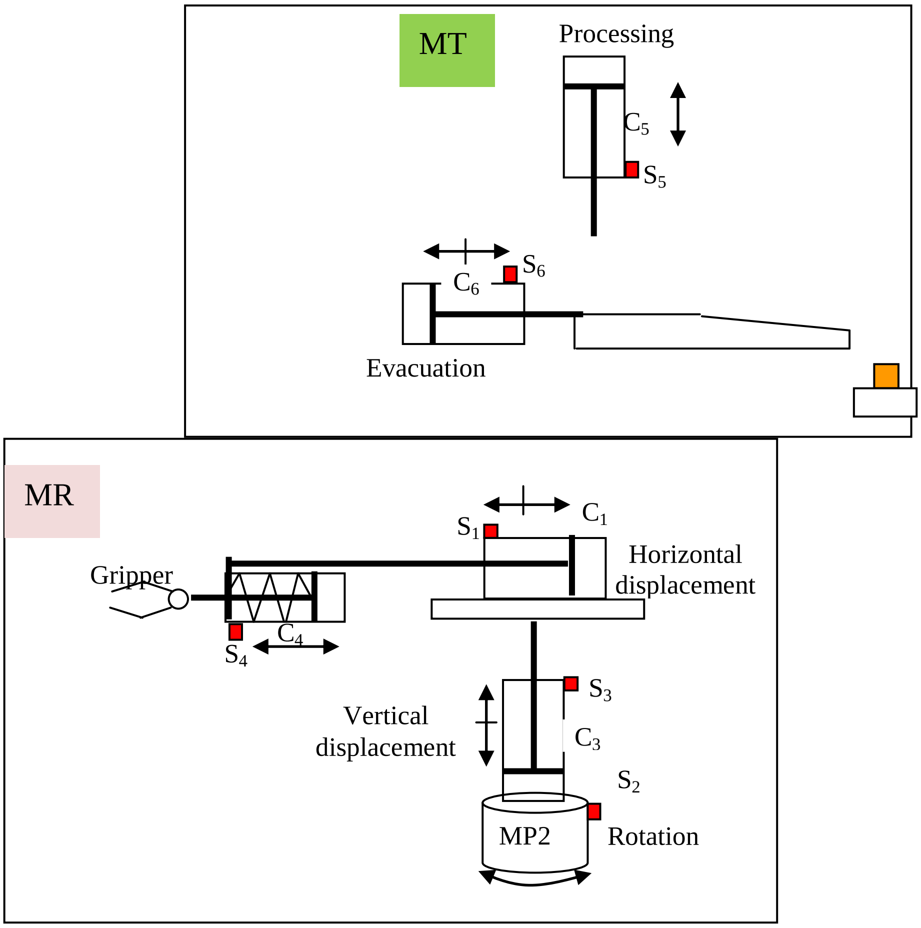

Fig. 2. Structure of the pneumatic drive of the processing station

3. Modeling of processing station

The modeling of the pneumatic actuator consists of two parts: shaping the power (pneumatic) part and shaping the electrical and control part. Both parts of system modeling mainly involve choosing components in the Component Library, placing them on the design sheet, setting parameters, and making connections between components [5].
If the component library is not visible in the workspace, it can be displayed by choosing Total View from the Library menu.

3.1. Modeling of pneumatic part

The model of the pneumatic part of the processing station was divided into three blocks [6] (Figure 3):
- the compressed air preparation unit block;
- the block of the manipulating robot;
- the block of machine tool.
The meaning of the elements used in the model is the following:
D1...D6 – pneumatic valve;
C1...C6 – pneumatic cylinders;
MP2 – rotary pneumatic motor;
DC1...DC11 – one-way flow control valve;
S1...S6 – sensors;
Y1...Y6 – relays valve control

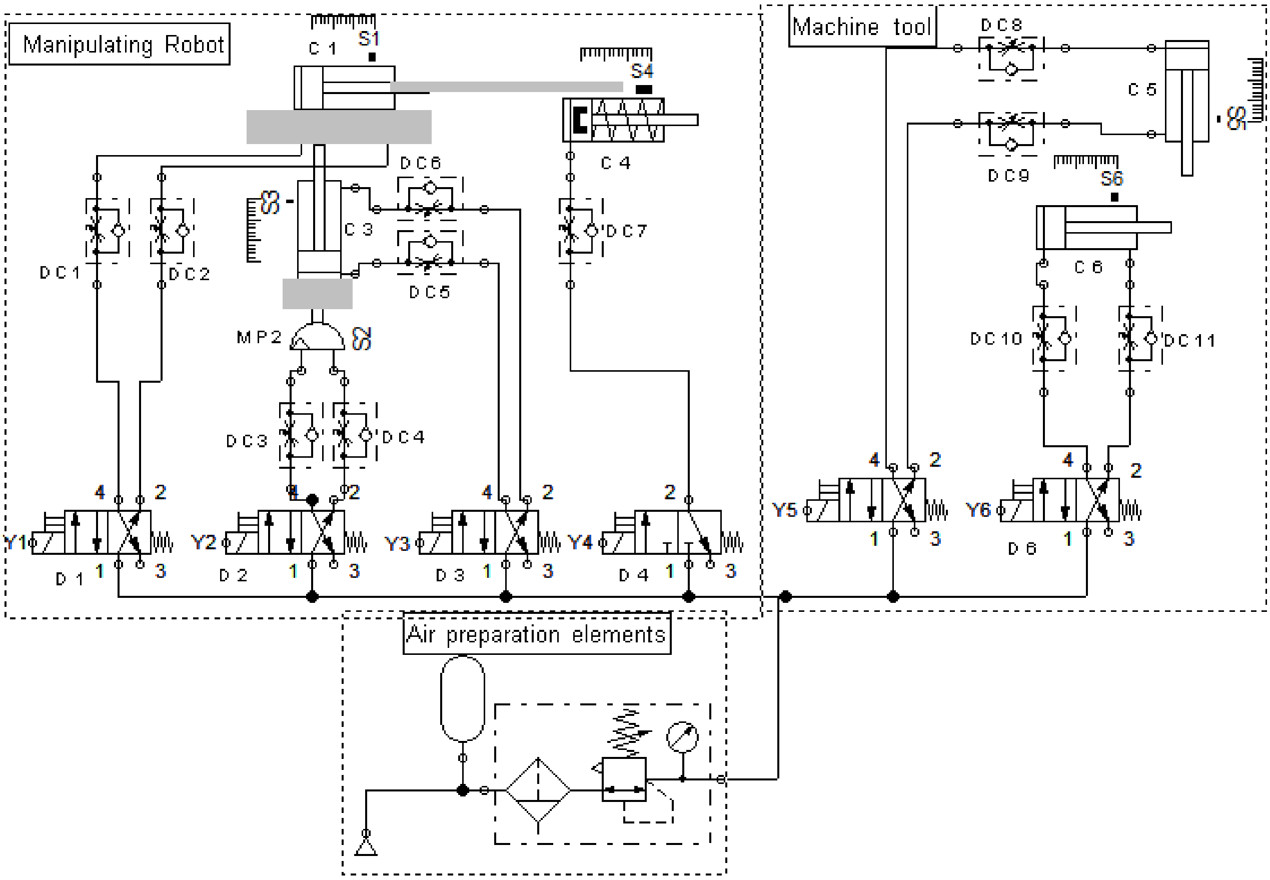

Fig. 3. FluidSim model of the pneumatic part for the processing station

3.2. Modeling of electrical and control part

The next step of the modeling is the realization of the electric circuit incorporating the actual control logic. This circuit is made on the same work sheet, separate from the pneumatic scheme, apparently independent of it [5]. The sequential control scheme proposed for the embodiment is shown in Figure 4.

This scheme requires power supply, contacts (button, contact sensors), relays and interconnections. All parts for the electrical part are located in the same component library.

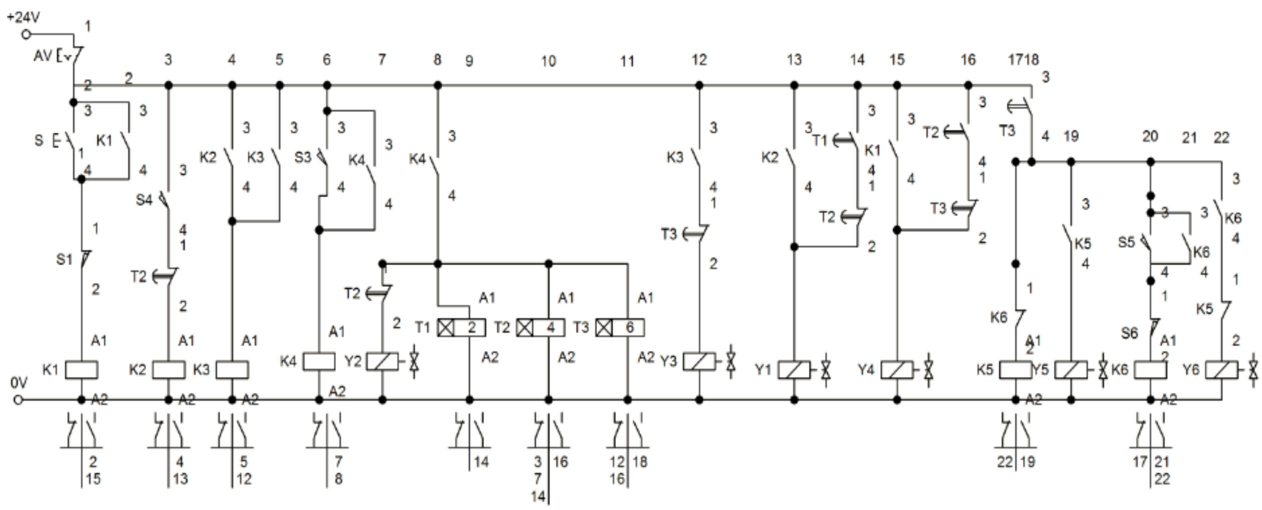

Fig. 4. Sequential control circuit diagram with contacts and relays implemented in FluidSim

4. Simulation results

Following simulation, FluidSim can generate a state diagram of pneumatic drive [7]. The state diagram records the state quntitie of important components and depicts them graphically (Figure 5).

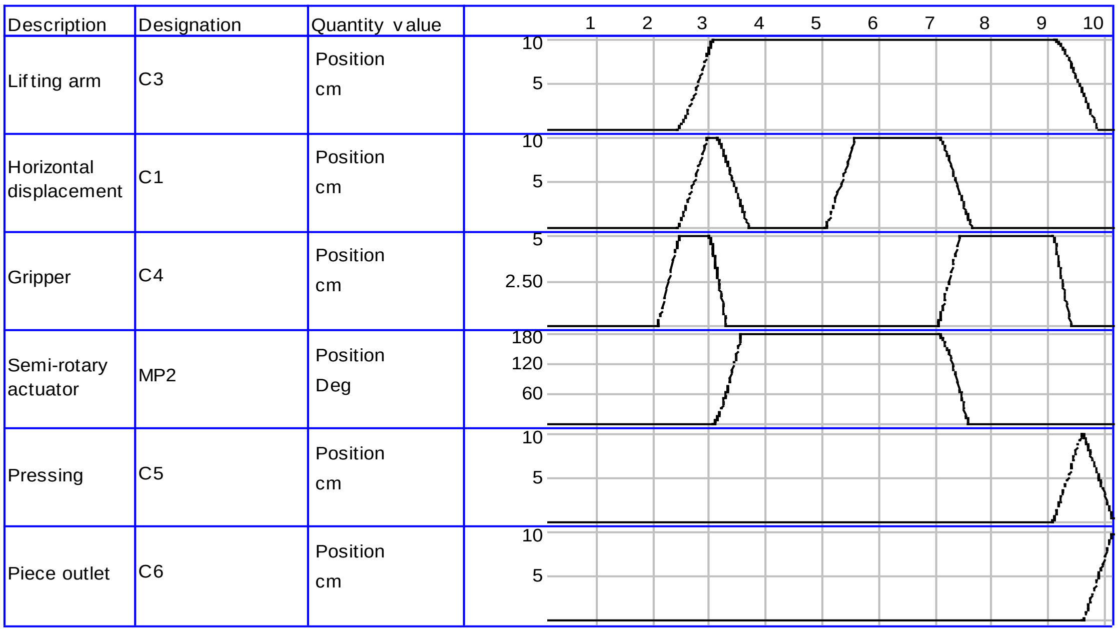

Fig. 5. State diagram of pneumatic components, in a work cycle generated by FluidSim

The state diagram highlights the operating sequences of the execution elements in the pneumatic drive.

5. Conclusions

The paper presents the results of the modeling of an automated electro-pneumatic processing station using the Festo FluidSIM Pneumatics software. FluidSim allows the drawing of electropneumatic circuits and can perform schema simulations based on physical components of the components. It eliminates the gap between drawing a circuit and effectively simulating the pneumatic system.
Both the pneumatic part of performed processing station as well as electrical and command part was proven correct functioning according to the solution and protocol required.
Simulation results showed the evolution of the typical elements of pneumatic drive. The practical and experimental aspects will be presented in a future work.

References

[1] C. Lazăr, O. Păstrăvanu, F. Schonberger, “Computer-assisted management of technical processes” (“Conducerea asistată de calculator a proceselor tehnice”), Matrix Rom Publishing House, Bucharest, 1996;
[2] *** FESTO FluidSIM Pneumatic 4.2, User manual;
[3] M.A. Drighiciu, “Hydro pneumatic drive and automation” (“Acţionări şi automatizări hidropneumatice”), Publishing House of University of Craiova, Craiova, 2003.
[4] B. Robert, van Varseveld and G. M. Bone, ˝Accurate Position Control of a Pneumatic Actuator Using On/Off Solenoid Valves˝, *˝IEEE/ASME Transactions on mechatronics˝*, vol. 2, no. 3, September, 1997, pp. 195-204;
[5] I.L. Alboteanu, ˝Pneumatic Tracking System for Photovoltaic Panel˝, *˝Hidraulica˝,* No. 1/2015, ISSN 145-7303, pp. 32-39;
[6] I.L. Alboteanu, Gh. Manolea, A. Novac, ˝Automation of a pumping station for low power applications˝, *˝Hidraulica˝*, No. 1/2014, ISSN 145-7303, pp. 58-64;
[7] http://www.festo.com/net/startpage/