БЪЛГАРСКА АКАДЕМИЯ НА НАУКИТЕ • BULGARIAN ACADEMY OF SCIENCES

ПРОБЛЕМИ НА ТЕХНИЧЕСКАТА КИБЕРНЕТИКА И РОБОТИКАТА, **57**
PROBLEMS OF ENGINEERING CYBERNETICS AND ROBOTICS, **57**

София • 2006 • Sofia

Structronical Stand for Knitting Needle Actuators Examination

Velitchko Dobrinov [1], *Dimitar Karastoyanov*[1], *Atanas Dobrinov*[2]

[1] *Central Laboratory of Mechatronics and Instrumentation, 1113 Sofia*
[2] *University of Oldenburg, Germany*

1. Introduction

The harsh requirements towards the construction and the operational characteristics of the needle actuators necessary for the new generation of knitting machines [1] define the need of a special device, with the help of which in conditions maximally close to the real-life working conditions of the knitting needles to be capable to couple fast and easily different end constructions of actuators in order to investigate their work capacity, functionality, speed and dynamic characteristics. The terms that have emerged, for the synergetic approach to design, and integration of sensors, actuators, computers, structures and mechanics, are "structronics" and "mechatronics". Using a structronical approach to the problem such device was successfully created in Central Laboratory of Mechatronics and Instrumentation (CLMI) – Bulgarian Academy of Sciences. The designed **Structronical Stand for Knitting Needle Actuators Examination** is composed of the following key assemblies and components: measuring head, mechanical experimental set-up for convenient attachment of the investigated actuators to the device, control electronics and specific software program for conduction of the experiments The paper is sponsored by NIF, Grant No ИФ-02-50/ 31.05.2006.

2. Principle of operation of the measuring head

For the full completion of the loop-formation process [2, 3] four basic positions of the knitting needle are distinctive – extreme back initial position, first position (positioned usually 15 mm from the initial position), second position (in our case 19 mm) and third position (30 mm). The accuracy of the second position is the most crucial for the successful loop-formation. For this reason an alternative second position (20 mm) is included for observation of the positioning accuracy as well as the possible

oscillations around the second position point. Thus sensors are needed in order to be able to detect the passing of the knitting needle through all five above defined basic positions during the normal operation cycle. For this purpose the photointerrupter RPI-1133 manufactured by ROHM was chosen because of its contactless operation, ultra miniature dimensions 4×4×5mm, built-in visible light filter, fast response and because of one of its important features concerning the high precision operation: its extremely small slit width (0.3 mm). For the measuring of the moments of time when the needle passes by or is present at any particular positions of the loop formation cycle, five photointerrupters are placed in such a way that they generate an electrical signal when the corresponding fin of the needle blocks the path of the light originating from the light emitter and directed toward the photo detector.

Fig. 1 shows the needle in its extreme rear initial position. In this moment the needle position is indicated by the output signal of sensor 1, which is activated by the rear edge of the lower fin of the needle (edge *a*). In similar way the other four photointerrupters indicate the presence or the passing by of the needle during the process of loop formation in the rest of the basic positions.

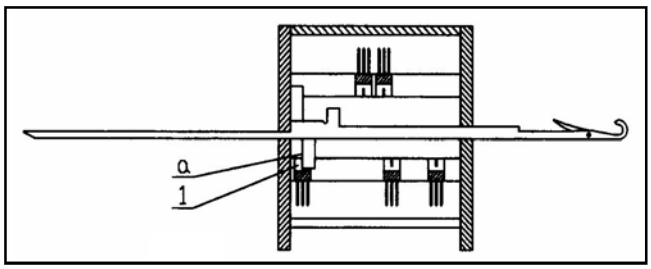

Fig. 1

The chosen design of the developed device ensures the possibility for the fast and easy changing of the fixed position of any of the five photointerrupters in any arbitrary position in the range of the normal movement of the needle. In this way without any constrictions the operational capacity and the characteristics of all kinds of actuators can be investigated in all possible modes of operation of the loop-formation cycle.

Fig. 2 shows the ready-made measuring head.

Fig. 2

3. Mechanical experimental set-up

The purpose of the mechanical experimental set-up is:

– to ensure stable and convenient platform for the conduction of experiments in conditions maximally close to the real operational conditions of the needles and the actuators

– to be steady and resistive to vibrations and concussions that usually accompany the operation of the actuators in order to prevent these disturbances from influencing the measurement results

– to ensure the possibility for fast and convenient changing of the stand's configuration in order to permit the coupling of different in construction, size, and principle of operation actuators

On Fig. 3 is shown the main part of the mechanical experimental set-up as well as the measuring head in the moment of investigating a pneumatic type actuator.

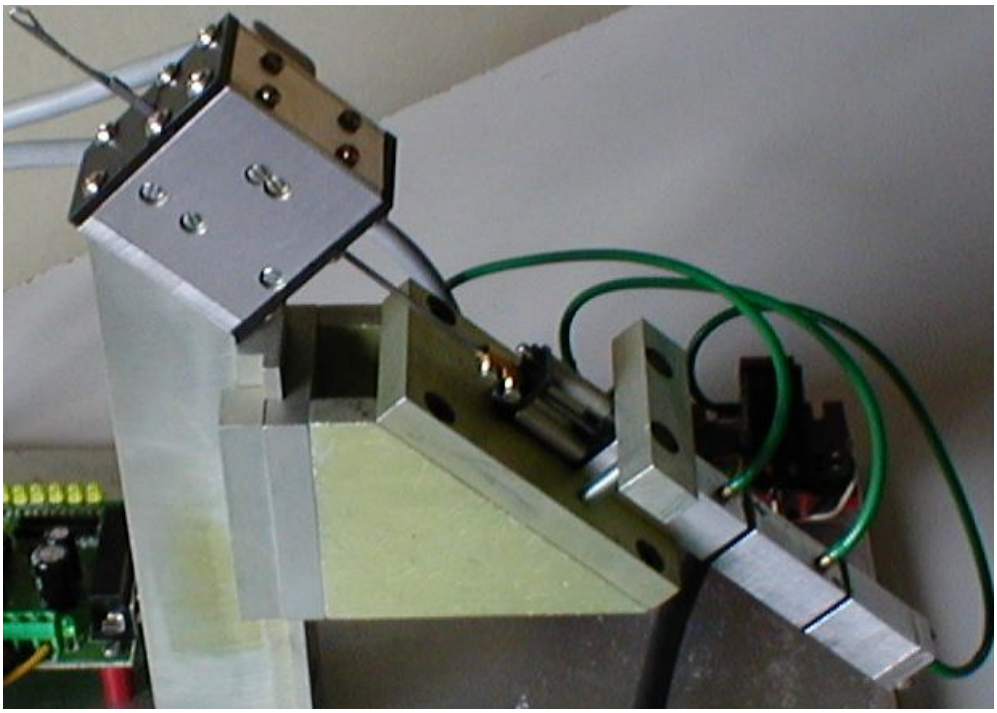

Fig. 3

4. Control electronics

For the conduction of the necessary experiments and measurements it is necessary to execute different motion sequences with various types of knitting needle actuators, each of which is for a fixed duration of time, or connected and controlled by the corresponding types of sensors. Beside that it is necessary to execute the various motion sequences for a predetermined number of cycles. For this purpose the presence of interface between the parallel port of the used PC and the experimental set-up as well as specialized software are needed.

The control electronics [4] is intended to ensure flexibility and convenience of the coupling and control of some of the most common preliminary experimental setups with practically every available computer with an available standard parallel port. With the help of the developed control electronics it is possible to control up to eight actuators, light indicators, DC motors or two stepper motors, as well as to read the output signals of up to five sensors: push buttons, photointerrupters, limit switches etc.

5. Software

The necessary specialized software program [5] was developed with the use of Borland C version 3.1. It is very convenient for the end user because in a very clear and concise way it ensures the means for entering of the necessary information for the whole sequence of movements and pauses, independently of their total number. Furthermore with such a program using the arrow keys and scrolling up and down the end user has the opportunity to review, compare, and modify each parameter in each entry of the list. During the execution of the program on the PC's screen in adequate fashion is presented the information about the actuated in each given moment actuator, the entered time duration for it movement, the activated sensors, the duration of the pauses between sequences, etc.

The program provides the possibility to define and measure intervals of time in the range of 0-3600 s with accuracy of 1 μs.

6. Conclusions

The developed in Central Laboratory of Mechatronics and Instrumentation (CLMI) – Bulgarian Academy of Sciences **Structronical Stand for Knitting Needle Actuators Examination** (Figs. 4 and 5) is a very convenient tool which is capable to couple fast and easily enough to different end constructions of actuators in order to investigate their work capacity, functionality, speed of operation and dynamic characteristics in conditions maximally close to the real-life working conditions of the knitting machines.

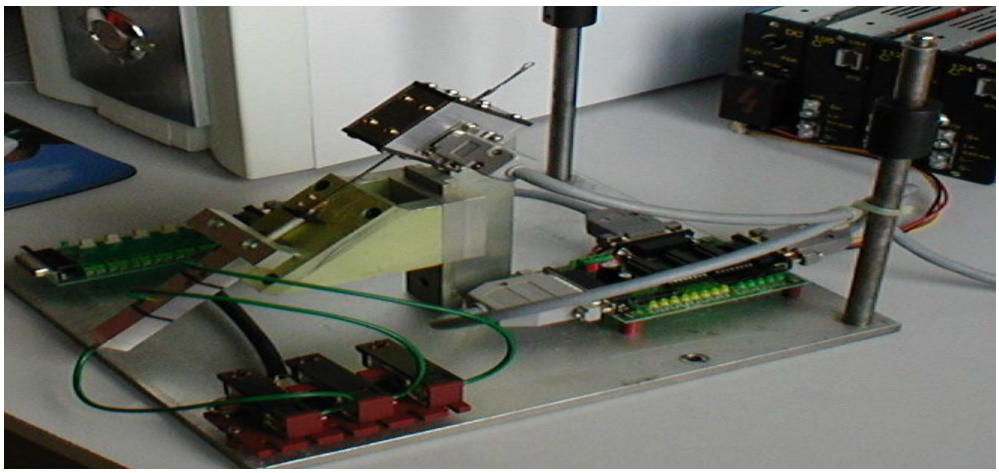

Fig. 4

Fig. 5

References

1. N i k o l o v, P. Method and Device for Production of Knitwear. US Patent 6,199,407 B1.
2. D o b r i n o v, A., D. K a r a s t o y a n o v, V. D o b r i n o v. Contemporary Technology of Loop-Formation. – In: XII National Conference “Robotics and Mechatronics ‘2002”, Dryanovo, Bulgaria.
3. D o b r i n o v, A., D. K a r a s t o y a n o v, V. D o b r i n o v. Recent Research into Knitting Process and New Proposed Way of Knitting. – In: XII National Conference “Robotics and Mechatronics ‘2002”, Dryanovo, Bulgaria.
4. D o b r i n o v, A., T. N e s h k o v , R. Z a h a r i e v. Electronic Experimental Module. – In: XIII National conference “Robotics and Mechatronics ‘2003”, Dryanovo, Bulgaria.
5. D o b r i n o v, A., T. N e s h k o v. Using the Electronic Experimental Module for Conducting Some Measurements. – In: XIII National Conference “Robotics and Mechatronics ‘2003”, Dryanovo, Bulgaria.

Структроническая установка для испитания задвижки иглы вязяния

Величко Добринов[1], *Димитър Карастоянов*[1], *Атанас Добринов*[2]

[1] *Центральная лаборатория мехатроники и приборостроения, 1113 София*

[2] *Университет Олденберга, Германия*

(Р е з ю м е)

Технологическая революция в производственных процессах базируется на интеграции еще в стадии проектирования электроники, систем управления, механики и т.д. Для обозначения интеграции сенсоров, испольнительных механизмов, компьютеров, механики и т.д., используются термины “структроника” и “мехатроника”. В докладе представлен структронический подход создания установки для испитания задвижки иглы вязяния.