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*Rudolf Janos, Marek Sukop, Jozef Varga, Vaclav Kubak, Jaromir Jezny***PRECISE POSITIONING ACTUATORS WITH STEPPER MOTOR***Рудольф Янош, Марек Сукоп, Йозеф Варга, Вацлав Кубак, Яромир Йезни***ТОЧНЕ ПОЗИЦІОНУВАННЯ ПРИВОДІВ ІЗ КРОКОВИМ ДВИГУНОМ***Рудольф Янош, Марек Сукоп, Йозеф Варга, Вацлав Кубак, Яромир Йезни***ТОЧНОЕ ПОЗИЦИОНИРОВАНИЕ ПРИВОДОВ С ШАГОВЫМ ДВИГАТЕЛЕМ**

*The aim of the industrial research addressing complex robotic modules forming positioning system with extremely high positioning accuracy of at least 0.5 microns, which will be competitive for success in the global markets, especially for experimental systems prestigious European and world research centers. That system should meet the increased demands for rigidity, resistance to thermal stress, resistance to radiation. An important part of the solution is the optimization of the kinematic structure of marshalling and control of the system.*

**Key words:** high-precision positioning actuators, precision sensors, stepper motor.

*Fig. 2. Bibl.: 6.*

*Мета сфери промислових досліджень полягає в розгляді складних роботизованих модулів, що утворюють систему позиціонування з надзвичайно високою точністю позначення, щонайменше 0,5 мкм, які будуть конкурентоспроможними на світових ринках, особливо для експериментальних систем престижних європейських і світових науково-дослідних центрів. Ця система повинна відповідати підвищеним вимогам до жорсткості, стійкості до термічних навантажень, стійкості до радіації. Важливою частиною рішення є оптимізація кінематичної структури сортування та управління системою.*

**Ключові слова:** високоточні приводи позиціонування, високоточні датчики, кроковий електродвигун.

*Рис.: 2. Бібл.: 6.*

*Цель области промышленных исследований заключается в рассмотрении сложных роботизированных модулей, образующих систему позиционирования с чрезвычайно высокой точностью обозначения, по меньшей мере 0,5 мкм, которые будут конкурентоспособны на мировых рынках, особенно для экспериментальных систем престижных европейских и мировых научно-исследовательских центров. Эта система должна соответствовать повышенным требованиям к жесткости, устойчивости к термическим нагрузкам, устойчивости к радиации. Важной частью решения является оптимизация кинематической структуры сортирования и управления системой.*

**Ключевые слова:** высокоточные приводы позиционирования, высокоточные датчики, шаговый электродвигатель.

*Рис.: 2. Библ.: 6.*

**Introduction.** An important part of the modules constituting the positioning system with extremely high positioning accuracy are their own drives (actuators).

Transmission of positioning mechanisms are functional groups in which the conversion is effected a transfer of energy necessary for the performance of the manipulator movement.

The drive is generally made up of a source of movement and transformation mechanism (transmission). The task source movement is the conversion of input energy into kinetic energy of a moving source movement. The power is positioning mechanism is put his arm (support member) in the prescribed manner to a designated state of motion so that the positioning mechanism implemented desired movement prescribed accuracy and speed. Drive - positioning actuator may utilize hydraulic, pneumatic or electric motors.

**Motor drive unit of actuator pointing device.** To drive the actuators are the demands made especially for extreme accuracy at a relatively great power and precision of the mechanical position.

Comparison of the different engine types for this requirement appears to be the most appropriate component using a stepping motor, which provides optimum properties in the control position with extremely high precision.

The comparison of the main advantages and disadvantages and to other types of engines as above, starting with a step motor allows you to set extremely precise mechanical positioning of the shaft as the most appropriate fundamental component of the generated torque in the assembly precision of the positioning.

The positioning system is increasing the final positioning accuracy. Currently used mainly electrically driven with a gear system (reducer), speed sensors and control system, is a structure of the drive chain of the robot arm, fig. 1.

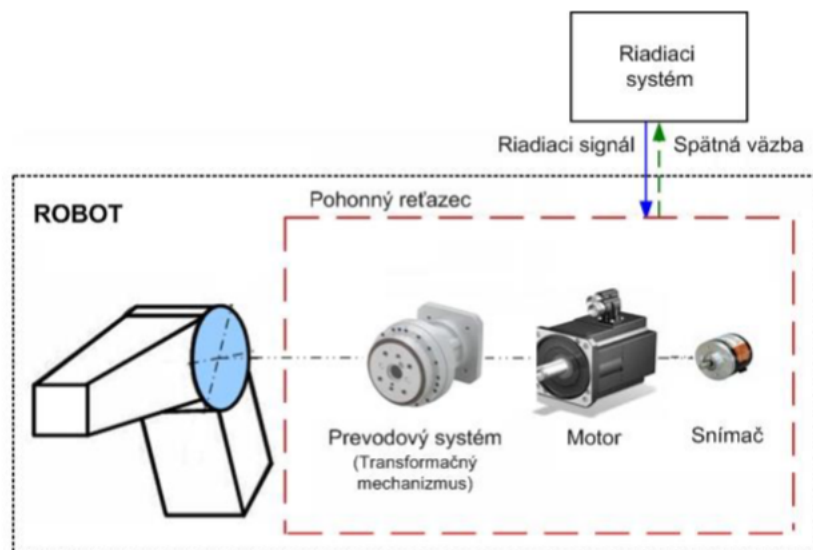


Fig. 1. Form of unilateral grasping

**Structure of positioning actuator.** The positioning actuator is conceptually built as an electric servo-mechanisms for controlling position (angle of rotation or through mechanical transmission feed path) action mechanism machine system, composed of precision gearboxes save the output in precision roller bearings and motors in a structural and functional compact built on the axial layout and dimensionally fair built-up area. Functionally crucial elements coaxially arranged aggregate of positioning actuator (compact drive unit) is an electric motor, gearbox, power semiconductor converters for power and control motor speed controller, respectively. position, engine components are typically speed and position sensors, representative characteristics and parameters of the module, the output member. POWERTRAIN actuator must allow for four-quadrant operation, ie Both directions of rotation and torque both directions. The actuator operates in closed loop feedback position control is either target (optimal positioning - manipulators, positioners, positioning tables, ...) or tracking (time optimal positional adjustment as soon as possible, follow the desired path / Precise Input speed - robots, multi-axis machine tools, antennas and monitoring systems, etc.). Speed control is only expressway feedback enables quick and precise monitoring of the desired speed. The system model actuator describes the concept for addressing the aggregate of (the drive with a transformative mechanism transformation mechanism for changing the kinematic parameters of movement - speed movement) and also describes the internal structure of the building actuator (complete block diagram), which is based on system components (basic internal functions module), (fig. 2).

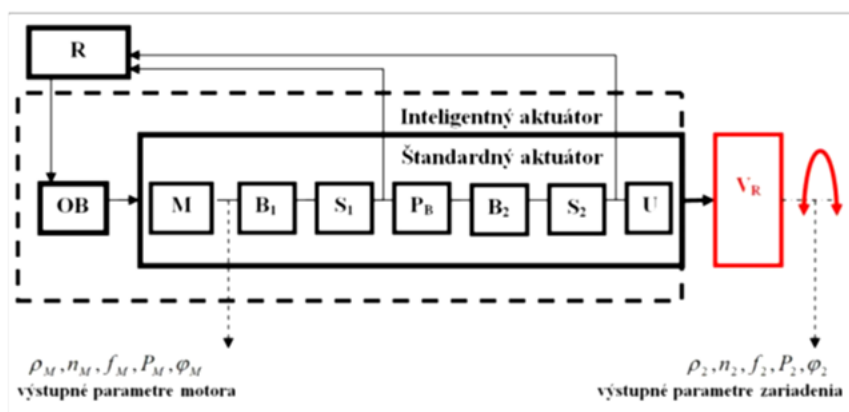


Fig. 2. System model of actuator

**Sensors for detection position.** In this case, it is essential that the position sensor which will verify the functional features and the parameters of the model have the measuring range

respectively. The resolution measured values several times higher than the desired resolution positioning of the load.

When determining the positioning accuracy of +/- 1 micron encoder must have a resolution better than 0.1 microns. It must also meet the minimum mechanical dimensions to put the sensor integrated into the interior of the drive.

One of the most preferred candidates for sensing the position of the ultra-precise dimensions Renishaw sensors that provide the required parameters to the linear position measurement and for measuring the position of the rotary output.

To measure the position of the linear actuator is suitable type of sensor board RESOLUTE - Absolute Optical linear encoders. This sensor provides a resolution of up to 5nm position.

The linear actuator is the most appropriate solution using linear transformer known in the tech world by the acronym LVDT (Linear Variable Differential Transformer). The sensor itself works on the principle of electromagnetic and contains no semiconductor devices. When properly selected material can be produced in a version in radioactive environments. This is necessary to negotiate with a particular manufacturer as a customer solution, as commercially available sensors are manufactured for commercial use without resistance to radiation.

Selection of the appropriate sensor is subject to two main requirements - the required dimensions and the ability to position resolution of 0.5 microns. What mattered was several leading manufacturers such sensors, and most importantly the ability eventually to produce sensor resistant to radiation.

**Conclusion.** It developed a number of conceptual proposals for the target application that is positioning system for positioning kryomagnetov Compact Linear Collider. Some suggestions based on previous experience with the positioning of some of the Large Hadron Collider.

*Contribution has arose with advancement of project: Výskum a vývoj inteligentných mobilných robotických platforiem a polohovacích systémov s vysokou presnosťou pre využitie vo výskume, vývoji a v priemysle, (2015-10961/33306:2-15F0).*

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