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CONCEPT OF CREATION AND GENETIC PREDICTION OF TECHNOLOGICAL EQUIPMENT OF NEW GENERATIONS

Author: Yu.N. Kuznetsov

Affiliation: Kiev Polytechnic Institute **named after Igor Sikorsky "**

Annotation. The results of scientific research by scientists KPI them. Igor Sikorsky during the creation and genetic prediction of the development of machine tools of new generations and their mechanisms using the latest achievements, combined into an interdisciplinary field of knowledge and built on a single structural and systemic approach. The idea was expressed of reviving domestic machine-tool industry through an innovative breakthrough and the implementation of the strategic goal "Get ahead without catching up!"

Keywords: machines, mechanisms, nodes, genetic operators, material point, modular principle, artificial intelligence

Introduction

The main feature of our time is the challenges of the fourth industrial revolution "Industry 4.0" with the orientation of production to the market, which is impossible without the integration of science, education, production and the service sector to achieve these basic goals [6]: 1. Increase productivity. 2. Improving product quality. 3. Lower production costs while saving energy and material resources. 4. Improving and reducing the share of physical labor. 5. Facilitation and reduction of monotonous intellectual (mental) labor. 6. Expansion of technological and functional capabilities of equipment. This determined the global trends in the development of engineering [9]. Achieving these goals in an independent highly developed state is impossible without domestic machine-tool industry - the core of mechanical engineering, where the main products - machine tools are considered as machines that create other machines. Without machine tools, it is impossible to manufacture other technological equipment of various functional purposes, which relate to anthropogenic systems (AGS) [3], which change in time as a result of the purposeful activity of Man.

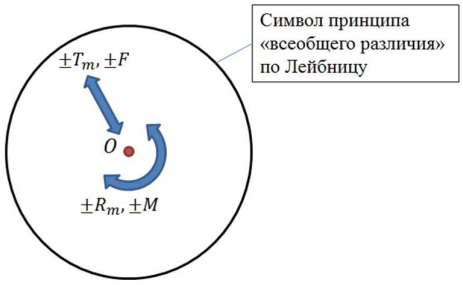
2. **Problem analysis**

From the first years of the Soviet regime, machine tool building chose the strategically destructive motto "Catch up and overtake!" (the first lathes of the Moscow factory "Red Proletarian" were called DIP-200 - to overtake and overtake, the height of the centers is 200 mm, but they, even with CNC, for example, mod. 16K20F3S1, never surpassed similar machines of leading foreign companies). Unfortunately, there are many people who unknowingly convince themselves that they should go in the lead of leading companies and countries, looking in the ass and taking as a basis the developments seen at international exhibitions. At the end of the 80s of the last century, attempts were made in the USSR to take a different path (for example, the Ivanovo Machine Tool Plant, which began to manufacture multi-purpose machines of the IR-500 type at the modern level, using the modular principle, the Gorky Kiev Machine-Tool Plant, which manufactured the first-born multi-spindle automatic lathes (MTA) with CNC). However, the unexpected happened and the countries of the post-Soviet space lost their leadership, and many machine-tool plants lost their positions and even ceased their activities. Today, there is still the opportunity to revive in many countries the domestic machine-tool industry and other branches of mechanical engineering (aircraft, shipbuilding, agricultural engineering, instrument-making). To do this, you must choose the strategically correct course "Get ahead without catching up!" and implement an innovative breakthrough in the field of science, education and production, using the latest achievements in various sciences (genetics, cybernetics, computer science, synergetics, socionics, etc.), combined into an interdisciplinary field of knowledge and built on a single structural and systemic approach (for example, NANO , BIO, INFO, KOGNO, SOCIO, ECO-technology) [8].

1. Research results

The postulate of a new scientific approach - from living Nature to the creation of AGS, which include static and dynamic machine, electrical, building technical systems (TS), thanks to the intellect of Man, which is declared in philosophical ideas and the prophecy of acad. Vernadsky V.I., Creating new developing TS is impossible without analysis and accounting of accumulated human experience, which as genetic information on various carriers is transferred from generation to generation. The history of the development of human society and the evolution of technology has always been associated with mechanics [5] .. However, with the discovery of electricity, human life was impossible without it. Electricity has become the main energy source of the vehicle and the primary converter of its alternative sources (water, wind and sun), competing with gasoline and gas. This trend has determined the special role of electromechanical science related to the research and creation of electromechanical energy converters, which is directly used in the processes of production, transportation, distribution and consumption of electrical energy. A new

look at the material point (Fig. 1) can be applied in the synthesis of TS for various purposes and performance [7,10,13].



Picture 1. Material point (t.O) - a

mechanical gene that carries information about the type of displacements and translational loads $(\pm T_m; \pm F)$ and rotational $(\pm R_m; \pm M)$ indicating the direction;

A material point can be motionless, as information about static AGSs of the "object" type (tools, constructions, supporting systems of technological equipment), and mobile, like information about dynamic AGSs of the "process" type. A fixed material point with a buildup of genetic information and a complication of the structure is used in geometric constructions of static AGS. A moving material point with increasing genetic information and complicating the structure is used both for transferring information from one point to another, and for the interaction of points. By analogy with the Flynn systematics, which first appeared in cybernetics as applied to computers, and then in TS theory, all types of information transfer by material points and their interactions can be represented by four classes (Fig. 2).

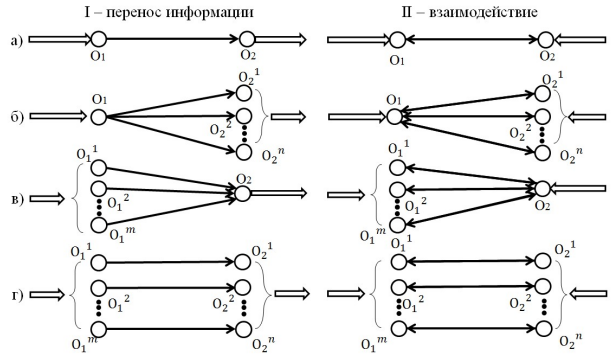


Рис. 2. Варианты переноса информации и взаимодействия материальных точек согласно систематики по Флинну: а-один вход, один выход; б-один вход, несколько выходов; г-несколько входов, один выход; г- несколько входов, несколько выходов

By analogy with electromagnetic fields and flows in the mechanics of various media, we can talk about kinematic, power, energy, material, information, communication and other flows that serve as the initial structure and contain an ordered set of genes with a given spatial sequence of their placement (distribution) within the boundaries of the geometrized topological space (surface).

Thanks to the fruitful cooperation of mechanics and electromechanics, using the open Periodic table of primary sources of electromagnetic fields and universal genetic operators (replication, inversion, crossing, crossing-over, mutations) [6, 7, 11, 17] created fundamentally new mechanisms, nodes and machines, which mechanical gears are replaced by electromagnetic ones: multi-spindle and revolving motor-heads; spindle units; self-acting motor spindles (M-W); spindle motor-drums, multi-axis mobile pyramidal-type drilling and milling machine and hybrid MTA. The use of high-speed M-Sh allows you to abandon gears in the drive of the main movement (past) (Fig. 3, a), individual electric motors with couplings (present) (Fig. 3, b) and significantly reduce the kinematic chains and the weight of the spindle drum (ШБ) (future) (Fig. 3, c, d).

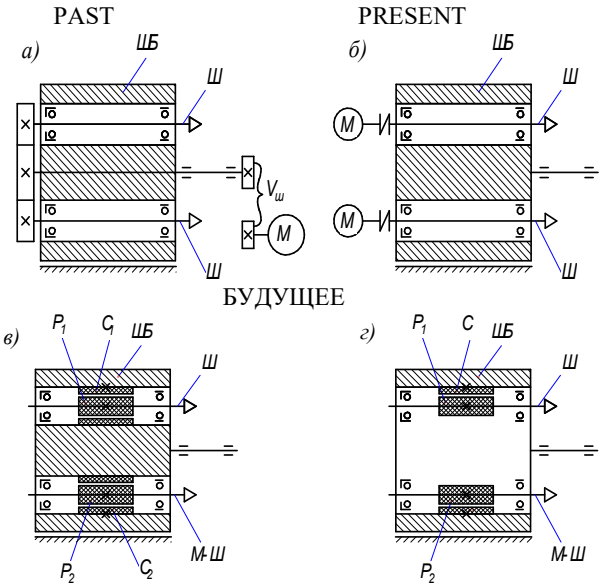


Рис. 3. Эволюция привода главного движения (вращения шпинделей) в МТА с поворотным ШБ: а – прошлое; б – настоящее; в, г – будущее (М – электродвигатели главного движения;$M_1 \dots M_z$ – электродвигатели вращения шпинделей $Ш_1 \dots Ш_z$; $(М-Ш)_1 \dots (М-Ш)_z$ – мотор-шпиндели; $C_1 \dots C_z$ – статоры М-Ш; $P_1 \dots P_z$ – роторы М-Ш; С – общий статор для всех М-Ш

In the KPI them. Igor Sikorsky proposed the concept of creating technological equipment of new generations, the main provisions of which are as follows [8.9]:

1. Genetic-morphological principle, including:

- a genetic approach to the classification, description, evolution and prediction of the development of TS [14];
- multilevel morphological approach to the structure and synthesis of TS [2,9,13].

2. The use of frame and shell structures of load-bearing systems based on the theory of structural mechanics [9].

3. Aggregate-modular principle [1,9].

4. The use of promising information technology and intelligent computer systems [8,9].

The implementation of the proposed concept requires the use of not only the basic laws of Nature, but also knowledge in various fields and TS (performed functions, flows and energy converters) [12]. .

The first scientific achievement of Man was mechanics - the science of the laws of motion of bodies, which is related to

all natural phenomena and the creations of technology, to all scientific research [5]. Mechanics as a science and as the first step towards facilitating the physical labor of Man is an ancient science, developed and turned into an engineering science. Man, being the creation and disciple of Nature, step by step begins to subjugate the forces of Nature, creating tools and production methods. Speaking about the future development of world and domestic machine tool building, it is necessary to turn to the scientific approach, known and new methods of forecasting and prediction for 50-100 or more years ahead [12,14]. An example of scientific genetic prediction is the multi-purpose robot machine of the future (Fig. 4). A long-term forecast with a probability of completion of 100% based on genetic prediction can be represented in the form of a pyramid of foresight [13]. With an increase in the size (weight) of the part Gd and the machine Gc, their ratio changes (Fig. 5):

I. Quickly assembled and ultra-precision mini-machines from modules in a case with an integrated computer control system that implement nanotechnology.

II. Desktop machines or 3D printers with artificial intelligence, controlled from a computer (smartphone) or chip in a person's head.

III. Floor (ground) mobile multi-axis robocar machines with a frame-shell supporting system, moved around the workshop and at the same time processing parts.

IV. A building (workshop) with a workpiece mounted on the floor (possibly grown using a 3D printer), intelligent robotic machines move along the walls and ceiling of which.

V. An open area under a canopy, on the floor of which a workpiece is installed (possibly grown using 3D printers), and intelligent robotic machines with tools for various purposes and designs move around and around it.

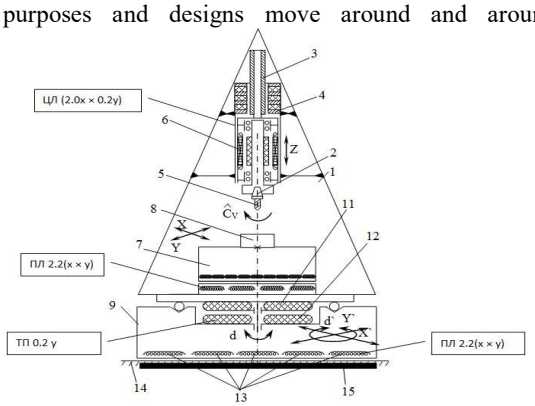


Fig. 4. Multi-axis mobile drilling and milling machine of the future without mechanical gears according to the patent of Ukraine for invention No. 101447 with genetic formulas of nodes (mechanisms)

For all machines of the future, when the shape of the workpiece approaches the shape of the finished part, i.e. with a significant reduction in removed allowances, cutting forces and at high processing speeds, as well as with the transition to frame and shell bearing systems (beds, columns, racks, etc.), the need for foundations, starting from mini-machines and up to unique .

Fig. 5. Geometric model for predicting the evolution of machines of various sizes (Gc-weight of the machine, Gd-weight of the part)

The discovery of seemingly paradoxical new effects and phenomena objectively existing in Nature allows us to forecast and anticipate the development of science and technology for many years to come and solve the most complex problems facing humanity, including energy, environmental, raw materials, information, etc. in many ways, Man turns to Nature, to himself and strives to create a new one in his own likeness [7].

For stationary structures, for example, bearing systems of machine tools, at the chromosomal level (parent chromosomes), elementary solids (of the correct form) in the form of a ball, cylinder, prism, cone, pyramid, etc. are used (Fig. 6).

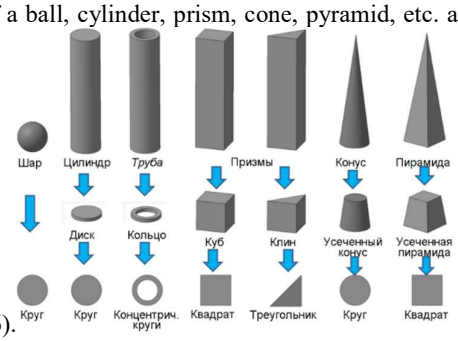
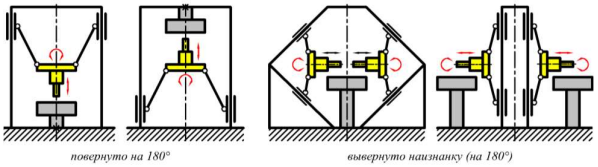


Fig. 6. Examples of elementary solids and figures - generating elements of a mechanical system

Under the influence of external influences of the environment or Man, elementary solids can have or take various solid forms, mutating. If we look at the origins of the creation of mechanical systems by Man, then the tools of the Stone Age represented simple forms of bodies, on the basis of which all subsequent inventions in mechanics appeared. It is from such positions that one can trace the development of technology from the past through the present into the future by the example of evolution of the development and synthesis of machine tools, like machines that create other machines, using geometric constructions for this.

For mechanical systems at the object level there can be a mechanical link - one or more connected solid bodies [2]. For example, from a pair of elementary cylindrical bodies of different diameters and different heights, you can create many mechanical links. If we look at the origins of the creation of mechanical systems by Man, then the tools of the Stone Age represented simple forms of bodies, on the basis of which all subsequent inventions in mechanics appeared [8-10]. It is from such positions that one can trace the development of technology from the past through the present into the future by the example of evolution of the development and synthesis of machine tools, like machines that create other machines [8, 10], using geometric constructions for this. A cylindrical wooden stick, as a straight line segment with an axis of symmetry, made it possible to obtain fire due to direct and reverse

rotation with friction at a point about another object. This was the beginning of the creation of a vertical drilling machine. The appearance of fire allowed Man to cook hot food from a dead animal, which was rotated on a spit - a horizontal rod. This was the beginning of the lathe. When Man learned to pour metal products, bearing systems, like other parts, they began to make metal, and with the advent of electric motors, software control systems and the modular principle [1,8,9], the number of layout options, for example, drilling and milling machines, significantly increased , but the inherited genetic information about the presence of Man near the machine and the location of the control panels on one side of the working area was preserved, which did not change the layout principle, leaving it asymmetric th. The return in the layout of drilling and milling machines to the symmetry that was genetically laid in the Stone Age and the use of advances in EM systems, electronics and computer science makes it possible to create new generation open access machines from different sides (Fig. 4) with a supporting system in the form of a frame of various symmetric shape [9]. The implementation of the proposed concept for creating a new generation of machines using genetic operators is shown in Fig. 7.

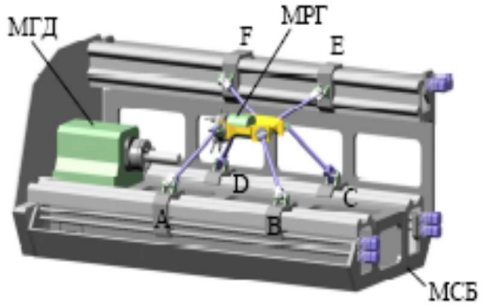


a) b)

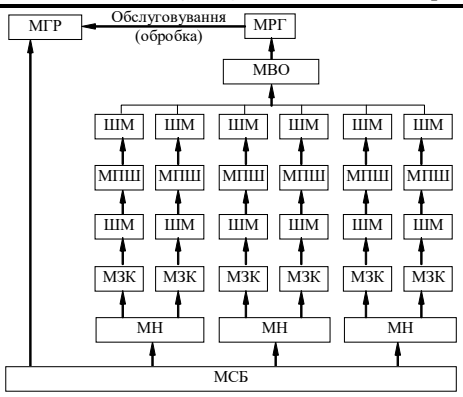
Fig. 7. Examples of "chromosomal" inversions of a machine with MPS of the "biglayd" type (a) and conversion of a single-position machine with several tool systems to multi-position (b)

Using the genetic operator of crossing at least two layouts with different genetic information - traditional (sequential kinematics) and modern (parallel kinematics), hybrid layouts of machines with parallel structure mechanisms (MPS) of the turning and drilling-milling groups with their codes - morphological formulas [9].

The modular principle of constructing machines with MPS (Fig. 8) is expedient and quite effective in computer modeling and visualization of the movements of the executive body [1,8,9].



a)



б)

Fig. 8. The layout (a) and block diagram (b) of a multi-purpose hexaglide lathe with the main modules: MSB - stationary; MHD - the main movement; MPG - turret; MN - guide module; MIO - module of the executive body; MIK - module for changing coordinates; ШМ - hinged module; MPSh - rod module of constant length;

Any technological principle can be represented in the form of two material points that come into contact and interact with each other - the processed object O_1 (details) and the processing object O_2 (tool) (Fig. 9), each of which performs translational and rotational movements in space in its coordinates $X_1Y_1Z_1$ *and* $X_2Y_2Z_2$ [7, 4,13].

The interaction of these points O1 and O2 (Fig. 9) can be represented as a convolved morphological model at the chromosomal level [7]:

$$M_{KC} = \left|\begin{Bmatrix}\omega_{x_1}, S_{x_1}, R_{x_1}\\ \omega_{y_1}, S_{y_1}, R_{y_1}\\ \omega_{z_1}, S_{z_1}, R_{z_1}\end{Bmatrix}\right| \wedge \left|\begin{Bmatrix}\omega_{x_2}, S_{x_2}, R_{x_2}\\ \omega_{y_2}, S_{y_2}, R_{y_2}\\ \omega_{z_2}, S_{z_2}, R_{z_2}\end{Bmatrix}\right|$$

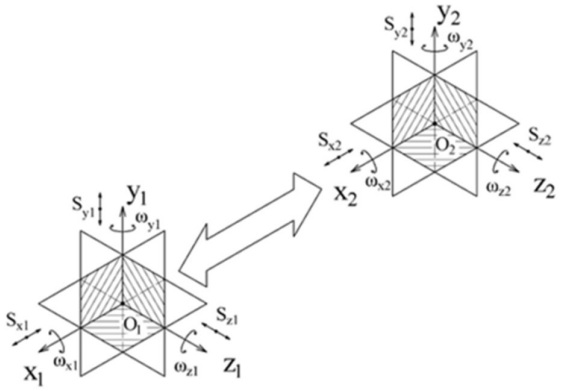


Fig. 9. A generalized interaction model of the workpiece and tool (a) and the proposed spatial kinematic cutting scheme in the form of the interaction of two material points O1 and O2 in Cartesian coordinate systems (b)

If there is no rotational or translational movement and points are placed on the geometric axis of the machine, the value 0 (zero) is used as an alternative to the implementation of the feature in the morphological model. Using the genetic-morphological approach, a kinematic cutting

scheme with digital code 401 [4] is presented from the morphological model, which for specific processing schemes is written as variants of the genetic code at the chromosomal level (Fig. 10): $(\omega_{x_1}, 0, 0) - (0, S_{x_2}, 0)$ - axial drilling of a rotating part (t.O1) with a non-rotating translationally moving drill tool (t.O2); $(0, 0, 0) - (\omega_{x_2}, S_{x_2}, 0)$ - axial drilling of a non-rotating part (t. O1) with a rotating and progressively moving coaxial tool (t. O2); $(0, S_{x_1}, 0) - (\omega_{x_2}, 0, 0)$ – axial drilling of a translationally moving part (t.O1) with a rotating coaxial tool (t.O2); $(\omega_{x_1}, S_{x_1}, 0) - (0, 0, 0)$ – axial drilling of a rotating and progressively moving part (t. O1) with a stationary tool (t. O2).

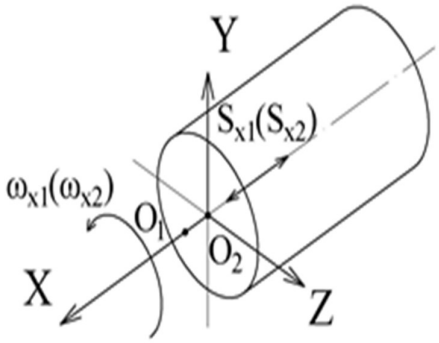
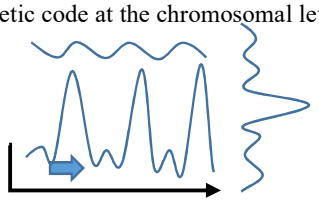


Fig. 10. Kinematic cutting scheme described by various variants of the genetic code at the chromosomal level



The thinking process of the Man-generator of ideas can be represented as a combination of combinations of waves of frequency pulses with bursts overcoming the psychological barrier and receiving responses in memory and a personal computer in the form of frequency pulses with the same parameters, within which resonance phenomena amplifying the pulse can occur (Fig. 11 ,12).

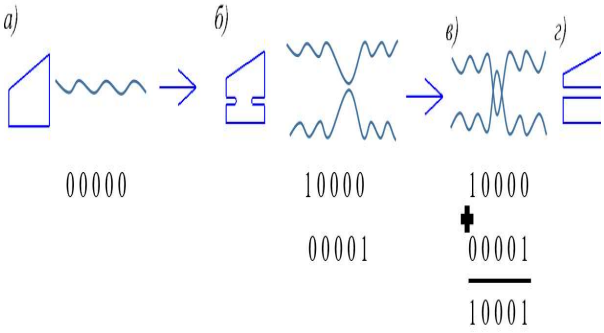


Fig. 11. Transformation of technical solutions using wave representation in the form of frequency pulses and a binary code in the plane XU

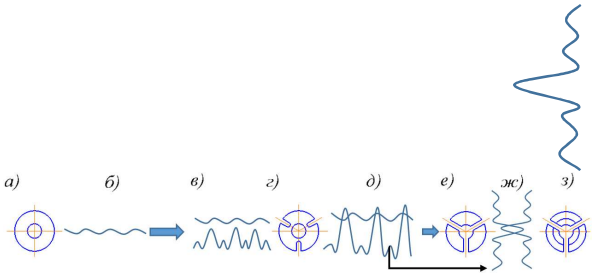


Fig. 12. Transformation of technical solutions using wave representation in the form of frequency pulses and a binary code in the plane UZ

Major conclusion

The results of genetic and structural-system analysis showed that the historically formed vast set of TS created by many generations of specialists has highly ordered systemic connections, the essence of which is revealed through the structure and genetic information of the elemental base of HA. It became apparent that Man is not the sole creator of technological progress, as previously thought, but remains only a student of Nature, which establishes the laws of structural organization, determines the genetic programs for the development of complex systems and dictates strict rules for their construction. With the birth of genetic electromechanics and mechanics, a new stage has begun in the evolution of technical sciences, which allows us to put forward new concepts and penetrate deeper into the system laws of the structural organization and development of complex developing systems. The genetic science of TS at this stage plays the role of a system-forming scientific discipline capable of transmitting knowledge to other areas of knowledge. The discovery and knowledge of the genetic principles of organization and the laws of evolution of generative systems of various nature opens up fundamentally new methodological possibilities, primarily related to the use of the prognostic and heuristic potential of genetic systems and determines the strategy of fundamental science on the path to the synthesis of knowledge. Remember the words acad. Konstantin Scriabin: "Whoever owns the genetic information will own the world!"

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