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FEATURES OF MANAGEMENT OF TECHNOLOGICAL PROCESSES IN MICRO-GRAVITATION AND MICRO-ACCELERATIONS CONDITIONS. 1. STRUCTURE FEATURES OF THE PHYSICAL AND MATHEMATICAL MODELS OF THE CONTROLLED TECHNOLOGICAL PROCESS

Introduction

In the second-half of XX century a large-scale development program was carried to create technologies and technological complexes for the purpose of study and use of weightlessness conditions to obtain substances and materials that are components, for example, of semiconductor structures, technical materials, biological and pharmacological preparations [1,2]. It became clear that the prospect for the development of 'thin' technologies depends on fundamental scientific principles and effective control of the motion of technological processes in the gravitational fields of different intensity and configuration and with different levels of micro-accelerations.

The special features of physical and chemical processes and the analysis of technological cycles under weightlessness conditions indicate their structural complexity as dynamic systems with control, which are been continuous poly-physical and poly-aggregate. Experimental data showed that the factors of space flight can be divided into two large groups, namely: the determining special features of the state of micro-gravity and the specific conditions of the functioning of automatic spacecraft. The development of space technologies requires detailed study of the mechanisms of phenomena both under the terrestrial conditions and under the conditions for approximating weightlessness, and also the development of the reliable methods of the controlled action on them taking into account concrete gravitational situation on board of the spacecraft. Basic applied problem consists in obtaining of materials and substances with the given physical chemistry properties.

The limited possibilities of setting experiments on board of a spacecraft and their high costs indicate ever increasing value of physical and mathematical simulation. Basic problem here consists of the establishment of the isomorphism of physical and mathematical models. The problem of the isomorphism of model requires the application of mathematical theory of conversions. The values, which correspond to the important concepts during the study of processes (laws of mass conservation, pulse, energy so forth), are the invariants of these conversions. The observability of process here comes out as the ratio of these invariants to a given frame of reference, selected in such a way that these or other simplifications would be unessential for the general theory. For the solution of this general problem it is necessary to find and to describe the concrete model of the class of phenomena or processes in question and to write down the appropriate equations, making them invariant relative to all broader classes of conversion.

Thus, for solving the applied problem of control of technological processes it is necessary to proceed from the fact of existence of two forms of reality: there are objects, between which there are time-spatial connections, and objects - between which these connections are absent. The first class is material models, and the second - form ideal physical-mathematical models. Between these classes of models it is necessary to establish the relation of isomorphism, which makes it possible to obtain concrete results, which allow comparison with the experiment, and it means to eat the possibility to correctly pose the problems of control of the structures (classes), induced by the studied processes.

State of the Theory of Control and Vibration Shielding

The tasks of the theory of vibration shielding relate to the non-classical tasks of the linear and nonlinear vibration theory, theory of automatic regulation, calculus of variations and optimal control, theory of differential games. The theories of passive and active vibration shielding were isolated. The sum of first development stage of the theory of vibration shielding brought well known monographs [3- 7]. The second stage is connected with the development of theory and practice of the systems of active vibration shielding. The characteristic feature of the works of this direction is the systematic application of methods and principles of construction and study of the automatic control systems and optimal control [8 - 14]. If we speak about third development stage of the theory of vibration shielding, then it must be noted that it is relatively young and connected with the application of differential- geometric, differential- topological and group-theoretic methods in the mechanics, physics, chemistry, contemporary (abstract) theory of control [15- 28]. The possibility of the effective application of these methods appear because of the need of studying the qualitative properties of the dynamic and controlled dynamic systems, which are reduced to a study of their regions of attainability and such structural properties as controllability, invariance, structural stability (roughness), aggregation etcetera. This direction is reflected in the articles [29 32].

To evaluate the applied aspects of the existing systems for control and vibration shielding for creating the conditions of conducting the technological cycles on a spacecraft, then it should be noted that basic problem is the guarantee of a state of prolonged weightlessness, monitoring and control of the levels of micro-gravity and micro-accelerations. The practical realization of these conditions requires the solution of a whole series of complex and principally key problems and tasks of mechanics, chemistry, biology, control and vibration shielding. By the distinctive special feature of the conditions for conducting and organizing the technological processes on board of a

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spacecraft is the decrease of forces and accelerations, which bear time-spatial nature [33-36]. The high degree of approximation to ideal weightlessness, characterized by the functional inequality is required for the solution of technological problem

$$0 < \varphi\,(x, y, z, t) \leqslant 1, \tag{1}$$

by the generated relation

$$n \leqslant \varphi\,(x, y, z, t)\, q_0, \tag{2}$$

where n-th is the value of micro-acceleration, q_0 – acceleration due to gravity on the earth's surface. It is shown in [37] that the analytical ideas (1) and (2) form the structures, which make it possible to introduce the classes of equivalence according to the relation of homotopy. The value of micro-acceleration is determined from the formula

$$\vec{n} = \vec{r} \times \vec{\varepsilon} + (\vec{\omega} \times \vec{r}) \times \vec{\omega} + 2(\vec{v}_r \times \vec{\omega}) + \frac{\mu}{R^2}\left(\frac{3\vec{R}\cdot\vec{r}}{R^2}\vec{R} - \vec{r}\right) - \frac{1}{m}\vec{F} \tag{3}$$

where $\vec{R}$ and $\vec{r}$ are the vector of the functions, which determine the geocentric position of the center of masses of technological module and the position of the point of continuous medium relative to the center of masses respectively, $\vec{\omega}$ – the vector of the instantaneous angular velocity of module, $\vec{\varepsilon}$ – the vector of instantaneous angular acceleration, $\vec{v}_r$ – vector of the relative speed of the point of continuous medium, μ – gravitational parameter of the Earth, $\vec{F}$ – main vector of all nongravitational forces, which act on the module, m – is the mass of module. In (3) the first two terms on the right side determine the rotatory part of the motion of module relative to the center of masses, the third - considers Coriolis acceleration, the fourth - heterogeneity of the gravitational field of the Earth, and the fifth - action of different nongravitational factors, namely: control system with the correction of orbit – $(10^{-2} - 10^{-1})q_0$, orientation system – $(10^{-3} - 10^{-2})q_0$, equipment – $(10^{-6} - 10^{-3})q_0$, aerodynamic drag – $10^{-6}q_0$, light pressure – $10^{-8}q_0$ and so forth.

With $n = 0$ the main force vector, generated by accelerations in the right side (3), is equal to zero and system is in equilibrium under the influence of the field of forces, distributed in the space-time continuum. With $n/q_0 << 1$ in the order of $(10^{-3} - 10^{-6})q_0$ experiments indicate the discrepancy in the requirements for the lowered gravity, for example, for obtaining the necessary semiconductor structures [35].

At the high frequencies of the order of $\nu > 1$ Hz the application of passive systems of vibration shielding does not have fundamental difficulties, but already in the region of frequencies $\nu \leqslant (0,01 - 1)$ Hz it is necessary to use a system of the vibration shielding of quasi-zero hardness or system of active vibration shielding (AVS). Their distinctive special feature consists into the ability to ensure the bearing capacity with how convenient to the small hardness of system, the low inherent noise, the small power supply, a sufficient working volume. But questions of speed, accuracy, stability with a change in the conditions of the flow of technological processes can derive them to the limitations of their principles of construction.

By the basic principle, which lies at the basis of construction AVS, there is principle of control according to deviation. There the error of the regulation of is affected by different uncontrollable external actions and is the measure for deviation from the specified regime. An increase of the corresponding factors in the locked outlines makes it possible to decrease the influence of the uncontrollable external actions and changes in the characteristics of the protected object. Many results of the theory of vibration shielding were connected with this fact [8 - 11]. The effect of deep negative feedback DNF is achieved either by direct increase in the strengthening factor or by creation of the sliding regimes in the relay systems and the systems with the variable structure [9]. However, effect DNF proves to be not capable of removing the influences of external actions, actions from the side of cross couplings and changing parameters not only of multidimensional vibration-shielding dynamic systems VDS, but also simpler according to its physical and topological structure. The presence of temporary delay, nonlinearities etcetera do not make it possible to unlimitedly increase the strengthening factors AVS, since this leads to the disturbance of stability conditions VDS as a whole, or worsening in the criteria of quality, presented to it. Thus, with the insufficient a priori information this effective under certain conditions means cannot be realized.

The possibilities, based on the compensation effects (principle of Petrov's two-channel construction) and theory of invariance [37], also have deficiencies. These possibilities are based on the detailed knowledge of the characteristics of the protected object, as a rule, either unknowns or badly caused and being changed in the time. Task becomes problematic, and frequently also insoluble, when a question stands not simply about control and vibration shielding of object, but in its optimum protection on several qualitative criteria [34, 35].

It should be noted that in classical SVZ, based on principles presented above, with time the amounts of the deviation of the controlled parameters accumulate, which reach the significant magnitudes, but which cannot all be practically considered.

In all enumerated cases, for which in essence is characteristic the insufficiency of a priori information, usual approaches are not applied. There appears to be a need for use or search for other methods and principles of construction SVZ. One of the approaches connected with questions of adaptation, is presented, for example, in the works [10, 38].

An essential drawback in principles examined above and methods of realization [SVZ] is the fact that the models of the objects of control are as a rule, material point, absolute solid or solid body being deformed. Technological modules and continuous media, placed in them and which are found in different states of aggregation are the objects of space technologies. Such objects relate to the classes of poly-aggregate and poly-physical dynamic systems. They should be considered as the interacting subsystems with the

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hierarchic structure of control of technological process according to any equivalence relation, assigned, for example, by functional dependence of the type (1) or (2). The classical systems for control and the vibration shieldings, unused information about the physical chemistry processes in the technological spacecraft modules, in principle cannot solve the basic task of obtaining substances and materials with the assigned properties. For the solution of these technological problems it is necessary to develop the theory of the distribution systems for control and vibration shielding of the parameters of continuous medium. Theory and principles of the construction of the distribution - concentrated systems for control and the vibration shielding, which possess the properties of the poly-controllability and of the poly-invariance, at the present time, are absent. Different questions of the theory of control of the distribution systems are reflected sufficiently fully into [39-42].

About isomorphism of the Mathematical and Physical Models of the controlled Technological Process

The physical characteristics of continuous media are stress, deformation, internal energy, entropy, temperature, thermodynamic and chemical potential, stress tensors and deformation and others. The defining parameters of continuous media include values as the functions of space coordinates and time, physical chemistry constants, fundamental constants $\gamma, \hbar$ and C. From the point of view of contemporary theories fundamental constants refer to any physical phenomenon and it is possible not to consider them only from the considerations, connected with the required level of the accuracy of theoretical description.

According to contemporary ideas there are four qualitatively different interaction modes, called fundamental. Besides the distinctions in kind fundamental interactions differ in quantitative sense in the force of interactions, characterized by intensity, and are arranged in the following order: gravitational, weak, electromagnetic and strong [43]. One should separately note that recently are examined still torsion interactions, which are arranged between the electromagnetic and the gravitational. In the quantum region the elementary particles, called by the carriers of interactions, correspond to such interactions. The forces of long-range interaction correspond to interactions (force of gravity, the inertial force, electromagnetic forces). They are called mass or volumetric. The forces of close-range interaction are directly connected with the molecular structure of matter and they are called surface.

Significant decrease of gravitational heat convection and its influence on the processes of heat-mass transfer with the forming of the physical chemistry properties of continuous medium comes out as important factor with the passage of technological processes under the conditions for approximating weightlessness (for example, the difficulty of mixing fusion). Diad’s “convection - heat-mass transfer” leads to the stratification of fusion, during which in the zone of melting the regions with different mechanisms of the realization of the dyad coexist, which lead together with the rheonomic fields of micro-accelerations to the distortion of the hydrodynamic state of fusion, the processes of crystallization and properties of the reared crystals. The effect of the absence of buoyancy negatively affects the separation of phases, but, from the other side, it makes it possible to obtain the dispersed mixtures of high uniformity.

One additional special feature of technological processes is connected with existence and formation of phases and phase transitions. By phase is understood the uniform part of the thermodynamic system, whose physical and chemical properties at all points are identical and do not depend on a quantity of substance. Phases are isolated by the interfaces not of great thickness, inside which property the systems can considerably change. One and also substance can be located in different phases (crystal, liquid, gas). They differ substantially, for example, in the density, the electrical conductivity (dielectric, semiconductor) etcetera, and they call them the states of aggregation. By phases usually are implied the objects, which consist of the large number of atoms and molecules (exponent of Avogadro - atoms). With a change in the actions (temperature, pressure, levels the pH, magnetic field, pour on micro-accelerations so forth) of phase can be converted into each other, i.e., they are observed phase transitions. An abrupt change in the properties of substance is characteristic property of phase transition, and the behavior of system in the environment of phase transition proves to be sensitive to the slight disturbances (admixtures, weak fields so forth) that it plays essential role in the solution of technological problems.

One additional special feature of technological processes is connected with existence and formation of phases and phase transitions. Phase is the uniform part of the thermodynamic system, whose physical and chemical properties at all points are identical and do not depend on the quantity of substance. Phases are isolated by not very thick interfaces, inside which the properties of the systems can vary considerably. Same substance can be located in different phases (crystal, liquid, gas). They differ substantially, for example, in the density, the electrical conductivity (dielectric, semiconductor) etcetera, and they call them the states of aggregation. By phases usually are implied the objects, which consist of the large number of atoms and molecules (exponent of Avogadro – 10^{23} atoms). With a change in the actions (temperature, pressure, levels the pH, magnetic field, pour on micro-accelerations so forth) of phase can be converted into each other, i.e., the phase transitions are observed. An abrupt change in the properties of substance is characteristic property of phase transition, and the behavior of system in the environment of phase transition proves to be sensitive to the slight disturbances (admixtures, weak fields so forth) that it plays essential role in the solution of technological problems.

Thus, the discrepancy in the requirements for the levels of micro-gravity and the micro-accelerations for the effective conducting of technological processes becomes clear, and also complexity and problematical character of the construction of the physical, mathematical and administrative models of these processes.

Qualitative and quantitative assessments are important in all stages of the

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synthesis of the models of continuous media and their study. At the qualitative level, that always precedes quantitative, adequate model of continuous medium protrudes topological space M. Before conducting a technological process, the property of topological space M to be non-khausdorf with the countable base of the open sets $\{W_k\}$ fits well.

Let E be Euclidean space with the Cartesian coordinate system relative to basis a_i fixed in it, associated with the technological module. Coating $\{W_k\}$ topological space M by the open sets $\{W_k\}$, that satisfies the conditions:

1. There exists a homomorphism φ_k of any set of $\{W_k\}$ to the open domain in E, i.e.,
$$\phi_k : W_k \to V_k \subset E,$$
2. If $W_k \cap W_s \neq \emptyset$, then the homomorphism
$$\varphi_{ks} = \varphi_s \circ \varphi_k^{-1} : \varphi_k(W_k \cap W_s) \to \varphi_s(W_k \cap W_s).$$

Is C^r – the smooth mapping of the regions of Euclidian space E. Then the topological space M, associated with its coating $\{W_k\}$, which satisfies the indicated properties, is C^r smooth variety. Pair (W_k, φ_k) is called local map of variety M, and the family of maps $\Phi = \{(W_k, \varphi_k)\}$ is an atlas AtlM of the local maps of variety [M]. Any map (W_k, φ_k) in the basis a_i is written in the form:

$$\varphi_k : x \in W_k \to \varphi_k(x) = x^i(x)a_i \in E, \tag{4}$$

i.e. each point $x \in W_k$ is placed in the correspondence of the collection of real numbers $(x^i(x))$. This collection is called the local system of coordinates of the map (W_k, φ_k) of the variety M. If two maps (W_k, φ_k) and (W_s, ϕ_s) of the variety M are given such, that

$$(W_k, \varphi_k) \cap (W_s, \varphi_s) \neq \emptyset, \tag{5}$$

and there exists a point X, which belongs to this intersection, then for it are determined coordinates, $x^i(x)$ and $y^i(x)$ in the maps (W_k, φ_k) and (W_s, φ_s) respectively. These two local coordinate systems are connected at the intersection (2) with transformation of coordinates

$$\varphi_{ks} : (x^i) \in \varphi_k(W_k \cap W_s) \to (y^i = \varphi_s \circ \varphi_k^{-1}(x^i) \in \varphi_s(W_k \cap W_s), \tag{6}$$

which is a homomorphism of the open set in e.

The atlases of local maps Atl_kM and Atl_sM on the variety M are equivalent, if in the intersection $W_k \cap W_s$ the conversion of the type (6) is identical. If atlases$A_j = \{(W_k, \varphi_k)\}_{k \in I}$ belong to class C^r, then they are called C^r- equivalent, where r determines the order of the differentiability of conversion φ_{ks}. Association C^r- equivalent atlases is C^r- maximum atlas on the variety M.

The set of maps Φ with the relation (6) can be identified with the family of the Lagrange and Euler coordinates, introduced in continuum mechanics, and it also determines the external state of medium. All functions $f : M \to R^1$ are such, that

$$\begin{array}{l} (x^i) \in \varphi_k(W_k) \to f_k(x^i) = f \circ \varphi_k^{-1}(x^i) \in R^1 \\ f_s(y^i) = f_k \circ \varphi_{ks}(y),\ (x^i) \in \varphi_s(W_k \cap W_s) \end{array}, \tag{7}$$

are functions of this external state.

The inter-phase interfaces are varieties with the edge for these phases, but with different orientation of the division surface. Then C^r - homomorphism (6) must transfer internal points into the internal, and the boundary into the boundary. If $\varphi_k : W_k \to H$ and $\varphi_s : W_s \to H$ are homo-morphisms of the environments of point to the open subsets in the Euclidean half-space H, where the dimensionality $\dim H = \dim E$ and $\varphi_k(x) \in E^*$, such that $\dim E^* = \dim E - 1$, then $\varphi_s(x)$ also belongs to Euclidian space. Otherwise mapping φ_{ks} will be a homomorphism of a certain open set in the neighborhood of point $y = \varphi_k(x)$ from $H \subset E$, and since the neighborhood of point y is not open in E, then the conditions of Brouwer's theorem about the invariance of region are not satisfied [2]. Limitations to the set M^*, where $\dim M^* = \dim M - 1$, the elements of coating $\{W_k\}$, which intersect M^*, is formed coating set M^*, which determines the structure of the smooth variety, called the edge of variety M and designated ∂M. If the Jacobean of mapping φ_{ks} is different from zero at all points of the field of it's of definition, then it is called diffeomorphism.

For definition of quantitative assessments it is necessary, besides state definition system by diffeo-morphism (6), to assign metrics as external characteristic of continuous medium, and to connect it with the space metrics, where this medium is inserted in the states, determined by diffeo-morphisms (6). It is given standardly in the form:

$$dS^2 = g_{ij}(x)dx^i dx^j = g_{ks}(y)dy^k dy^s, \tag{8}$$

where g_{ks} – Euclidean metric tensor in E. From (8) it is evident that this metric has different representations in different atlases of the maps, which assign coordinate systems, from the maximum atlas to the varieties $M \subseteq E$.

The internal states of continuous medium can be also identified with the topology of the differentiated varieties and varieties with the edge, similarly introduced for the external description. Fundamental here is the introduction of the metric properties of this medium, which reflect quantitative relations and invariance of internal characteristics (homogeneity, isotropism, curvature, twisting, connectedness, density, magnetization and so forth) with respect to inclusion maps F, determined in (6).

The agreements of external and internal certificates makes it possible to determine the measure for the deviation of the metric properties of continuous medium from the Euclidean measure and to introduce non-Euclidean certificate in the appropriate geometry. It is clear that this measure for deviation must make completely determined physical sense and all parameters of medium must be coordinated with it, at least locally. Hence it follows that these parameters cannot bear arbitrary nature. They can be interpreted as the intercommunication, which limit the motion of continuous medium or its elements.

In the analytical mechanics of continuous systems four kinds of intercommunication are examined [3]. Variable fields correspond to these connections. The fields of the first and second kind are created by the vectors of displacement and speed of the element of continuous medium. The connections of the third kind (St. Venant connections) are determined by the conditions of the compatibility of St. Venant, introduced in the form linearized equations in the theory of small deformations. They coincide with the condition of equality to zero tensors of Einstein, namely:

$$R_{ik} = \frac{1}{2}\eta_{ik} = 0,\ \forall i,k \in [1,3]. \tag{9}$$

With the disturbance of conditions of continuity, i.e., with the property of being a Hausdorff continuous medium as topological space, the condition (9) is disrupted, i.e.,

$$\eta_{ik} \neq 0 \tag{10}$$

Tensor η_{ik} is called the tensor of the incompatibility of deformations and is the measure for deviation from non – Hausdorf of the medium, i.e., by the measure of the nonfulfillment of the conditions of continuity of medium. Equations

$$R_{ik} = \frac{1}{2}\eta_{ik} \tag{11}$$

with the fulfillment of conditions (6) analytically define the connections of the third kind and the variable fields of the third kind in the space of the components of strain tensor ε_{ik}, in this case these equations (8) do not depend on the law of the motion of system as the external state of medium, i.e., they must be invariant relative to inclusion maps (3). The space of the variables of field ε_{ik} is six-dimensional function space. With the fulfillment of conditions (7) the connections of the fourth kind appear, but in order to consider equations (8) as the equations of relation, it is necessary to increase the number of variables of field, and to that aim the components of the instantaneous speed of deformation $\dot{\varepsilon}_{ik}$ are selected. These variables form the variable fields of the fourth kind, and their space is also allotted by the structure of function space, but larger dimensionality for the fulfillment of conditions of independence from the law of motion of the elements of continuous medium. Actually these connections bear nonholonomic nature, and the motion of continuous medium can be considered as the motion of restricted system with the defined and sufficiently wide conditions, subject to the principles of the Lagrange and Hamilton formalisms, developed and examined in [45].

This theory can be used during the study of the physical properties, for example, of semiconductor materials and to obtain them with the given properties taking into account the body forces, generated by microaccelerations. Here the task of the agreement of the certificates of the external and internal state of medium in its different states of aggregation appears, which leads to the non-Euclidean geometric prototypes, and the task of control of the internal states of medium as managing the connections of categories examined above. These tasks of control were not examined and are tasks of analytical construction.

Important is a question about the possibility of the propagation of the analytical mechanics of continuous systems with the connections to the processes, in which it is, for example, necessary to consider reciprocal effect to the state of continuous medium of mechanical and quantum-mechanical interactions and control of them. Theory will be considered satisfactory, if the topological properties of continuous medium with its characteristics of internal physical description will be coordinated by means of the final relationships. Is it possible to select these functional relationships as the variables of state or to construct the generalized functional by means of these relationships? This question remains to be solved.

Another question relates to the establishment of the equivalence of the idea of non-Hausdorf as the topological property of continuous medium, and with the condition for the disturbance of continuity (1). Do the fractal structures appear during the fulfillment of conditions (3) from the part of this 1 work, according to which it would be possible to indicate the criterion of property of being a hausdorff and to obtain (to determine) invariant or invariants, which characterize mechanisms and regimes of the disturbance of conditions (4). The chemical processes, which lead to fundamental changes in the totality of the physical properties of the end product of interaction in comparison with the properties of initial reagents, are the radical method of changing the physical properties of materials and substances.

Let us examine continuous medium as physical chemistry set.. Important task in the stage of the construction of models is the selection of the variables of state, which include the flow diagram of reagents chemical processes the speeds of flows, equation of chemical reactions, the levels of [pH], concentration of substances, volumes, pressure, thermodynamic flows, thermodynamic forces such as, for example, an affinity of reactions etcetera. Between all these variables there is a connection, determined by laws ore experimentally. Basic question is which of these variables should be considered independent variables. Thus, for instance, dissipative function for different systems can be expressed in the form the sum of the correlated flows and forces. This function provides information about the number of degrees of freedom, since each term corresponds to one degree of freedom. In the work [46] the algebraic criteria of the independence of the selection of the parameters were established, and the structures of varieties come out as the parametric sets. It should be noted that appearing peculiarities associated with the dimensionality of the varieties of the parameters, can be erased by the change of parametrization, but geometric special features can be unavoidable by the replacements of the parameters. In the works [46,47] it was shown that the chemical set, as algebraic structure, relates to the class of nonassociative algebras. Question: is it possible to connect the algebraic property of nonassociativity of chemical set with the arrow of time? If the answer is positive, then there must exist a connection with the thermodynamic arrow of time, i.e., the temporary asymmetry of continuous medium as chemical set, can induce the three-dimensional anisotropy of this continuous medium, but as the physical chemistry set, whose state is located far from the position of equilibrium. Here the task of control consists of the guarantee of a possibility of controlled three-dimensional modulation of the process of the transformation of atomic composition in the volume, first of all, of the solid and close to it phase of substance. Another, contradictory, problem is connected with the spontaneous formation of the regulated structures. The effects of self-organizing do not make it possible to create, for example, the nano-structure of arbitrary geometry. The task, in addition consists in control of the phase transitions, which make it possible to selectively move away atoms from the materials of the, i.e., three-dimensional- modulated change in the composition, structure, the physical and chemical properties of materials and substances.

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With the formulation of the problems of control it is important to consider symmetries and conditions for their disturbance with the description of passages "order-disorder (chaos)". The disordered phase of substance has a higher degree of symmetry in comparison with the ordered phase, i.e., it has all the elements of symmetry of the ordered phase, and also it can be invariant, for example, relative to the operation of translation. At the same time the completely ordered structure is phase with the smallest symmetry, for which translations are permitted, which preserves the distances between the planes, which contain the atoms of one type [17, 48, 49]. Reduction in the symmetry specifies the appearance of new limitations, which lead to the appearance of the additional constraints between the determining (essential) values. Asymmetry can serve as the adequate characteristic of phase transition. It is important to determine criterion or measure for asymmetry and to indicate parameter or group of the parameters, which correspond to them. This approach leads to the task of the classification of the parameters on the levels of the calculation, for example, of the influence of fundamental interactions or pour on micro-accelerations with the synthesis of the model of continuous medium and the construction of the technological process of obtaining of materials and substances with the assigned properties. It is clear that this parameter space does not form disjunct sets, but the question remains: is this parameter space a smooth variety, or is it a variety with the edge.

This classification makes it possible to isolate in one model of technological process two levels, namely: micro- and the macro-descriptions, necessary for molding of the tasks of control and vibration shielding, and the measure for asymmetry is selected as the characteristic (determining) functional parameter, which depends on the generalized coordinates or functions from the generalized coordinates, which correspond for this measure.

The task to model a continuous medium requires the construction of a closed system of equations for the determining functions. The equations of mass balance, pulse, energy and entropy are valid for any continuous media. The physical and mathematical principles of their selection and construction are partially reflected into [50 - 54]. Functions satisfy some limitations, generating a set of permissible functions. On this set the limitations of the smoothness are introduced most frequently. Special feature consists in the fact that the decrease of the class of smoothness corresponds to an increase in the number of degrees of freedom. Thus, if characteristic function suffers break along a certain surface, then this indicates that is simulated another physical structure, for example, of dislocation in crystal lattice of semiconductors, quantum holes and quantum barriers, quantum threads and quantum points, cracks in the deformed solid and so forth.

Summary

The above-indicated two levels of the description of continuous medium make it possible to consider it as two interacting subsystems. One subsystem is classical, and another - quantum and these two subsystems interact, i.e., the state of classical system depends on the state of quantum, and vice versa. Such systems are called poly-physical [47, 55]. A question arises: when it is possible to disregard quantum special features of one of the subsystems and when this it is not possible to do so. This question is fundamental with the determination of the tasks of control and vibration shielding by technological process.

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