

SEARCH OF THE MOLDING FORM CONNECTOR PLANE ON THE APPROXIMATION BASIS BY THE MANY-SIDED SURFACE WITH USE OF THE CONVEX SETS THEORY

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ABSTRACT

Use of plastic as material for production of different products – one of the priority directions of the current technologies in construction and the industry. The important aspect of such technology, processes should be considered as high-quality production of molding forms for the subsequent production of plastic products. It allows to unify production of difficult products, to increase optimality procedures of their production, reliability and quality of the received products. The general ideology of the search for the molding form connector plane is revealed by means of an approximation with a many-sided surface. The technique of searching for the connector plane molding form using the theory of convex sets has been developed. The generalized technique for searching of the molding form connector plane of plastic products on the basis of approximation of a many-sided surface with the use of the theory of convex sets is offered. The possibility of application of this technique for the solution of a task of increasing the accuracy of linear and circular interpolation of a movement trajectory of the tool cutting edge on the processing center is shown.

KEYWORDS: *Molding form, Technology of Casting, Connector Plane, Approximation, Many-Sided Surface & Convex Sets*

Received: Dec 11, 2017; **Accepted:** Jan 01, 2018; **Published:** Feb 01, 2018; **Paper Id.:** IJMPERDFEB2018118

1. INTRODUCTION

Plastic is one of perspective materials which is used for production of different products by means of the molding form (MF) or the so-called casting under pressure (CUP). In particular, different researches show that since 1997 world consumption of plastic annually increases approximately for 4% and such tendency is characteristic and now [1, 2].

Moreover, casting under pressure is one of the main methods of thermoplastic materials processing. This method allows to produce high-quality products with a fine precision at high efficiency. But, at the same time it should be noted that this method of thermoplastic materials processing is followed by the multifactorial physical phenomena.

Technological equipment (TE) or MF – the main forming tool. In the TE, the product is formed, the structure of the material is formed during the filling of the cavity, the sealing of the casting material and its cooling [2–4]. In the manufacture of plastic products by the CUP method, one of the most important and laborious stages is

the design of the technological equipment. The main important tasks in the design of TE include a complex research of the features of modern molding forms and the creation of a method for searching the plane of the connector, which makes it possible to save the product from production defects, thereby increase the quality of the made products.

Under the production defect means various damages [3]:

- Crushing of a supporting surfaces product elements
- Longitudinal bend and corrugation of product walls
- Edge fins on a product surface owing to friction forces
- Deformation of a product, buckling and other

Correctly designed and qualitatively made MF allows to provide the required accuracy of the parts sizes, to receive a surface without traces of ingates and pushers, to keep physical and mechanical properties of the used plastic material, to create a product with the minimum residual stresses, not subject to buckling. Implementation of the specified requirements has to be combined, ensuring the minimum cost value of a product. It is reached by the choice of an optimum arrangement of the plane of the connector of a form.

2. METHODOLOGY

The Main Directions of Researches in the Field of Search the Plane Connectors of the MF

In [5] the features of location the main and additional connector plane (CP) for removing the gates are analyzed. The theoretical information about structure and properties of plastic, methods of their receiving and processing is provided. Features of a casting under pressure method and also the main types of automatic molding machines are considered. Special attention is paid to bases of design and calculation of molding forms systems.

All [6] main aspects of plastic casting under pressure are analyzed. In the book bases of connector plane, selection process is provided. Features of a CP arrangement for production of thin-walled products, such as compact disks in which an important role is played by change of pressure along the product plane because of the high resistance to a flow are described. Defects of MF because of an irrational CP arrangement are considered.

Work [7] is devoted to quality management of casting under pressure process where offer the guide to receiving quality plastic products. Questions of form designing, to material processing, production of parts, assembly of a product, its finishing, packaging and delivery to the consumer are considered. Each stage is also in detail considered to show how the increase in standards of separate operations leads to the creation of the first-class products. Regulations on CP and factors which need to be considered at the choice of an CP arrangement are separately provided.

The research [8] is concentrated on the current state of plastic, methods, technologies, the equipment and potential use for the second time of the processed materials. The solution of the problems arising at the choice of a CP arrangement is considered. Some designs of MF with possible options of a CP arrangement are given.

Features of the Molding forms Connector Planes

Rationally designed connector MF allows to remove a product freely. The process of removing the product from the mold takes place in four stages [9-11]:

- Extraction of a product and ingates from a matrix
- Colliding of a product from a punch
- Forced dumping into the form connector
- Return of removal system to initial position

Depending on a form design and the removal system of a form the sequence of stages changes, sometimes separate stages are absent or are combined. Dumping isn't recommended to be applied to large products. And for very easy and superficial products colliding and dumping are combined. On an arrangement of the planes of the connector distinguish [12–15]:

MF with the horizontal connector (Figure 1, a) when the connector planes of a compression mold and heating plates are parallel;

MF with the combined connector (Figure 1, b) when additional connectors are required for production and products extraction of a difficult configuration.

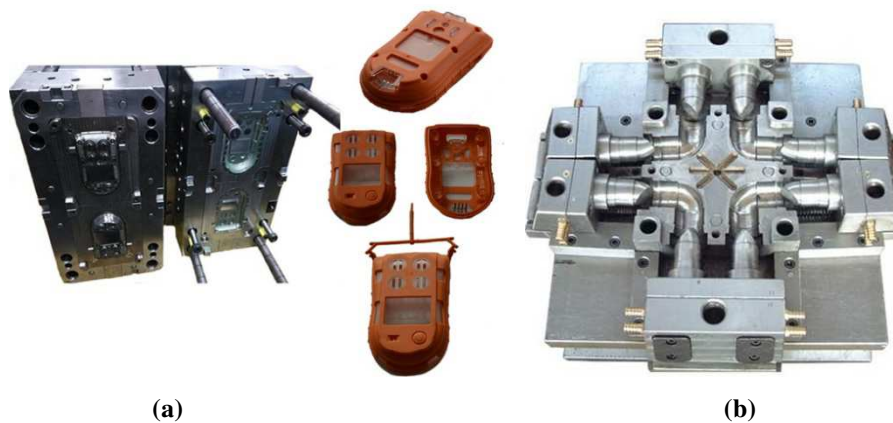


Figure 1: Types of the Molding form Connector Planes

When determining the form connector plane and model of a plastic product are guided by the following reasons:

- The model or parts of the model must be freely removed from the forming cavity (FC);
- To have all casting in a one-piece matrix, it prevents emergence of defects at distortions;
- The quantity of rods has to be minimum, an arrangement of rods preferably horizontal;
- The most responsible surfaces which are exposed to machining whenever possible to have below or in the vertical plane as upper surfaces turn out less dense and clean.

For a rational plane connector arrangement the main are: complexity of a product; type of the FC elements; type of MF.

Complexity of a product. Groups of plastic parts complexity are generalized in Table 1 [13].

The plastic part in a form has to be, whenever possible, the simplest, such that it could be made in simple (with one-two connector planes) a molding form. The configuration of a part shouldn't interfere with a free current of weight when filling a form [14, 15]. The form of a product has to provide a application possibility of one-piece matrixes and

punches (in connector matrixes and punches the labor input and cost of production are considerably increased). The responsible sizes shouldn't get to the connector plane, it reduces their accuracy on thickness bark. For easy department bark the line of the connector has to be on sites of a simple configuration contour product.

When developing the drawing of casting define the optimum plane of the MF connector and specify [16]:

- All external and internal biases
- The surfaces requiring further machining
- Deviations of the sizes
- Sites of a surface which shouldn't have traces from pushers and also traces of a material current
- Requirements for tightness
- Types of protecting or decorative coatings
- Sites on which the porosity isn't allowed

Thus, when designing casting, it is necessary to aim at one connector plane. For this purpose, casting shouldn't have the external and internal undercuts interfering free removal it from a molding form. The possibility of one connector plane creation is determined by the rule of light shadows. At the same time it is necessary to create right angles and rather roundish edges in those places where it is almost feasible. Dredging and openings it is necessary to have whenever possible perpendicular to the connector plane. If casting is located in semi-forms, then for reduction of shrinkage internal stresses internal walls carry out inclined planes. The casting located in motionless and mobile semi-forms has to have the greatest surface of a rod in a mobile semi-form. The side undercut interferes with free removal from casting from MF and have to form a side rod or a mobile cheek. Elimination of this undercut allows to remove casting in the direction perpendicular to the connector planes. If the configuration of an internal cavity with undercuts can't be changed, then the technology design of casting provides dredging under the flange replacing a bottom.

In the analysis of assembly units, the sizes of parts subdivide on the interface and are freed. Deviations on the free sizes of the parts produced from plastic are established on the sizes parallel to the compression mold connector plane, on the 5th class of accuracy

Type of the FC Elements

There are integral MF connector elements (matrixes and punches) [18]. At connector, they are on product traces from the connector plane and there can be an inevitable profiles' shift of a product and create ledges on a surface that isn't always admissible. Therefore, connector forms are acceptable where similar defects are admissible. Technology of production and operation of such forms is high and therefore the mark left by the connector plane of connector elements and the shift of profiles can be ranging from 0,01 up to 0,03 mm.

Table 1: Groups of Castings Plastic Parts Complexity

Groups of Castings Complexity	Characteristic of Surfaces		Examples of Castings
	Outside	Internal	
I. Simple	Rectilinear and smooth, with the low strengthening edges, with fillets, lugs, openings, flanges, low ledges and deepenings	None	Covers, flanges, handles, disks, plugs, flywheels, wing nuts, body of fender lamps, grids of radiators, etc.
II. Not complicated	Rectilinear and curvilinear, with availability of the strengthening edges, fillets, brackets, lugs, flanges with an opening and deepenings, an open box-shaped or open configuration	Simple, with smooth flat sites in the form of the simplest geometrical figures, without ledges and deepenings	Body of a simple box-shaped or cylindrical configuration, brackets, caps, tubes of lenses, figured flanges
III. Difficult	Curvilinear and rectilinear, with insignificant number of the crossed planes, having the acting parts and deepenings of a difficult configuration	Difficult, with two crossed planes or cylindrical surfaces, with deepenings and ledges, edges, crossing points, lugs	Difficult body of devices, body of engines of motorcycles, bicycles, motor scooters, pumps, reducers, crankcases and gearboxes
IV. Particular and unique	The curvilinear and straightforward, crossed at an angle, having speakers of a part and deepening of very difficult configuration	Difficult, with the curvilinear and rectilinear crossed surfaces, with availability of the deep crossed channels, ledges, profound places, edges and crossing points	Blocks and heads of cylinder blocks of automobile engines, difficult body of pumps, impellers, difficult body of devices and so forth.

MF Type

MF Types are divided by operational signs of MF on removable manual, removable using mechanization (automatic, semi-automatic) and stationary. The connector of these compression molds is made with the help the pressing devices or mechanisms of the recharger. Unlike removable, stationary MFs (or their separate plates) are rigidly connected to heating plates of a press. The connector of stationary MF is made by means of a press at its disclosure. Constructive signs of MF are subdivided on one-nesting and multineasting. The number of the connector planes depends on a design of MF and a product. MF with one horizontal connector are called two plates, with two horizontal connectors – three-plate, etc.

It is recommended to the horizontal planes to give a bias or to set casting to tilt position. But, it is necessary to aim at the number of connectors and rods in MF was minimum. Also, it is necessary to consider that side rods increase labor input of production of MF. Thus, the direct connector plane is the most preferable, especially at a symmetric arrangement of working cavities in many-placed MF. When designing a casting of a difficult configuration, it is also necessary to consider that extraction from MF.

3. RESULTS AND DISCUSSIONS

General Searching Ideology of the a Molding form Connector Plane

In the design of MF, one of the most responsible and difficult stages is search of the connector plane (CP) equipment, especially for the parts having irregular shape. To ensure free extraction and colliding of a product from the MF, which will prevent chipping or rupture of the product, it is necessary to develop a method of CP searching.

The product arrangement between the making-out cavities of separate parts defines the arrangement of CP, but doesn't define orientation of an axis of a product concerning a form axis. Connector plane crosses the CF. The form of a surface and quantity of CP always depends on a product configuration (for example, difficult MF in Figure 2).

In some designs, it is necessary to use friction forces for formation of the connector plane.

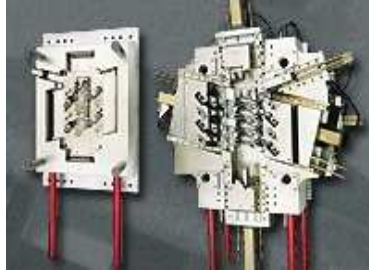


Figure 2: Difficult MF with Many Connector Planes

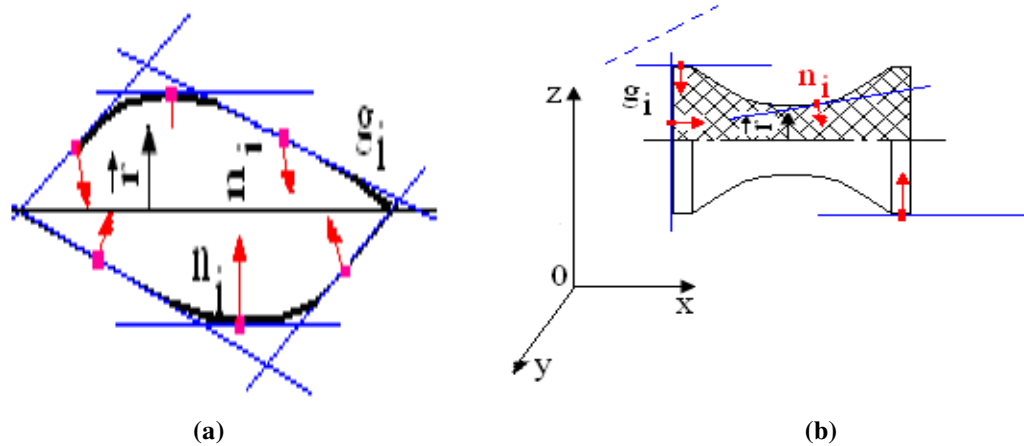
One of the methods for solving the problem of CP searching is surface approximation of a molding part a many-sided surface which is provided by the construction of the doubly connected edge list (DCEL) [21].

The essence of the method is that the surface of a molding part approximates the many-sided surface provided to DCEL.

Development of Search Molding form Connector Plane with Use of the Convex Sets Theory

We will assume that the surface of a molding part is approximated by means of the basic functions defining the surface of movement of the cutting edge of the tool when processing CF on the processing center. Each surface element of the part forming an edge defining its linear interpolation of a cutting edge trajectory movement can put in compliance its normal vector $\overline{n(g_i)}$ which is a gradient of function which displays CF in the system of machine coordinates.

Let the approximate direction of a normal vector of the connector plane be known, therefore, initial approach of a normal vector of the connector plane \bar{r} is set. $G = \{g_1, g_2, \dots, g_n\}$ – set of surface elements. We will provide a set of edges of G as three not crossed subsets: $G = G^+ + G^0 + G^-$; $G^+ = \{g \in G : (\overline{n(g)}, \bar{r}) > 2 \cdot 10^{-2}\}$; $G^0 = \{g \in G : (\overline{n(g)}, \bar{r}) \leq 2 \cdot 10^{-2}\}$; $G^- = \{g \in G : (\overline{n(g)}, \bar{r}) < -2 \cdot 10^{-2}\}$. The example, approximations is given in Figure 3.



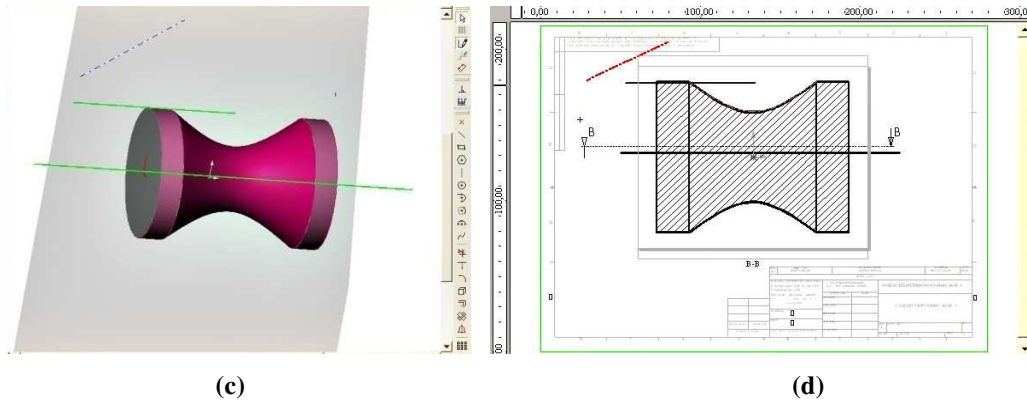


Figure 3: Approximation by the Basic Planes: (a) A Part in the Form of a Drop; (b) Insulator; (c) Approximation of a 3D Model of a Part in Solid works; (d) Approximation of a Part on the Drawing in Solid works

Let's say G^0 includes edges, normal a vector of which are almost perpendicular to the chosen direction \bar{r} . It is necessary to modify a vector \bar{r} so that function $F(r) = \sum_{g \in G^0} (\overline{n(g)}, \bar{r})^2$ was minimized under a condition $\|\bar{r}\|^2 = 1$, thereof, we will find a vector, which in mean square most orthogonal to all vectors $\overline{n(g)}$ for $g \in G^0$. For the solution of this task, it is possible to use Lagrange's function:

$$L(r, \lambda) = \sum_{g \in G^0} (\overline{n(g)}, \bar{r})^2 - \lambda (\|\bar{r}\|^2 - 1) \tag{1}$$

where \bar{r} – the approximate normal vector direction of the connector plane; $\overline{n(g)}$ – normal vector of edges; λ – Lagrange's multiplier.

Having differentiated (1) we equate derivatives to zero, we will present systems in the form:

$$\begin{cases} \frac{\partial L}{\partial r} = 2 \sum_{g \in G^0} (\overline{n(g)}, \bar{r}) \cdot \overline{n(g)} - 2\lambda \cdot \bar{r}; \\ \frac{\partial L}{\partial r} = \|\bar{r}\|^2 - 1; \end{cases}$$

and

$$\begin{cases} \sum_{g \in G^0} (\overline{n(g)}, \bar{r}) \cdot \overline{n(g)} = \lambda \cdot \bar{r}; \\ \|\bar{r}\|^2 = 1. \end{cases} \tag{2}$$

We will consider the linear operator $A\bar{u} = \sum_{g \in G^0} (\overline{n(g)}, \bar{u}) \cdot \overline{n(g)}$, let $\bar{r} = \bar{u}$, then solutions of system (2) will be solutions

of a spectral task for operator A. If the vector \bar{v} and number λ are solutions of a task, then after the scalar multiplication of the first equation of system (2) on a vector \bar{v} taking into account the second equation of system (2) we receive: $\lambda = F(\bar{v})$. The range of the linear operator will be located on a positive material half shaft as the operator A is positive. Proceeding from the aforesaid, it is possible to draw a conclusion that a task to come down to search of the minimum own value of

operator A and own vector relevant to it.

Operator A it is possible to present in the form expressions for the elements of a matrix A: $A_{ij} = \sum_{g \in G^0} (\overline{n(g), e_i})(\overline{n(g), e_j})$. We will designate through $\det(A)$ a determinant of a matrix A. If, then all vectors $\overline{n(g)}$ where, lie in one plane, which normal vector matches a normal vector of the plane of the MF connector. In this case, the normal vector can be found by vector multiplication of non-collinear vectors of two edges from a set G^0

Before solving a problem in a general view, it is necessary to evaluate the lower edge of values of function $F(u)$. As this lower edge matches the minimum own value of a positive matrix A, the following assessment takes place at: $\|u\|^2 = 1: F(u) \geq \text{sp}(A) - \sqrt{\text{sp}(A)^3 - 12 \det(A)}$, where $\text{sp}(A) = A_{11} + A_{22} + A_{33}$ – a trace of a matrix A. Existence of this assessment means a possibility of one CP creation, without solving the spectral problem provided by the system. If by results of assessment, it is visible that search of the decision can result in satisfactory results, then process of the decision is carried out (any of spectral task solution methods for positive matrixes).

The second stage – search of the minimum own value of operator A. The search problem of the minimum operator A own value and own vector corresponding to it can be written down so: if $\overline{u_0}, \overline{u_1}, \dots, \overline{u_{m-1}}$ meet conditions:

$$\overline{u_{k+1}} = A\overline{u_k} - \alpha_{k+1,k}\overline{u_k} - \alpha_{k+1,k-1}\overline{u_{k-1}} - \dots - \alpha_{k+1,0}\overline{u_0}, \quad (k = 1, 2, \dots, m - 1) \tag{3}$$

then $(\overline{u_i}, \overline{u_j}) = 0$ at $i \neq j$, $\overline{u_k} \neq 0$ ($i, j, k = 0, 1, 2, \dots, m - 1$), then we select coefficients $\alpha_{m,m-1}, \alpha_{m,m-2}, \dots, \alpha_{m,0}$ so that a vector

$$\overline{u_m} = A\overline{u_{m-1}} - \alpha_{m,m-1}\overline{u_{m-1}} - \alpha_{m,m-2}\overline{u_{m-2}} - \dots - \alpha_{m,0}\overline{u_0} \tag{4}$$

there were orthogonal to vectors $\overline{u_0}, \overline{u_1}, \dots, \overline{u_{m-1}}$ coefficients are determined by a formula:

$$\alpha_{mi} = \frac{(A\overline{u_{m-1}}, \overline{u_i})}{(\overline{u_i}, \overline{u_i})}. \tag{5}$$

In parallel with creation of system of mutually orthogonal vectors $P_0(\lambda) = 1; \overline{u_0}, \overline{u_1}, \dots, \overline{u_{m-1}}$ we build the sequence of polynomials $P_m(\lambda) = (\lambda - \alpha_{m,m-1})P_{m-1}(\lambda) - \alpha_{m,m-2}P_{m-2}(\lambda) - \dots - \alpha_{m,0}P_0(\lambda)$. As in this space there is no more n of mutually orthogonal vectors, on some step will have $\overline{u_m} = 0$, at the same time $A\overline{u_{m-1}} - \alpha_{m,m-1}\overline{u_{m-1}} - \alpha_{m,m-2}\overline{u_{m-2}} - \alpha_{m,0}\overline{u_0} = 0$. It will give linear dependence of vectors $\overline{u_0}, A\overline{u_0}$ and $A^m\overline{u_0}$, and the polynomials $P_m(\lambda) = (\lambda - \alpha_{m,m-1})P_{m-1}(\lambda) - \sum_{k=0}^{m-2} \alpha_{m,k}P_k(\lambda)$ will be a divider of the minimum polynomials of a matrix A. At $m=n$, $P_m(\lambda)$ – characteristic a polynomials of a matrix A. If by $m < n$, we choose a new initial vector $\overline{u_0}$, orthogonal to vectors $\overline{u_0}, \overline{u_1}, \dots, \overline{u_{m-1}}$ we repeat with it the same process. If it appears insufficiently, that is the total quantity of orthogonal vectors still will be less n, then we carry out calculations with a new vector $\overline{u_0}$ orthogonal to all previous, etc.

Let us write down the Lanczos method is applicable to this task [23]. We choose any initial vector $\overline{u_0} \neq 0$, and we find $A\overline{u_0}$. Then, we select coefficients α_{10} so that the vector $\overline{u_1} = A\overline{u_0} - \alpha_{10}\overline{u_0}$ was orthogonal to a vector $\overline{u_0}$. Follows from a condition of orthogonality that $\alpha_{10} = \frac{(\overline{Au_0}, \overline{u_0})}{(\overline{u_0}, \overline{u_0})}$. If we receive that $\overline{u_1} = 0$, then vectors $\overline{u_0}$ and $A\overline{u_0}$ both are linearly dependent and $P_1(\lambda) = \lambda - \alpha_{10}$ will be a divider of the minimum polynomials of a matrix A. If $\overline{u_1} \neq 0$, then we form a vector $A\overline{u_1}$ and we select coefficients α_{21} and α_{20} so that the vector was orthogonal to vectors $\overline{u_0}$ and $\overline{u_1}$.

At the same time $\alpha_{21} = \frac{(\overline{Au_1}, \overline{u_1})}{(\overline{u_1}, \overline{u_1})}$; $\alpha_{20} = \frac{(\overline{Au_1}, \overline{u_0})}{(\overline{u_0}, \overline{u_0})}$. If it turns out that $\overline{u_2} = 0$, then $A(A\overline{u_0} - \alpha_{10}\overline{u_0}) - \alpha_{21}(A\overline{u_0} - \alpha_{10}\overline{u_0}) - \alpha_{20}\overline{u_0} = 0$ [23].

From here, vectors $\overline{u_0}, A\overline{u_0}$ and $A^2\overline{u_0}$ are linearly dependent, and the polynomials $P_2(\lambda) = (\lambda - \alpha_{21})(\lambda - \alpha_{10}) - \alpha_{20} = (\lambda - \alpha_{21})P_1(\lambda) - \alpha_{20}$ will be a divider of the minimum polynomials of a matrix A, but if $\overline{u_2} \neq 0$, then we continue orthogonalization process. The third stage – search of own vectors A. As $\overline{u_m} = 0$.

Let λ_i – some root of the minimum polynomials of a vector $\overline{u_0}$. Then we look for own vector corresponding to this own value in a look:

$$\overline{x_i} = v_0 \cdot \overline{u_0} + v_1 \cdot \overline{u_1} + \dots + v_{m-1} \cdot \overline{u_{m-1}} \tag{6}$$

Follows from a $A\overline{x_i} = \lambda_i \overline{x_i}$ condition:

$$\begin{aligned} &v_0(\overline{u_1} + \alpha_{10}\overline{u_0}) + v_1(\overline{u_2} + \alpha_{21}\overline{u_1} + \alpha_{20}\overline{u_0}) + \dots \\ &+ v_{m-2}(\overline{u_{m-1}} + \alpha_{m-1,m-2}\overline{u_{m-2}} + \\ &+ \alpha_{m-1,m-3}\overline{u_{m-3}}) + v_{m-1}(\alpha_{m,m-1}\overline{u_{m-1}} + \alpha_{m,m-2}\overline{u_{m-2}}) = \\ &= \lambda_i v_0 \overline{u_0} + \lambda_i v_1 \overline{u_1} + \dots + \lambda_i v_{m-1} \overline{u_{m-1}}. \end{aligned} \tag{7}$$

As vectors $\overline{u_0}, \overline{u_1}, \dots, \overline{u_{m-1}}$, are linearly dependent from (7) follows:

$$\left. \begin{aligned} &v_0(\lambda_i - \alpha_{10}) - \alpha_{20}v_1 = 0, \\ &v_1(\lambda_i - \alpha_{21}) - \alpha_{31}v_2 - v_0 = 0, \\ &v_2(\lambda_i - \alpha_{32}) - \alpha_{42}v_3 - v_1 = 0, \\ &\dots \\ &v_{m-2}(\lambda_i - \alpha_{m-1,m-2}) - \alpha_{m,m-2}v_{m-1} - v_{m-3} = 0, \\ &v_{m-1}(\lambda_i - \alpha_{m,m-1}) - v_{m-2} = 0. \end{aligned} \right\} \tag{8}$$

Coefficient $v_{m-1} \neq 0$, differently all other coefficients $v_i = 0$. Let $v_{m-1} = 1$, from here we find:

$$\left. \begin{aligned} &v_{m-2} = (\lambda_i - \alpha_{m,m-1}), \\ &v_{m-3} = v_{m-2}(\lambda_i - \alpha_{m-1,m-2}) - \alpha_{m,m-2}, \\ &\dots \\ &v_0 = v_1(\lambda_i - \alpha_{21}) - \alpha_{31}v_2. \end{aligned} \right\} \tag{9}$$

After the provision of the connector plane is defined, it is necessary to calculate the sizes of the TE gate system as the quality of a product is influenced not only by an arrangement of the connector plane, but also the sizes of channels on which fusion directly comes to CF. The configuration and the sizes of the gate channels (GC) need to be chosen, so that temperature and speed of a current of fusion were sufficient for filling of OP, and the fusion pressure transmitted from a nozzle through GC in the making-out cavity was enough for casting material consolidation at an endurance stage under pressure. The nature of filling of CF defining the key quality indicators of a product depends on their design. Therefore, it is necessary to design, molding system rationally. Nevertheless, in each case it is necessary to consider the features of a formation connected way with its technological capabilities.

At the same time, the generalized search technique of the molding form connector plane of plastic products on the basis of approximation by a many-sided surface with use of the convex sets theory consists in the following sequence:

- To deliver to each element of the surface forming an edge of a part in compliance its normal vector.
- Formalization of a part edges set.
- Correction of the approximate normal vector direction of the connector plane by means of Lagrange's function.
- Search of the minimum own value of operator A and own vector corresponding to it by means of the Lanczos method.
- Search of own vectors A.
- For the approximate normal vector direction of the connector plane to construct sets G^+, G^0, G^- .
- Definition of connector plane provision.

At the choice an arrangement of the MF plane connector tasks are solved generally: a casting arrangement in motionless or mobile semi-forms; minimization of connectors and rods in MF; possibility of one-piece matrixes and punches application.

For a rational arrangement of CP, it is also necessary to define: complexity of a product which is made; optimum nesting; type and structure of MF and configuration of a product in it, unconditional reliability of form work to meet technical requirements for this product.

4. CONCLUSIONS

Accuracy of casting depends first of all on the accuracy of MF production and an arrangement of the connector planes.

As a result, the offered method of MF connector search, can be used in the design of the MF and it gives the chance to prevent the deformation of a product at its extraction from a form. The distinctive feature of the offered technique is a modification of the formalized description of molding form connector plane search on the basis of approximation by a many-sided surface with the use of the convex set theory.

The offered technique of the MF connector plane search allows to increase the accuracy of linear and circular interpolation of a tool cutting edge movement trajectory of the processing center, because the surface of a product is interpolated by the basic planes. This method gives the chance to prevent deformation of a product at its extraction from

MF.

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