# CHART SCREW AND ITS APPLICATION TO THE ADJOINT KVAZIVINTOVYH SURFACE EXCEPT INTERFERENCE

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***Summary.* There is proposed the method of exclusion interference conjugate quasi screw surfaces in space mechanisms based on parametric kinematic screw.**

***Keywords:* quasi screw surfaces, kinematic screw, interference.**

*Formulation of the problem.* One of the main directions of descriptive geometry is formation of complex conjugate of quasi screw surfaces, which are inextricably linked with all sectors and types of production.

*Analysis of recent research.* In the works of A. Nikolaev and G. Apukhtin kinematic linear screw is considered in connection with conjugate surfaces. A. Podkorytov expanded opportunities of existing screw diagram; the characteristics of nonlinear screw surfaces are defined.

*The wording of the purposes of the article*. Develop a method of geometric modeling quasi screw surfaces which exclude interference, based on parametric kinematic screw in relation to spatial mechanisms.

*Main part.* The introduction of more modern technology of processing products in flexible automated productions, processing modules, in its turn, requires the development of effective methods of geometric modeling quasi conjugate screw surfaces.

Consider the geometric representation of the kinematic screw in two turns around the axis, which intersect and use this image to the folding and unfolding movements of the solid body [1].

Images of axis which make direct turnovers, associated with points that lie on the circle, can be found in works of many authors. However, this formulation used by the authors relatively solid body.

Through improvements, this formulation was able to consider more cases of folding and unfolding movements of the solid body. Improving the geometric image of a screw we will call spatial parametric kinematic screw.

Let there be given two turnovers around the axis intersecting *i* and *j* (fig. 1) with the shortest distance AB with angular velocities $\omega_A$ and $\omega_B$ and the angle $\gamma$ between them.

We will define effective movement. Let’s find the direction of the geometric sum of vectors $\omega_A$ and $\omega_B$, applied in an arbitrary point (fig. 2). Let's denote this sum through $\omega_C$:

$$\omega_C = \omega_A + \omega_B,$$

Module vector $\omega_C$ can be determined from the equality

$$\omega^2{}_C = \omega^2{}_A + \omega^2{}_B + 2\omega_A\omega_B\cos\gamma, \tag{1}$$

and its direction from equalities (1.2)

$$\frac{\omega_A}{\sin\beta} = \frac{\omega_B}{\sin\alpha} = \frac{\omega_C}{\sin\gamma}. \tag{2}$$

Here are $\alpha$ and $\beta$ - angles, that vectors $\omega_A$ and $\omega_B$ formed with the vector $\omega_C$, $\gamma = \alpha + \beta$.

Divide $\omega_A$ and $\omega_B$ (fig. 1) into components $\omega_A\cos\alpha$ and $\omega_B\cos\beta$, that are parallel to $\omega_C$ and $\omega_A\sin\alpha$ and $\omega_B\sin\beta$, perpendicular to $\omega_C$ components $\omega_A\cos\alpha$ and $\omega_B\cos\beta$, as parallel and in the same direction, equivalent to rotation with angular velocity.

$$\omega_C = \omega_A\cos\alpha + \omega_B\cos\beta \tag{3}$$

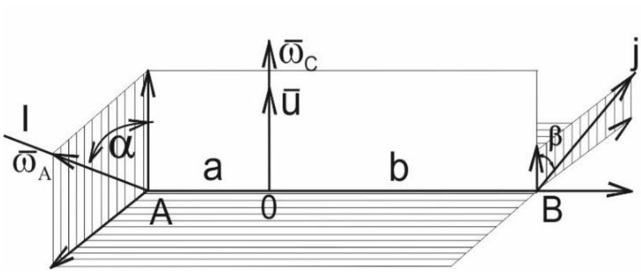


Fig. 1.

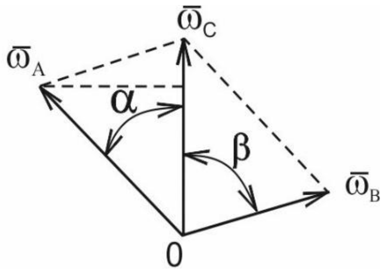


Fig. 2.

Around parallel axis passing through the point O of the line AB and satisfies equality

$$\frac{AO}{\omega_B\cos\beta} = \frac{OB}{\omega_A\cos\alpha} = \frac{AB}{\omega_C} \ . \tag{4}$$

$AO$ and $OB$ will be further denoted respectively as $a$ and $b$.

Components $\omega_A\sin\alpha$ and $\omega_B\sin\beta$ are equal in magnitude (fig. 2), but in the inverse direction. They form a couple of turnovers, equivalent to progressive motion with velocity, module of which

$$u = AB\ \omega_A\sin\alpha = AB\ \omega_B\sin\beta. \tag{5}$$

Apply vector $u$ at point $O$. Obtain a combination of two movements: the rotation movement with angular velocity $\omega_C$ and progressive movement with velocity $u$, directed by $\omega_C$. This set of two vectors is equivalent to screw with a parameter $h$, defined by (4) and (5):

$$h = \frac{u}{\omega_C} = b\ \mathrm{tg}\alpha = a\ \mathrm{tg}\,\beta. \tag{6}$$

The distance between axes $i$ and $j$ measure from point $O$ on the axis $x$, considering its directed, for example, to the right (fig.1). In this case $b$ is positive, $a$ - negative. Let's attribute the plus sign to the angle formed by the rotation of ray, in which lie $\omega_C$, around the point $O$ counterclockwise when viewed from the positive end of the axis $Ox$, and in another case, the minus sign (fig. 1 and 2).

Under this condition, in this case the angle $\alpha$ is positive, and the angle $\beta$ - negative; therefore, in the equality (6) $tg\,\beta$ is negative. Since also $a$ is a negative value, then

$$a\,tg\,\alpha > 0.$$

From equation (6) we find:

$$\frac{a}{b} = \frac{tg\,\alpha}{tg\,\beta}. \tag{7}$$

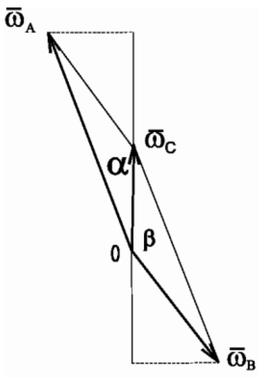


Fig. 3.

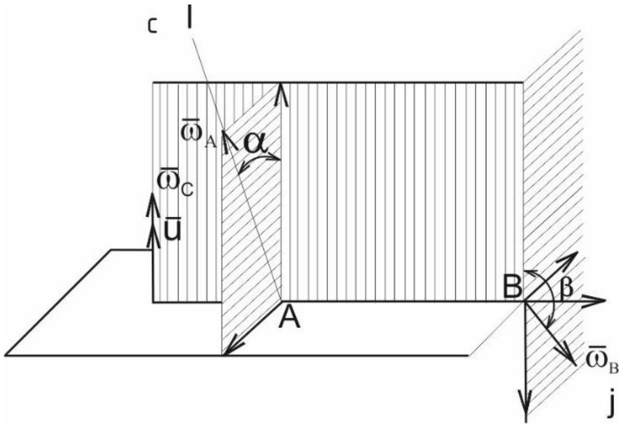


Fig. 4.

So the instantaneous axis of rotation is a sliding screw motion, equivalent to two rotations around the axes that intersect, is parallel to the diagonal of the parallelogram formed by the angular velocity of rotation; this axis passes through a point which divides the shortest distance between the axles of turnovers into parts directly proportional to tangents of the angles which are formed by using components of turnovers from the axis of effective (screw) movement.

Deriving equalities (6) we have assumed that the angles $\alpha$ та $\beta$ – both sharp (Fig. 1 and 2). Suppose now that one of the angles, such as $\beta$, is obtuse (fig. 3 and 4). In that case $\omega_A$ as a side, lying opposite the obtuse angle, by the absolute value will be greater each of the other two $\omega_C, \omega_B$.

Divide now $\omega_A$ and $\omega_B$ into components:

1) In the direction of $\omega_C$
2) In the direction, which is perpendicular to $\omega_C$.

We find:

1) $\omega_A \cos\alpha$, directed upward and $\omega_B \cos\beta$, directed down.

Suppose that the first one by the absolute value greater than the second.

2) $\omega_A \sin\alpha$ and $\omega_B \sin\beta$ , which lie in a horizontal surface, are numerically equal, parallel and oppositely directed.

Components $\omega_{\mathrm{A}} \cos \alpha$ and $\omega_{\mathrm{B}} \cos \beta$ are equivalent to the rotation with angular velocity

$$\omega_C = \omega_{\mathrm{A}} \cos \alpha - \omega_{\mathrm{B}} \cos \beta. \qquad (8)$$

Around parallel axis passing through the point O, lies on the continuation of the line $AB$ and satisfies the equalities (4).

Components $\omega_{\mathrm{A}} \sin \alpha$ and $\omega_B \sin \beta$ are equivalent to the progressive movement with velocity $u$, satisfying the equality (5). Effective movement will be screw movement with parameter $h$, which is defined by equality (6), and the axis $OC$, which position is determined from the equality (7).

Suppose that $\omega_{\mathrm{A}} \cos \alpha$ larger than $\omega_{\mathrm{B}} \cos \beta$. In this case$\omega_C$, which lies on the continuation of $AB$ behind the vector with a greater angular velocity ($\omega_{\mathrm{A}} \cos \alpha$) and directed to the side of rotation with a greater angular velocity, i.e. upward, will coincide with the direction u. This screw is been right. If $\omega_{\mathrm{A}} \cos \alpha < \omega_{\mathrm{B}} \cos \beta$, then screw is directed to $\omega_{\mathrm{B}} \cos \beta$, (down),

$$\omega_C = \omega_{\mathrm{B}} \cos \beta - \omega_{\mathrm{A}} \cos \alpha.$$

The point of application O of vector $\omega_{\mathrm{C}}$ is been on a continuation of AB at right, behind the point B. Screw in this case is left.

Thus, the screw will be right in the following cases: if the angles $\alpha$ and $\beta$ are both sharp.

The screw will be left if at angles α-sharp, and β - dull $|\omega_{\mathrm{A}} \cos \alpha| < |\omega_{\mathrm{B}} \cos \beta|$.

Screw fully characterized axis $C$, sliding velocity $u$, $C$ is parallel and angular velocity $\omega_C$, directed by $C$. The screw can be defined as the axis $C$, parameter $h$ and the angular velocity $\omega_C$. We denote screw through $(C, h, \omega_C)$.

In cases where you need to know $u$ and $\omega_C$, agree to mark the screw $(C, h, )$.

Setting screw $h = \frac{u}{\omega_{\mathrm{C}}}$ that has the length and longitudinal movement of the body expresses the angle of rotation equal to one radian be positive if $u$ and $\omega_{\mathrm{C}}$ directed in one direction; if $u$ and $\omega_{\mathrm{C}}$ directed in opposite directions, then $h$ will be negative.

Accordingly, the screw will be right, if the parameter $h$ is positive and left if $h$ is negative.

If $h = 0$, the screw will be rotational movement. Rotational movement around the axis $A$ with angular velocity $\omega_{\mathrm{A}}$ will be marked by symbol $(A, \omega_A)$.

If $h = \infty$ , then screw movement turns into gradual. Gradual movement with speed $u$, which is parallel to any straight $T$, denoted agree $(T, u)$, and T will be called direct axis translational motion.

With a significant positive value of the coefficient of relative displacement of the axis of parametric kinematic screw takes place interference of the teeth of the cutting tool profiles and part of the involute profile, which belongs to the tooth head of the wheel, resulting in a cut of this part of the profile. In this case there is a worsening of the tooth wheel.

With a significant positive value of the coefficient of relative displacement of the axis of parametric kinematic screw takes place interference of the teeth of the cutting tool profiles and part of the involute profile, which belongs to the tooth leg of the wheel, resulting in a cut of this part of the profile.

Changing profiles tines leads to increase accuracy of kinematic mechanism. Circumcision legs tines of gear wheels is undesirable because it reduces wheels of leg tooth , which reduces the ability of loading the mechanism.

Thus, we determine the accuracy of the average values of relative displacement at which the lack of legs and sharpening cutting heads, only in this case ruled gear meshing interference.

*Conclusions*. The accuracy and performance of construction quasi helical surfaces, which exclude interference, based on parametric kinematic screw it can be the basis for the formation of precise methods of designing complex surfaces of parts, ensure their optimal form and size in terms of reliability, precision profiling and productivity development work.

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