Next Scientists
Journal of Social Sciences and Humanities Research Fundamentals

TYPE Original Research
PAGE NO. 26-29
DOI 10.55640/jsshrf-05-04-07

Activation of Students' Independent Cognitive Activity by Homologous Substitution

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OPEN ACCESS

SUBMITED 14 February 2025
ACCEPTED 13 March 2025
PUBLISHED 11 April 2025
VOLUME Vol.05 Issue04 2025

Abstract: This article highlights the importance of activating the independent cognitive activity of university students using the homologous substitution method. Solutions to positional and metric problems were considered using the homologous substitution method, which replaces cases of three-dimensional spatial forms with those that are homologously compatible with them.

Keywords: Applied geometry, descriptive geometry, homologous substitution, students, independent cognitive activity, activation, plot transformation, one-to-one correspondence, surfaces, surfaces rotation, positional and metric tasks.

Introduction: Today in our republic, the rapid development of science and the rapid updating of knowledge, the introduction of high-quality and efficient equipment, technologies, the introduction of a modern information and communication system in all areas, including the educational process, require improved teaching of applied geometry, especially for higher education institutions.

In the science of applied geometry, when constructing drawings of various geometric shapes, along with the methods of plot transformation, the homologous substitution method can be used.

In this article, we will provide the following information about the reduction of the homologous substitution method and the theoretical foundations of its creation.

Let us consider the construction of the central projection of triangle ABC on the plane Q through the spatial center S (Fig.1). In this case, the rays SA, SB and SC passing through the point S intersect with the plane P, forming the points SA∩P=A', SB∩P=B' and SC∩P=C'. The connection of these points gives the triangle A'B'C'.

Let the line of intersection of the planes of triangles ABC and A'B'C' be a straight line a=P∩Q. It has an intersection, while the traces of the sides of triangle A'B'C' on the straight line are the points B'C'∩a=1', A'B'∩a=2', and C'A'∩a=3' the sides of triangle ABC are the intersection points of the straight line BC∩a=1, AB∩a=2, and CA∩a=3. In this case, the points 1≡11', 2≡21' and 3≡31' will be superimposed on the line A.

If we project the ends of triangle ABC through an arbitrary center S1 in space onto the second side P1 of the plane P, we get triangle A1'B1'C1'.

In this case, the projection of the center S onto the plane P1 will be S1'. As can be seen from the drawing, even in this case, the traces of the 1', 2' and 3' sides of triangle A'B'C' on the cut line, a will be at the same point as the traces of the sides of triangle ABC. The lines connecting the corresponding vertices of triangles A'B'C' and A1'B1'C1' pass through the point S'. This will establish an unambiguous correspondence in the space between the points of triangles ABC and A'B'C' and the points of triangles A'B'C' and A1'B1'C1'.

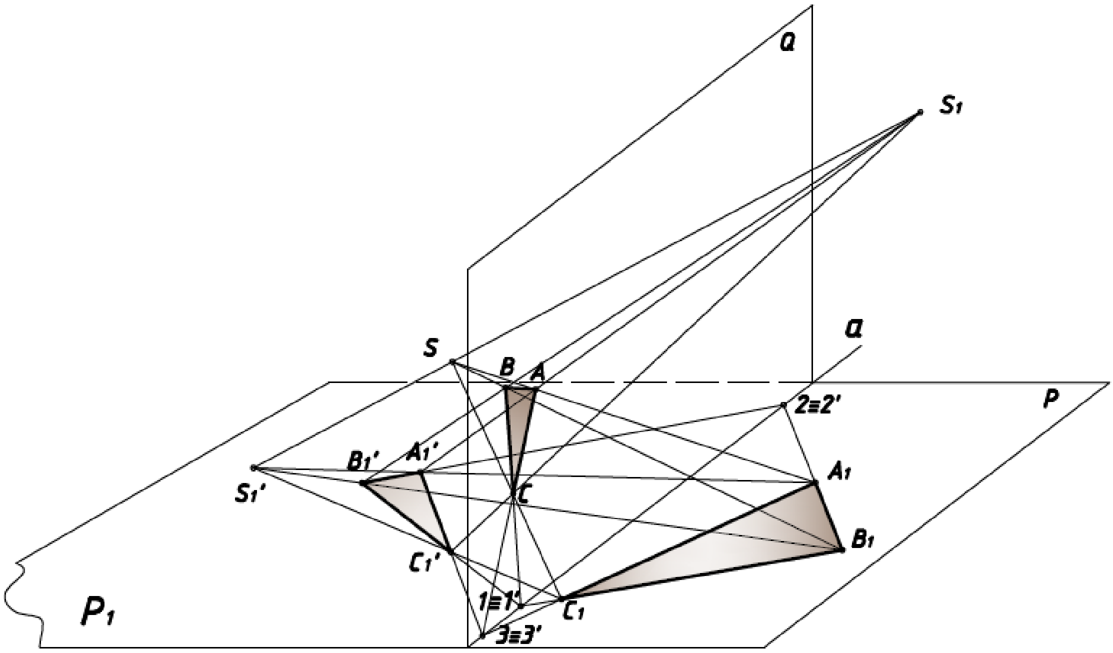


Fig.1

Based on the above constructions and conclusions, the homologous replacement method will be issued as follows.

On the plane, the method of homologous substitution is defined by the homology center, a pair of corresponding points, and the homology axis. Any flat shape defined on a plane based on the above can be replaced by a flat shape that is homologous to it. Also, a circle, an ellipse, a parabola, and a hyperbola defined on a plane can be replaced by their corresponding homologous second-order curvature.

These conclusions, in turn, are called Desargues' theorem.

If the rays connecting the corresponding ends of any triangle on the plane pass through a point, then the points of intersection of the corresponding sides of these triangles lie on the same straight line.

In Fig. 2, substituting triangle ABC into triangle A1B1C1, which is homologous to it, we obtain the inverse theorem to this theorem as follows.

If the points of intersection of the corresponding sides

of any triangle on the plane lie on the same straight line, then the lines connecting the corresponding ends of the triangle pass through one point.

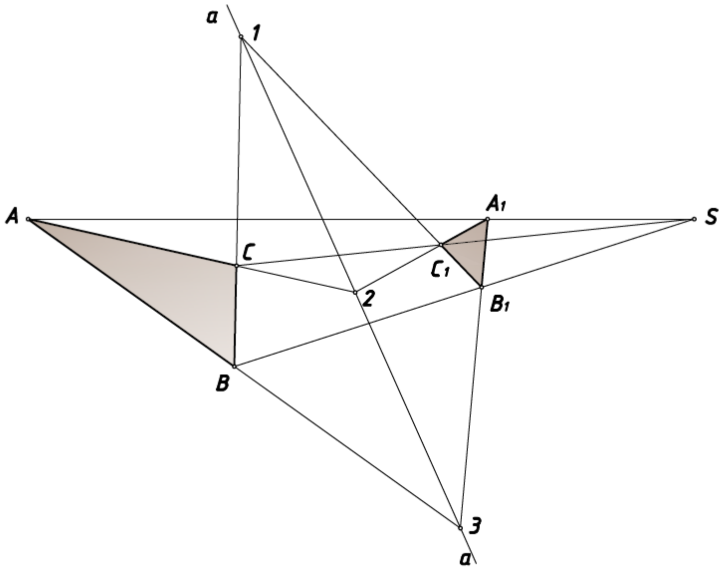


Fig.2

The following special cases of homologous substitution can be given, based on cases where the axis and center of homology are indicated in the drawing.

1. The center of homology S is a point, and although the homology axis is an irregular straight line a∞, the lines connecting the corresponding sides of homological plane shapes are parallel to each other (Fig. 3a). that is, AB//A1B1, BC//B1C1, and AC//A1C1.

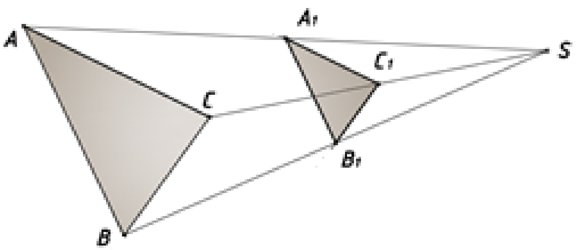
2. The center of homology S∞ is a nonlinear point, and although the homology axis is a straight line, the rays of homologous planar shapes connecting the corresponding points are parallel to each other (Fig. 3b). that is, AA1//BB1//CC1.

3. The center of homology S∞ is located at an infinitesimal point, and the axis of homology a∞ is a nonlinear line, then the corresponding points are lines in contact with homologous planar shapes parallel to each other, and the corresponding sides of the planar shapes are also parallel to each other (Fig. 3c). That is, AB//A1B1, BC//B1C1, AC//A1C1 and AA1//BB1//CC1.

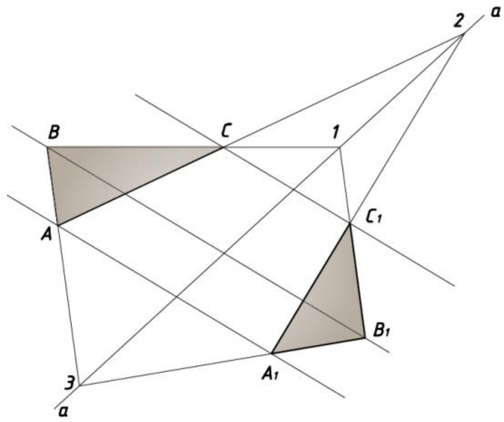
4. If the center of homology S∞ belongs to the homology axis, then the lines connecting the corresponding points of homological shapes are parallel to each other, and the intersection points of the corresponding sides of homological shapes belong to the homology axis (Figure 3d). That is, BC=B1C1=3 S, AC=A1 C1=2 S, AB=A1 B1=1 S

Using the homologous substitution method, it will be possible to replace the states of three-dimensional spatial forms with those that are homologous to them. In this case, you will need to specify the center of homology, the position of the homological replacement plane, and the corresponding homology points. By performing such substitutions, it is possible

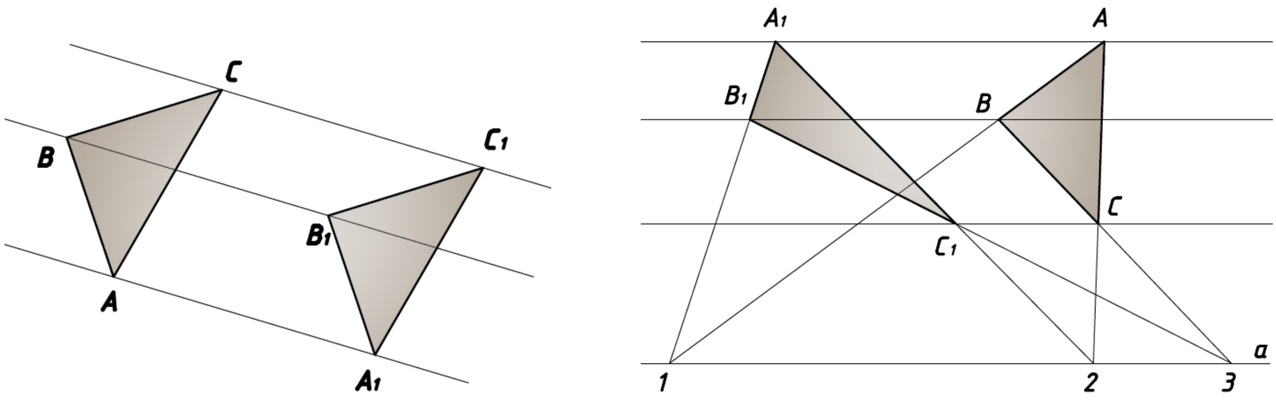
to facilitate the solution of general (elliptical in cross-section) second-order surfaces, taking into account their geometric position and related positional and metric problems, by bringing them into rotation.



a)



b)



c) *d)*

Fig.3

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