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The use of multidimensional space in the graph-analytical description of multifactorial events and processes

[1]Mahmudov Maqsud Sheralievich

[1]Doctoral student, Bukhara Institute of Engineering Technology, Uzbekistan, Bukhara

E-mail: shm.maxmudov@mail.ru

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***Abstract** - The article discusses the grapho-analytical properties of straight lines in a special case applied in three-dimensional space in order to automatically line the plastic function used in the design of shell surfaces.*

Keywords: *Hypersirt, polyhedron, linearity, plastic function, internal and external approximations, special cases of straight line, bisector plane.*

1. INTRODUCTION

In geometric modeling, a straight line is one of the simplest geometric shapes. It is known [1] that one and only one straight line passes through two points.

Given two points A and B that do not overlap, a single straight line can be drawn through them.

The part of a straight line bounded by two points is called the straight line intersection and is denoted as [A B] or [A B] ∈ a.

In most cases, straight lines are designated as lowercase letters of the Latin alphabet a, b, c,…. If a given straight line is bounded, then it is marked as [A B], [CD], [EF].

In the general case, the orthogonal projections of a straight line in the plane of all projections are projected as a straight line. Therefore, the projections of a straight line in the plane of projections will be a straight line (straight line cross section). It is determined by the projections of two different arbitrary points.

For example, to make orthogonal projections of a straight line Q given in Figure 1A≡B, (AB) ∈Q we make orthogonal projections of points A and B belonging to this line, i.e. A^{I}, A^{II} and B^{I}, B^{II}. and the lines aII are the horizontal and frontal projections of the straight line Q given in space. Also, the cross section AB and its projections A^{I}, B^{I} and A^{II}, B^{II} determine the position of the straight line Q in space, and vice versa.

If a straight line makes an acute angle with respect to the planes of projections, then the orthogonal projections of such a straight line in the general case form an arbitrary acute angle with respect to the projection axes. A straight line that is parallel, perpendicular, or perpendicular to the projection planes is called a straight line in the special case. (Figure 1)

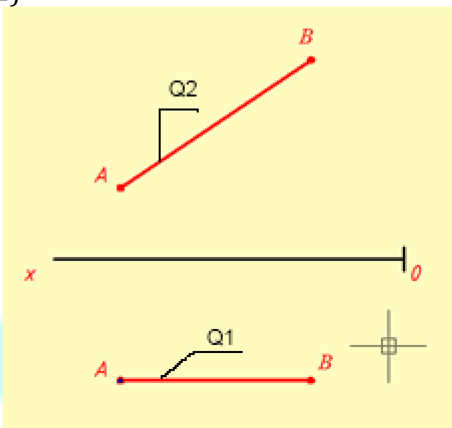
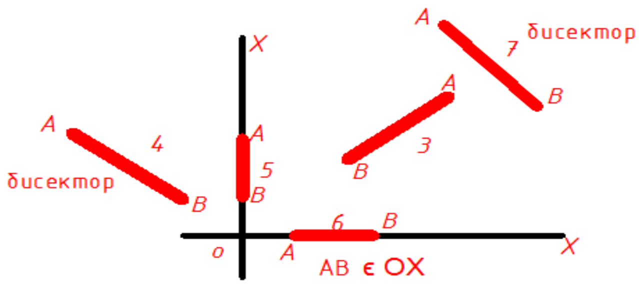


Figure 1. a straight line diagram in a special case.

An analysis of the available literature shows that the parallel and perpendicular cases with respect to the projection planes as a straight line in a particular situation are not considered in the remaining cases, so we decided to fill in this gap in this article. Therefore, we first gave a classification of the special states of a straight line relative to the projection planes (Table 1) and noted the mutual equality or difference of the coordinates of the special cases, which in turn allowed to describe the process of generating orthogonal projections of a straight line in a special situation. We



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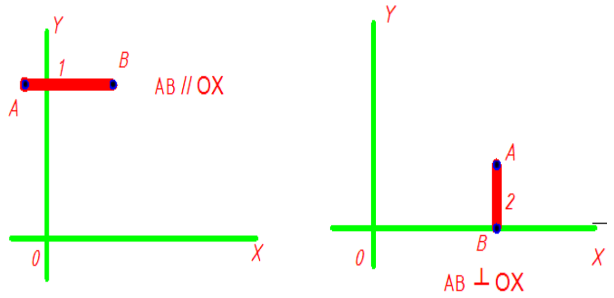
have given the appropriate diagram for each case below.

f the representation of a straight line in E^2 [A B] is given in space E^2, that is (in the hoy system), find the

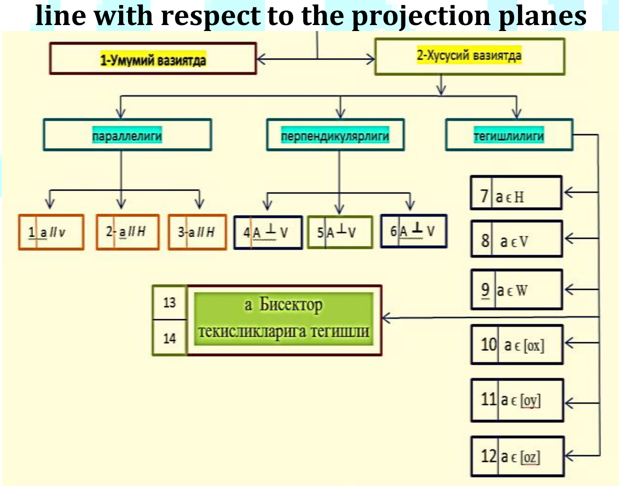


number of its special cases (Figure 2).

2- Figure [A B] is a special case diagram in cross-sectional E^2 space

(Table 1)

Classification of special states of a straight line with respect to the projection planes



A total of 7 different situations arise. Now we determine the number of positions in the OXYZ system, ie in E^3, relative to the projection planes of the straight line.

Andy ***OX_1 X_2X_3 X_4*** that is, let us consider the states of a straight line in four-dimensional space.

E^4 OX_1 ▯ $OX_2 \perp OX_3 \perp OX_4$ since we divide the E^3 system;

The problem is to make an orthogonal projection of the section A B in space E^4.

Given: ***A(30;40;50;80) B(90;70;50;110)***

Diagram of section A B in space E^4 Orthogonal projection of section A B in space E^4

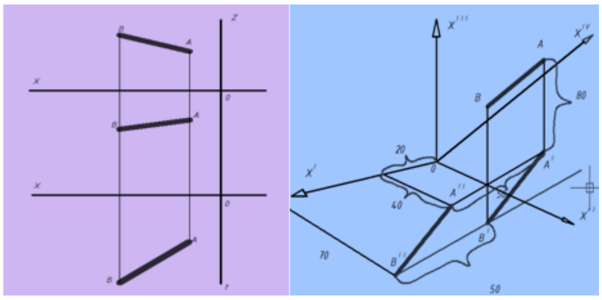


Figure 3. Axonometry of [A B] in space E^4 AB // X^IOX^{II} is nothing more than the example itself. AB // OX^IX^{II} X^{III} in that case $X_A^{IV} \equiv X_B^{IV}$ will be.

A (20; 30; 40;) B (20; 30; 50;) of section A B in space E4

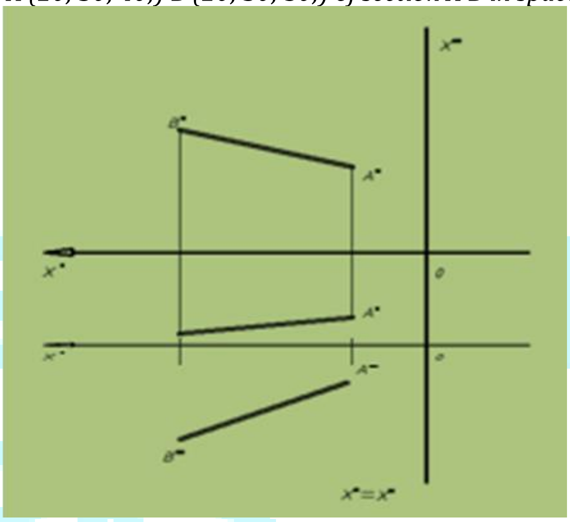


Figure 4. epyurasi

The problem is to make an orthogonal projection of the section A B in space E^4.

Given: A (30; 40; 50; 90) B (110; 70; 80; 90)

(Figure 5-6)

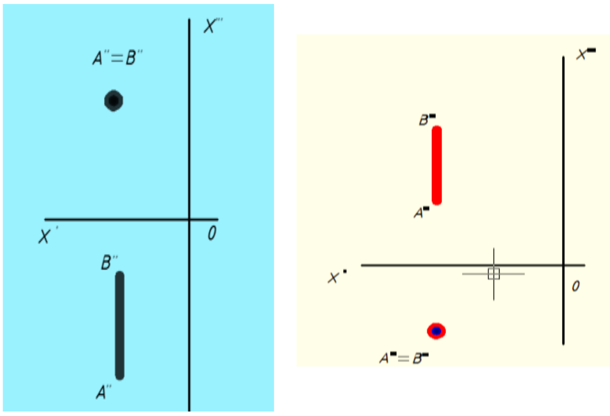


Figure 5 E4 is the plot of section A B in space Figure 6 E4 is the plot of section A B in space

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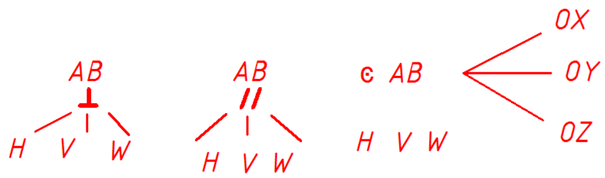
$X_I = X_3 \quad X_A \neq X_B$



A(30;40;50;90) *B(100;40;80;110)* *Bunda* $X_A^{II} = X_B^{II}$ *=40 in that case* $[A\ B\ ]$ *// O X^I X^III X^IV* will be.

Terms of parity

Xossa 1. *If* $|X_A^I| = |X_B^I| =$ $[A\ B\ ]$ *// O X^I X^III X^IV* will be.

Xossa 2. *If* $|X_A^{II}| = |X_B^{II}| =$ $[A\ B\ ]$ *// O X^I X^III X^IV* will be.

Xossa 3. If $|X_A^{III}| = |X_B^{III}| =$ $[A\ B\ ]$ *// O X^I X^III X^IV* will be.

Xossa 4. *If* $|X_A^{IV}| = |X_B^{IV}| =$ $[A\ B\ ]$ *// O X^I X^II X^III* will be.

Drawing: // Xossa 1 A (70; 80; 30; 50) B (70; 10; 70; 30)

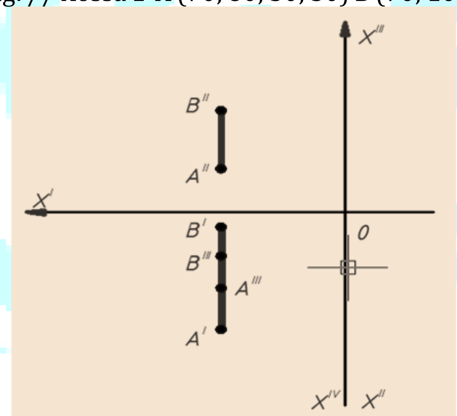


Figure 7. Characteristic 1. A diagram of parity

Perpendicularity condition

If [A B] is perpendicular to one of the cross-sectional projection planes, then the corresponding coordinates over each point in the wet are mutually equal.

Xossa 5. If $|X_A^I| = |X_B^I| = |X_A^{II}| = |X_B^{II}| = = |X_A^{III}| = |X_B^{III}| =$ *as* $|X_A^{IV}| \neq |X_B^{IV}| =$ if$[A\ B\ ]\perp$ *OX^I X^II X^III* will be.

Xossa 6. If$X_A^I| = X_B^I = X_A^{II} = X_B^{II} = X_A^{IV} = X_B^{IV}$ *as* $X_A^{III} \neq X_B^{III}$ *if* $[A\ B\ ]$ □ *O X^I X^III X^IV* will be.

Xossa 7. If $X_A^I| = X_B^I = X_A^{III} = X_B^{III} = X_A^{IV} = X_B^{IV}$ *as*$[A\ B\ ]$ □ *O X^I X^III X^IV* will be.

Xossa 8. *If*$X_A^{II}| = X_B^{II} = X_A^{III} = X_B^{III} = X_A^{IV} = X_B^{IV}$ *as* $[A\ B\ ]$ □ *O X^II X^III X^IV* will be.

Drawing: ⊥ ***Xossa 5 A(50;40;30;70) B(50;40;30;20)*** $A\ B$ □ *OXYZ*

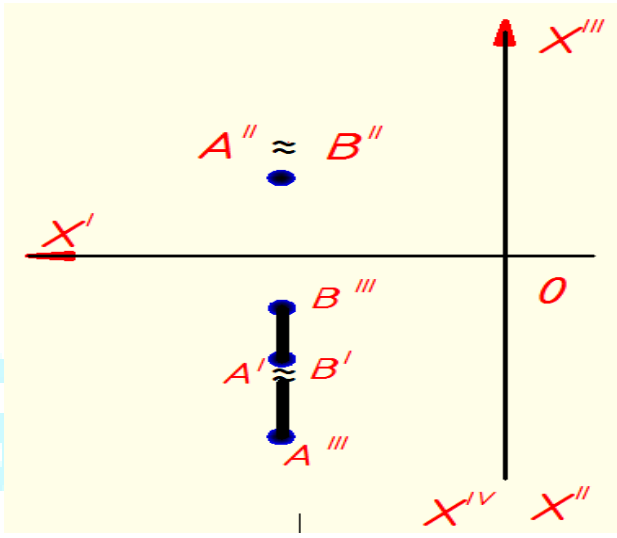


Figure 8. Properties 5. Perpendicularity diagram

Appropriateness properties

Xossa 7. *If* $X_A^{IV} = X_B^{IV}$ *if*$[A\ B\ ]$ *cut* □ *O X^I X^II X^III* lies in the plane ie [A B] ∈ *O X^I X^II X^III* will be.

Xossa 8. *If* $X_A^{III} = X_B^{III}$ *if* $[A\ B\ ]$ ∈ *O X^I X^II X^IV* will be.

Xossa 9. *If* $X_A^{II} = X_B^{II}$ *if* $[A\ B\ ]$ ∈ *O X^I X^III X^IV* will be.

Xossa 10. *If* $X_A^I = X_B^I$ *if* $[A\ B\ ]$ ∈ *O X^II X^III X^IV* will be.

Xossa 11. *If* $X_A^I \neq X_B^I$ *if* $X_A^{II}| = X_B^{II} = X_A^{III} = X_B^{III} = X_A^{IV} = X_B^{IV} = 0$ *if* $[A\ B\ ] \in O$ *X^I* will be.

Xossa12. *If* $X_A^{II} \neq X_B^{II}$ *if* $X_A^{II}| = X_B^{II} = X_A^{III} = X_B^{III} = X_A^{IV} = X_B^{IV} = 0$ *if* $[A\ B\ ] \in O\,X^{II}$ i.e. [A B] cross section $[0X^{II}$) lies on the axis.

Xocca 13. *If* $X_A^{III} \neq X_B^{III}$ *if* $X_A^I| = X_B^I = X_A^{II} = X_B^{II} = X_A^{IV} = X_B^{IV} = 0$ *if* $[A\ B\ ]$ ∈ *[O X^III)* will be.

Xocca 14. *If* $X_A^{III} \neq X_B^{III}$ *if* $X_A^I| = X_B^I = X_A^{II} = X_B^{II} = X_A^{IV} = X_B^{IV} = 0$ *if* $[A\ B\ ]$ ∈ *[O* X^IV) will be.

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Drawing: ∈ Xossa 7 $X_A^{IV} = X_B^{IV} = 0$ *A(50;40;30;70)* *B(50;40;30;20)*

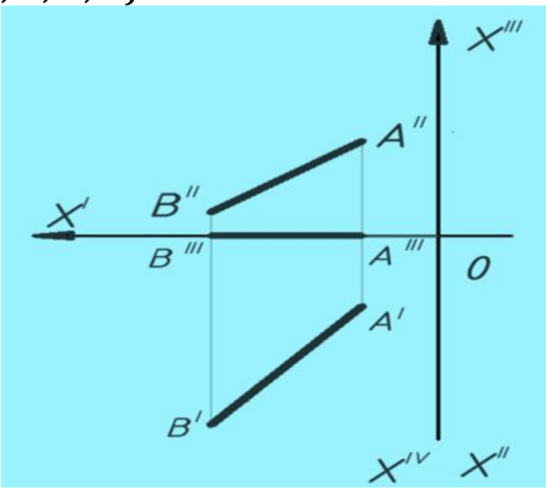

Figure 9. Xossa 7. Appropriateness diagram

And (etc.) straight lines lying in 3 bisector planes. $O\ X_1 X_2 X_3;\ O\ X_1 X_2 X_4\ ;\ O\ X_2 X_3 X_4 \ldots\ldots C_4^3 =$ $A_4^3 = 4.3 * 21 = 24$ 24 different placements are possible.

Based on the laws of mathematical functions:
E^2 7 kinds $= 7{*}2^0$, E^3 $= 7{*}2^1 = 14 = 7{*}2^1$, E^4 $14{*}2=28 = 7{*}2^2$
E^5 $28{*}2=56 = 7{*}2^3$, E^6 $56{*}2=112 = 7{*}2^4$

There will be a special case.

E^n space $7{*}2^{n-2}$ units of a straight line relative to the projection planes. Thus [A B] the straight line section is generally relative to the projection planes $7{*}2^{n-2}$ case.

Thus, the study of all the special cases of a straight line intersection leads to the thorough and conscious mastery of the following knowledge by students:

1) In the projection planes of the edges of the detail, ie the plane of the horizontal projections relative to the frontal profile, the parallelism, perpendicularity and the corresponding orthogonal projections.

2) To be able to quickly and accurately determine their location in detail V, H, W;

3) The growth of their spatial imagination leads to the effective use of geometric constructions in the construction of axonometric projections.

4) In the future it is planned to conduct time-based graphometry on graphic work performed with and without use in the cases specified in the examination of students' knowledge.

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