

# GRAPHIC REPRESENTATION OF THE MULTIKINDS OF THE COMPLEX SPACE $K^4$

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## ABSTRACT

For display of functional dependence of two appropriate validity replaceable orthogonal and oblique-angled coordinate systems in a bidimensional plane are used. Coordinate systems of three-dimensional spaces serve for formation of dependences of three replaceable parameters as lines and surfaces. Use of complex numbers allows to form spaces with measurements of the mental and appropriate validity of compound these numbers. It is offered for display of dependence of complex replaceable parameters to use multivariate spaces  $K^n$ . Formation of such spaces possible at an arrangement of complex planes of function and its argument mutually ortogonally or under an any corner. Thus as a basic element the model of complex number submitted in rectangular or oblique-angled system of coordinates serves grapho-analytical.

E.g.: Key words: complex space, multivariate surfaces, grapho-analytical display.

## 1. INTRODUCTION

Multivariate spaces with use of the appropriate validity and complex numbers find application at the decision of practical tasks with many replaceable parameters in different spheres of activity. A question of development and practical use of the theory multivariate Evklid's Evklid's spaces concerning multipleparameter systems thoroughly developed M.S.Gumen. The further development of a basis of the theory of multivariate spaces have got in works M.S.Gumen, E.V.Martyn for a case if instead of the appropriate validity complex numbers are used. Thus dependence between complex parameters  $\omega$  and  $z_1, z_2, \dots, z_j, \dots, z_n$  with independent one from another arguments  $z_n$  answers a n-measurable hyper surface of complex space  $K^n$ . Character multykind, that is realized in this space, unequivocally determined, on the one hand, by number mutually independent and dependent replaceable, and also character of the imposed connections between compound  $x_j, iy_j$  complex argument  $z_j$ . For a case of dependence of two complex replaceable  $w=u iv$  and  $z=x iy$  as space for display of a hyper surface as diagram of function complex replaceable, (1) four-dimensional complex space  $K^4$  with measurements compound  $u, iv, x, iy$ .

## 2. CONSTRUCTION OF GEOMETRICAL MODELS OF THE MULTIKINDS OF COMPLEX SPACE

### 2.1. The evident image and complex plotting of complex space $K^4$

Let's consider character multikind as models of functional dependence (1 two complex replaceable parameters  $\omega$  and  $z$ . Everyone compound  $u=u(x, y)$  and  $v=v(x, y)$  complex replaceable simultaneously represents function of two generally independent replaceable. Value of these functions makes set of the points appropriate to analytical expressions. Ranges of definition of these compound apply to the common plane - the expanded complex plane  $oxy$  - as uniform plane with a range of definition appropriate to it (1). Obviously, the equations compound define surfaces  $u(x, y)$  and  $v(x, y)$  in three-dimensional complex spaces  $oxyu$  and  $oxyiv$  (fig. 1, a). The diagram of function  $w=w(z)$  we shall receive superposition of both surfaces in complex space  $K^4$  (fig. 1, б). Thus the range of definition of function complex replaceable represents general for functions  $u=u(x, y)$  and  $v=v(x, y)$  area. In three-dimensional complex coordinate under spaces  $oxyu$  and  $oxyiv$  anyone with compound functions complex replaceable answer bidimensional multikinds  $uxy$  and  $vxy$ . They represent directing three-dimensional complex hyper cylinders  $u$  and  $v$ , forming for which serve parallel to axes accordingly  $oiv$  and  $ou$  straight lines. Mutual crossing hyper cylinders defines a bidimensional multikind of complex space  $K^4$ . It represents a geometrical place of points of this space which satisfies a condition (1).

Fig. 1. Formation multikind complex space

The projection of multikind can be received spaces  $K^4$  on complex plotting by the manipulation of bidimensional coordinate planes around of axes. At overlapping bidimensional coordinate planes  $oxy$  and  $oiv$  with a plane  $oxu$  rotation around of axes  $ox$  and  $ou$  forms complex plotting a point of space  $K^4$  (fig. 2, a) which unequivocally determines its position in this space. Such plotting at the carried planes  $oxy$  and  $oiv$  (fig. 2, б) use for display of prototypes and images of functional dependence of complex replaceable parameters. On it there are no projections of two compound  $u$  and  $iv$  as bidimensional surfaces three-dimensional Evklid's spaces  $E^3$ .

Fig. 2. Complex plotting of a point of complex space  $K^4$   
One of variants of complex space  $K^4$  can be received, using complex plotting four-dimensional Evklid's spaces  $oxyzt$ . At display of prototypes and images only in planes  $z$  and  $\omega$  the last can be represented separately and independently one from one to planes of plotting. Such way is used for evident representation about behaviour of function complex

replaceable, for example, in robots A.V.Becadze, A.I.Markushevech and others.

## 2.2. Formation multikind complex space $K^4$

Of feature of formation of complex plotting and the evident image multikinds complex space  $K^4$  we shall consider on an example of the image of a hyper surface of trigonometrical function of complex argument: we shall Notice, that the number acts in expression (2) factor at the appropriate validity. For display of this function we use parities: the Appropriate validity and mental compound functions complex replaceable are defined by expressions and can be submitted in three-dimensional complex spaces  $oxyu$  and  $oxyiv$  by bidimensional surfaces. Complex plotting (4) we shall receive with the help of epure Monzha (fig. 3), having used for constructions in quality secant the planes parallel to coordinate planes  $oxy$  and  $oxiv$ .

Fig. 3. Complex plotting of surfaces  $u$  and  $v$   
The image of surfaces can be submitted in different kinds of an axonometry, but with use of identical directions of coordinate axes  $ox$ ,  $oy$ ,  $ou$  and  $oiv$  (fig. 4).

Fig. 4. Axonometrical images of surfaces

## 2.3. Projections and the evident image of a hyper surface of a sine

Complex plotting of a hyper surface as diagram of function (fig. 5) we shall receive in view of geometrical interpretation of complex space at overlapping its coordinate planes of the appropriate validity and mental variables.

Fig. 5. Complex plotting of hyper surfaces of a sine

The axonometrical image of a hyper surface as diagram of function complex replaceable given on fig. 6.

Fig. 6. The axonometrical image of a hyper surface of a sine

It is established, that complex plotting of such function in complex space  $K^4$  represents imposing of two complex drawines surfaces  $u=u(x, y)$  and  $v=v(x, y)$  in view of the general(common) plane  $oxy$  as to area of their definition. Construction of its axonometrical image of hyper surfaces of a sine can be carried out, using parallel complex coordinate underspace  $oxyu$  secant complex hyper planes of a level with on traces  $iy=0 \dots \pm i3$ . At value  $iy=0$  we receive the diagram  $u=\sin x$  the appropriate validity replaceable in a plane  $oxyu$ . Any value  $iy \neq 0$  translates it, omitting three-dimensional space, at once in complex space  $K^4$ .

## 3. APPLICATION

Practical value of particularly put problem of formation multikinds complex spacious consists in an opportunity of reception of evident images and complex drawings at once all complex replaceable parameters connected between self. Skeletons multikinds allow to carry out the graphic analysis of behaviour of partial diagrams of complex function of the appropriate validity replaceable at discrete values of the appropriate validity or mental compound complex argument of function of complex argument.

Grapho-analytical dependences of complex parameters allow to receive with the help complex drawings construction at once six graphic dependences between appropriate to the validity appropriate to the validity and mental, mental compound complex of parameters as intermediate result of the decision of multiple parameter tasks in the field of research, in particular systems of chemical technology, a hardware and fire protection.

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