capabilities which make it possible to define or assign a quality attribute of the constituent models.

The problem of obtaining the "extended axonometry" for the assembly drawings can be formulated as follows:

Transform a spatial object model so that under the prescribed projection means and constant structure of a structure graph all nonderivative figures and complex figures having the part rank and entering the structure would not enter each other (come into touch at least) and all the structure components would be visible.

The paper contains the algorithm and data on the software realization within the framework of the geometrical modelling system and the computer graphics "KITEZH".

A Novel Technique for Solid Modelling

S.I.Rotkov, A.A.Zudin
Nizhny Novgorod

Modelling the objects by the constructive solid geometry (CSG) method involves a library of basic elements (BEL) of which the designed object is made up. Such an approach is used practically in all the geometric and graphic solid modelling systems developed both abroad and in the USSR. It involves a preliminary decomposition of the object into its constituents, specification of the Boolean operation as well as the elements form and position parameters in the basic coordinate system of the structure. All these steps are inadequate to the operations performed by the designer who uses manual drafting or a computer drafting-system with the graphics-editing capabilities.

A new technique for geometric modelling of solids is presented, based on the use of a graphics editor for 2D objects in combination with the solid modelling codes using orthogonal projections, the superposition method for composite body synthesis, and descriptive geometry methods for generating progections of 3D objects.

Algorithmically, the technique is based on the 3D geometric element (GE) and BEL data recovery operation from their projection on a multi-view draft.

This operation applies to a wide range of GE's (a point, a vector, a line, a surface, a solid). For a large class of solids the object model can be recovered without the CSG method. Generally, a combination of the CSG mathod and the recovery is used to handle structurally complex solids, where the recovery operation creates the BEL models and specifies the element form and position parameters in the basic coordinate system of the structure. The present technique features a simple geometric data input that can be carried out using any graphics editor designed for processing 2D GE's, thus simplifying the designer's task and saving the time required to model the object of the design by simultaneously designing in different spaces.

The report concludes with the information on the algorithmic and programming implementation of the above technique, based on the "KITEZH" system.

Language of Geometric Configurations in Engineering and Computer Graphics

V.O.Andreev, G.Ya.Uzilevsky
Ulyanovsk, Oryol

P.Garvin's descriptional model of the language is taken to expose the structure of the language of geometrical configurations (LGC) in engineering graphics. For 2D geometric space the simplest element is the point that forms the first level of construction. By moving the point onto the plane one can receive a segment, curve,arc, circle etc. These elements enter the second level of construction and are the material for forming planes coming into the first level of integration.

The elements of the first and second levels of construction are polyfunctional: they form the first and second levels of organisation as they fulfil a connective function by producing geometric elements and objects. It follows from the above-stated that LGC consists of two levels of construction, one level of integration and two levels of organization.

The computer graphics development shows that now a days the primitives and structure ties between them are singled out and distinguished. "Autocad" graphic workstations may serve as an example of it. In this case the point, the arc, the circle, the curve, the hexagon and the ellipse function as primitives, the point, the arc, the circle and the curve being the structure ties that is indicative of self-organization of the graphics system. Due to the fact that primitives and ties are well described with P.Garvin's model we have a language for engineering and computer graphics (2 D).

The ways of using LGC in forming the computer graphics user language and constructing the intellectual user interface are discussed.

Application of the Idea of Constraint in Geometric Modelling Systems

V.M.Golubev
Novosibirsk

The problem of positioning and orientation of geometric primitives in two-dimensional and three-dimensional space is one of the most important problems in user interfaces in geometric modelling systems.

One of the approaches to solving this problem is discussed in the paper. It deals with the application of the idea of constraint between geometric primitives. The history of the approach can be traced back to the pioneer work of Sutherland in the field of computer graphics.

Constraint is a geometric relation or dimention (distance, angular dimention, etc.) connecting the parameters of one or several primitives.

Examples of constraints: the relation of the tangency of two circles on the plane, coaxiality of two cylinders, distance between the centers of two spheres, etc.

It is shown that the application of the approach allows to improve the quality of the user interface in geometric modelling systems in general and to increase considerably the number of different variants of positioning and orientation of primitives. The questions of realization of the approach in the frames of the interactive geometric modelling system INSM-3D are regaded in the second part of the paper.

Some Unsolved Problems of Topography

A.S.Antipin, P.A.Shary
Moscow

The new technical possibilities which appeared as a result of further development of visual data systems have given rise to the new problems requiring new original ideas for their dicision. These problems become especially apparent in the process of constructing the terrain data processing expert systems.

The land surface classification using variables of "relative position in relief", that are global veriables, is the problem of this class, too. An essential moment for solving the problem of classification and finding the objective methods for the global variables is the derivation of "generating functions" which allow to define the extent of the expression of the system's features ("surface-gravity in relief" system). This is useful for separating the poorly expressed land sueface parts from the strongly expressed ones at some cut-off level.

The necessary condition for successful solving these tasks is the construction and utilization of a suitable data model. The properties of geographic data (multidimensionality, fuzzy entities and relationship definitions and complex spatial definitions) make the modelling of geographic data uniquely difficult. The models themselves tend to be complex and the resultant data files tend to be not very compact.

Two basic types of spatial data models have evolved for storing image data in the digital form: vector and tessellation models. One approach to the storage and processing trade-offs between tessellation and vector data structures is to store the spatial data in (usually) the raster or grid form. The data are then converted to vector format if necessary for perfoming a given analytic or manipulative process. Another approach is to devolop a new tessellation or specifically raster-oriented algorithms for the processes which currently have only vector-oriented solutions. The distinguishing and classification of the forms of relief, the combination and correlation between computer-aided and visual analysis of the relief data should be selected depending on the data model type used in the system.

Software for Geometric Data Access to Data Bases

O.N.Surina
Moscow

GEDA is an interactive programmer's toolkit for the users of dBASE III+, CLIPPER, etc. It is a data independent system which allows the user to represent data in graphic form and to realize graphic access to databases. GEDA operates on PC/XT/AT, IBM PS/2 computers and is compatible with DOS or OS/2 operating systems.

The main features of GEDA are:

- data representation as chart diagrams with different representation modes (polylines, splines, markers);
- data representation as a projection of three dimensional surfaces with hidden line removing;
- data representation as point diagrams (each record is a point on a diagram) and the selection of relevant records using graphic input devices;
- capturing pictures to Paintbrush PCX format and outputting such pictures to screen for graphic illustration of the stored data.

GEDA has a built-in graphic editor which allows the user to prepare graphic pictures for qualitative output to printer/plotter of to save them in picture metafiles.

GEDA consists of three subsystems:

- interactive graphic programs (EXE files), called from the database management system (DBMS);
- interface programs (in the DBMS language), which prepare interface files and call graphic programs;
- service programs (EXE files), called from the database management system.

For the adaptation of GEDA to the user's database it's necessary to adapt only small interface programs written in the DBMS language. The other programs of GEDA are data independent. GEDA can be easily adapted to other database management systems (not dBASE or CLIPPER) which operate in DOS or OS/2.

Software for Dynamic Geometric Modelling on Computer

A.I.Surin
Moscow

DING is a FORTRAN-77 programmer's toolkit of 2D/3D time-dependent geometry and animation. DING allows the user to create different wire-frame time-dependent geometric models and analyse these models in graphic form as computer films. DING's user creates so-called geometric processes using static and dynamic geometric primitives, defferent geometric and time operations and their superpositions. Dynamic primitives are geometric primitives defined on some time segment. Geometric processes can be analysed in the graphic form using the DING graphic subsystem, which allows the user to receive static pictures and computer films.

There are many modes of representation of geometric primitives by different graphic images. Computer films can be output to the display screen directly or saved in files. It is possible to save films in GX1 and GIF data formats for further playback. The program on DING is a sequence of CALL operators. It is convenient for developing the interactive programs.

CRYSTAL is an example of application software developed on DING. It is an interactive program for graphic analysis of crystal structure dynamics, simulated on the computer. CRYSTAL interpolates the dynamic geometric model of the crystal for any time moments using the information about the simulated process. This geometric model can be analysed by the user in graphic form as computer graphic pictures (static pictures and computer films).

The main features of CRYSTAL are:

- choosing different three dimentional fragments of the crystal;
- crystal observation from different points of view;
- different graphic representations of atoms (colour markers, circles, toned spheres);
- different screen playback modes (frame by frame, fast playback, frame superposition, trajectories);
- film saving in Show Partner and Autodesk Animator files.

DING and CRYSTAL operates on IBM PC/XT/AT, IBM PS/2 computers and are compatible with DOS or OS/2.

The Geometry of Chaos

S.V.Klimenko, S.V.Matveev, V.V.Smirnova,
E.V.Chernyaev
Moscow

Chaos is a phenomenon which is easier to show than to explain. The chaos phenomenon is strongly connected with the non-linear dynamic systems dealt with in most scientific disciplines.

The chaotic behaviour of a dynamic system will reveal itself in the fact that the solution of the equations describing its behaviour is not unique. Nor it becomes clear that for "showing chaos" it is necessary to correlate some visual image with the solutions of the mentioned equations, i.e., to visualize the functions presenting the solutions. The methods of visualization are strongly affected by the computer graphics that provides a possibility to obtain almost instantly (using modern graphical workstation) various pictures, both artificial and those reflecting certain aspects of real-time behaviour of modelled systems. The chaos "work" often takes shape of fractal structures. The coastline, mountain, skyline and cloud contours, human lungs and blood vessels have fractal-like structure, i.e., they have common property of self-similarity. A good illustration of this property is provided by the Mandelbrot set. Fractal structures are traces of a chaotic process. The picture of transfer to chaos in logistic map may be an example of informativity and clearness of graphic presentation of dynamic systems properties. The studies of trajectories of the dynamic systems in the three-dimensional phase space is another important aspect of

investigating the properties of such system.

Here, a problem of three-dimensional perception of a traiectory arises, which can be solved by means of the computer graphics using various algorithms and methods of visualization. The systems containing strange attractors are the most interesting ones: the Lorentz system, the Rikitake system, the Rossler attractor and the simple attractor. One of the properties of the strange attractors is that the attractor structure is reproduced on continuously lessening scale. This indicates that the fractal properties play an important role in the above phenomena.

Computer graphics helps to use this more effectively, therefore, computer visualization makes the exploration of chaos not only real but even pleasant.

Natural Object Pictures of Different Ranges on Space Images and the Form of Introduction of Digital Analytical Results in Structural-Geological Constructions

A.A.Zimov
Leningrad

The discription of an image-picture of natural formations includes the following:

- a lineament, a line;
- concentric formations, rings, arcs;
- homogeneous fields, blocks, zones and variations thereof.

In practice lineaments, concentric formations and homogeneous fields are described as a finite set of space-ordered and morphologically-different elements of a smaller size forming pictures of a much higher range.

In general positions it corresponds to the hierarchical model of a structural organization of natural complexes.

Using the principles of frequency filtration it is possible to select the objects of the highest range using the pictures of the lowest range.

The results are greatly influenced by the size and the form of the frequency filtration frame.

The preparation of a picture of the most detailed level is of great importance. The elements of the picture are characterized by the brightness intensity and gradient and the texture of the image which are different for each class of objects. For their adequate representation in the preparation the adaptive transformations of the image are used.

When selecting the element of a higher range there arises the problem of indistinct contours which is connected with the width of the transition zone between the adjacent elements of the picture of this rank.

The representation form of the results convenient for the use in structural geological formations is no less important. For this purpose the part of the picture image characterizing the investigated process or the object is chosen according to the training selection.

The readability of the results of processing was improved by the use of the hystogramme table according to the given parameters.

Intelligent Interface of Object-Oriented Programming

S.H.Borisov, V.P.Evmenov
Leningrad

The main automation problem consists in the direct participation of some application domain specialists in the program and program system design.

There are many approaches to the program design. Their analysis showed the necessity to find a common method containing the artificial intelligence elements and object-oriented program elements.

The main point of the suggested method is using frame structure for data specification. Here, the program algorithmic part is considered as an independent element of the specialist's knowledge. The connection with data frames is realized by procedures. Data frame consists of common system slots (frame name, creation data, etc.) and such slots as display output pointers for the update, range check pointers, etc. User slots determine each frame data parameter. User slots contain the following elements: parameter ordinal number, parameter title, type, dimension, hereditary pointer, etc. Data frames are connected with other frames through the hereditary mechanism using parameter titles.

Data frames on the physical level represent the text file that provides wide possibilities not only for data processing but also for the transmission to the networks connecting different computers.

This method was realized on computer SM1420 in the multipurpose operating system. Now it is beeing designed on the personal computer. The method showed the best results in the multipurpose operation system. [59]

Set of Programs "OEMIS"

A.S.Aliev, A.G.Ashurbekov,
M.G.Dalghat, N.V.Tupik
Makhachkala

Set of programs "OEMIS" (SP "OEMIS") serves for supporting the process of projecting, making and operating optical and electronic multiforeshorten measuring systems for measure check of the surroundings and for the determination of objects in space including the person himself, according to the data of visual analysis of space.

The mathematical base of SP is the viewing transformation of space, expressed in homogeneous coordinates. Here, the operators used are given and their influence upon space is shown. Further the principal correlations for space determination of an object at different positions of sensors in a standard form and through above mentioned viewing operators are presented.

SP "OEMIS" consists of two relatively independent parts. The first part imitates the process of three-dimensional stage transformation into the picture recieved by a matrix or linear sensor. The succession of using the operators is given and grounded, the interaction of corresponding program blocks is also shown. This part of SP "OEMIS" imitates three-dimentional computer graphics, receiving the spatial picture with regard for viewing transformation and peculiarities of the sensor.

The second part of PS "OEMIS" contains the succesion of actions, i.e., rendering the information received from the sensors into the measured space position of the objects. The corresponding program blocks are given and their peculiarities are indicated. The results of the investigation of the conditions

necessary and sufficient for a simple determination of the space sensor position (the problem of adjustment) are given. Common and particular cases are examined. The results of the investigation of sensor discrete influence and of ordering the calculations for determining the accuracy of the obtained measurements are given.

The software (SP "OEMIS") may be used:

- when electing the measuring diagram for evaluating its potential accuracy with regard for the sensor discrete values;
- in the process of making the measuring system for calculating technological values of tolerance while setting sensors and optical blocks;
- during the operation of the measuring system to compensate the deviations from the given parameters including those which appear during this process.

Some examples give information about SP "OEMIS" usage when choosing measuring and constructive diagrams of measuring systems. In conclusion, the performances of SP "OEMIS" realized on the computer integrated system (EC BM) are presented. It is also noted that the transference of SP to the microcomputer will allow the computer-aided design system to create optical and electronic multiforeshorten measuring systems with friendly graphic I/O interface of initial and intermediate data. Some problems of working out a criterion of accuracy of multiforeshorten measuring system functioning are put forward.

Creation and Visualization of Constructive Solid Geometry Models

N.S.Shupta
Novosibirsk

Methods of creation and visualization of constructive solid geometry (CSG) models in system "Konstruktor" are described.

The system is intended for: - creating CSG models;

- visual, geometry and integrity analysis of the models.

CSG model is created:

- of primitive solids (blocks, spheres, cones, cylinders, tores);
- of procedural solids (revolution solids, translation solids);
- of the models already built by means of the Boolean set operations.

"Ray casting" algorithm is used for solving the problems of visual, geometry and integrity analysis.

Dialogue is carried out by means of multiview visualization. The system has been realized on IBM PC/AT computer in the frames of graphic technology URRI-VAD worked out at the Computer Center of the Siberian Division of the USSR Academy of Sciences.

Generation and Visual Analysis of Polyhedral Models

S.A.Upolnikov
Novosibirsk

Methods of generation and visual analysis of geometric objects in the interactive solid modelling system GRAN are regarded. The system GRAN is a user interface for the faced model processor. It provides the following functions:

- synthesis of geometric forms with the application of special operations of areal sweeping (translation and rotation);
- creating assembly with the application of affine transformations and Boolean operators;
- visual analysis of the assembly;
- mass-property analysis of the assembly.

Initial representation of the models is based on the face approximation of curvilinear surfaces.

Visual analysis is based on special fill area algorithms and Z-buffer technique.

Dialogue is carried out by means of multi-view visualization on the basis of graphical menu technology.

The system GRAN has been realized on IBM PC with the application of the algorithms of the geometric modelling SPACE program package in the frames of the technology of creating interactive graphic programs URRI-VAD worked out at the Comuter Center of the Siberian Division of the USSR Academy of Sciences.

Artificial Intelligence Methods in Producing Electronic Maps

E.A.Zhalkovsky, A.I.Maydanich
Moscow

A wide development of computer graphics means in solving the navigation and ecological problems caused the need in producing the specialized map displays based on general digital terrain data (DTD) adapted to the specialities of the particular tasks ("electronic maps"). The difficulties in forming the "electronic map" are clear from the man's way of percepting the map as a whole that is not equal to the sum of the individual perceptions produced by the parts of the cartographic image (conditional signs, various text styles, etc.). The reason of this phenomenon is in the presence of multiple space and logical relationships taking place between various map objects, the interpretation and ranging of which is made by the cartographer on the basis of his own knowledge and experience. To preserve important space and logical relations while producing the "electronic maps" we have designed a semiotic model of the cartographer's actions during the process of the selection of map objects and, on the basis of the problem field analysis have defined the main set of the lexical units of the model language.

The model syntax is formed on the basis of the syntax of the known language of situation planning. During the practical stage we have used an expert system (ES) for the model development and utilized suggested by Ross Quinlan method of "interactive dichotomy 3" (ID3) for the creation of the rule set. The differences between the designed ES and the traditional ones are in the fact that both input and output information of our system

is the graphic form. This caused a need in design of some software utilities that analyse the source DTD and interpret it in terms of the model language. The use of ID3 method, which could build rules automatically with the sets of positive and negative examples allows us to significantly reduce the difficulties in creating the inference rules set, becuase as our experience shows, it is much easier for the cartographer to draw (describe) some situations connected with a rule, than to explain this rule directly. At present the designed expert system is on the stage of the "research prototype".

Transformational Techinique of Interactive Systems Development

V.O.Georgiev, A.I.Enikeev
Kazan

In recent years there has been a great deal of interest in the development of the interactive systems. A wide variety of classes of problems requiring an interactive way of solution and new facilities represented by computers provoke the development of new interactive systems. In order to increase the efficiency of the developing process and attain high quality of these systems we need appropriate technological tools. Among such technological tools transformational technique of software development seems to be very useful. This technique provides a possibility of computer-assisted transformation of the programs according to given transformation rules, to generate new programs or to optimize the existing ones. In this report we consider an application of transformational technique to interactive system development. We present a conceptual model of the interactive system with the special functions providing the interactive control and methods of transformation of the "scenario" type interactive system into the equivalent system with the "built-in" program interaction. Such transformation seems to be reasonable in case of repeatedly reusing the same scenario in oder to increase the efficiency of the dialogue interaction. The conceptions and methods presented in the report were applied to the development of interactive tools supporting CAD (RADIS, DIAMON), Data Base and CAI-systems. These tools are applied within the operational environment compatible with MS DOS.

"Baby", a Self-Learning Dialogue System

V.D.Solovjev
Kazan

The paper describes an approach to designing an interactive self-learning system extracting knowledge from input statements in the dialogue mode.

The syntax of a language and the semantics of words can be automatically taught, new knowledge being extracted with regard to the situations described in input statements.

The overall strategy of designing an appropriate system is based on modelling learning processes in man, particularly in very young children, which are described in psychological and psycholinguistic works. The learning models developed by G.Piaget and D.Slobin have been applied.

A semantic formal language is described which makes it possible to represent the semantics of discourse in a formalized way. The initial subject-orieted knowledge described in terms of this language is entered into a frame-type knowledge base.

A dialogue model is generated as a system of interconnected assigned frames from the knowledge base. Basically, this model is similar to T.A. van Dijk's situational text model.

The mechanisms for modifying the frames of the knowledge base have been proposed which make it possible to accumulate knowledge. Such an approach can be used for automatic generation of the knowledge bases of expert systems, as well as for adaptation to the user in the dialogue mode.

"Puchina"- a Simulator of the Computer Navigation System with Audio, Visual and Tactile Interface

V.G.Sirotin
Novosibirsk

The system described presents a scientific and experimental interest and is now on the stage of pilot implementation. It allowed to test the concept and the main principles of the creation of this kind of systems, to formulate the requirements for the tools and "polyprotocols" of speech, tactile, graphic and digital data exchange inside the system.

"Puchina" has been worked out for simulating the vessel navigation processes in coastal waters. In the applications of this kind traditional devices of entering information into the computers such as keyboards, "mice" or digitizers are unacceptable, their only alternative being audio (speech)-tactile input and audio (speech)-graphic information output.

The system has been realized on the IBM PC 386/387 computer conjugated with the speech reeognition and speech generation device "MARS-1" through the sequential port. The tactile information input is simulated by the application of a standard IBM PC "mouse".

"MARS-1" can recognize up to 120 words or short phrases transferring to the communication channel with IBM PC either the number of the recognized word from the vocabulary which was input beforehand or the information about the nature of the error which appeared in the process of recognition. As to the speech synthesis "MARS-1" possesses an ability to "pronounce" in Russian an arbitrary text transmitted to it through the communication channel in the form of special character sequences.

"Puchina" can recognize four types of speech commands, namely:

Type 1. (Switching on/off a unit or a device). Examples: "Enter subsystem "Deckhouse", "Recognize the object", "Switch off the first engine".

Type 2. (Single inquiry). Examples: "How many meters to the shoal?", "Report our co-ordinates", "How many kilometers are covered for the moment?", "Report the amount of fuel left".

Type 3. (Regular inquiry). Examples: "Report the speed of the vessel every 40 seconds", "Report the depth every 30 seconds", "Report the wind velocity on the third sensor every fifty seconds. (Executing the commands the system will "pronounce" the corresponding phrases in the given time intervals)."

Type 4. (Change of the parameters). Examples: "Increase water reserves by 30 per cent", "Decrease the revolution of the fourth engine by 53".

Tactile commands are given by means of so-called tactile gestures. Ideally, a tactile gesture is "drawing" a certain figure on the screen with a finger. Since the system does not possess appropriate technical potentialities tactile gesticulation in implemented by means of the manipulations with a "mouse". The following tactile gestures are realized in the system:

1) "Switch on/ this object" (simple instruction);

2) "Switch off" ("drawing" a cross-shaped figure);

3) "Change the value" ("sticking" the marker to the pointer of the corresponding indicatior and "putting" it into a new position);

4) "The field of interest" (drawing a rectangle on the map visualized on the screen).

The system simulates 31 devices of the vessel whose readings are visualized and can be reported in the form of synthesized speech information. Part of the devices are controlled by the operator by audio and tactole means, the rest are passive sensors.

The architecture of the "Puchina" system allows to simulate the work in real time scale.

CONTENTS

ВИЗУАЛЬНЫЙ АНАЛИЗ
И ИНТЕРФЕЙС

ТЕЗИСЫ ДОКЛАДОВ МЕЖДУНАРОДНОГО СИМПОЗИУМА

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