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TRANSFORMATION OF GEOMETRICAL MODELS INTO NUMERICAL MODELS

Summary. Paper presents creation of graphical models and their transformation into numerical models

1.Starting-point

Preparation of input information describing workpieces, tools, machine tools a fixtures for mechanical engineering is an important task of CAD/CAM/CIM systems.

Using of numerical models is advantageous in relation to further processing by computer equipment.

In the paper attention is given to creating of graphic models of a part , its transformation into numerical model and subsequent processing by CAPP (computer aided process planning) system.

The CAPP system is designed by principle of generating elementary operations of process planning and by principle of knowledge databases. CAPP uses numerical models of parts, machines, tools and preparations.

The numerical model of part is unambiguous description of geometrical (dimension, code of surface type, orientation of surface, location of surface in coordinate system,...) and qualitative properties (roughness, precision) of volume elements and surfaces of part. These properties are in numerical form.

We consider that every part is a system consists of elements and relations among them. The elements are copied by geometrical and qualitative properties and by relations. Relations (e.g. deviation of position) are worked out between two or among more elements of part . As the number of properties and relations is too high it is useful to consider only that fact of real object - part which are essential in relation to the goals of solution. The model carries only part of reality and describes only the properties important.

We can work out geometrical models of volume part by volume principle or by surface principle.

As sides of volume part are limite by plane or rotary surfaces, we can model volume part by surface principle. Every surface of part is described. The numerical model is possible to represent in a matrix. Every line characterizes one surface of part and a column determines chosen parameter of surface.

The process of graphic designing of particular parts is based on line model. The part is described by lines and curves which characterized the shape of part. In the model are used only generatrix. From this graphic model it is necessary to create geometrical model. This created geometrical model consists of volume (3D) and surface (2D) part elements. The surface elements limit the volume elements. Using the surface model is advantageous as the final part originated by realization of particular surfaces in process of machining.

Geometrical and qualitative model can be inputed by standard graphical software (for example AutoCAD) or by our own graphical editor GR-CAD.

2.Alternative of transformation graphical model into numerical model

There is possibility to enter graphical models and their transformation into numerical models in several ways.

Geometrical elements of numerical models, describing the parts from the point of view of geometry, can be created by standard graphical software (AutoCAD).

AutoCAD is able to save the graphical information in DWG, DXF, DXB and IGES format. Transformation of ordinary binary DWG format into binary format used by CAPP would be difficult. Therefore for the further processing of graphical data it is more advantageous to use textual ASCII files DXF and IGES. Together with graphical information describing geometry of part it is necessary to save also non-graphical information.

The non-graphical information are in direct relation to quantitative parameters of the part.

There are following attitudes to transformation of graphical and geometrical models into numerical models:

*2.1.*The graphical (geometrical) and non-graphical (qualitative) parameters are transfered by DXF textual ASCII file. Qualitative parameters are inputed in DXF format through the attributes of entity. It is possible to transform this textual file into CAPP format in simpler way. DXF file contains also information of the part which are not necessary for further processing in CAPP. This alternative is advantageous in the possibility of creating the geometrical models in easy and comfortable way by standard drawing and editing functions (fig.1).

2.2. Another possibility (fig.2) is to use program language AutoLISP from AutoCAD system. AutoLISP aided entering of geometrical and qualitative parameters in ASCII form in chosen textual format. It is necessary to process and transform this file again into binary CAPP format. Advantage of this alternative is in simplicity and compactness of geometrical and qualitative model. It is suitable to use instead of language AutoLISP a more powerful ADS modul of AutoCAD for more difficult tasks. AutoLISP and ADS modul aided access to internal database of AutoCAD which completly and complexly describe the part.

2.3. This alternative is based on ASE system (AutoCAd SQL Extension) which enable the operation with non-graphical data saved in external database. This operation can be carried out inside of AutoCAD or by using of database system (Oracle, Informix, dbase and Paradox)

2.4. This alternative is based on graphical program GR-CAD (fig.3) that was developed by authors of this paper. This program is modul of CAPP system. This simple graphical editor enables to create model with geometrical and qualitative parameters of the part. Generated model is direct in CAPP format. To enable the quick control an ASCII file is also generated. The graphical modul take directly into consideration requirements for drawing of the part and inputing of qualitative parameters.

3.Conclusion

Graphic model is possible to create by varied graphical system (e.g. AutoCAD, Microstation) which make enable to transfer values in DXF or IGES format file.

Difficulty can be in transmission ASCII format to binary CAPP format. Therefore is also convenient to apply single purpose graphic system (e.g. GR-CAD) which direct uphold the binary CAPP format whereby drawing, describing and editing of graphic model is in satisfactory user level.

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Fig.1.

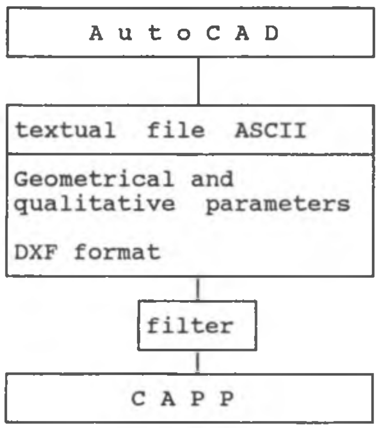

Fig.2.

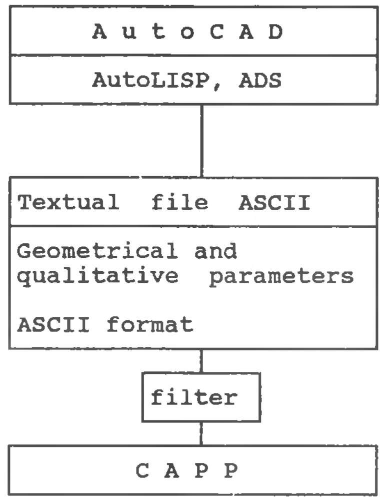

Fig.3.