

METHODS FOR GENERATING MESH SURFACES USING CAD SYSTEMS

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ABSTRACT

One of the most popular graphic software in CAD systems is AutoCAD that is used frequently by a very great number of users thanks to its numerous advantages. In this paper we present several methods to create mesh surfaces which consist of polygonal network generated by the 3DMESH and PFACE commands. Among other representative commands for creating mesh we can mention: 3DFACE, EDGESURF, RULESURF, TABSURF, etc. The SURFTAB1 and SURFTAB2 system variables which determine the network density on the M and N directions have also been highlighted.

KEYWORDS: AutoCAD, mesh, polygonal network

1. Introduction

AutoCAD is a product of the Autodesk company and is currently the most popular CAD program. By using AutoCAD, we can represent the real world objects in a three-dimensional space and make technical drawings and graphics in a two-dimensional space. It is used as a tool in drafting and design work by engineers, architects and students in technical domain. AutoCAD drawing completely replaces traditional designer's instruments (pencil, ruler, eraser, compass, square, etc.) [1].

Compared to technical drawings and handmade drawing graphics, AutoCAD software using has the following advantages:

- real scale projects can be achieved;
- implementation design accuracy is very high;
- execution time is reduced because there are libraries with standardized items that can be inserted in the design;
- the design quality is very good;
- execution costs are reduced;
- drawings can be exported to other applications and then processed;
- remote file transfer is easy by Internet using.

In this paper we created some 3D Polygon meshes. The 3D polygon meshes are a collection of vertices, edges and faces that can define the simple or

complex shapes of polyhedral objects. There are some commands that can create 3D Polygon meshes. From these commands we mention: 3DMESH, 3DFACE, EDGESURF, etc.

2. Methods to generate mesh

We can create mesh objects using the following methods [7]:

1. *Generate mesh primitives* - Standard shapes, such as boxes, cones, cylinders, pyramids, spheres, wedges, and tori are generated.
2. *Generate custom meshes* - Use 3DMESH to create polygon meshes, usually scripted with AutoLISP, to create open-ended mesh. Use PFACE to create mesh with multiple vertices defined by coordinates that we specify.
3. *Generate mesh from other objects* - Generate ruled, tabulated, revolved, or edge-defined mesh objects, whose boundaries are interpolated from other objects or points. Thus, RULESURF, TABSURF, REVSURF, EDGESURF commands are highlighted.
4. *Convert from other object types* - Convert existing solid or surface models, including composite models, to mesh objects. For this case, the MESHSMOOTH command is used.

3. Working type

In this paper we analyzed the second and third methods.

The 3DMESH command allows a polygonal network creation by specifying the vertex number (node) in two directions M and N, indicating the location of each vertex. The network density is defined as an MxN form matrix of vertices, like a grid. The M direction is usually given by X axis direction and the N direction is given by Y axis direction. Each face of the created surface is defined by four vertices (nodes) or by four edges, thus taking the form of a twisted quadrilateral in space [3].

3DMESH command syntax:

Command: 3DMESH

Enter size of mesh in M direction: the number of vertices in M direction is indicated

Enter size of mesh in N direction: the number of vertices in N direction is indicated

Specify location for vertex (0, 0): the first vertex coordinates are indicated

Specify location for vertex (0, 1): the second vertex coordinates are indicated

This is continued in the same manner until all nodes are defined by the MxN matrix are finished.

In figure 1, 3DMESH command effects are visualized.

Command: 3DMESH

Enter size of mesh in M direction: 3

Enter size of mesh in N direction: 4

Specify location for vertex (0, 0): 150,70,-60

Specify location for vertex (0, 1): 180,14,-40

Specify location for vertex (0, 2): 230,12,15

Specify location for vertex (0, 3): 250,18,40

Specify location for vertex (1, 0): 200,80,-100

Specify location for vertex (1, 1): 230,30,-70

Specify location for vertex (1, 2): 280,20,-10

Specify location for vertex (1, 3): 300,30,20

Specify location for vertex (2, 0): 220,130,-170

Specify location for vertex (2, 1): 280,50,-110

Specify location for vertex (2, 2): 370,30,-40

Specify location for vertex (2, 3): 380,70,-15

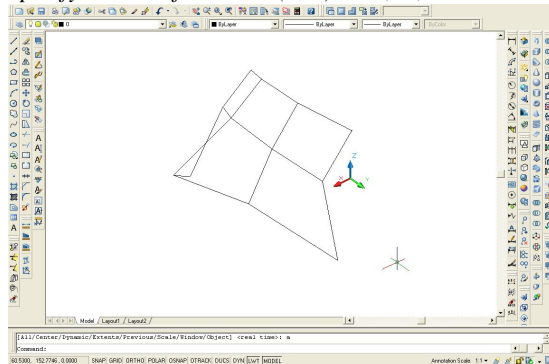


Fig.1. The 3DMESH command

The 3DFACE command allows the drawing of rectangular or triangular flat surfaces anywhere in the

three-dimensional space by indicating three or more points that define their contours.

In figure 2, 3DFACE command effects are visualized.

Command: 3DFACE

Specify first point or [Invisible]: 180,80

Specify second point or [Invisible]: @40,0,60

Specify third point or [Invisible] <exit>: @-40,0,0

Specify fourth point or [Invisible]

<create three-sided face>: Enter

Specify third point or [Invisible] <exit>: @0,30,0

Specify fourth point or [Invisible] <create three-sided face>: i

Specify fourth point or [Invisible] <create three-sided face>: @0,0,-60

Specify third point or [Invisible] <exit>: i

Specify third point or [Invisible] <exit>: 180,80

Specify fourth point or [Invisible] <create three-sided face>: Enter

Specify third point or [Invisible] <exit>: Enter

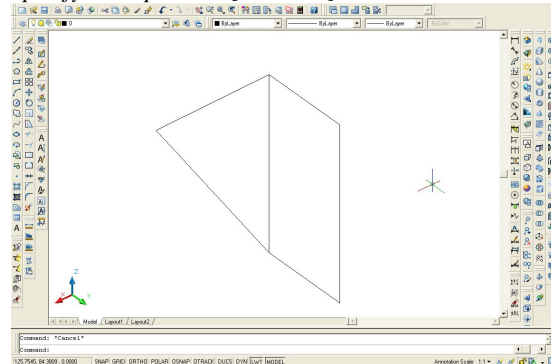


Fig.2. The 3DFACE command

The PFACE command is similar to the 3DFACE command and allows the drawing of a polygonal network so that each side can have multiple vertices. Each face is defined by indicating the coordinates and the sequence of vertices.

The EDGE command allows the change of the visibility of any 3D faces after drawing it.

The EDGESURF command allows the drawing of a polygonal network in the three-dimensional space defined by four continuous entities which are actually the surface edges. These entities may be lines, arcs, 2D or 3D polylines on condition they joined together.

EDGESURF command syntax:

Command: EDGESURF

Current wire frame density: SURFTAB1=6

SURFTAB2=6

Select object 1 for surface edge: the first edge is selected

Select object 2 for surface edge: the second edge is selected

Select object 3 for surface edge: the third edge is selected

Select object 4 for surface edge: the fourth edge is selected

In figure 3, EDGESURF command effects are visualized.

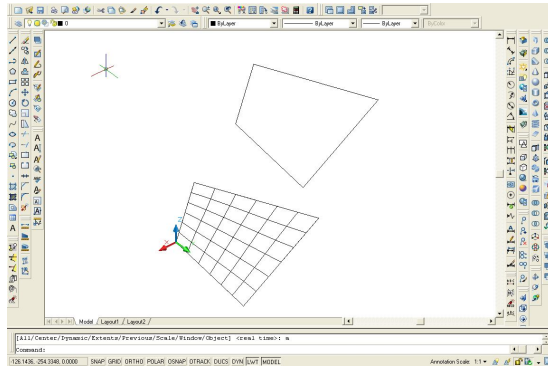


Fig.3. The EDGESURF command

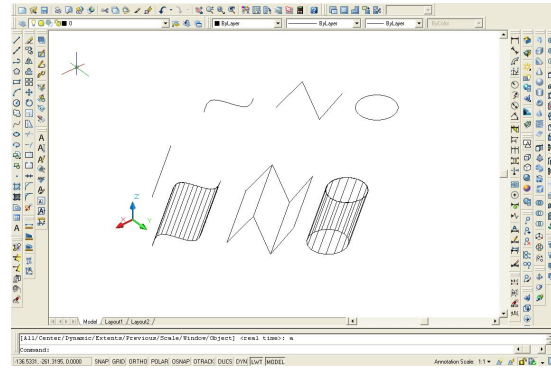


Fig.5. The TABSURF command

SURFTAB2 and SURFTAB1 system variables determine the network density in the M and N directions.

The RULESURF command allows the generation of a surface ruled between two curves. The two curves can be opened or closed objects, such as points, lines, arcs, polygons, circles, splines and polylines. When generating the surface, the two curves must be closed or opened.

RULESURF command syntax:

Command: RULESURF

Current wire frame density: SURFTAB1=16

Select first defining curve: the first curve is selected;

Select second defining curve: the second curve is selected.

In figure 4, RULESURF command effects are visualized.

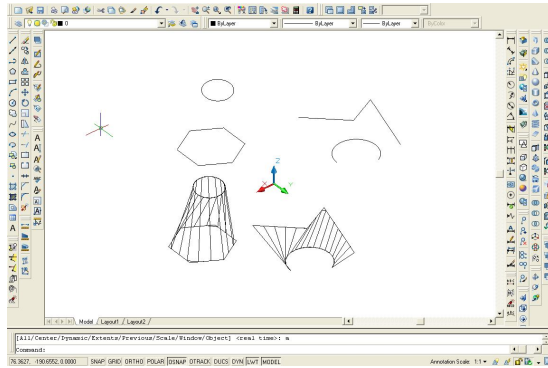


Fig.4. The RULESURF command

The TABSURF command allows the creation of surfaces defined by a trajectory curve and a direction vector. The trajectory curve may be a line, arc, circle, ellipse, 2D/3D polyline or spline. Direction vector can be a line or open polyline.

TABSURF command syntax:

Command: TABSURF

Select object for path curve: the directory curve is selected;

Select object for direction vector: the directory line is selected.

In figure 5, TABSURF command effects are visualized.

The REVSURF command permits the generation of a surface of revolution of polygonal network shape by rotating a directory curve or a profile around an axis. The directory curve can be an open or closed object of the following types: point, line, 2D/3D polyline, arc, circle, ellipse, arc of ellipse, spline curve, circular ring or polygon. The density of the polygon network which determines the surface of revolution is controlled by SURFTAB2 and SURFTAB1 system variables.

REVSURF command syntax:

Command: REVSURF

Current wire frame density: SURFTAB1=16

SURFTAB2=16

Select object to revolve: directory curve is selected

Select object that defines the axis of revolution: axis of rotation is selected

Specify start angle <0>: the start angle value is specified

Specify included angle (+=ccw, -=cw) <360>: the end angle value is specified

In figure 6, TABSURF command effects are visualized.

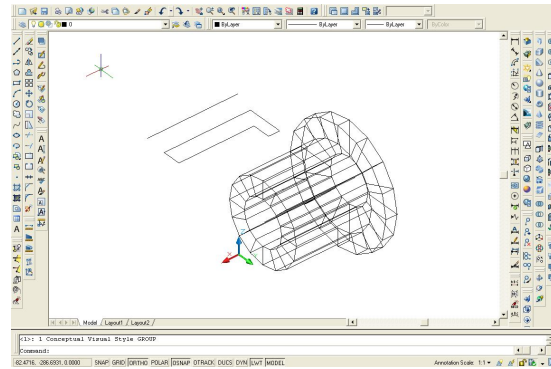


Fig.6. The REVSURF command

SOLID command allows the creation of opaque polygonal regions [2], [5].

SOLID command syntax:

Command: SOLID

Specify first point: the first point is specified

Specify second point: the second point is specified

Specify third point: the third point is specified

Specify fourth point or <exit>: the fourth point is specified

Specify third point: Enter

In figure 7, SOLID command effects are visualized.

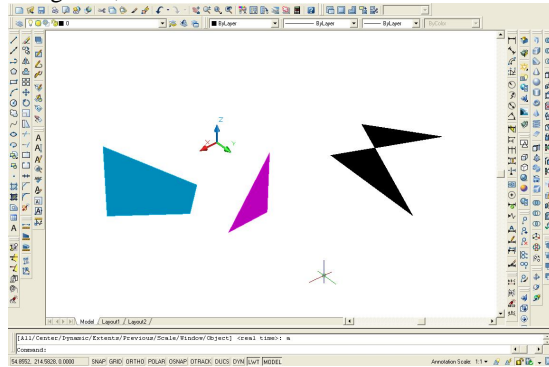


Fig.7. The SOLID command

In figure 8 are presented the meshes mentioned in this paper. In this case, we wanted to realize a more realistic image, applying the REALISTIC VISUAL STYLE command that is found in the Visual Styles toolbar [4], [6].

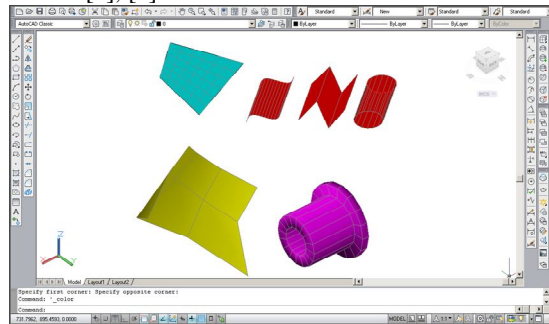


Fig.8. The meshes with the REALISTIC VISUAL STYLE command

4. Conclusions

AutoCAD - computer aided design is the most popular program of graphics and design aided by computer used in domains such as: architecture, geography, astronomy, techniques, etc.

In conclusion, we can continue to generate polygonal and polyface meshes but it is recommended that we convert to the improved mesh object types to obtain improved edit capabilities. The methods present in this paper referred to mesh surfaces creation. We used for this several concrete examples based on the following commands: 3DMESH, PFACE, 3DFACE, EDGESURF, RULESURF, TABSURF, etc. SURFTAB2 and SURFTAB1 system variables control the network density in the M and N directions.

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