Ave Cruce Salus Mea

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program: Win3ds38 - 3d files viewer and manipulator.
compiler: flat assembler
author: Maciej Guba aka macgub
web: http://macgub.co.pl
- if this site not works, search the web
for keyword 'macgub'.
email: macgub@macgub.co.pl

This application don't uses any particular 3d graphic library.

Written from scratch in pure assembler. Thanks to all, who was helping me to do it. Especially:

Jan Pawel II, Tomasz Grysztar, Madis Kalme, Mikolaj Feliks, Lostcauz, Brian Paul, Reverend, Pablo Reda, MHajduk, Ica, James Foley, Andries van Dam, Steven Feiner, John Hughes, Richard Phillips, tthsqe, J. Burkardt, Morgan McGuire, Pierre Bezier, Przemyslaw Kiciak and many others...

Program is 32 bit, needs SSE4 extension, in full mode.

When only SEE3 is present some functions (rendering models) are disabled.

After run program shows dialog to open file.

Choose file in 3ds or asc format.

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Program user interface buttons/keys description.

Vocabulary:

This words ad abbreviations I use as synonims:

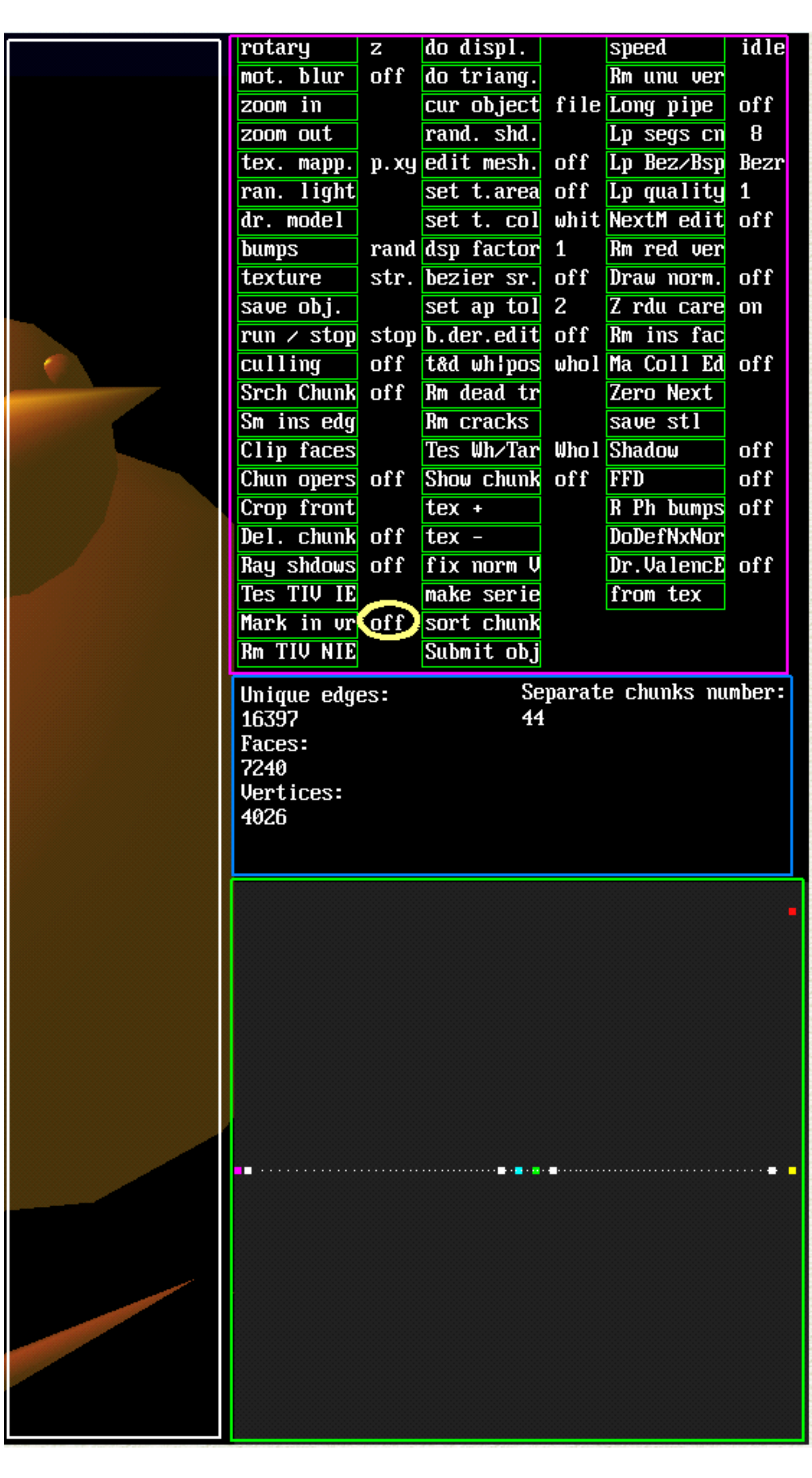
1. triangles, faces, tris
2. vertices, points, verts
3. coordinate/es, coord/s
4. button/s, butt/s
5 displacement, displac
6. tesellation, triangulize, triangulate
7. program, app
8. cooeficients, cooefs

Main content:

Many GUI buttons is based on cyclic switching between options ex. 'rotary', 'dr.model', 'bumps', 'texture'.. When last option is achieved, after next pressing button - first option is switched. This buttons have */flag/* - see yellow marked flag example on picture I inserted after next few text lines - short description of option currently switched. For example. 'rotary' button have */flags/* - 'y', 'x', 'z', 'cust'. Which means rotate around axis y, x, z and custom rotary using mouse. Some buttons have no */flag/*, after pressing such button only one operation (block of operations) is (are) performed. Such buttons are for ex. 'zoom in', 'zoom out', 'ran. light'. Moreover some options are available parallel, after pressing button or hitting keyboard key. For example choosing render model may be performed through 'dr. model' menu button or space key. Some operations have no GUI button, only key, for now such operations are: X key - load texture, N key - load new 3d object, M key - join 3d object to current existing. All key only operations are OS dependent file loading operations.

App window is divided to:

/main part area/ – with displayed current model and eventually some help temporary decorations (ex. edit bars), see part of yellow chicken fragment on screenshot below (marked by white rectangle);
/buttons area/ - on right side of window, marked using violet rectangle on picture below;
/info area/ - marked by blue rectangle, this area contains some information about mesh – vertices, faces, edges, manifold chunks and others (current) numbers;
/Next edit area/ - green rectangle, allows modify and (local) manipulation on mesh.



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Unique edges:          Separate chunks number:
16397                  44
Faces:
7240
Vertices:
4026
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note: final 38 release buttons look may be diffrent than above..

Below I try write some information about GUI buttons.

Keys / GUI Buttons description (under left mouse button click):

SPACE key / 'dr. model' button - switching between displaying models: flat, smooth shading, spherical environment, texture, bump, smooth + texture, two texture and bump + texture mapping parallel edges only (smooth shaded, textured lines), flat with float single precision Z coordinate, point light with shadow light position dependent, real Phongs shading with float normal vector interpolation... Description of actual displaying model on bar located at top of app window.

TAB / 'ran. light' button - generate three nonlinear directional lights (Phongs illumination).

F1 / 'mot. blur' button - motion blur on/off.

F2 / 'cur object' - cyclic switching between objects - from file and predefined: heart (Sanctissimi Cordis Christi) and tetrahedron.

F3/F4 and +/- keys / 'zoom in/out' buttons - no comment.

F5 / 'tex. mapp.' button - choose bumps also texture mapping planar or spherical (planar according to axis X, Y, Z).

F6 / 'bumps' - switching between random bumps and texture dependent.

F7 / 'texture' - select texture: red white stripes, xored face, mandelbrot fractal fragment also blank (which can be used in smoothing objects edges). App also allows load texture from external file (X key).

F8 / 'save obj.' - choose format you want save 3d model currently shown on screen ‘3ds’, ‘stl, ‘ply’ and ‘asc’ format are supported. Saving to current directory. File name has one from ‘a-z’ letter and ‘object’ word. Possibility to save file above 65535 particles (tris, verts) in 3ds format. To do it - first sort and optimize chunks - use 'sort chunk' button.

Files in 3ds format exported from app can be opened correctly on old versions of Blender or eventually by 3dConverter shareware app.

Using ‘save obj.’ also chunks information can be saved. (For now only chunk numbers.)

‘process’ button – do save operation in format you select by ‘save obj’ button.

F9 / 'Culling' - backface culling on/off.

F11 / 'run/stop' button - main rotary on/off.

F12 / 'rotary' - main rotary cyclic switching - around axis X, Y, Z and custom - use mouse and hold it left button.

D / 'do displ.' - do displacement mapping texture dependent.

T / 'do triang' - triangulate the faces of objects; i.e. to divide each face into four smaller faces. Possibility enable tessellation from a separate area - see 'set t. area' button description.

Some info related:
'Tes Wh/Tar' button - Sets the flag of this button to 'tesA' -> tessellation from selected area. Flag 'Whol' means tessellation of the entire object after pressing 'do triang' button described in this paragraph.
't&d wh|pos' button - Sets the flag of this button to 'posi' means tessellation of only the positive (+) coordinates of the vertices. Flag 'whol' - tessellation of both positive and negative coordinates vertices based on faces…
To apply the correct iteration of the tessellation of only a part of the object, removal of all cracks (see "Rm cracks") is mandatory, all cracks must be removed.

U / 'rand. shd.' button - random point (spot) light position and obliquity of plane on which shadow falls. Use 'Shadow' button to display.

V / 'edit mesh.' button - edit option, possibility to edit according to vertex, single face or edge. Use left mouse button and yellow handlers.

W / 'set t. area' button - set tessellation area - default is whole screen (some margin is not used).

C / 'set t. col' - set color that will by bypassed when displacement occurred, available options - black 0x00000000, white 0x00ffffff.

F / 'dsp. factor' - set displacement factor, determine displaced bumps higher or lower. This butt also determines normal vector tolerancy in merging vertices feature - 'Rm red ver' butt.

B / 'Bezier sr.' button - select Bezier patches, which will be calculated and displayed. Now are predefined four Bezier-patch objects - tea pot, tea cup, tea spoon and a cube. Possibility to edit such patch based object, (see 'b.der.edit' button description).

A / 'set ap tol' button - set approximation tolerance when removing redundant vertices (merge vertices) is launched. When vertices are enough *near* they may be collapsed using 'Rm red ver' button. 'set ap tol' button sets how much *near* vertices to collapse should be. This button also determine spaces between cloned/copied object (see 'make serie' button description). Also using this button user can change pipe diameter. This operation is performed after hitting 'Long pipe' button; - So this butt have many purposes, and its flags (integer numbers) indicates more situations..

E / 'b.der.edit' button - draw Bezier derives, selected by B key, 'Bezier sr.'button. Possibility to edit Bezier patches by stopping animation (button 'run/stop') and move yellow bars with pressed left mouse button, when left button is released new position of bar and is accepted. Bezier patches are recalculated permanently. To achieve previous geometry restart app.

't&d wh|pos' button - when displacement or tesselation are performed (use butt 'do displ.' for displacement, 'do triang' for tesselate) determines which part of object is affected. Flag -> 'posi' means that only positive 'z' coefficients vertices are affected, if set on flag -> 'whol' all vertices are affected during displacement/tesselation process.

S / 'speed' button - toggle animation speed. Flags 'idle', 'full'. Some rendering models use only two threads, some four, a few displaying models (edges , nodes) only one.

'Rm unu ver' button - remove unused vertices, other words remove this vertices that indexes are unused in triangles list. This option make vertices list shorter.

P / 'Long pipe ' button - make long multi segment pipe based on Bspline or Catmull-Rom spline or Bezier curve. If flag appropriate to this button is equal 'edit' -> editing pipe mode is switched - hold left mouse button on yellow bar - moving node, hold right mouse button and move mouse - rotate pipe project. By pressing once again 'Long pipe ' button -> set flag 'calP' - calculate and render pipe, diameter according to flag of 'set ap tol'. Setting flag to ‘calW’ - calculate 3d object with wall based on rotated, setted previously, curve. After next pressing 'Long pipe' butt, base object is calculated and currently displayed.

'culling' button switch backface culling default set 'off'.

'Lp segs cn' menu button - determine long pipe segments count.

'Lp Bez/Bsp' button - determine type of curve that is base to making long pipe object. Flag options 'Bezr' - Bezier, flag 'Bspl' - Bspline type.

'Lp quality' - determine long pipe object quality (triangles count per segment).

H / 'NextM edit' menu button - use */Next edit area/* that allow basic edition on:

1. *Next* 3d object - joined to earliest loaded mesh (use key 'M'). Flag is 'Nx.O'

2. Manifold chunk. Flag is 'chun'

3. Whole object. Flag is 'whol'

4. Whole part of object from tesselate area. Use 'set t. area' button to select area you need. Flag is ‘area’

Draws bars on I called */Next edit area/* below menu buttons and info area. If flag appropriate to this button is set on 'Nx. o': blue bar on this */Next edit area/* determines 'X', 'Y' position, violet bar determines 'Z' position, yellow bar determines scale of loaded freshly new part of mesh, red bar position - allow rotate around center point this part of 3d object, green bar allow nonregular scale, only along 'X' and 'Y' axis. White bars - set bend process of object, Bezier (white dots) curve dependent (for now looks good on low poly objects) . Moving bars (with mouse and its left button) perform change parameters described above. Only vertical position of violet and yellow bars can be changed. If flag appropriate to this button is set on 'chun' it enables separate chunk edition possibility. Press 'Show chunk' button and set its flag to 'on' - app will display bar on every triangle, unique to chunk possessed this tri. Click with left mouse button on bar and choose current chunk you will edit. Colored bars on */Next edit area/* now describes chunk editing possibilities. If flag of 'NextM edit' button is set on 'whol' - now user can do modifications on whole object; ‘area’ flag description - correspond to above.

'NextM edit' button also sets which part of object user may edit via free form deformation - 'FFD' button.

'Rm red ver' button - removing redundant/merge vertices, according to approximate tolerance value (use 'set ap tol' button to set this value). Removing redundant, enough near vertices option is processed only on verts placed in tessellate area - set this area using 'set t.area' button.

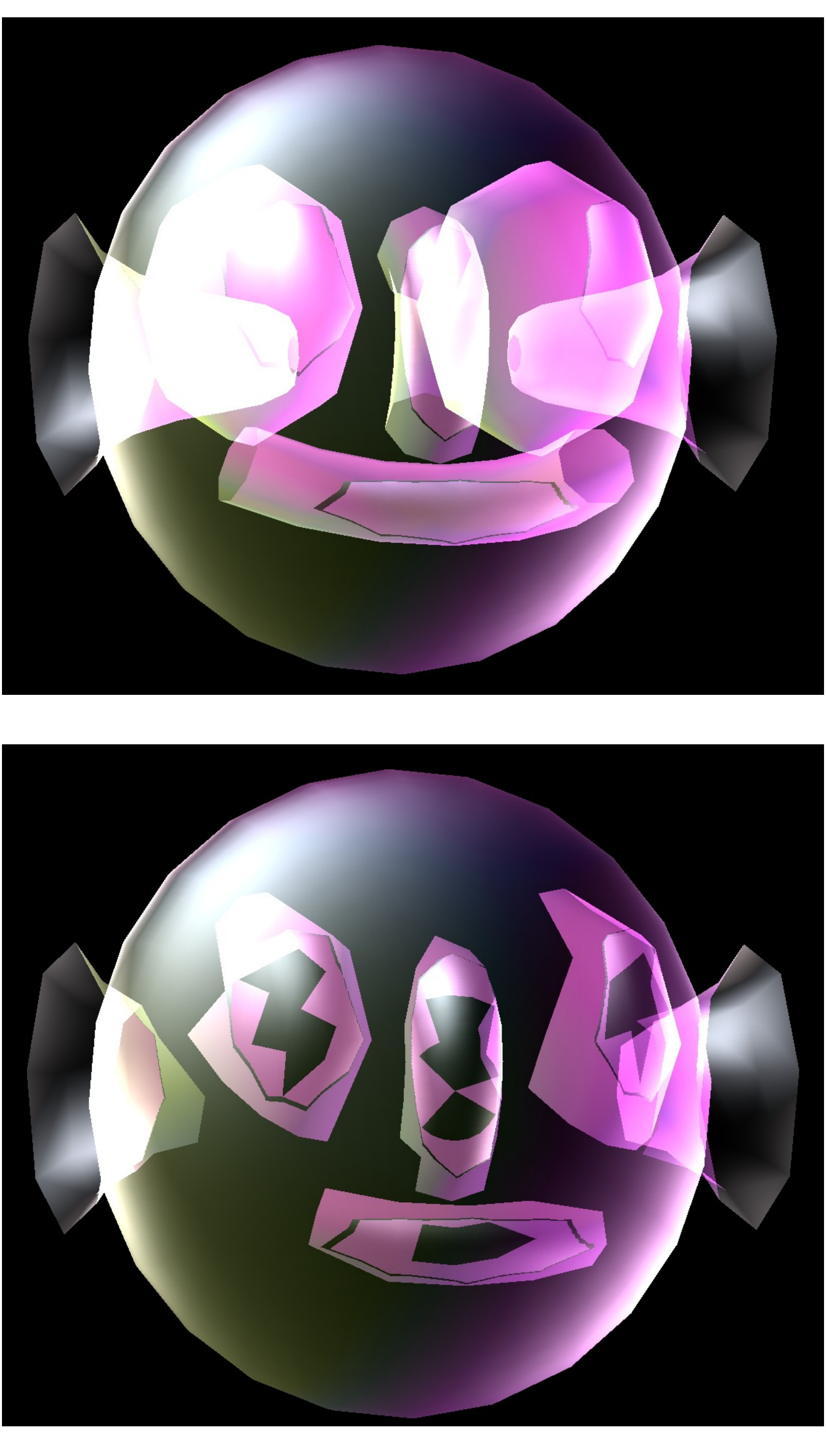
By pressing 'dsp factor' button user may set tolerancy of normal vectors possesed by vertices to merge ..

O / 'Draw norm.' button - when flag of this button is set on 'tri.' drawing faces (triangles), when on 'vert' drawing vertices dependent normal vectors.

R / 'Z rdu care' button - when set 'on' - take care about 'Z' coefficient of vertex during remove redundant vertices operation, when flag appropriate to this button shows 'off' during collapse enough *near* vertices process, care on only on 'X' and 'Y' position of vertex. 'Rm red ver' button - perform removing redundant vertices operation (merging vertices).

'Rm ins fac' button - try to remove inside faces - that are covered by other faces outside mesh. This operation reduces faces and vertices number. Removing operation is solved by multi time rotating and projecting on about 1000x1000 pixels area (not displayed), works correct when projected front triangles area is not smaller than 1 pixel. Currently operation uses 4 threads. Be patient - it take some time no matter how complex is 3d object. (But calculations on bigger objects, that contains many vertices and faces for sure will take bigger period of time).

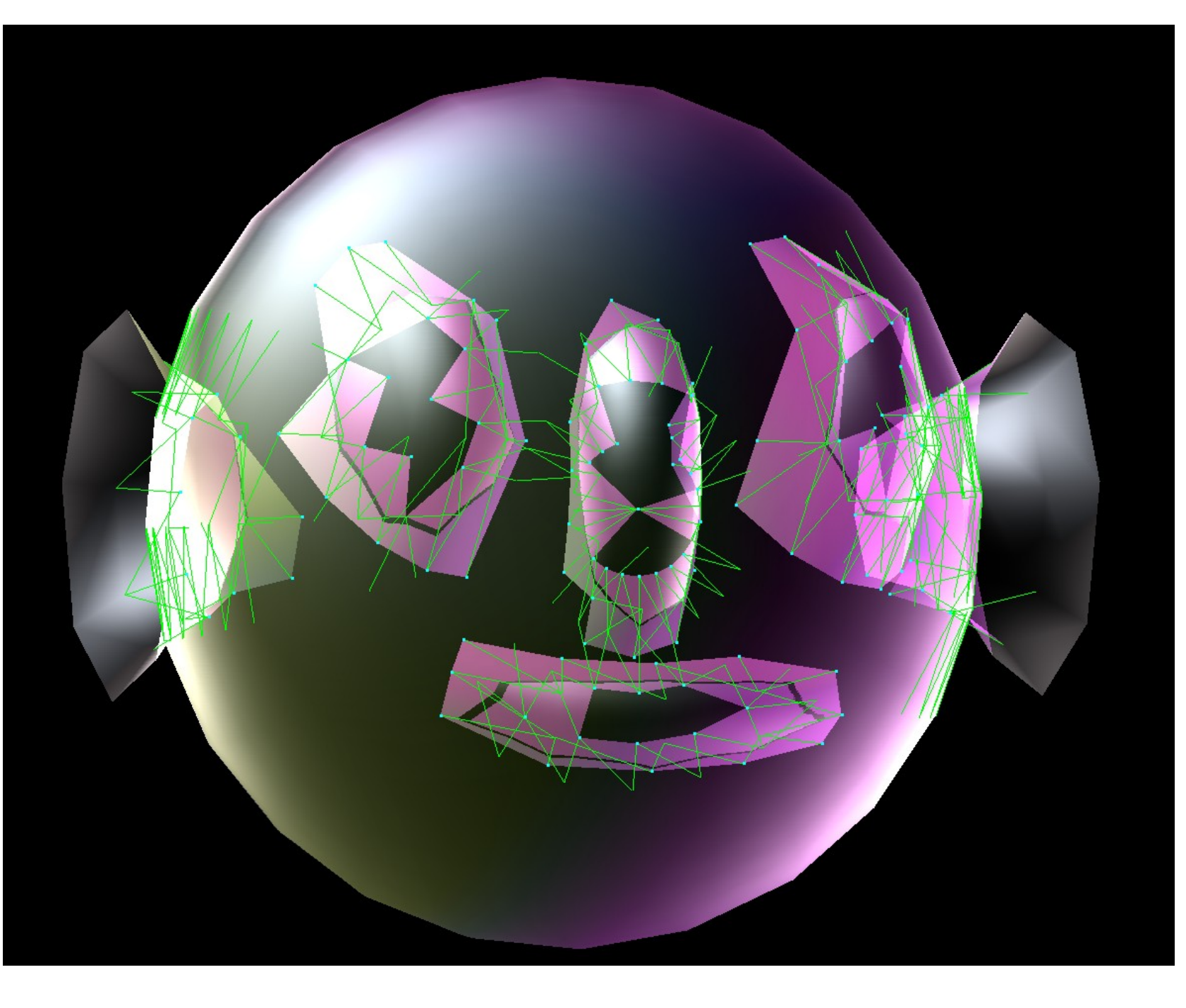
Below are presented object before and after remove inside faces operation...



'Mark in vr' button - searching for inside vertices option. Vertices are counted. This value is displayed on */info area/* - below buttons menu area. Calculations may take some time - are done through many parallel projections.

'Ma Coll Ed' button - mark and count - number displayed on */info area/* - collided edges. It means edges that intersect other triangles. Flags allowed for button 'off' and 'on'. This operation will be slow on very complex objects. Brute force n to n solving method. Process use 4 threads for now.

Below is presented object with marked green intersected edges and inside vertices – visulised by blue dots.

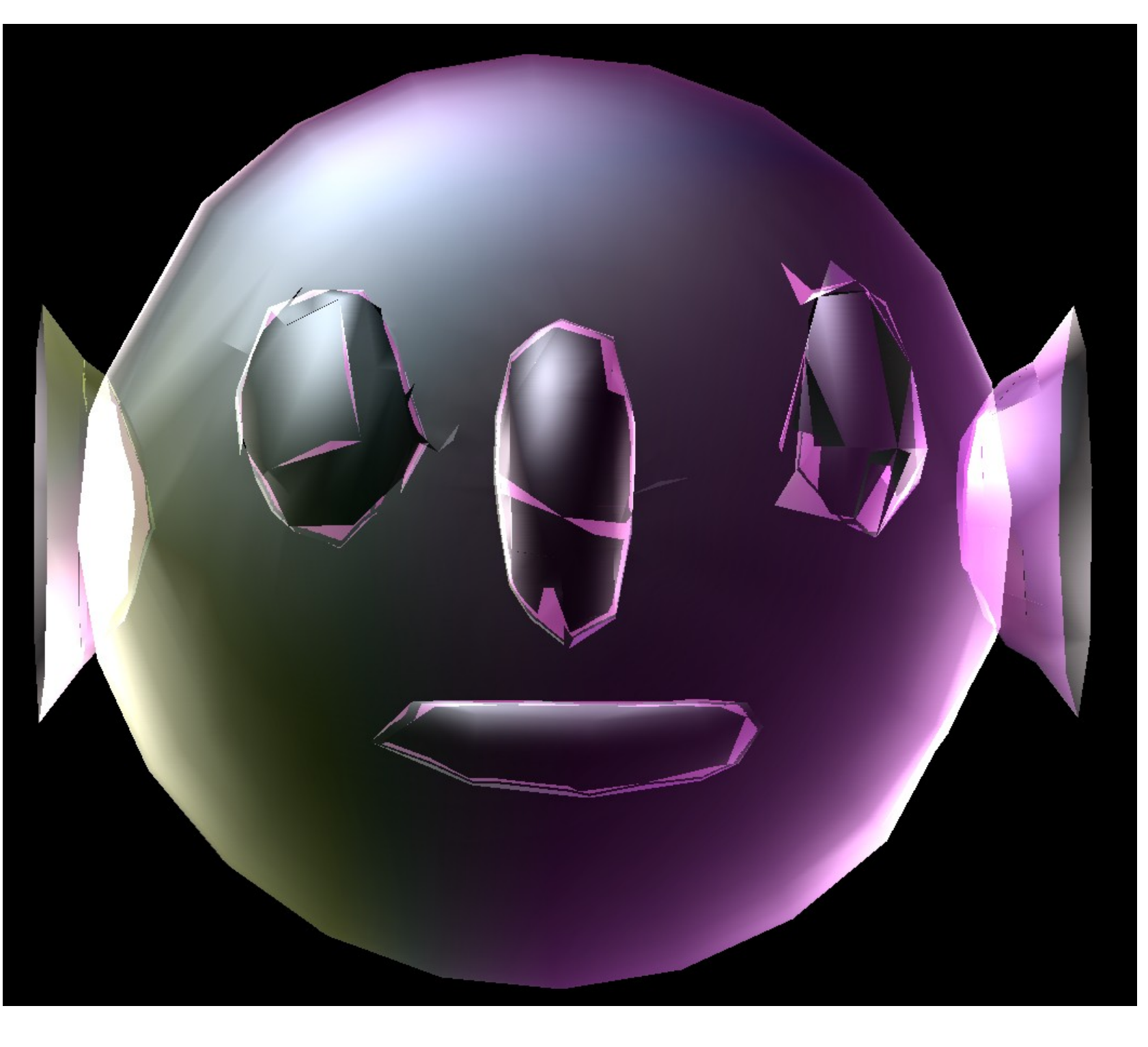


'Tes TIV IE' button - tessellate (triangulate) triangles with at last one inside vertex and at last one edge that intersect. First 'Ma Coll Ed' - mark collided edges and 'Mark in vr' - mark inner vertices buttons flags must be set 'on'. Don’t forget about removing cracks from triangle net ('Rm cracks' button).

Operation performed correctly on object presented on picture below...

'Sm ins edg' button - smooth inside edges. This option try improve inside stucture of mesh. After removing inside faces (which is simplification option), inside edges adjacent to faces/triangles that are removed, are usually jagged. This option try to fix such situation. Some small margin is leaved. Option require correct senses of normal vectors. May be slow. Mesh topology improvement effect of this process will be best seen in transparent rendering models.

Below is presented some partly succesfull attempt of ‘smooth inside edges’ process.. Only mouth shape of face schema object seems to be corrected OK..



'Clip faces' - clip faces that are in tessellate area. Such area can be set using 'set t. area' button.

'Del. chunk' button. - By pressing this button set its flag to 'Del.' - ability to delete separate chunk. Pause animation using 'run/stop' button, move mouse cursor on unique triangle mark (bar with unique color, in center of triangle, separate to each chunk) and click with left mouse button. Selected chunk will be deleted. Object parameters verts/faces/edges/chunks counts will be recalculated after each delete operation.

'Crop front' button - crop front (of view area) faces, some small margin (a few degrees in each direction) is leaved.

'Chun opers' button. - By pressing this button and setting its flag to 'invr' - ability inverse sense of normal vectors from separarate chunk. Flag 'tess' allow tesselate selected chunk, flag 'mirr' allow perform mirror copy 'Y' axle depend. Flag 'merV’ allow merging vertices from only one chunk – dont use this merging one chunk feature – I must work on it.

To use features this button allow, do as follow:

Pause animation using 'run/stop' button, move mouse cursor on unique triangle mark (bar with unique color, in center of triangle, separate to each chunk) and click with left mouse button. On selected chunk will be performed appropriate, according to flag of ‘Chun opers’ button operation.

'Ray shadows' button - calculate and display raycasted shadows of mesh. This option is done on 4 threads. To see shadows, object must have proper geometry. Part of mesh/ whole scene covers other objects parts – this parts are hidden to impact of light ray. Operation use three points light sources. Non realtime on complex objects.

'Rm TIV NIE' button - remove triangles with at last one inside vertex and without any intersected edge. First 'Ma Coll Ed' -> mark collided edges and 'Mark in vr' -> mark inside vertices buttons flags must be set 'on'.

'Rm dead tr' button - some triangles have duplicated, or even tripled index of vertex - so it geometric representation is line, or point - remove such triangles to save memory space.

'Rm cracks' button - remove cracks. After tessellation of chosen area of object (not whole) may take place such unneeded artifact: Along edge may occur vertex that only touch edge but is not possessed by this edge. Routine appropriate to this button cure this situation. Operation may require repeating to patch all cracks. Removing all cracks is obligatory to iterate correctly tessellation/triangulation operation when not whole object is affected. I suggest user to click this button several times until triangles count visable on */info area/* becomes stable. See 'do triang.' button description.

'Tes Wh/Tar' button - set tessellation mode (under 'do triang' button). If flag of this button is set to 'tesA' -> area tessellation. Setting flag of 'Tes Wh/Tar' button to 'Whol' means whole object tessellation after pressing button 'do triang.' button.

'Show chunk' - show manifold chunks bars, color is individual for each chunk. Chunks may be found by 'Srch Chunk' button.

'tex +', 'tex -' buttons - changes 'zoom' of texture mapping. Visual effect may be different in various rendering models - (clipped/tiled/..).

'fix norm V' button - fixing normal vectors option - Do random rotary and parallel projection two times with disabled and enabled backface culling. Triangles that was rendered first time and not second time have non correct sense of normal vector. (Render operation is performed only in inside memory area, not displayed on screen.) Pressing a few times this button make possible cure mismatched sense of normal vectors. Use this option when mismatched normal vectors are inside separate chunk. If whole chunk has uncorrected normal vectors - better use 'Chun opers' option and button.

'make serie' button - make copy of current object, and display this copy with increased current 'X' coord value - this value determines 'set ap tol' button flag/value.

'sort chunks' - sort triangles list according to detected manifold chunks. Also do chunks structure - describes min, max, middle vertices coordinates in chunk. I tried rearrange vertices list - tried perform situation when every chunk has one continuous part of this list may be slow on complex objects. Use this button before saving to 3ds file when object has above 65535 elements.

'Submit obj' - this button allow submit changes after edition using */Next edit area/* (ex. separate chunks edition) and after free form deformation. See 'FFD' button description.

'Zero Next' button - allow set *Next variables* - showed as color bars on */Next edit area/* to its start position. Also FFD (free form deformation) patch net will be restarted.

'Shadow' - display flat shadows on current texture.

'FFD' button - allows free form deformation based on single Bezier patch ('patc' flag), or Bezier volume ('vol.' button flag). Green derives are displayed - possibility to make deformation of whole model (as default) using left mouse button and drag yellow bars. You may perform free deformation on only separate fragment of mesh, so: single chunk (works ok only in single Bezier patch deformation cause) and *Next* joined object (loading by M key). Use 'NextM edit' button to switch ffd edition on fragment you want tune.

'R Ph bumps' button - switch rendering bump mode in Real Phong based models. Currently - "texture + Phong" and "glass". This option requires SSE4+ CPU.

'DoDefNxNor' button - do deformation according to /Next/ joined Object (loading by 'M' button). According to its normal vectors. Use 'set ap tol' button to increase/decrease effect.

'Dr.ValencE' button - mark valence - single edges located at border of manifold chunk.

'From tex' button - allow transform to current texture to 3d. Basic pixel to voxel operation is performed. After transform to 3d texture is diagnosed if it is possible transform to 3d. If no, opertaion is abandoned. Sometimes this proc is not correct..

X key - load texture (raw format 512X512 pixels 24bit 0xRRGGBB). I tried bmp format, (uncompressed 24, 8, 4bit win and os2 versions) but it is very buggy.

N key - load new mesh (old will be abandoned).

M key - load new mesh and join it to the old. Possibility to edit position of fresh load mesh using 'NextM edit' button. See description of this button for details.

ESC key - exit.

Right mouse pressed button and move - setting position of texture, (works in all drawing models, but is visible only in texture displaying models).

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General note about implemented operations. - Some of it may run terrible slow especially on 'large' objects. Maybe some tests for low detail objects may prevent your speed disappointing. Note that even operations on small objects may be slow, because way of solving problem. Its 32 bit app, so object above ~10 000 000 vertices/faces may be too big for 4GB RAM limit - some operations allocate temporally many memory (because using memory greedy pivot lists). Many operation cannot be launched parallel in the same time (ex. editing - chunks / Bezier patches / long pipes).

"No work is ever complete,

and this one is no exception."
Pierre Bezier