

Ave Cruce Salus Mea

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program: Win3ds36 - *.3ds / *.asc files viewer + demonstration of several graphics effects + tiny based on Bezier curves and patches 3d objects editor + some manipulation on 3d mesh routines.

compiler: flat assembler

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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 Grzytar, Madis Kalme, Mikolaj Feliks, Lostcauz, Brian Paul, Reverend, Pablo Reda, MHajduk, Ica, James Foley,

Andries van Dam, Steven Feiner, John Hughes, Richard Phillips,

thtsqe, J. Burkart, Morgan McGuire, Pierre Bezier, Przemyslaw Kiciak and many others...

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

When only SSE3 is present some functions 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 synonyms:

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

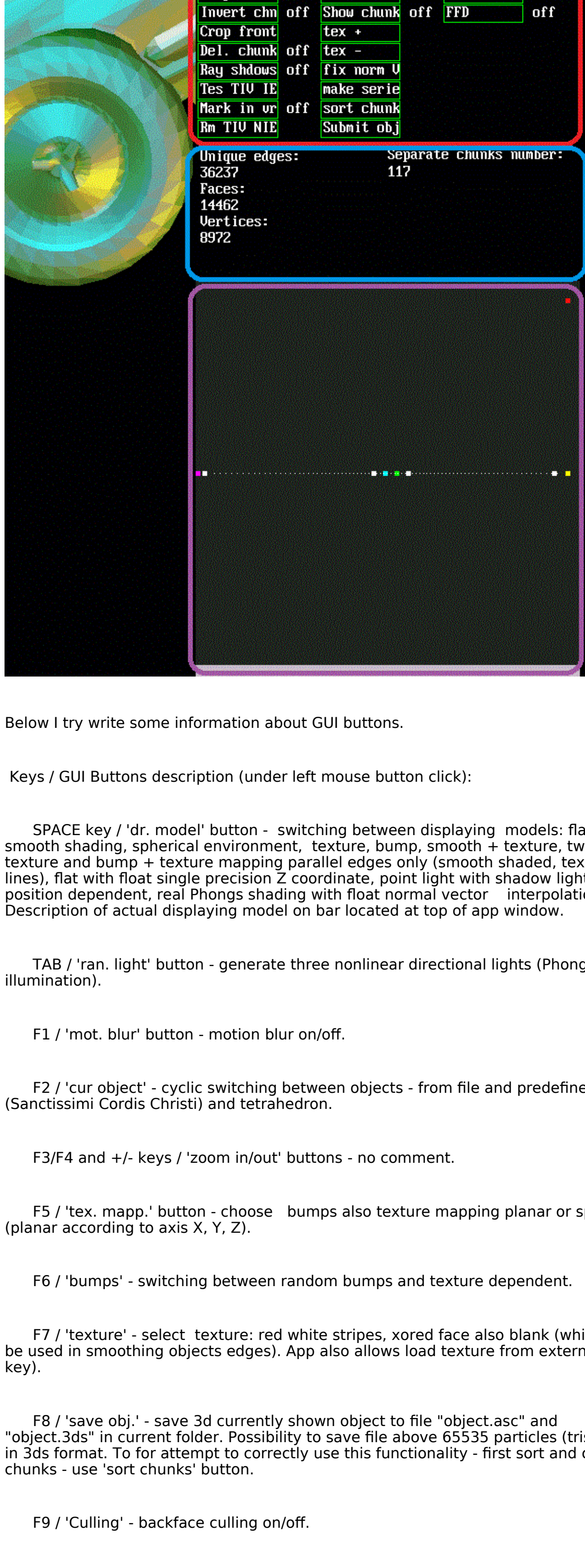
Main content:

/main part area/ - with displayed current model and eventually some help temporary decorations (ex. edit bars), see flat shaded tires fragment on screenshot below;

/buttons area/ - on right side of window, marked using red 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/ - violet rectangle, allows modify and (local) manipulation on mesh.



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 Phong 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 also blank (which can be used in smoothing objects edges). App also allows load texture from external file (X key).

F8 / 'save obj.' - save 3d currently shown object to file "object.asc" and "object.3ds" in current folder. Possibility to save file above 65535 particles (tris, verts) in 3ds format. To for attempt to correctly use this functionality - first sort and optimize chunks - use 'sort chunks' 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' - to 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 whlpos' button - Sets the flag of this button to 'posi' means tessellation of 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 portion 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 0x00ffff.

F / 'dsp. factor' - set displacement factor, determine displaced bumps higher or lower.

B / 'Bezier sr.' button - select Bezier patches, which will be calculated and displayed. Now are predefined four Bezier patch - 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 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 flags (integer numbers) appropriate to this butt have many purposes..

E / 'b.der.edit' button - draw Bezier derivatives, 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 whlpos' button - when displacement is performed (use butt 'do displ.' for displacement) 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 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 Bspine 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 'calc' - calculate and render pipe, diameter according to flag of 'set ap tol'. 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' - Bspine type.

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

H / 'NextM edit' menu button - Draw */Next edit area/* that allow basic edition on Next 3d object - joined to earliest loaded mesh (use key 'M'). Draws bar I called */Next edit area/* below menu buttons and info area. If flag appropriate to this button is set on 'Wh. 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 non-regular scale, only along 'X' and 'Y' axis. White bars - set bend process of object, Bezier (white dots) curve dependent. Moving bars (with mouse and its left button) perform change parameters described above. Only vertical position and violet and yellow bars can be changed. If flag appropriate to this button is set on 'chun' it enables separate chunk editing 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.

'Rm red ver' button - removing redundant 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.

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 4 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).

'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.

'SrcH Chunk' button - search for separate manifold chunks. Try find edge of triangles that are adjacent one to another: It mean form one of such triangle is possible "go" to other triangle along its edges (I promote to vertices) to other triangle from separate chunk. Chunks are counted, number displayed on */info area/*.

'Sm ins edg' button - smooth inside edges. This option try improve inside structure of mesh. After removing inside faces (which is simplification option), inside edges of 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.

'Clip faces' - clip faces that are in triangulation (tessellation) area. Such area can be set using 'set t. area' button.

'Invert chn' button - invert sense of normal vectors in one separate chunk. Pause animation using 'run/stop' button and switch 'Show chunk' button flag 'on'. Then move mouse cursor on unique triangle mark (bar with unique color, in center of each triangle, separate to each chunk) and click with left mouse button. Senses of all triangles normal vectors in whole chunk you have chosen will be reversed.

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

'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.

'Ray shdows' 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.

'Tes TIV IE' button - tessellate (triangulate) triangles with at least one inside vertex and at least 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 chunks from triangle net ('Rm cracks' button).

'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.

'Rm TIV NIE' button - remove triangles with at least 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 visible on */info area/* becomes stable. See 'do triang.' button description.

'Tes Wh/Tar' button - set flag 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 modes - (clipped/tiled/..).

'fix norm V' button - fixing normal vectors option - Do normal 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 'Invert chn' 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.

'Triangles' - 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 perfect situation when every chunk has one continuous part of this list. But now it's buggy.

'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.

'Mirror ch.' - allow perform mirror 'Y' axis depend reflection of chosen chunk. First display chunk using 'Show chunk' button. Set flag of button I describe in this paragraph to 'on' and click mouse left button on bar that visualize chunk you want to mirror. Mesh geometry will be changed, chunks count will be increased.

'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' to increase/decrease effect.

'Dr.ValencE' button - mark valence edges. (This option very seldom works correctly.)

X key - load texture (raw format 512X512 pixels 24bit 0xRRGGBB). I tried bmp format, (uncompressed 24, 8, 4 bit 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).

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 temporarily 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