



DeskArtes Expert Series 7.0:
Excellence in 3D CAD data healing
The 1st of Nov, 2005

New functions in the Expert Series 7.0

The main emphasis with the DeskArtes Expert Series 7.0 has been in the development of STL and VRML file fixing tools. There are several new functions and improvements available for these purposes in the new Expert Series 7.0, especially in the 3Data Expert and its subset programs Spectral Expert and Dimensions Expert. Some of the new functions are also useful and available in the Design Expert, Render Expert and View Expert programs.

The new functions include several new interface features, new and improved STL/VRML repair, new Boolean functions, improved VRML input and detailed color and texture coordinate handling for VRML files. This document describes the use of these new features in a consolidated manner. Now even the most difficult STL and VRML files can be repaired easily.

1. New User Interface Features

New **Display Toolbar** includes shortcuts to new user interface features.



Icon 1 (camera): New **View Window** allows the storing of views during a session. The user can save views, delete views, rename views and return to a selected view at any time during the session. The views can be reordered and a simple fly by animation can be performed through the views in the list.



Icon 2 (hand): New **Selection Window** shows the selected objects in one window. The user can change shading, wireframe, hide, show, unselected, activate, passivate and locate a selection in the Model Tree through the Selection window.



Icon 3 (three boxes): Show/hide Model Tree.

Icon 4 and 5 (half spheres): Clipping on off, show clip curves.

Icon 6 (tube and a surface): Show/hide trim curves on surfaces.

Icon 7 and 8 (arrow and checkered): Show Texture Markers and Show Textures Images

Icon 9, 10, and 11 (red/yellow triangles): Show/hide intersecting, duplicate and overlapping triangles.

2. Improved Selection Functionality

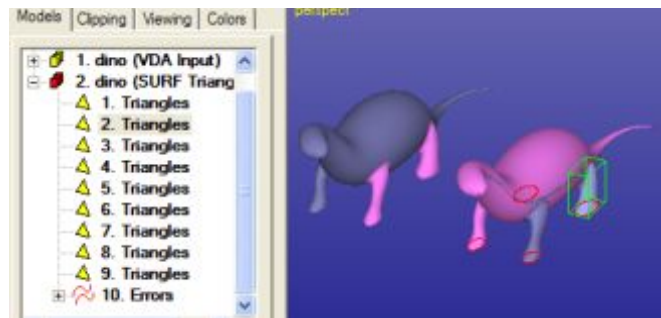
The speed of the multiple selection and delete is greatly improved. Multiple selection will play a major role in the new STL fixing process.

The graphical selection on the screen normally selects the Surface or Triangle element that is pointed. If the **Alt button** is pressed while selecting the surface the corresponding Part node is selected instead. This allows you to select a part in the Model Tree just by pointing one surface on the screen.

3. New Surface Triangulation

The new surface triangulation preserves the original surface decomposition of a part. Previously all triangles were collected in on Triangle element. The preserved surface subdivision allows the user easily to select individual surfaces in the data and will be useful in the new STL fixing process.

In the image below we can see that each surface now generates a separate Triangle element.



4. New STL Fixing Functionality

The most important improvement in the Expert Series, especially in the 3Data Expert functions, is the changes in the automatic STL fixing and Boolean operations. Previously the STL fixing combined and handled the STL data as one big group of triangles. In the version 7.0 the topology generation now looks the triangle input order and triangle surface number when connecting them to neighbors. This technique will sort several topological errors automatically.

If the intersection errors are checked during the repair process, the erroneous triangles (duplicate, overlapping) can be connected with neighbors after all correct triangles are set. This even further increases the chances of generating correct STL data.

In the process the surface decomposition of the part is kept and the separate surfaces can be cut against each other with the Boolean command to fix missing intersections in the STL file or to merge overlapping surfaces.

New STL Verify and Repair are started through the same Verify and Repair commands as the old operations. The Classic automatic STL fixing is still available if the Edit/Customize "Classic STL handling" is set on.

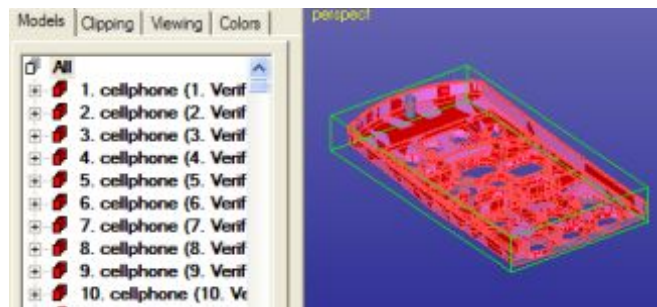
The STL fixing process, step 1: STL Verify

The STL fixing starts by running the new STL Verify command on the data. This command will find intersections, gaps and separate components in the input data.

Check intersections sets on the intersection, overlapping and duplicate checking. *Report gaps* collects the gap curves from the input data. *Connect erroneous last* will connect the found duplicates and overlapping triangles after other triangles are connected, *Separate faces* will separate the resulting STL file into separate surfaces using the given angle limit. *Separate parts* will consider each selected part as a separate entity for verifying.

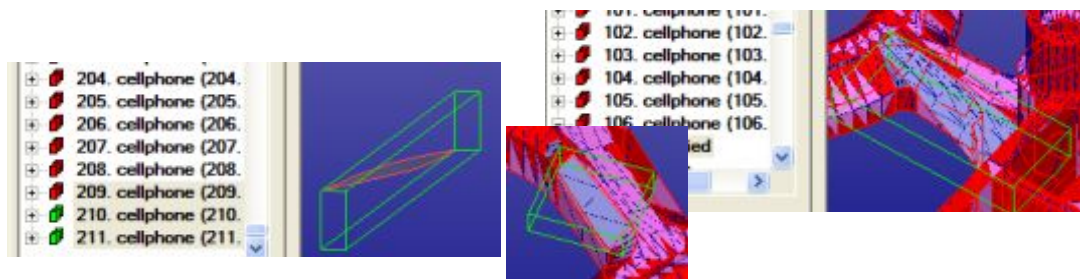


Below we can see an example file cellphone.stl run through the STL Verify:



The cellphone is a very bad part consisting of over 211 separate parts and several intersecting triangles before the repair operation.

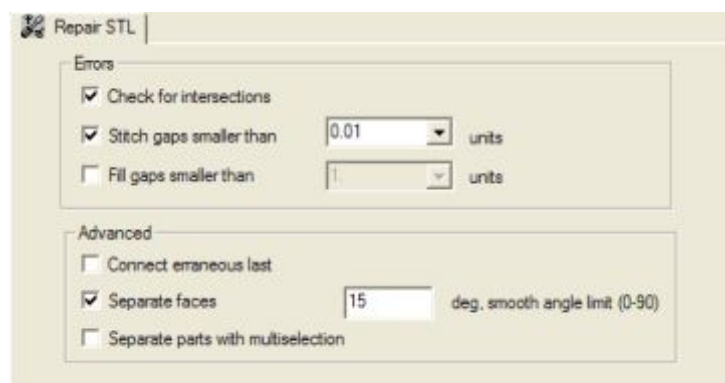
After the STL Verify the found parts are sorted in decreasing surface area order in the Model Tree. It is a good practice to take a look in the end of the list and remove some small and insignificant fragments from the data. Also, closer visual investigation shows us that there are some extra or bad surfaces we want to remove before going into the Repair command. These erroneous surfaces can be easily picked and deleted.



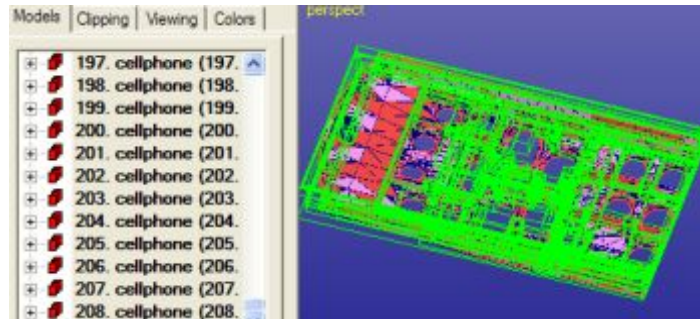
The STL fixing process, step 2: STL Repair

After the Verify operation we can go to the Repair (*you can start directly with the Repair if you are sure that the model is relatively correct and does not need manual surface removal as seen above*). The cellphone model extents are very small but that is not a problem due to the to new relative tolerances used inside the STL model repair library.

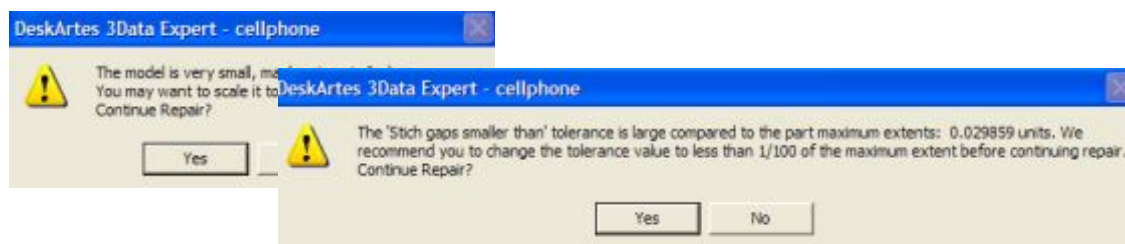
Most of the parameters are the same as with the STL Verify. *Stitch gaps* stitches thin long gaps and *Fill gaps* fills gaps smaller than the given tolerance with triangles.



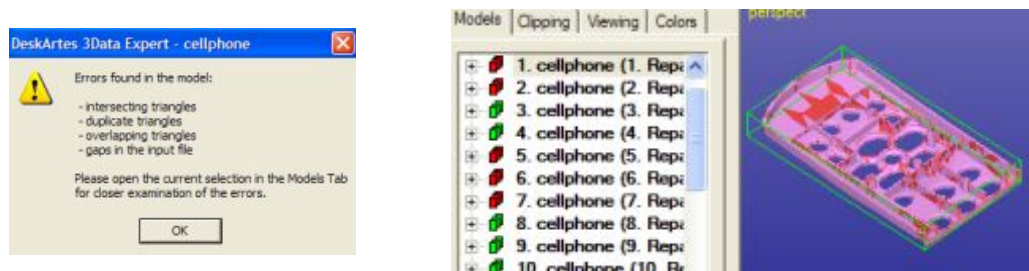
The original input data is separated into more than 200 different parts after the Verify operation. Before the STL repair command we must use multiselection to select (all) necessary parts in the Model Tree. This can be done by first selecting the part 1. with the left mouse and then selecting the last part 208 with the left mouse while keeping the Shift button down, i.e. using multiselection in the Model Tree.



We will first run the Repair with the parameters shown above. The software now warns the user if the model is very small or if the stitch tolerances are large compared to the size of the model.



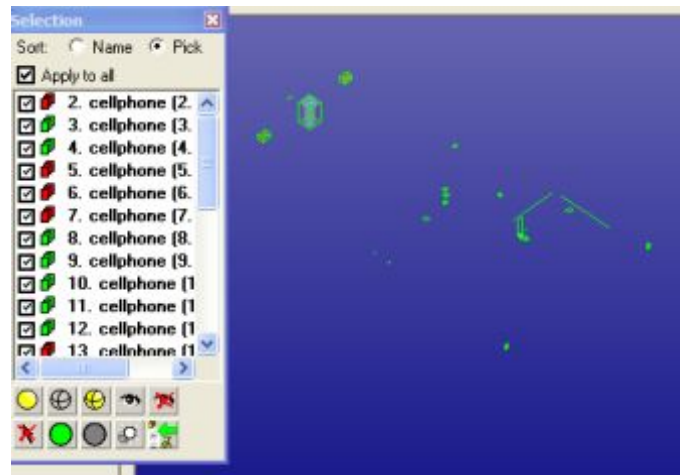
During the Repair operation the model is removed from the display system memory to enable handling of bigger models. After the Repair is ready an error message is shown, as expected with this model:



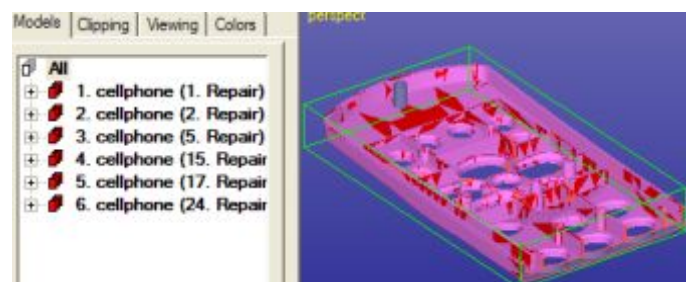
Most of the gaps are stitched, the number of intersecting triangles has dropped as well as the number of separate parts in the Model Tree, which is now 26. The part 1. contains the biggest surface area and makes the main body of the final part.

There are 26 separate parts in the Model Tree now. Most of these are useless parts made of thin triangles, left over with the topology generation process. These can be selected from the end of the Model Tree or from the screen and deleted. The new Selection Window can be used to keep track of the parts to delete (or not to delete).

The Selection Window is here used to identify and collect the very small parts, which can be deleted before continuing the Repair. You can also go directly through the Model Tree and delete small parts or you can select the small parts graphically from the screen.



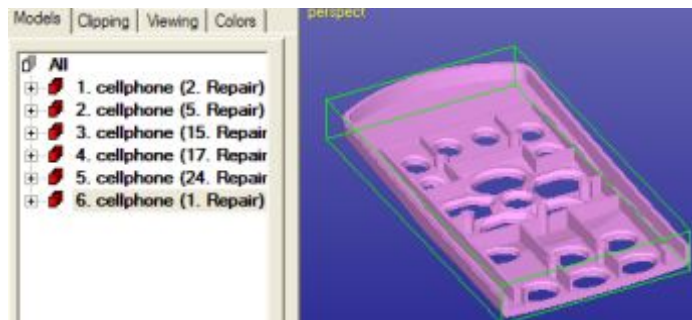
After a few delete operations we will see that the model is made of a main body and five smaller parts which must be combined into the main body with Boolean command. But before we go to boolean, we need to Repair each part to a correct STL model.



First we will Repair the part 1, the main body. The best way to repair the part is first to have a look at the red triangle areas and gap areas. Graphical selection at these areas will reveal if there are some overlapping faces and we should delete these before running the automatic Repair again. The erroneous faces can be easily selected from the screen and deleted (*Note: we could have removed several overlapping surfaces after the first Verify if we took a closer look at the model*). If the screen looks messy you can turn temporarily off the error triangle display with the Intersecting, Duplicate and Overlapping triangle icons in the Display Toolbar.

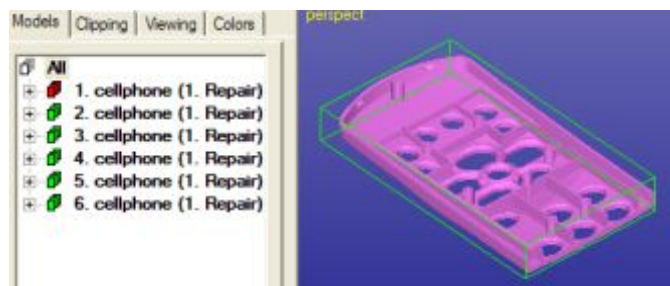


Above is an example of a bad face which is selected and subsequently removed. After removing some bad faces and rerunning the automatic Repair we will get an ok result for the main body (*there may be some minor intersections but they will not disturb the Boolean or building process*):



The result of the last Verify or Repair command is always put in the end of the Model Tree and the first (largest) part is selected after the command. This allows the user to find the rest of the parts (smaller) generated from the last repair command easily after the selected part.

The separate smaller parts are also run through the Repair before the next step, as seen below.



5. New Boolean Functionality

There are two new functions added into the Boolean command set:

The *Join*, *Remove* and *Intersect* commands are used to make Boolean operation between two disjoint parts in the Model Tree as before. The two new commands will work also between two Triangle surfaces. **Cut Surfaces** will cut the first set of surfaces (accepted by pressing Set part 1, can be a multiselection) with the second set of triangle surfaces (Set part 2). **Merge Surfaces** will merge the first set with the second set.



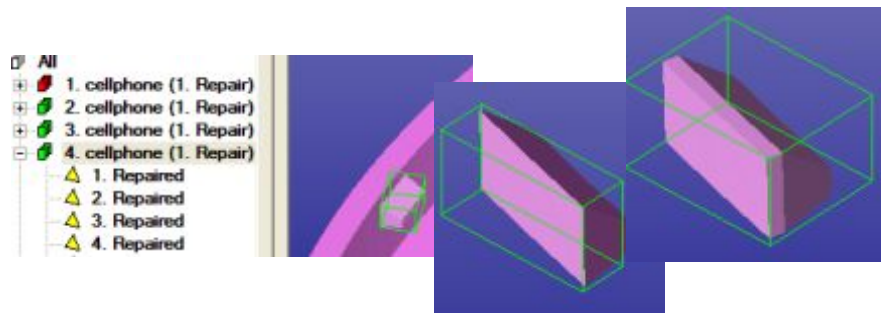
Note: for Cut the second surfaces must intersect the first surfaces in such a way that it creates a closed intersection or separates an area fully at a border of the part 1. For Merge the two surfaces must be overlapping and lay within the maximum distance.

The Cut result is the two surfaces from the part one generated when intersected with part 2. Part 2 is left intact.

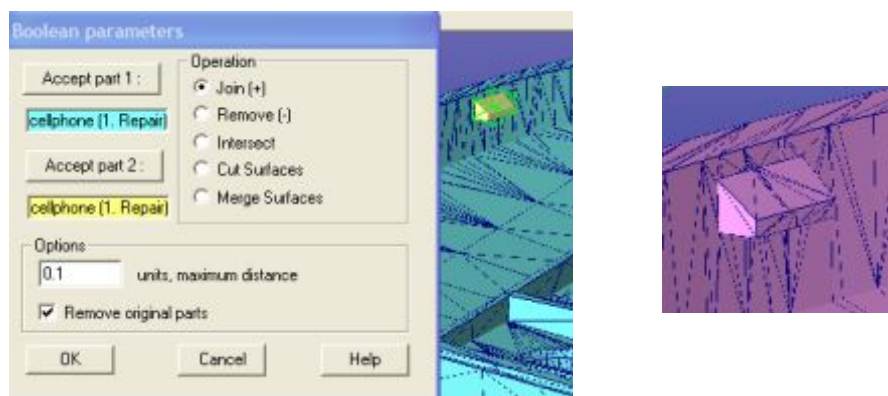
The Merge Surfaces result is four surfaces, two from both sets of surfaces. The user must select the surfaces which are deleted (normally two) to make a good solid STL file.

The STL fixing process, step 3: **STL Boolean (and Extrude)**

Now we need to combine the cellphone parts into one solid STL file. The parts are not intersecting so we need to add material to the small knobs before the Boolean. We will select the correct surface to add material and then use the Solid/Extrude command on one surface:

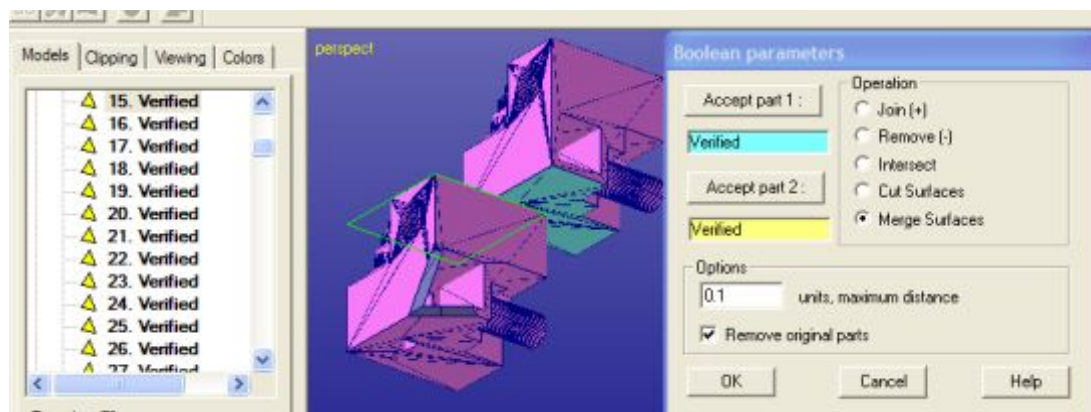


After generating material on the small part with the Modify/Extrude command we will make a Boolean Join between it and the main body.

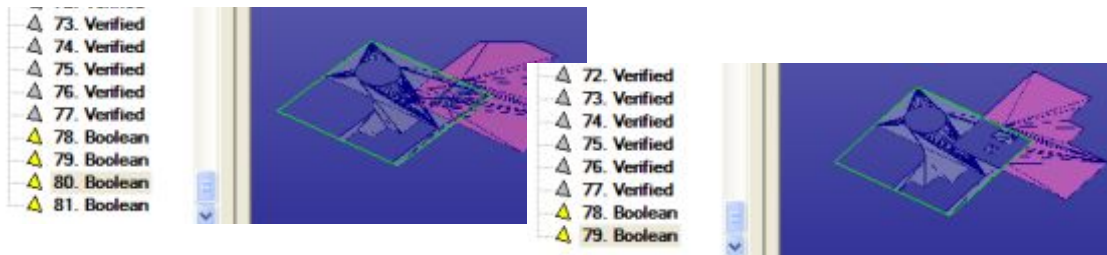


The same process is repeated with the other parts and finally we will have one solid STL file.

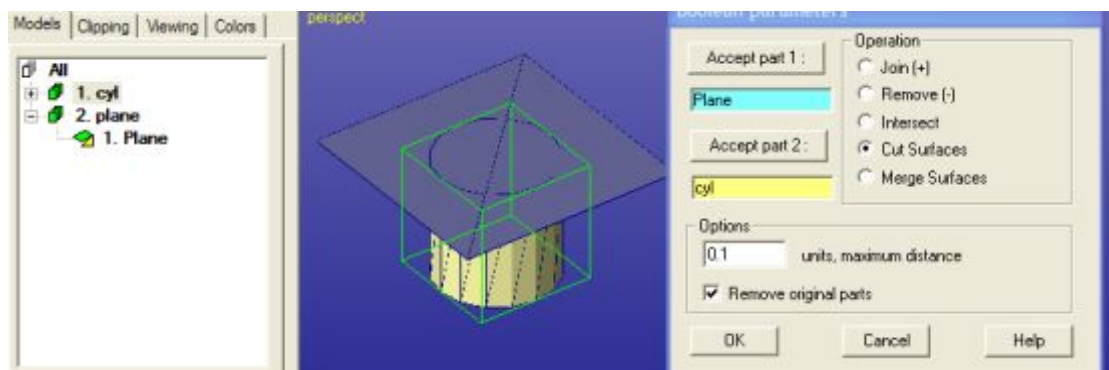
Boolean Merge Surfaces can be used as follows: First select the two overlapping surfaces you want to merge (the blue surface and the hidden yellow below). Also make sure that the maximum distance is sufficient for the two parts:



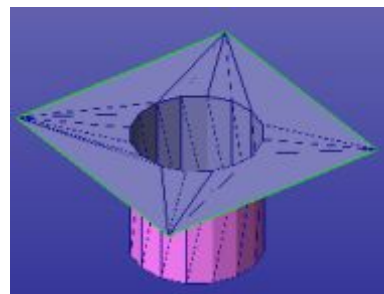
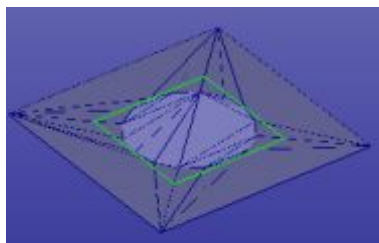
The result is a set of four surfaces (Boolean) from which the user needs to select the ones that will make a solid STL from the original data (here the outer parts, seen on right hand side):



Boolean Cut Surfaces can be used to cut create a missing intersection between two set of surfaces.
Below the plane is cut with the *cyl* part:



The result is the two surfaces generate from the plane, from which the user must select the correct surfaces to form a solid:



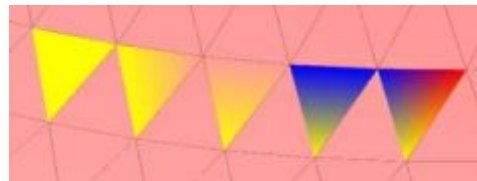
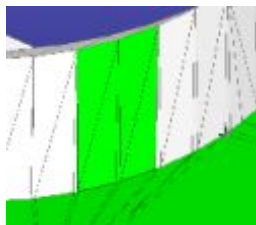
6. New STL/VRML Color Functions

The VRML input has been greatly improved for both VRML 1.0 and VRML 2.0 versions.

The VRML part colors and textures can be restored on a part automatically after the part repair or split with the Restore VRML colors command. Sometimes the changes in the model are too large for the automatic restoring to succeed. Two new commands have been added in the Triangle Edit toolbar to enable the color and texture coordinate fixing in a VRML model.



Color copy icons allow the user to select a color from any triangle and copy it into another triangle. With VRML models the individual corner color values as well as texture uv-coordinate values can be copied from one triangle to another for correct VRML output. By selecting two corner points as a source, the third point, target, will receive interpolated values from the two source points.



Note: you must set on the Show STL Colors in the Colors Tab to be able to see the individual triangle colors.