DeskArtes
3Data Expert 15.0

Quick Start Guide

First Edition

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Contents

Foreword

The *3Data Expert 15.0: Quick Start Guide* document introduces the basic 3D model handling for Additive Manufacturing: triangle model repair and model splitting with *3Data Expert.*

There are two simple lessons, and it should not take more than 15 minutes to go through the examples.

The first lesson fixes an erroneous STL model for 3D Printing using the Auto Repair process available with 3Data Expert 15.0 software.

The second lesson describes methods to split and combine STL parts for 3D Printing. Large parts must be split, and pins must be added to be able to attach the manufactured parts correctly with 3Data Expert software.

The pictures in this document can differ from the version you get. Most of the pictures have been grabbed with the *classic* theme, while the *dark* theme has been used for some of them. The theme can be changed from *Edit > Preferences.*

3Data Expert **modules**

DeskArtes *3Data Expert* consists of several modules targeted from home and DIY use to education and professional Additive Manufacturing. Each module has different menu and toolbar set, and which set you see depends on your license. With an evaluation license the *Base* menu and toolbar set is shown.

– *3Data Expert Free* is an entry level tool targeted for viewing, verifying, repairing, dimensioning, and communicating 3D geometry information. It allows you to input triangle models, create consistent topology, check errors, orient normal vectors, repair gaps and self-intersections, edit triangles and output STL data for 3D printing, without any cost. In the tutorials, when information relevant to the *Free* module is handled, it is marked with `Free`

– *AM Expert* module (an option to *Free* and *Base*) provides automatic AM process selection based on part requirements (material, size, accuracy, tensile strength, and post processing). The *AM Expert* database currently contains data for 129 professional AM systems, and it is regularly updated.

– *3Data Expert Dimensions* is a simple, economical, and user-friendly tool for STL repair and 3D model splitting for machines with a smaller build area. The tools include Repair, Splitting and Connect with Pins or Lap Joint. Information relevant to *Dimensions* will be marked with `Dime`.

– *3Data Expert Lite* includes all standard 3D model preparation tools for 3D Printing and Additive Manufacturing. Available tools include geometry generation, Boolean and 3D markup commands, Offset, Hollowing, Coloring and Texturing, Solidify (aka "shrink wrap"), as well as Slicing and Tool compensation. Optional 3D Nesting makes *3Data Expert Lite* a perfect 3D data preparation tool for powder-based AM systems. Information related to *Lite* will be marked with `Lite`.

- *3Data Expert Base* is a professional tool for preparing 3D models for Additive Manufacturing and Simulation applications. There are several commands for manipulation of both 3D surface models and 3D faceted models. These commands include Surface triangulation, STL verification and repair, STL Offsetting, Splitting, Connecting, Decimation, Smoothing, Solidify, Boolean, Part subdivision, 3D Nesting, Z Compensation, Slicing and Tool Compensation as well as STL Coloring and Texturing. Supports can be generated for DLP, metal and stereolithography processes. Special Sand Support command creates supporting plates for delicate sand parts with a push of a button. Information relevant to Base is marked with `Base` . However, most of the tutorial contents are applicable with *Base*.

- *3Data Expert Color* (`Color`) contains a subset of *3Data Expert Base*, especially meant for handling color models. A variety of color and texture specific input formats are handled: VRML, ZPR, 3DS, OBJ, PLY. *3Data Expert Color* has previously been labeled as *DeskArtes 3DEdit Pro*.

3Data Expert tutorials

The full tutorial set for 3Data Expert contains several documents which cover different aspects of model repair, coloring and print preparation. The tutorials are available in the software distribution package through the *Help > Tutorial Documents* menu:

- *3Data Expert 15.0: Quick Start Guide* gives a short introduction to model repair and splitting for 3D Printing with *3Data Expert* `Base`, `Lite` and `Dime` modules. Estimated completion time 15 minutes.

- *3Data Expert 15.0: Tutorial 1 – Working with 3D Models* introduces basic viewing, measuring, automatic repair, split, connect, hollow, offset, 3D Text, Boolean, cut, reduce, 3D nesting, surface triangulation and other model manipulation functions available for STL files. Applies to all *3Data Expert* modules. Estimated completion time is 3 hours.

- *3Data Expert 15.0: Tutorial 2 – Working with Colors* introduces basic automatic repair and coloring for 3D Color Printer users. For `Base`, `Lite` and `Color`. Estimated completion time is 1 hour.

- *3Data Expert 15.0: Tutorial 3 – Separating Shells* describes the use of Shell Separation commands in 3Data Expert. These commands enable separating a part into several shells for different material (shore value) or color definitions in a single part. For `Base` only. Estimated completion time is 30 minutes.

- *3Data Expert 15.0: Tutorial 4 – Generating Supports for AM* explains the use of the Generic Supports command and Sand Supports command. The support generator can be used to generate supports for DLP, metal, stereolithography and sand-based processes. Adding extra connectors to prevent parts from warping and bending during the build is explained. Also,

slicing, slice preview and slice filling is demonstrated. Estimated completion time 1 hour.

- *3Data Expert 15.0: STL and VRML repair examples* document includes more advanced model repair operations with *3Data Expert*. Applies to Base and mostly to Lite, Dime and Color. Estimated completion time 2 hours.

The tutorial documents and the geometry files for the tutorial examples are found in the *Tutorials* folder and its subfolders (*GeomFiles*, *Tutorial 1*, *Tutorial 2,* etc.) in the 3Data Expert installation directory.

Lesson 1 – Basic Workflow

Welcome to 3Data Expert 15.0 tutorial Lesson 1. 3Data Expert 15.0 is a 64-bit implementation allowing you to handle huge models for Additive Manufacturing (AM) and Simulation applications. But let's start with simpler models.

This lesson shows you how to fix an erroneous STL model for AM using the automatic tools with 3Data Expert 15.0. Before starting the lessons, please make sure you have received and installed the software evaluation license from DeskArtes. If you do not have a license yet, it is very simple to request an evaluation license. First start the program from the desktop icon:
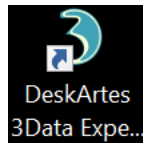
Then go to the *Program licenses* dialog through *Help > Licenses* command. There you can find the *Request evaluation license on-line* button.
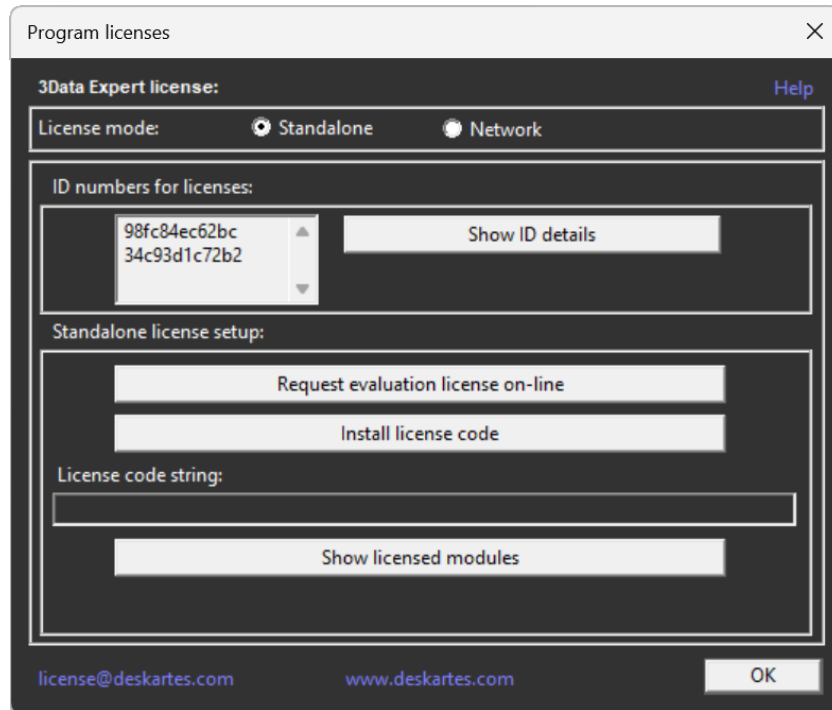
Press it and it will open the DeskArtes license request page on your favorite web browser. Fill in the required fields and press *Submit evaluation request* button to send the license request to DeskArtes.

You will receive a 15-day evaluation license within 24 hours.

When the license arrives, press *Install license code button* in the *Program licenses* dialog and *Copy/Paste the license string* into the input field that appears:

You can choose between three locations for the license. The first one, "ProgramData" folder, is usually the best one because it allows other users to access the license, too.

Then press *OK* as requested to accept the license. Finally, *restart* the software. Now you are ready to go ahead with the lessons!

Basic workflow for STL files

The default settings of 3Data Expert 14.1 allow a straightforward workflow for processing STL files which either are already correct or easily repairable. The workflow consists of four steps:

1. Model file input.
2. Model positioning.
3. Preparation for AM: support structures, slicing.
4. Output as STL file, CLI slices or slice bitmaps.

If you have previously worked with 3Data Expert, you will see that the process is significantly simplified, with more automation by default. However, you can still do all the operations possibly required with more difficult models. Some of these operations are explained later in this document with hands-on examples.

Let's first look at the preferences (*Edit > Preferences* and its *General* section). The *units* query dialog and *Operation Mode* dialog are turned off by default, setting the default unit as millimeters and automatic model verification or repair turned on. You can, of course, turn them on if input models require more interaction during input and verification.
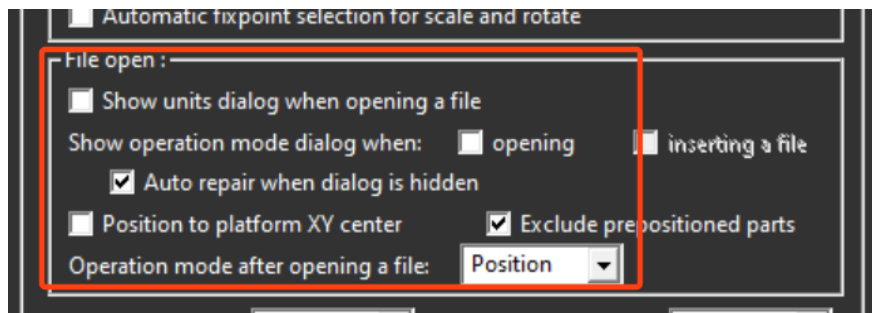

We'll first **open file *dino-scaled.stl*** *in the Tutorials/GeomFiles* folder, using the *File > Open* command. Make sure that *Files of type* is set to *STL* or *All files* to see the file in the Windows file open dialog.
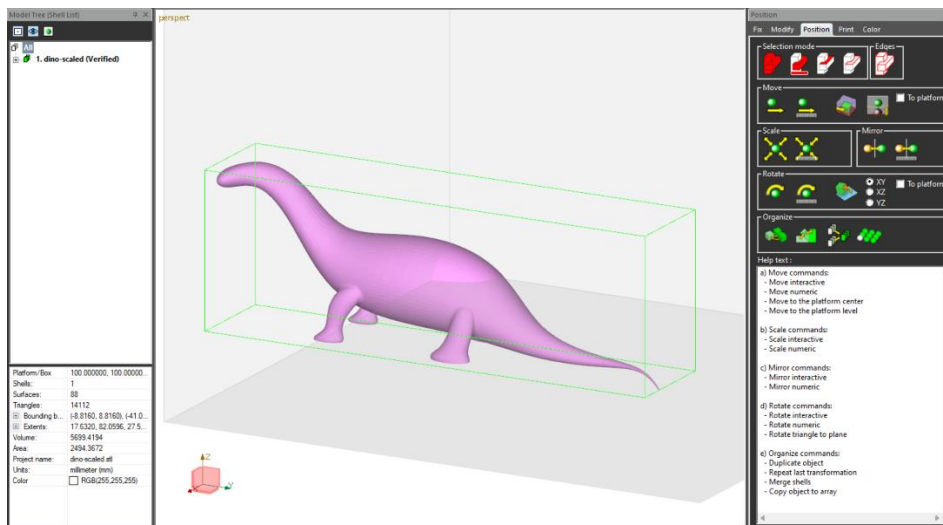
As we see from the object properties area and the coordinate axes drawing, the model is clearly outside the *GenericDLP* workspace loaded with the default *Print Configuration*:

Platform/Box	100.000000, 100.00000...
Shells:	1
Surfaces:	88
Triangles:	14112
⊟ Bounding b...	(-8.8160, 8.8160), (-41.0...
X (min, ...	(-8.8160, 8.8160)
Y (min, ...	(-41.0298, 41.0298)
Z (min, ...	(-13.7997, 13.7997)
⊞ Extents:	17.6320, 82.0596, 27.5...
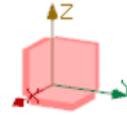
We will therefore use the *Move to Platform Center* command to move the dinosaur model to center of the workspace and 5 mm above the platform (the default bottom offset of the Generic*DLP* Print Configuration):
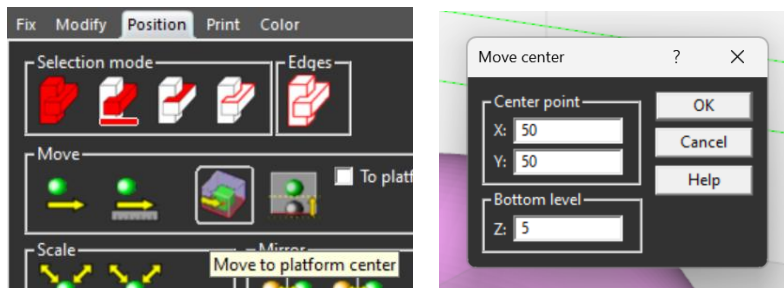
Because the model is now correct and properly positioned inside the workspace, we can proceed and create the support structures necessary for its AM printing. The procedure is covered in detail in another tutorial, and here we will show the simplest step in three pictures:
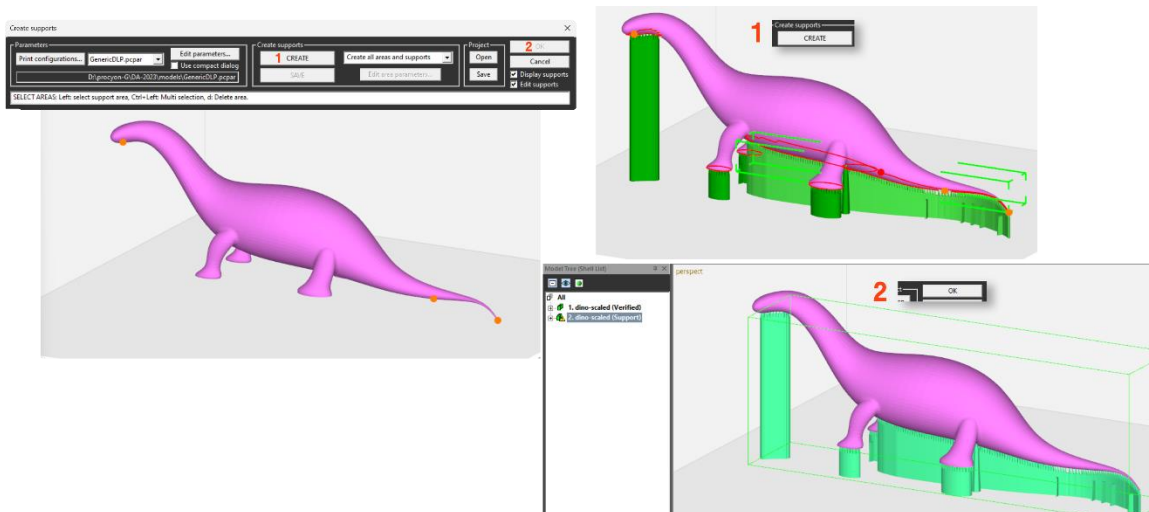
The left picture shows the state when support structure generation has been started: local minima points are highlighted. Step 1 is to click the *Create* button, which creates support geometry based on the *Print Configuration* parameters, as well as model geometry and topology. In step 2, the automatic supports are accepted with the *OK* button and appended to the model tree.

You can next output the model and the supports, either in one STL file or as separate STL files, depending on your process requirements. You can also slice the model and save the slices as a CLI file or as bitmaps, again depending on what your AM system wants to receive. In this picture two views of the slicing are shown, all 326 slices in the background image and 61 bottom slices in the inset image.
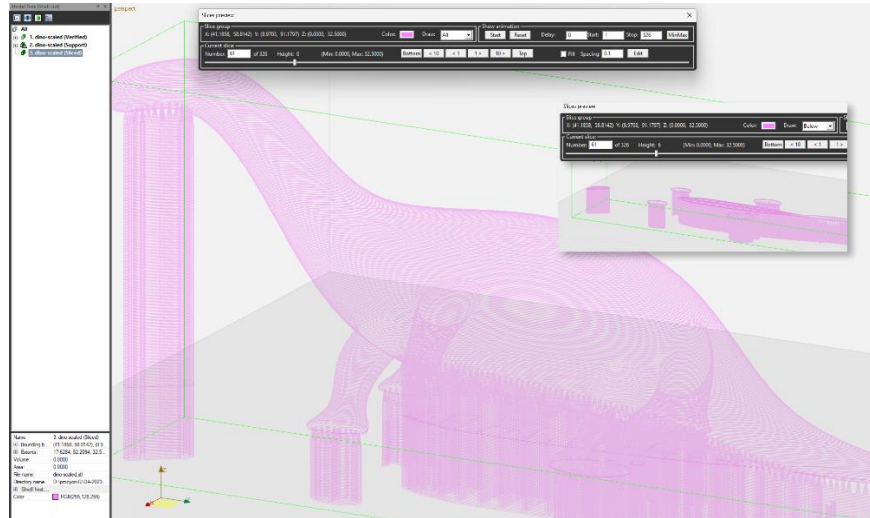
If the slices are exported as bitmaps, below we see part of the ZIP package contents (left) and bitmaps of four different slice levels (bottom slice with supports only, two middle levels with both model and supports visible and, last, a level near the dinosaur top):
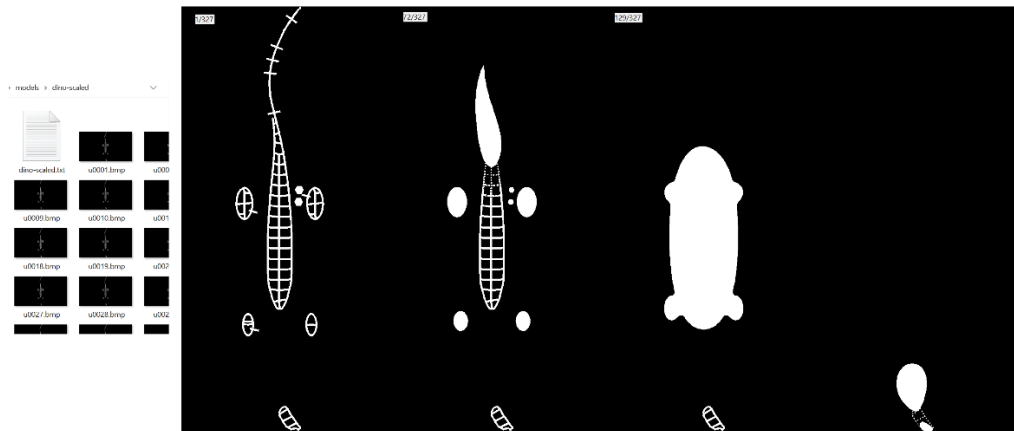
During the workflow, you can save the intermediate results as a DeskArtes proprietary .3de format, or its compressed .3dez version. In addition, mainly for iterative work with support structures, you can use the .3de_project file format. These formats maintain, among other features, the topology of the entire model.

In the following chapters will well go more deeply inside the repair process. The knowledge can be useful even if the basic workflow covers most of your AM production needs.

Lesson 2: Fully automatic STL fixing

After the quick introduction to the simple workflow, let's now study the most AM - related repair and modification procedures. During this lesson you will also learn how the user interface of 3Data Expert works.

Auto Repair process for STL files

When inputting a triangulated model into 3Data Expert, an automatic analysis and repair process is started. In normal everyday use you can verify and correct most of the models using the Auto Repair process. We will now show how the Auto Repair process works. Certain interactions in the following (like units and operation mode selection) are automatic by default, but they are shown here to emphasize what you can do when the automatic procedure doesn't do what you need.

If you choose to continue with the default automation, you can skip the rest of this chapter and continue to the *Workspace* chapter.

First open the *dino-connected.stl* file in the *Tutorials/GeomFiles* directory with the *File > Open* command. Make sure the *Files of type* is *STL*:
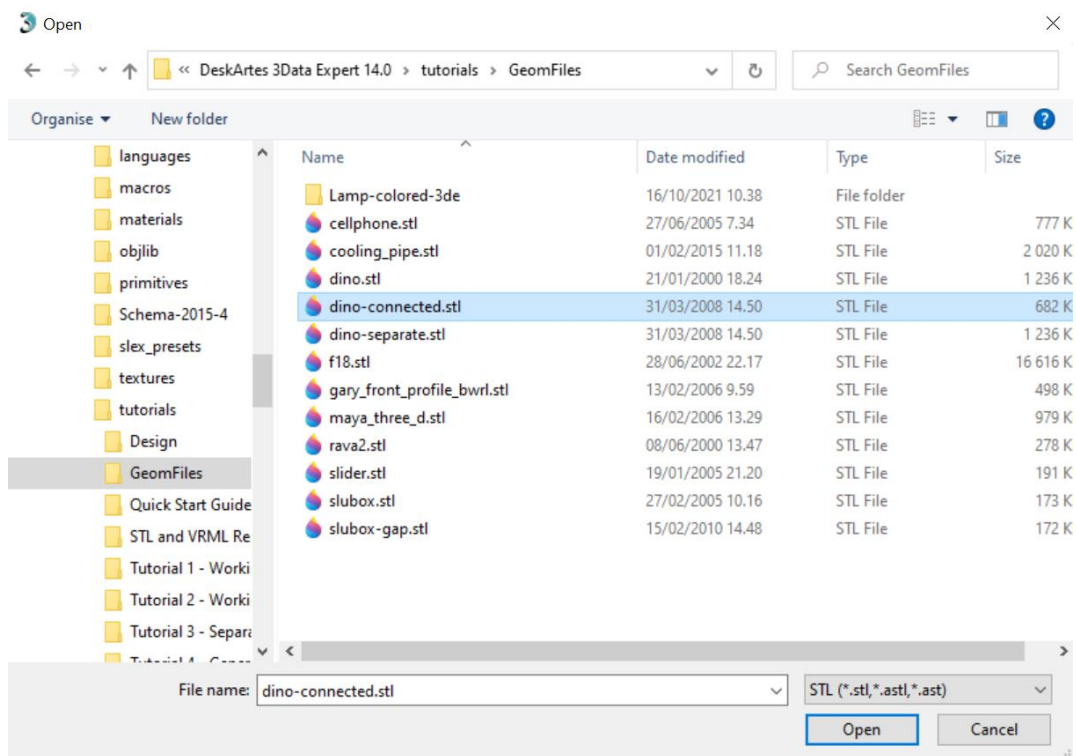
Press *Open* to bring the model into the software. If you often handle models with different units (like millimeters and inches), you can switch on the unit selection dialog display setting in the preferences (*Show units dialog when opening a file*). If you see the unit selection dialog now, accept the proposed units *Millimeters* (with automation, millimeters are automatically assumed):
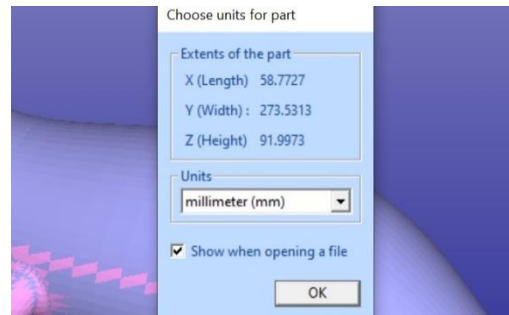
Press OK to continue and you will be prompted for the Operation Mode. 3Data Expert has six main operation modes: *Fix, Modify, Position, Print*, *Color* and *View*. *Note: The contents of the Operation Mode window depend on the 3Data Expert module you are running.* The different modes are used for specific tasks:

- *Fix* takes you to automatic model verification and repair and contains shortcuts to the main tools used for repair work.

- *Modify* lets you change the model geometry with features which are necessary or useful for production.

- *Position* contains tools which help you optimize the positioning of components on the printing platform.

- *Print* shows tools for preparing a repaired and positioned model for your AM printer, such as creating support structures and slicing.

- *Color* displays the tools for painting and texturing. These tools check the model for errors and set it to "what you see is what you get" display color mode.

- *View* minimizes the Operation Mode window and allows you to examine the model and then return to Operation Mode selection when clicking the minimized window again.

The normal way to begin repairing a model is to start with the Fix mode. To start fixing **press the Fix button** in the Operation Mode dialog now**.** *3Data Expert* will begin automatic model verification (*Fix Model > Verify Shells* command). A progress bar appears. When the analysis is ready, the *Auto Repair* dialog with *Model status* message is displayed:
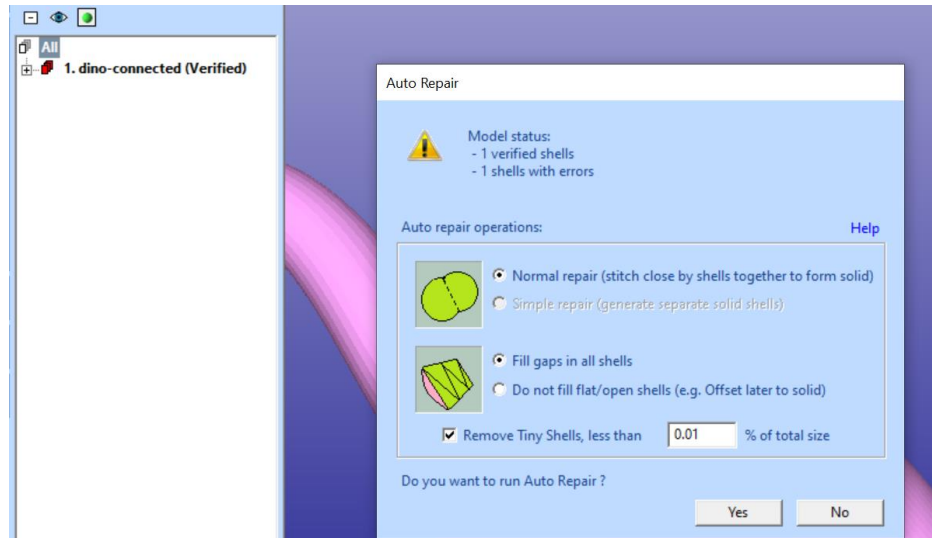
The model is verified for errors and divided into separate shells during verification. In this case we get only one shell (*1. dino-connected (Verified)*), which also contains errors. The display shows red *Gap curves* through the surfaces. You can use different viewing commands when the Auto Repair dialog is visible (see below). Gaps are an error type you must fix during the repair process of *dino-connected.stl*.

The shell has errors (i.e. gaps), which is indicated by the red icon 🔴 in the Model Tree (correct shells would have green icons 🟢 or, sometimes, 🟢⚠ if the model contains only unharmful errors).

On the right-hand side of the graphics area, you will see the *Tools Window*. The *Fix Tab* on the *Tools Window* provides shortcuts to the commands available for repair, like Repair Shells and Fill Gaps commands. The *Help text* window at the lower part of the Tools Window also contains information for required repair actions. Command icons are greyed out while in Auto Repair process. We will learn more about these commands in the Tutorials, now we will follow the Auto Repair process.


Auto Repair is the best path to follow when repairing everyday models. Auto Repair will attempt to fix all shells with errors in the Model Tree. Especially when you only have one shell, like now, you should always try Auto Repair first. The parameters for Auto Repair are automatically set based on the model properties. *Normal Repair* is set because there is only one shell to repair, and *Fill gaps in all shells* is

set because there are no open/flat shells in the result (which would require offset or some other fixing methods available in 3Data Expert).

Press the Yes button to initiate Auto Repair now.

When Auto Repair is started each shell is run through the automatic repair command (*Fix Model > Repair Shells* command) using automatically calculated parameters. For each shell, a progress bar shows the progress of the repair. After the Auto Repair process the following Model Status message is displayed:
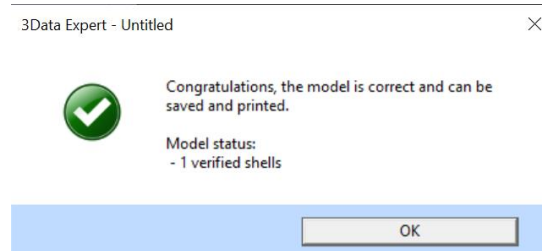
Press **OK** to close the window.

During Auto Repair, 3Data Expert fills all gaps and removes non-manifold triangles (overlapping triangles, multi-edge triangles, duplicate triangles, triangles having less than three neighbors, etc.) from the model. Overlapping and duplicate surfaces are analyzed and connected in the optimal way. If you want to learn more about triangle errors, please see the "Triangle errors" page in the Online Help chapter "Handling Faceted Files".

The *dino-connected.stl* model only has simple errors, like inverted triangles and gaps, which are all fully repaired during the Auto Repair process. The model is now correct and can be 3D printed (or taken into simulation software), as indicated by the status information in the Help text window below the Fix Model Tab on the right-hand side of the screen.
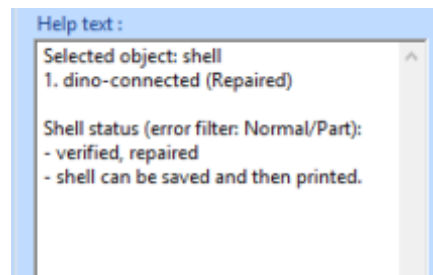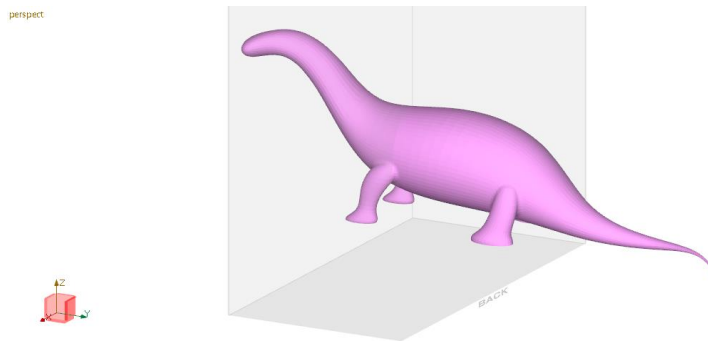

Workspace

When you open a file in 3Data Expert, a workspace is automatically added to the model and shown in the graphics window. In the case of the dino-connected.stl model, you get the following warning
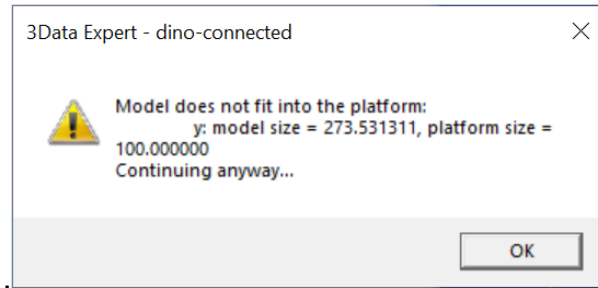
This happens because the dino model does not fit into the workspace in the y-direction.


Note that the coordinate axes indicator (at bottom-left in the dark theme) of the view shows as red the directions in which the model extends outside the workspace.

We do not concentrate on the workspace now. We will later teach how to split the model to be able to manufacture it with the printer specified in the *Print Configuration*. Now we will just turn off workspace display with *View > Show Platform* command (or the icon).
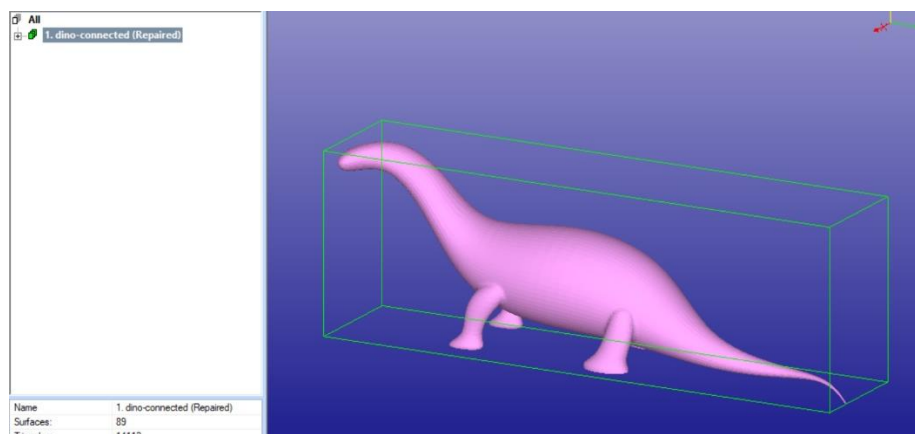
## Automatic positioning into workspace

By default, 3Data Expert just loads the geometry where it was in the input file. You can turn on automatic positioning if it better suits your workflow, in *Edit > Preferences*:
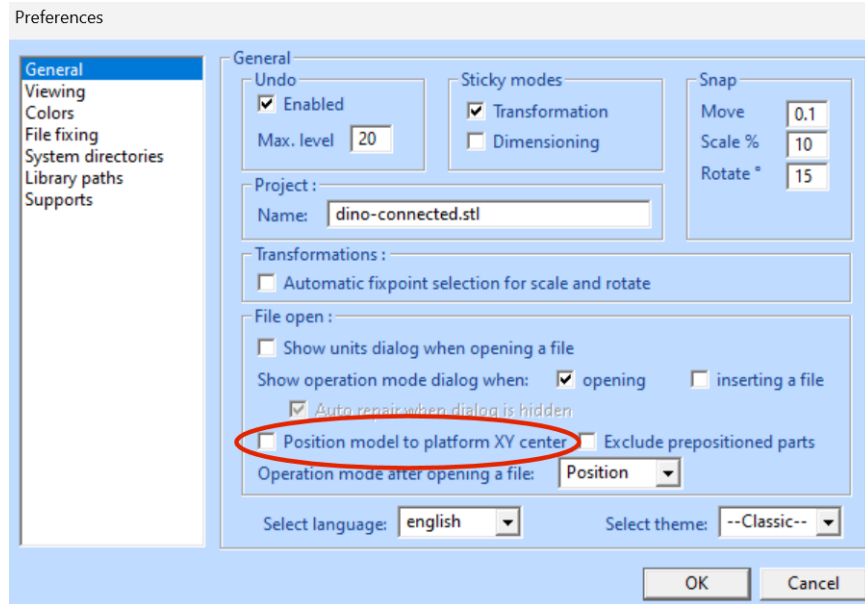
When the checkbox *Position model to platform XY center is turned on,* models are automatically positioned on the platform, around its center. Sometimes, mainly when importing models from other formats than STL, automatic positioning can move model parts in an undesired manner:
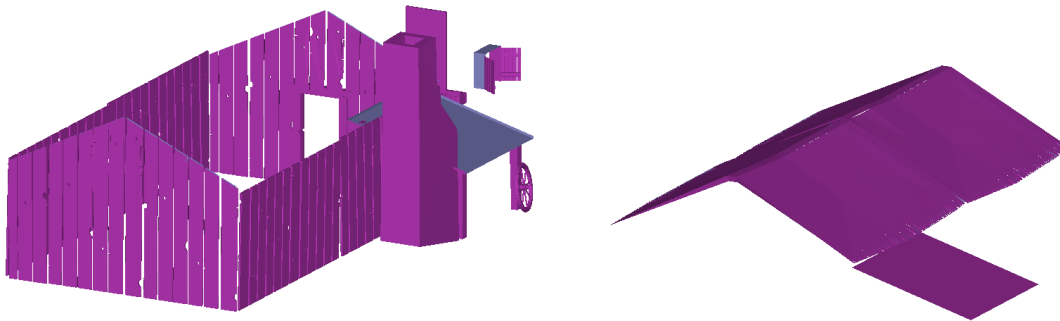
In this case you can simply "undo" automatic positioning to restore the model into its original position using command *Edit > Undo Input*:
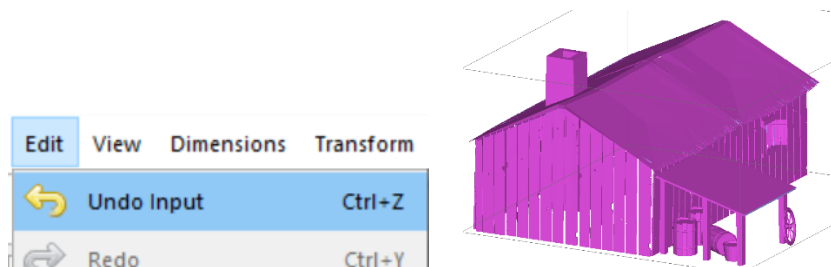
Basic viewing commands

You have just fixed your first model with 3Data Expert software. Now try the following commands to become familiar with viewing operations.

Note that the commands below do not alter the model's true 3D coordinates. They only alter the eye-point location:

- **Rotate** the model on the screen by pressing the *middle mouse* (*MMB*) and moving the cursor. MMB rotation is always available. *Left mouse button* (*LMB*) rotation is available most of the time except when working with painting, texturing, curve editing, and transformations, However, LMB is mostly used for selecting objects, as shown later. In case you do not have 3-button mouse, you can also use key combination Ctrl + Shift + LMB or Ctrl + Shift + *mouse wheel* (*MoW*).

- **Rotate** the model *around a selected surface point* by pressing the *right mouse button* (*RMB*) and moving the cursor. A blue cross indicating the rotation middle point appears on the part surface if the cursor is on top of the model when the *RMB* is pressed. When you keep the *Alt* key down before and during the RMB rotation, the nearest triangle corner is chosen as the rotation fix point.

- **Pan** the model by dragging with the *Shift + MMB* (or *LMB* most of the time) (*Shift + MMB* means pressing the Shift key and dragging with the mouse). For panning, you can also use *Shift + MoW.*

- **Pan** *with rubberband* by dragging with *Shift + RMB.*

- **Zoom in/out** by rotating the *MoW.*

- **Zoom in/out with** *Ctrl + MMB (or Ctrl + LMB).*

- **Zoom to box** *with Ctrl + RMB.*

- **Hide all** by pressing the   icon with LMB *(or F5)*

- **Show all** by pressing the   icon with LMB *(or F6)*

- **Fit the model** by pressing the   icon with LMB *(or F7).*

The main viewing command icons reside in the *Viewing Toolbar*:

Try them out now. The tooltips provide a short description of each icon (let the cursor remain on top of the icon for a short while to see the tooltip)*:*

Also, the *Viewing Planes* toolbar allows you to select any projection direction as the viewing direction with *LMB*:


You can show the green selection box around the selected object by pressing the Show Bounding box icon in the Viewing Toolbar:

Try also Clipping functionality through the Clipping Tab to look inside the model.

The Clipping Tab is opened with the icon. The clipped area can be displayed with different ways, like as wireframe or transparent.

Clipping also enables to extract real time slice information of the model. *Real time slices* can be used to visually check the model quality or be copied to the Model Tree for internal model dimensioning with the *Edit > Save Clip curves* command.
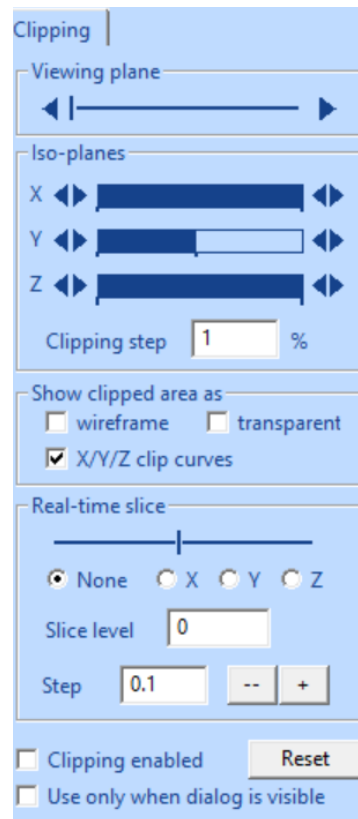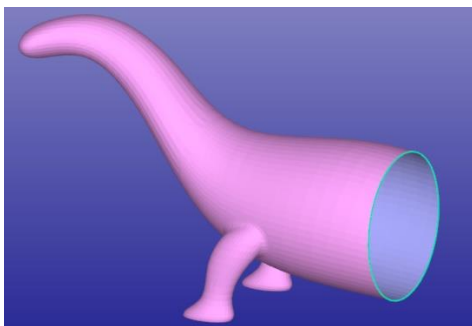
Selecting objects

On the left-hand side of the 3Data Expert software window, you can see the Model Tree tab.

This tab tells you the current contents of the program database. With this example you can see one *shell* (aka node, group) *1. dino-connected (Repaired)*. The node 1. includes the correct dino model, as indicated by the green ⬦ icon with the shell. The *(Repaired)* text describes the last command run on the surfaces, which in this case is repair.
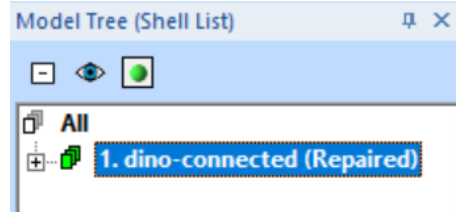
Above the model tree a row of object-dependent buttons is shown. Three buttons are always displayed: ⊟ for collapsing the tree, ◉ for showing or hiding the selected object, and ⬤ for fitting the selected object in the graphics window.

If you click the *+-icon* at the shell 1. it will open and display the separate triangle surfaces the *dino* model is made of. During the repair process the model is subdivided into separate surfaces along sharp edges. Triangle surfaces are indicated by a yellow triangle ⚠ icon and the last operation name, i.e., *1. Repaired* for the first and largest area triangle surface in the model and so forth.
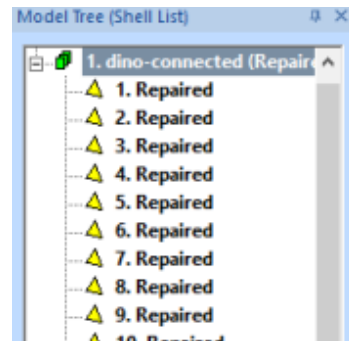
Below the model tree, properties of the selected object are displayed. The properties shown vary according to object type.

| Name	1. dino-connected (Rep...
Surfaces:	89
Triangles:	14112
⊞ Bounding b...	(-29.3866, 29.3867), (-9...
⊞ Extents:	58.7732, 273.5319, 91....
Volume:	211089.6094
Area:	27715.1914
File name:	dino-connected.stl
Directory name	C:\Program Files\Desk...

You can select objects at different levels either directly from the Model Tree with LMB click or graphically from the display area. For example, the fourth surface (*4. Repaired*) selected from the Model Tree corresponds to the sole of the front right leg of the *dino* model. This is indicated with some highlighting and a green bounding box around the selected surface in the display area:
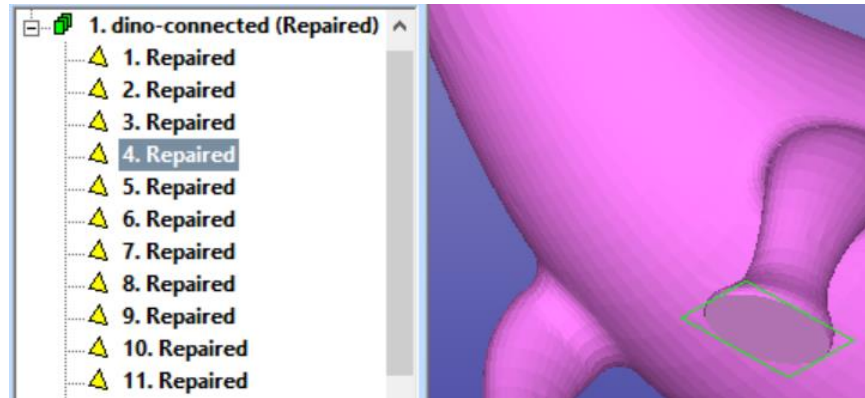
Different objects can also be selected graphically from the display area with LMB. On the right-hand side of the screen, you can see the Tools Window which includes the *Selection mode* icons.

The *Selection mode* icons allow you to set the graphical selection level to *All, Shell, Surface,* or *Gaps*. The default mode, *Shell* level, is shown "underlined" with a red band, as shown in the image on the right. If you click on the dino model on the screen with the LMB, shell *1. dino-connected (Repaired)* will be selected in the Model Tree.

Generally, the Tools Window contains handy shortcuts to available commands in the selected Operation Mode. The *Help text* window shows useful advice for the selected object or for the command in progress.
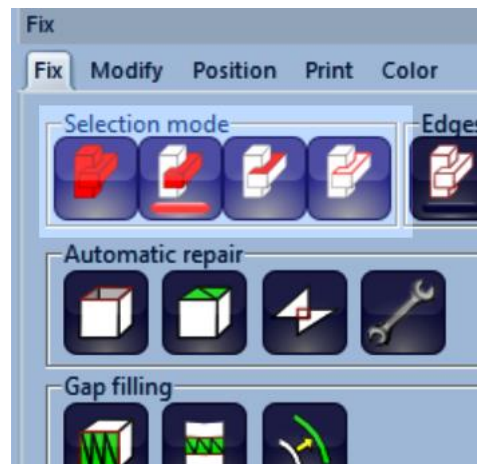
With DeskArtes 3Data Expert software you should normally select an object and then run the desired command on it, as seen in the next lesson.

Lesson 2 - Splitting and Combining STL

One of the most common tasks with 3D Printing is to split a large model into smaller pieces to fit into the build area. This lesson shows you how to split large STL models for Additive Manufacturing. Sometimes building a very tall part is more expensive than building two shorter parts simultaneously. Also, the building area may not be large enough for a very big part. Correct joining of the split parts is ensured by adding guiding pins to the models.

This lesson does not apply to the *Free module*. **Free**

### Splitting the *dino* model

Start by inputting the DeskArtes geometry file *DinoOk.3de* in the *Tutorials/GeomFiles* directory. **Give the *File > Open* command.** During the input you are prompted if the previous *dino-connected* model should be stored into *.3de* (DeskArtes proprietary format) file. You should press **No** when prompted and continue to the file Open window. Set the correct *File of type (.3de)* and **select the DinoOk.3de** file for input.
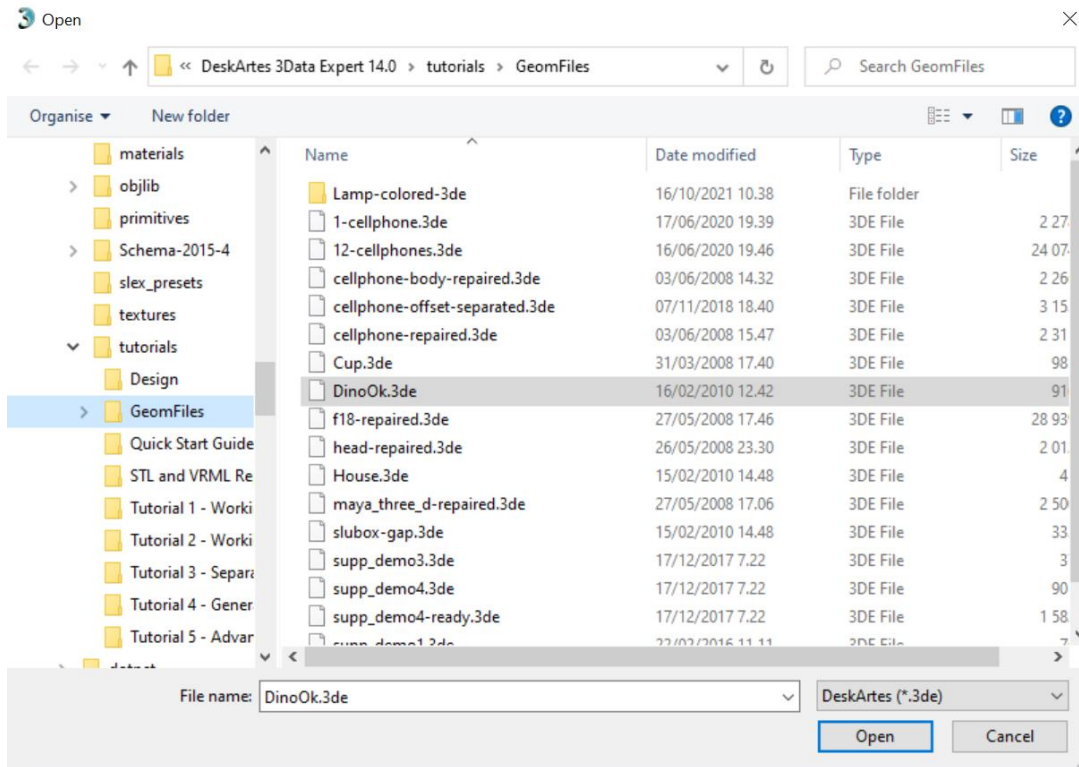
The file includes a correct triangulation of the familiar *dino* model. You should accept the proposed units and **go directly to the *Modify* mode** by pressing the *Modify* button (shown on the right) in the Operation Mode Window.
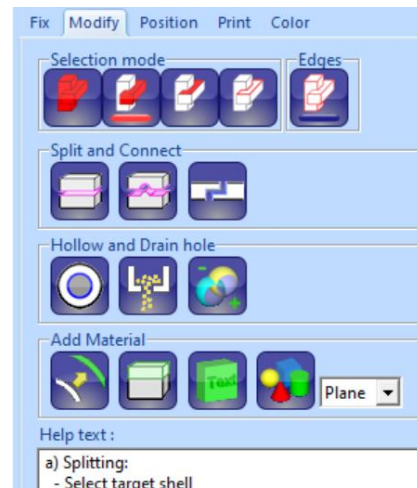

Modify

You should see the following dino model:
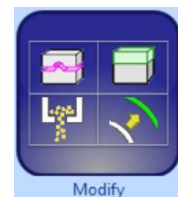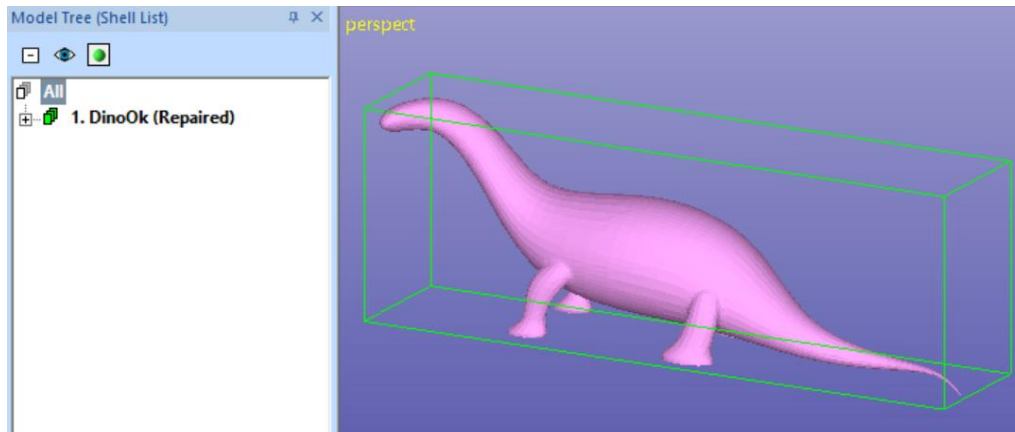
with the Modify Tab shown on the right-hand side of the screen.

The Modify Tab gives shortcuts to the mostly used model modification commands, like split, connect, add lap joint, hollow, offset, drain hole and 3D text. The Help Text provides context sensitive help to the commands.


Select node *1. DinoOk (Repaired)* by clicking it with the LMB in the Model Tree. Before the splitting, we must take a correct view to the model because the splitting plane is generated by extruding a user-defined split polygon away from the viewer. Normally, with 3D Printing the correct way is to split the model perpendicular to the z-axis to make the part lower. Thus, **take a view from the x-axis direction with** **+** *LMB (or View > Ortho View > Front (+X)).*
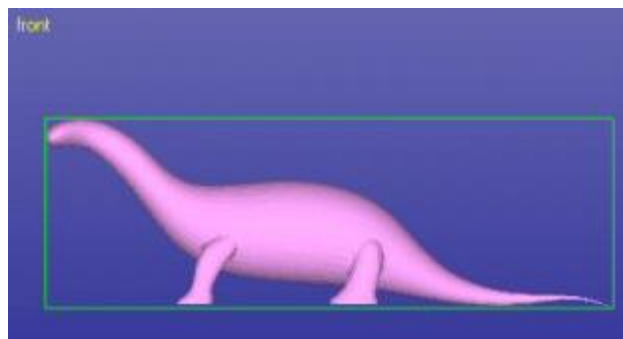
The splitting is started with command *Modify Faceted > Split* or with the command shortcut in the Modify tab:

The system prompts you to take the correct view direction if no yet set:
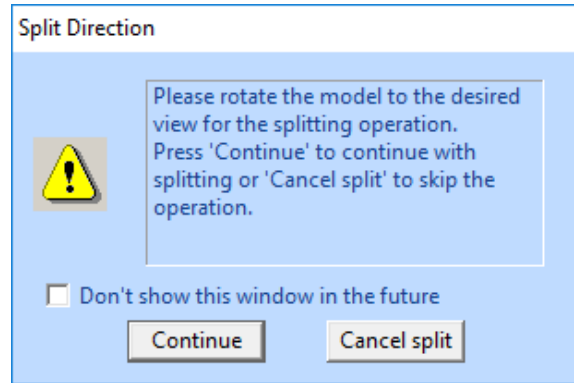
When the view is correct you can **press Continue** or Cancel to quit. You may hide this window permanently if necessary, by ticking the *"Don't show this window in the future"*.

The *Split STL* parameter dialog appears. The system asks you if you wish to use a *Polyline* (*linear), Curved* split line, or *Coordinate value.* We will **select *Polyline*** for this exercise:
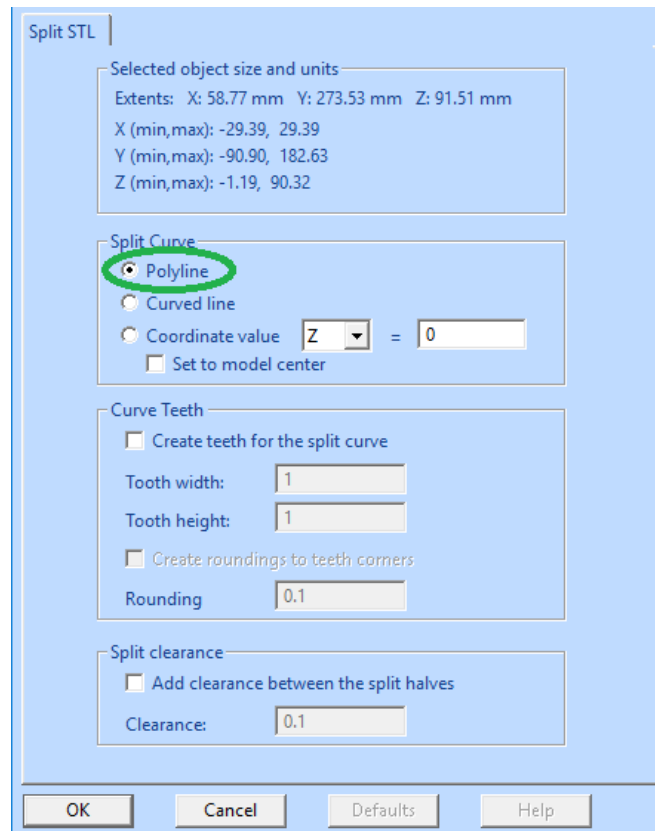
After pressing OK, the system goes into the curve edit mode where you can define the shape of the splitting surface. **Press OK** now to start the curve edit mode.

In the curve edit mode you can draw the shape for the splitting surface. **Draw a horizontal line by giving two points with the LMB clearly outside of the *dino* model** as seen in the image below:
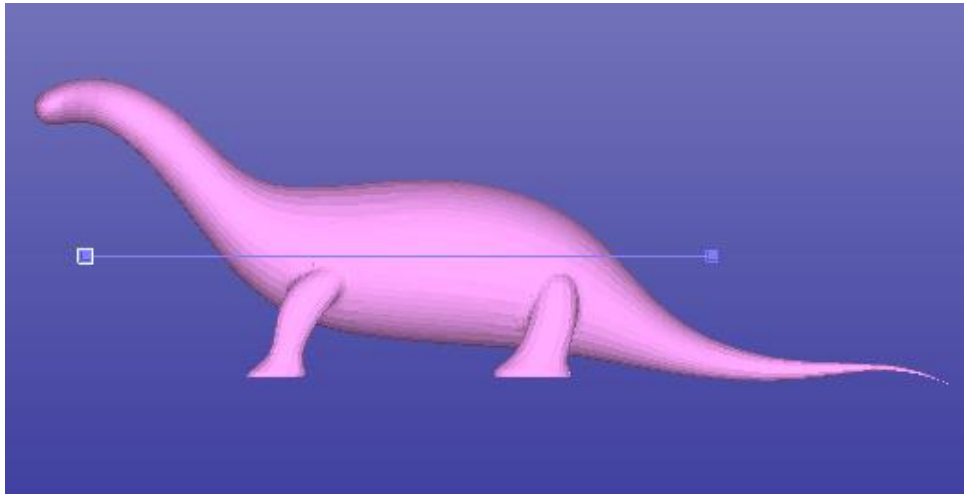
The curve editing is finished by **pressing the *RMB*** (or *ESC* key to cancel). When RMB is pressed the model is split along the plane defined with the polyline. After a while the result is available in the Model Tree. You can **select the upper part** with LMB click on the graphics area or selecting the correct shell from the Model Tree.
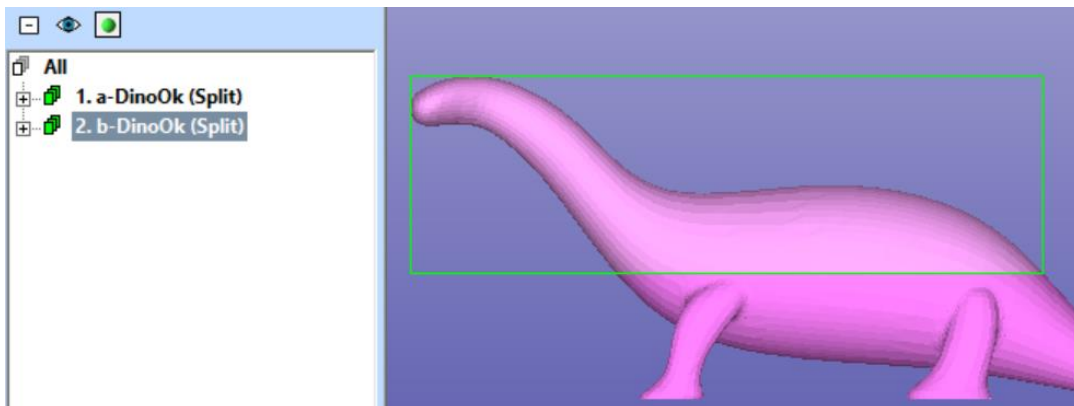

The two halves are named with prefixes *a-* and *b-* to distinguish between the shells above the split line and below the split line.

Creating the pins

We would now be able to position the separate parts of the model and store them into STL files for 3D Printing. However, precise joining of the printed components would be difficult or impossible. To be able to position the parts accurately we shall add pins in the models to connect them accurately together after finishing the build.

We will first locate the necessary primitives (sphere, cone, cylinder) which will connect the two parts together. For that purpose, we will need a nice view to point the pins on the model. Here we are also using the shaded+wireframe view mode available with the ![icon] icon.

Let's start. First **rotate the model, erase the screen and display the lower part of the dino**. Zoom in to the front end of the model to be able to accurately position the connectors with the next command.
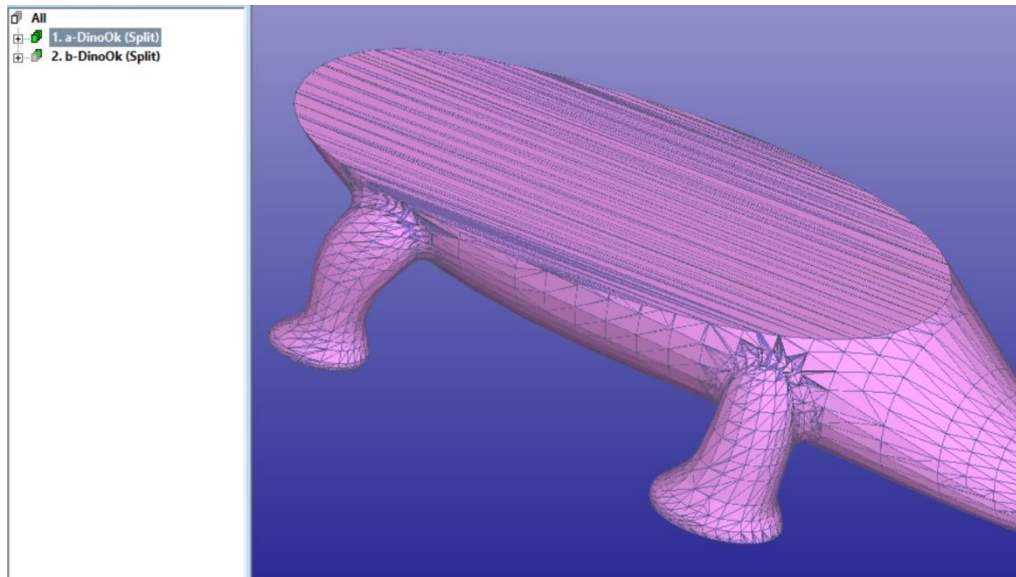
The pins are now **created with the *Modify Faceted > Connect* command** or using the Modify Tab shortcut

After the command is given, it is possible to give the *shape* and the *size* for the pin to be created. The software computes default values based on the model bounding box when *use default (1/10 of max ext)* is set. Now set *Diameter* and *Length* both to 10.0, as seen below:
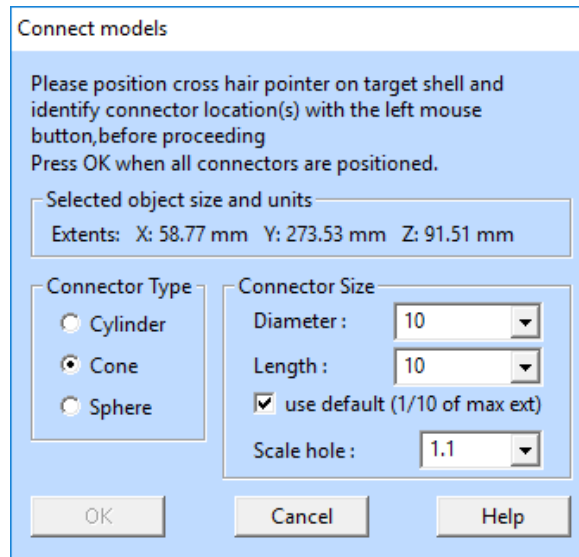
The pins are positioned with LMB clicks on the display area on top of the dino model. Give two locations, the positions for the red conical pin location indicators should look like the image below when set. Note that you can use the MMB zoom and MMB rotation to change the viewpoint when locating the connectors.

If a connector location is not correct you can remove it by clicking on the red indicator cone again. Then reposition with another LMB click on the correct location.
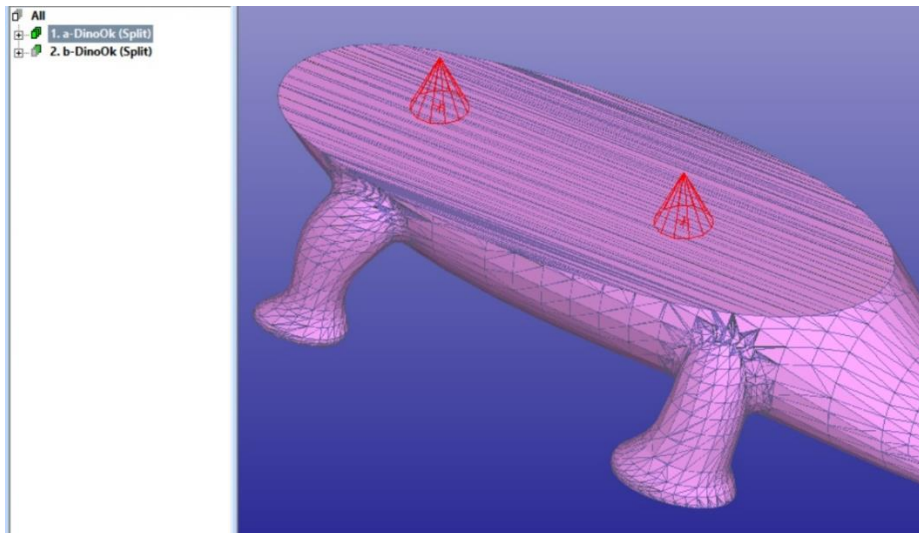
When ready **Press *OK* to generate the connectors.** After a while you will see the connectors added to the selected shell (in shaded mode again with the ⬤ icon):
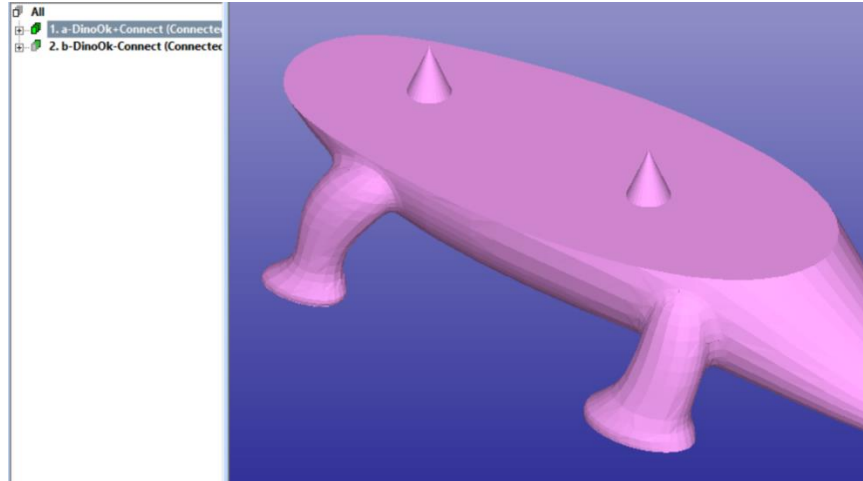
Corresponding holes are automatically created to the complementary component shell.

Transferring the result for 3D Printing

You can save both components into the same STL file by selecting the Model Tree root *All*. Anyhow, you usually want to build and position the parts separately in the 3D Printer. For that, select each shell separately and **output** it to a proper STL file **with *File > Save As* command**.

If you wish to save the two parts into one file, you should move the shells apart from each other with the *Transform or Print Preparation > Move to Platform* menu commands prior to outputting the model for 3D Printing. To output one file, select the Model Tree root All before the File > Save As command.

Further Reading

This *Quick Start Guide* has given you the skills to

- Verify and repair models with moderate or few errors for 3D Printing.

- Model splitting for building with systems having smaller build areas than the part size.

- Data transfer of the repaired model to further processes has also been explained.

Each 3Data Expert software comes with a set of useful tutorials available through *Help > Tutorial Documents* menu.

More information and other STL manipulation tools can be found in the *Handling Faceted Files* section of the application Help pages. These pages contain information on model verifying, repairing, splitting, offsetting and hollowing for Additive Manufacturing.