

# rhinoreverse™

Version 2 (for Rhinoceros® 4)

## Tutorial



02. August 2007

rhinoreverse™ is plug-in software for the CAD-system Rhinoceros® (www.rhino3d.com). The purpose is to create spline-faces based on a given mesh of point data. The user interactions have been reduced to sketching boundary curves for the new faces. All calculations for approximation and adjustments of transitions will be done automatically. This leads to a very simple and intuitive handling of the software. One big advantage is the option to represent large complex shapes by only a few faces.

Different interfaces to read point data are available:

**Input:** \*.stl, \*.pol, \*.wrl, \*.vrml, \*.af, \*.nas

rhinoreverse is easy to use and it is a cost saving alternative to other reverse engineering solutions. rhinoreverse is a product of iCapp GmbH.

New in Version 2:

- **More design flexibility and high data quality.** N-sided faces with more than four boundary curves can now be sketched by the user. The accordant trimmed faces are created automatically and the seams are adjusted to reach Rhinos stitching tolerance. The resulting faces, ready for any solid modelling operation, show high accuracy (close to the given mesh) and smooth transitions.
- **Ease of use.** rhinoreverse offers to work on the command level of Rhino 4. This makes the use lean and fast.
- **Simplified data management.** All data are now stored within Rhinos' 3dm-file. Extra files will no longer be needed to store rhinoreverse's mesh and grid information.

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## Content

### ***Download and install rhinoreverse™ software:***

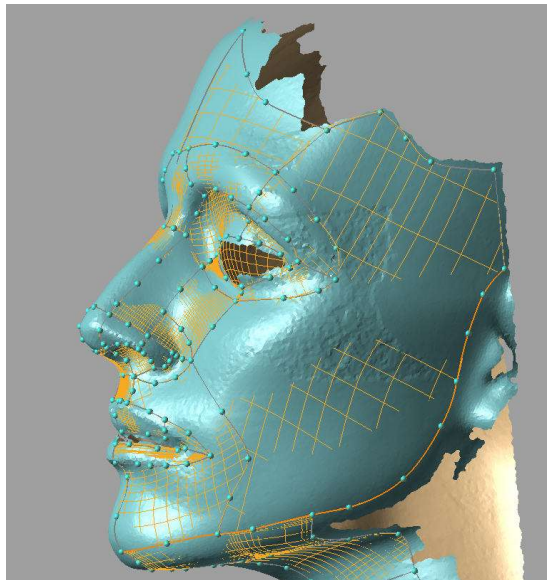
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### ***Created the faces within 3 steps:***

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*The meaning of “poly lines” is to divide the mesh surface like a grid. The poly lines should be placed near curvature changes. Each cell of the grid, which is completely bounded by poly lines, will be approximated automatically by one spline-face.*

## 1. Download

1. Make sure, that Rhino is already installed on your computer.
2. Download the installation version of rhinoreverse from the web-site [www.rhinoreverse.icapp.ch](http://www.rhinoreverse.icapp.ch). A request window will appear:



The image shows a web form for downloading rhinoreverse. It has the title 'rhinoreverse™' and a sub-header 'Download information will be sent to:'. Below this are two input fields: 'EMail Address \*' and 'Real Name:'. A 'Submit' button is located below the fields. At the bottom left is the iCapp logo with the tagline 'Speed up your design'. At the bottom right is the contact information for iCapp GmbH: 'Technoparkstr. 1, CH-8005 Zürich, contact@icapp.ch'.

3. Please enter at least your valid email address. The download location will be send to this email address:

```
Please download RhinoReverse.zip at
http://www.icapp.ch/iCapp-Daten/http-Download/1B3\_RhinoReverse.zip

For further information visit http://rhinoreverse.icapp.ch/
Some examples can be found in:
http://www.icapp.ch/rhinoreverse/download/DemoData.zip

Please do not hesitate to contact mailto:rhinoreverse@icapp.ch
if you have any questions or suggestions

Enjoy!
```

4. Click on the given link and save the rhinoreverse-zip-file to the C-partition (hard disk) of the computer, where you want to install the software.

**Attention:** The installation can fail, if the installation files have been stored on any other disk and you try to install via network link!

5. Unzip the installation file and run file "Setup.exe". The installation will be done automatically. Please follow the installation process.

## 2. Install the plug-in

The installation of the plug-in shall be done automatically. If not, please use Rhinos plug-in manager. You will be asked for a license.



*rhinoreverse license request*

With clicking on the button **Trial (15)...** you can test the software as long as your trial period is valid (number of remaining days is displayed in brackets). If you want to buy a license, please click on **Mail License Request**. An automatically created email including your Node-ID will be prepared. Send the mail directly to iCapp GmbH (rhinoreverse@icapp.ch). iCapp will generate a valid license key for the use on your computer only. Please enter the returned license key to the field of the dialog and click on **Register**.

- **Example Data** will be copied to "Install-path\RhinoReverse\Example\_Data".
- **Tutorial**. The tutorial can be opened by Rhinos help-mechanism: Help/Plug-ins/Rhinoreverse. The corresponding file "Tutorial\_Eng.PDF" is stored in directory "Install-path\RhinoReverse\Tutorial".

### 3. Start Rhino 4

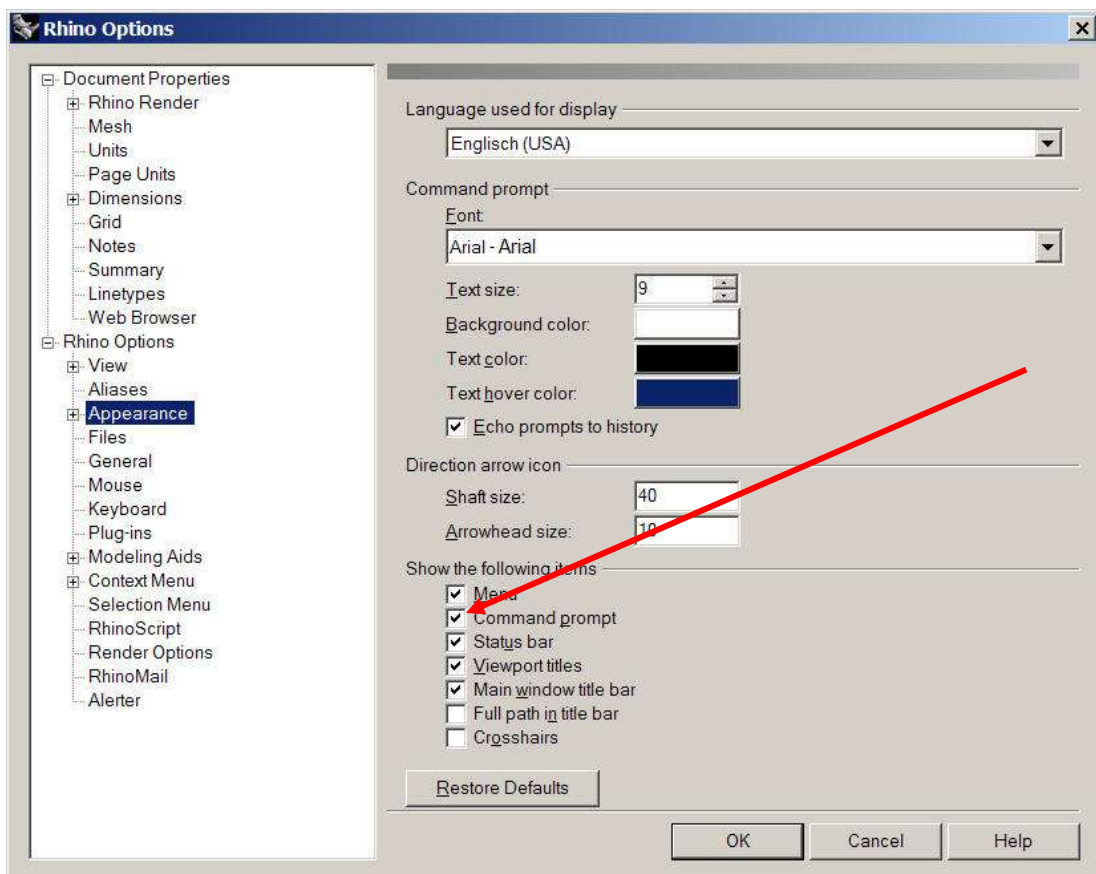
Start Rhino 4 by using the start menu of your windows system. rhinoreverse will automatically be initialised. The toolbar will appear.



*rhinoreverse toolbar*

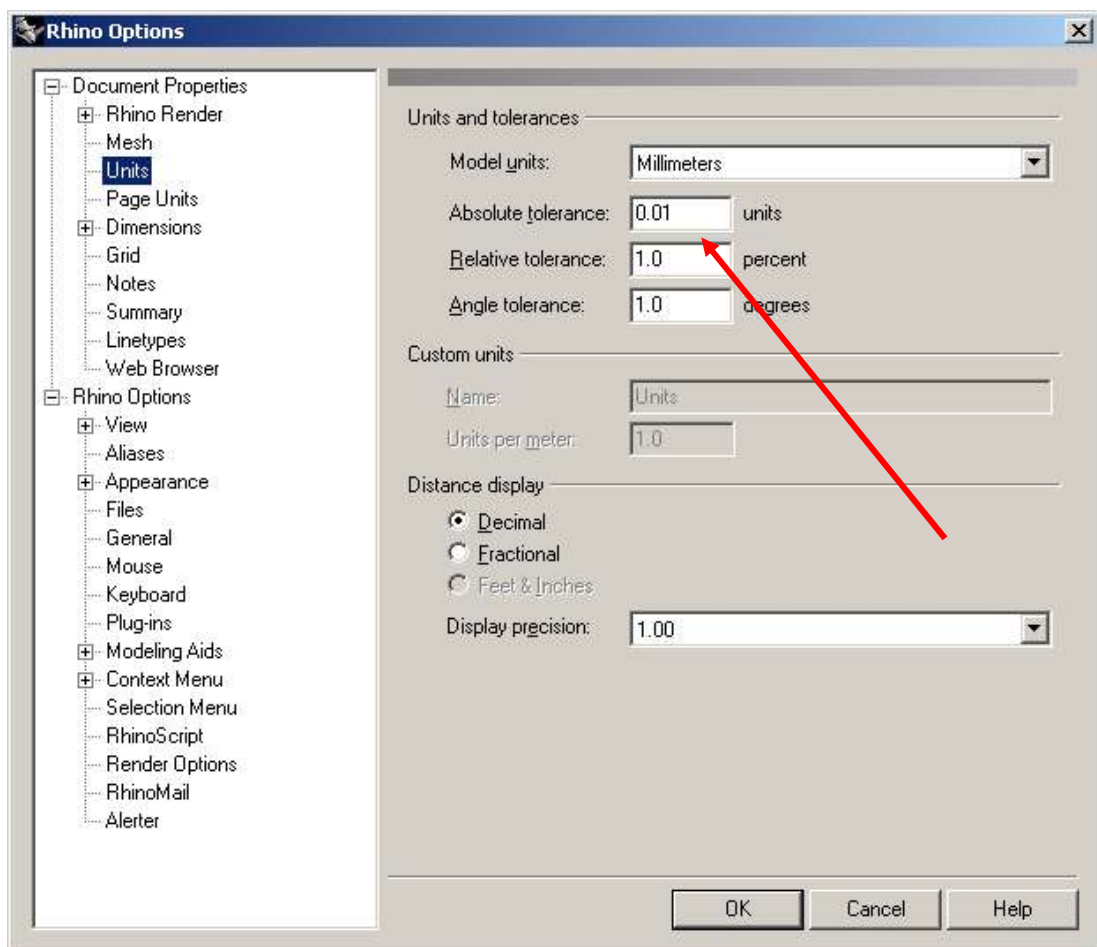
After calling any of rhinoreverse's commands, the menu-entry **iCapp Tools** will also be shown in the menu. If you want to use the command mode, make sure that the command prompt of Rhino is active:

Click on the menu entry **Tools/Options**, display the option-set **Appearance** and activate the option **Command prompt**.



*Activate the command prompt*

- a. Check Rhinos default **Absolute Tolerances** in the menu Tools/Options/Units. If it is too small, rhinoreverse will refine the new faces a lot in order to reach the tolerance at the transitions (0.01 seems to be reasonable value for a model space of 1000 mm).



*Check Absolute Tolerance*

## 4. Load mesh data

**Attention:** You find all functions in the menu **iCapp Tools**. They also can be executed by enter them in the command window of Rhino. The commands have the same name, but use the additional prefix **RR**. If you type **RR** in the command window of Rhino, you will get a list of all available **rhinoreverse** commands. You will also find a list at the end of this document.

- a. Click on the menu-entry **LoadMesh** (command: **RRLoadMesh**) to open any mesh file. Select any available rhino-mesh-object and enter or press option “f” to read a mesh from file. Following file formats are available: \*.stl (Stereo-Lithography), \*.pol (PolyWork V1), \*.wrl and \*.vrmf.

**Attention 1:** The given point cloud must be meshed. Point clouds, that exists of independent points, can not be used!

**Attention 2:** Big data amount leads to a slow view management and data handling. In this case a reduced data displaying will be done.

## 5. Define faces by sketching poly lines

Please check the internal parameter for the measurement uncertainty if you use meshes coming from measurement devices. **rhinoreverse** could produce wrinkles if this tolerance is too small. If it is too high, the resulting faces could get larger distances to the mesh. Please call **RROptions** and adjust the **RMS** parameter (see section 8).

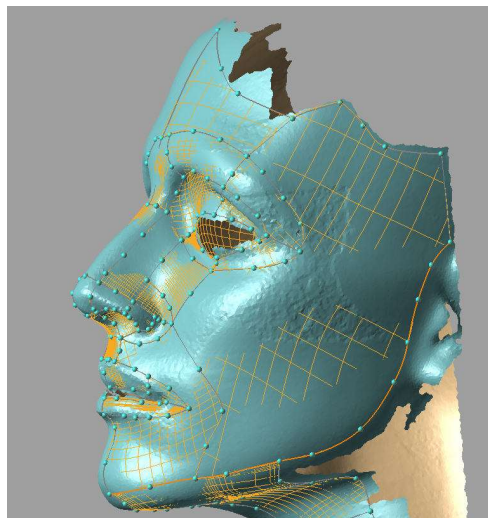
**Example “Head”:** The given mesh data

“Install-path\RhinoReverse\Example\_Data\Head\_start.pol” comes from a laser scanner, the measurement uncertainty was approx. 0,25 mm. In this case we have to set RMS to 0,25 (default: 0.1).



## 5.1 Sketch poly lines

- a. Click on the menu-entry **Edit Grid** (command: **RREditGrid**) to activate the edit-mode. (if your last call was RRLoadMesh, the grid mode will automatically be activated).
- b. **Click with the left mouse button** somewhere on the mesh. The first point of a poly line curve will be set.
- c. **Moving the mouse** will show you (preview) all options to go on defining points for the current poly line. Clicking with the left mouse button will accept the preview and set the current point.



*Every closed loop of poly lines defines one face (max. 25 poly lines).*

When a closed loop is ready, the loop will be filled with one face. Poly lines that consist of only one single point will be deleted automatically from time to time.

## 5.2 Edit poly lines

- a. **Activate** any poly line by clicking with the left mouse button on the line. The active poly line is highlighted in orange.

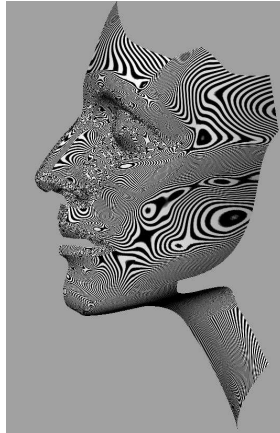
- b. **Move** single points of the active line, by selecting and moving them with the left mouse button.
- c. **Delete points.** Activate the point with the left mouse button and press key **Delete** of your keyboard.
- d. **Delete poly lines.** Activate the poly line and press key **Delete**. If no point is shown in red the active line, shown in orange will be deleted.

## 6. Calculate faces

Please define a grid of poly lines, which covers the loaded mesh data. Start-faces will be calculated automatically and displayed. When transferring these intermediate face data to Rhino, using the menu entry **Commit** (command: **RRCommit**) an automatic healing will adjust the transitions (positions and tangents) between the faces.

**Attention:** *Sometimes the displaying mode is not sufficient for the current job. Please call **RROptions** then to change the display options. Enter OK to apply the changes. Find more about the options in chapter “Additional Tools”.*

- a. **Transitions between faces.** To check the transitions between the faces several Rhino-Commands are available (like the typical zebra-plot). If the resulting quality does not satisfy the users needs, one can use rhinoreverse's heal command (**RRHeal**) on a selected set of faces to improve the transitions.



*Zebra plot in Rhino*

## 7. Calculate Curves

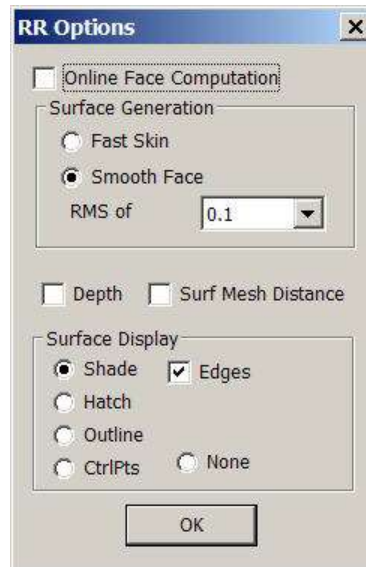
The user also has the option to transport the designed poly lines as curve-entities to Rhino. Please use menu-item **Commit** (command: **RRCommit**) and set the option Curves.



*Wireframe curves in Rhino, defined by poly lines in rhinoreverse*

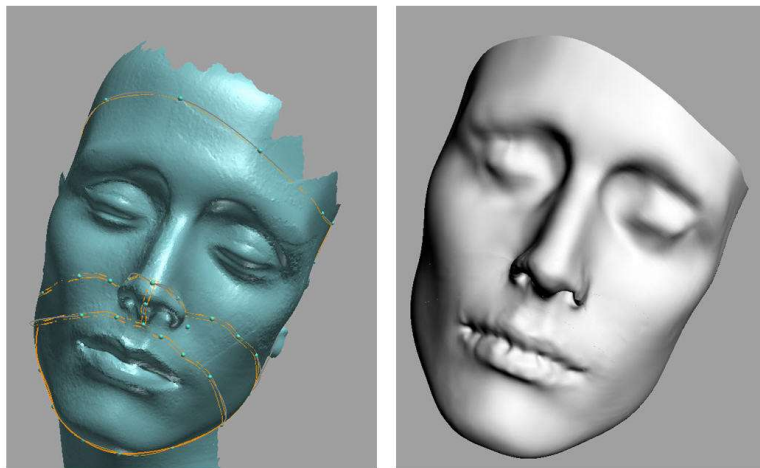
## 8. Additional Tools

- a. **Options**. Opens a dialog to set some specific options for rhinoreverse (command: **RROptions**).



*rhinoreverse Options*

- **Online Face Computation - on -**. Face approximation will be done automatically (if the option is off, the approximation will be done when calling “Commit”). The default setting is –off-.
- **Surface Generation - Fast Skin -**. Fast and robust skinning method will be used for the fast calculation of rough faces.







*Fast Skin Method: The boundary curves of 4 faces (left) have been sketched easily to calculate NURBS faces (right). The result of such fast and simple method could show little ripples (see the mouth).*

- **Surface Generation - Smooth face -**. Accurate approximation method will be used.
  - **RMS of X [units]**. Expected measurement uncertainty or white noise of the mesh, coming from any measurement device. The setting limits the approximation iteration to an adjusted, meaningful internal tolerance. Please adjust the setting to the white noise of your mesh.
  - **Depth Test - on -**. Hidden objects will not be displayed.
  - **Surf Mesh Distance**. Please set also option “Online Face Computation” on –true-. When now modifying any poly line point the affected faces will be recomputed and also a color plot will be shown. This option is still experimental! The color scaling depends on the current setting for the white noise of the mesh (RMS). The color scaling goes from green over yellow to red. Green colors the range between +/- 1x RMS, yellow between +/- 2xRMS and red +/- 3xRMS).
  - **Surface display - Shade -**. The faces will be shown in shaded view.
  - **Surface display - Hatch -**. The faces will be displayed by their iso-curves only to get a transparent view on the mesh and the grid.
  - **Surface display - Outline -**. Only the outlines will be shown with an offset to the inside. This option is to control closed and open loops.
  - **Surface display - CtrlPts -**. The control polygons of the faces will be displayed.
  - **Surface display - none -**. Switches off the displaying of faces.
- b. **Heal**. All transitions of a selected set of faces will be adjusted automatically to reach Rhinos “Absolute Tolerance” and to reach also as good as possible Rhinos “Angle Tolerance” (command: **RRHeal**).



- c. **Patch**. When designing a face model it often appears, that the user wants to close a hole between several faces and he only needs a resulting face which runs tangential to the neighbouring faces keeping also the boundary curves. The menu-item **Patch** (command: **RRPatch**) enables to close such holes automatically. After calling the command, the user has to select the boundary curves of the faces, which do not have to build a closed loop.

## Tabulations

Commands, that deal with our mesh and grid structure:

Tool	Menu-Entry	Command	Description
	<b>Load Mesh</b>	<b>RRLoadMesh</b>	Load any mesh data file
	<b>Edit Grid</b>	<b>RREditGrid</b>	Display the grid, which belongs to the selected mesh. Enable modifications.
	<b>Commit</b>	<b>RRCommit</b>	Adjust the transitions of rhinoreverse faces and transport the faces (curves) to the Rhino model
	<b>Options</b>	<b>RROptions</b>	Set tolerance and display options
	<b>Hide Mesh</b>	<b>RRHideMesh</b>	Hide or show the mesh object
	<b>ImportGridV1</b>	<b>RRImportGridV1</b>	Enables to import grid files, that have been designed with RhinoReverse version 1.

Additional tools, that work on faces:

	<b>Heal</b>	<b>RRHeal</b>	All transitions of a selected set of faces will be adjusted automatically to reach Rhinos "Absolute Tolerance" and to reach as good as possible Rhinos "Angle Tolerance".
	<b>Patch</b>	<b>RRPatch</b>	Covers a open or closed loop of selected face boundary curves.