

Cimatron[®]



Cimatron
CAD/CAM Solutions for Manufacturing

Re-Engine

Version 12



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Revised 2001.



Preface

Cimatron develops, markets and supports tools to automate the mechanical engineering process. Our systems support all phases of product development, with solutions for computer aided design (CAD) and manufacturing (CAM). **Cimatron's integrated technology** approach combines design tools with optimized command output to computer-controlled manufacturing equipment. Drafting-table-to-shopfloor integration lets Cimatron clients realize dramatic efficiencies in product development and manufacturing.

Cimatron^{it} - Cimatron's flagship product - covers the entire spectrum of design, engineering and manufacturing processes, including:

- A complete range of **wireframe, surface and parametric solid modeling tools** with rendering capabilities;
- Advanced **assembly, sub-assembly and part management**, and **associative drafting functionality**;
- Comprehensive, accurate **data exchange interface utilities** covering **DXF, DWG, IGES, JAMA-IS, VDA, PTC, STEP, SAT, CATIA** and **UNIGRAPHICS**;
- Powerful and intelligent **NC applications** for precise multi-axis machining.

The modular yet integrated structure of Cimatron^{it} grows to accommodate cutting edge tools and techniques. These now include the new **Quick Tooling** applications:

- **QuickSplit**

QuickSplit automates the search and separation of core, cavity and sliders to assist in determining the number of actions required to create a mold. After separating core, cavity and slides, QuickSplit identifies the parting lines and generates the parting surface.

Automatic and interactive tools allow the construction of parting surfaces for any complex geometry. Embedded Draft Analysis enables designers to identify potential problems with undercuts and confirm minimum draft per side.

QuickSplit is tolerant of surface models with gaps, mismatched boundaries or missing faces, therefore bypassing data corrections and saving precious time.

Component motion animation, dynamic cross-sectioning and clipping planes, reduce human error and verify parting design. QuickSplit enables several trial and error iterations in a very short time - resulting in optimal draw directions.

- **QuickElectrode**

QuickElectrode is an EDM electrode design solution used for shortening the electrode process. QuickElectrode is used for burn area selection, electrode design, management, documentation and manufacturing.

The QuickElectrode Navigator enables full control over the display and activation of electrodes, while allowing several users to collaborate on the same part.

QuickElectrode's report generation features includes set-up sheets, burn location

reports and a full electrode schedule, thereby alleviating the tedious task of documenting the process .

- **QuickConcept**

QuickConcept is a preliminary design and review package which allows tool designers and their suppliers to hold *virtual* review meetings over the Internet in real-time. Multiple users can connect to each other to section, label, dimension, and identify points of interest and problem areas of any given tool. All members of the review meeting will interactively view the same screen at the same time.

- **QuickCompare**

QuickCompare assists the tool designer in determining the scope and effect of Engineering Changes (ECOs) on the tooling process. QuickCompare mathematically compares the geometrical differences between two sets, graphically marks these differences and documents the changes in a CAD file. Here, the designer updates related components and tooling, while archiving ECOs. The typically long *CAD investigation process* is significantly shortened. QuickCompare ensures that all ECOs have been located, whether or not they were communicated from design.

- **MoldBase 3D**

MoldBase3D offers an innovative *wizard-based* approach to parametric mold base design. MoldBase3D automatically creates 3D solid (parametric & associative) moldbases, with all components and accessories, from industry-standard catalog suppliers such as HASCO, DME, PCS, FUTABA, DMS, PEDROTTI, RADOUREDIN, SIDECO, STRACK and MISUMI. Creation of the assembly and detailed drawings of each plate are automated, complete with 2D and 3D section views, ordinate dimensions, labels, balloons, and an itemized Bill of Materials. This module is fully associative to the mold design and changes are automatically reflected in all stages of the design process.

Cimatron's automated engineering expertise benefits many industries, as competition requires tighter development cycles and efficient fabrication.

Powerful modules within Cimatron^{it} expand your system's capabilities. These may be purchased from your Cimatron representative.

This publication provides a detailed description of the major features of the appropriate Cimatron^{it} application/topic. It is intended to help users in the daily operation of Cimatron^{it}.

A list of Cimatron^{it} documentation, for the current version, is shown on the next page.

Cimatron Documentation

Cimatron^{it} documentation comprises Reference Manuals, On-Line Help and Tutorials which together provide a comprehensive guide to Cimatron^{it}.

The list of Cimatron^{it} documentation, for the current version, is as follows:

Cimatron ^{it} Reference Manuals	Publication	Description	Display Options *
	Fundamentals & General Functions	Introduction to the fundamentals of Cimatron ^{it} and description of the General functions.	A H
	Modeling	Description of the wireframe and surface Modeling functions.	A H
	QuickSplit	QuickSplit automates the search and separation of core, cavity and sliders to assist in determining the number of actions required to create a mold.	A H
	QuickElectrode	QuickElectrode is an EDM electrode design solution used for shortening the electrode process.	A H
	QuickCompare	QuickCompare mathematically compares the geometrical differences between two models, graphically marks these differences and documents the changes in a CAD file.	A H
	Drafting	Description of the Drafting functions.	A H
	Solid Modeling	Solid Modeling functions including Sketcher.	A H
	MoldBase 3D	Description of the functions associated with the detailed design of mold plates and components. MoldBase3D offers an innovative <i>wizard-based</i> approach to parametric mold base design.	A W
	Numerical Control	Description of the NC functions.	A H
	Cimatron IMSPost	Cimatron IMSPost is a macro-based system for developing and customizing postprocessors.	A W
	General Post Processor	General Post Processor (GPP) functions.	A
	Finite Element Modeling	Description of Finite Element Modeling (FEM) functions.	A H
	Utilities	Various utilities that may be used with Cimatron ^{it} . These utilities are either Internal , run via the USER function, or External , run via the Main Menu.	A H
	Data Interface Utilities	Description of Cimatron's <i>comprehensive</i> data interface utilities; DXF, DWG, IGES, JAMA-IS, VDA, PTC, STEP, SAT, CATIA and UNIGRAPHICS.	A W
	CimaDEK	Cimatron's specialized Developer's kit, for programming customized functions.	A
	CimaRender Pro	A photo-realistic rendering package.	A W
	MPDM: Getting Started MPDM: Administrator	Description of how to use Manufacturing Product Data Management to track and organize all files and data associated with a project.	A W
	Re-Enge	Description of Reverse Engineering design functions.	A
Cimatron ^{it} Tutorials	Design - covers QuickCompare and QuickElectrode .		A H
	Drafting - covers the DMS function.		A H
	NC - covers the differences between versions 11 and 12.		A H

* Legend:

A	Acrobat PDF
H	HTML
W	Winhelp



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Introduction

How can designers incorporate digitized data into their design database - and how can manufacturers reverse-engineer existing parts with the speed and precision necessary to make a profit?

Re-Enge brings the shapes and contours of physical objects into the **Cimatron** CAD/CAM environment. Using Re-Enge, you can import infinitely large point clouds - yet its speed, precision, and ease of use will help you finish the job accurately, on time - the first time.

Powerful tools transform 3D point data into smooth, precise CAD surfaces, STL meshes, and splines. The resulting smooth CAD shapes are identical to parametric entities generated in **Cimatron** itself, and you can use the full **Cimatron** toolkit to expand on the design, add mold drafts, and generate NC toolpaths to mill the finished shape.

Point data may be obtained from a variety of sources, including Coordinate Measuring Machines (CMM), laser digitizers, Touch Probes mounted on milling machines.

Overview

- Input of Point Data.
- Visualization of Point Data.
- Point Cloud Reduction by Filtering.
- Point Cloud Division by Stenciling and Manual Editing.
- Point Cloud Planar Projections.
- Point Cloud Sectioning.
- Point Cloud Ordering.
- Break Points within Point Clouds.
- 2D and 3D Curve Fitting.
- NURBS Surfaces creation directly from the point data.
- SLA mesh creation from point data.
- STL file generation.
- Save a point data file into ASCII or Binary format.

Point Data

A point cloud is a collection of data points in space. Every single point in the point cloud is defined by the triplet $X Y Z$. These triplets are measured from the physical model. All digitizers create an approximation to the physical object by measuring a number of discrete points. See Figure I-1. The quality of the resultant geometry created by Re-Engage is directly dependent upon the quality of the digitized point data used in input.

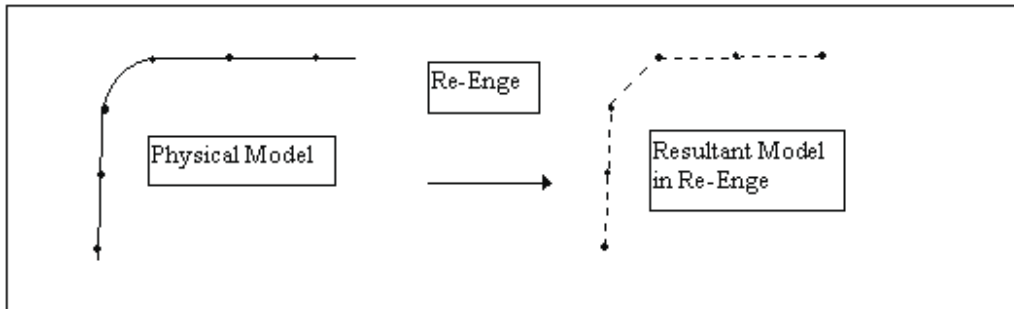


Figure I-1: Approximation to the Physical Model

Point data may be classified into single valued or multi-valued data. A single valued point cloud is one in which for every coordinate pair XY , there exists one (and only one) Z value. See Figure I-2.

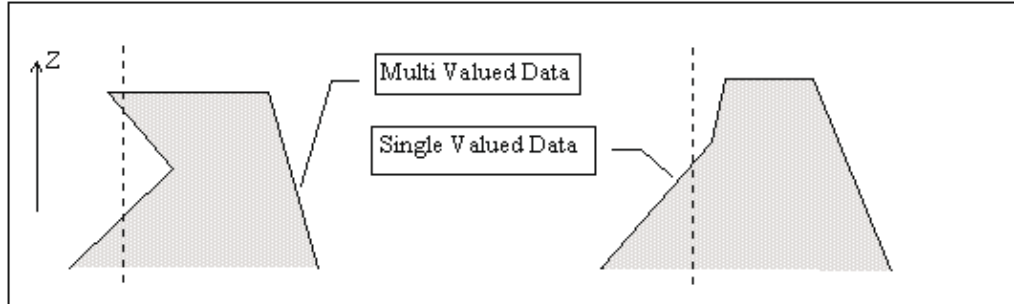


Figure I-2: Single and Multi Valued Objects

Point data forms the starting point for all operations in Re-Eng. There are two main classes into which most point clouds may be classified. See Figure I-3.

- Scan line or sections
- Random

Re-Eng can read and treat both classes of point data.

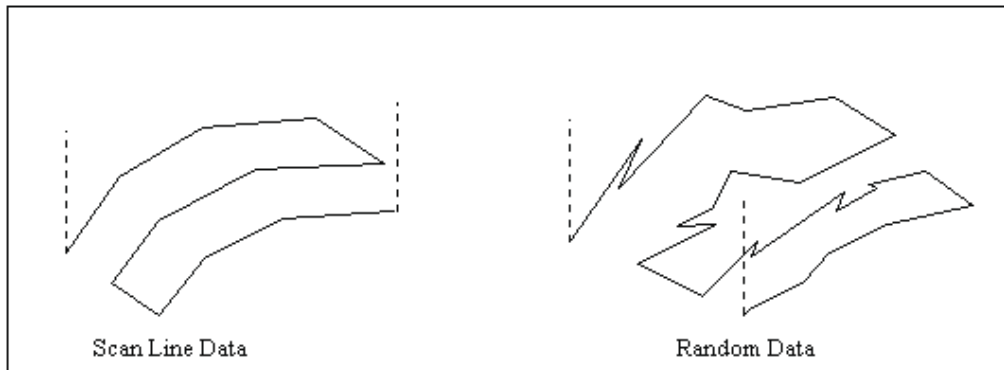


Figure I-3: POINT DATA CLASSES

- Note:**
- Only point clouds located on displayed levels will be loaded into ReEng.
 - Points may only be picked from point clouds located on visible levels.

Acceptable Point Data Formats

Re-Eng can be configured via the ReEng ASCII Processor (RAP) to read most ASCII data formats.

In addition to the above, Re-Eng supports two data formats of its own: Re-Eng binary format (**filename.mdb**) and Re-Eng ASCII format (**filename.mda**).

The location of the RAP configuration files is as follows:

- **<cim_root>\var\re_eng\filter** under Windows/NT

and the file name is generically **config.<ext>**

For example, in order to read SNK format files, a configuration file - **config.snk** should be placed in the RAP configuration files directory: the data file should have **snk** extension.

For details of how to configure the RAP and sample files, see Appendix A.

When a data file is read, a point cloud is created in Re-Eng. This point cloud contains all the data points in the input file. A point cloud is represented in Re-Eng as a Point Cloud Entry. Every Point Cloud Entry has an associated bounding box, which is the smallest axis aligned box which contains all the data points.

The Windows file browser is now used for file input and output.

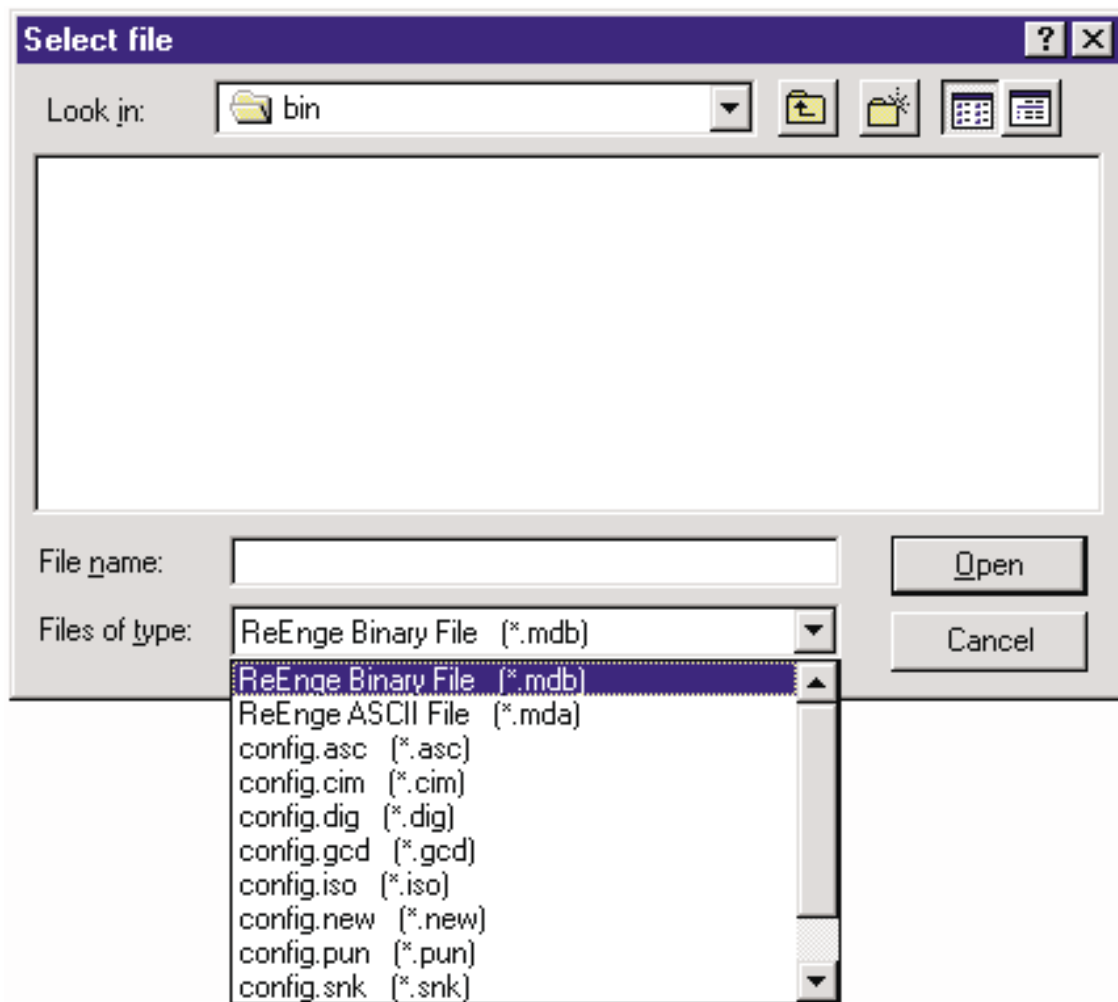


Figure I-4: Windows Browser for Input/Output File

- Note:**
- All filters found in the re_eng/filter directory are added to the file selection list.

□



Chapter 1

The Interface

The Interface Menu

The Interface menu area is divided into two zones: the Command Zone, composed of 15 modals, and the Point Cloud Zone. Initially, although the Point Cloud Zone contains one entry, i.e. the Empty Cloud, a new entry is added for every new point cloud.

The Command Zone

There are five pages of commands, each page contains the commands relative to a geometrical element, or in the case of the **GLOBAL** page, commands which have global scope. The top right hand modal indicates which page is currently active, the select page modal.

There are two types of commands, multiple and single. **Multiple** commands are applicable to more than one geometrical element at a time, for example **BLANK**. A **Single** command is applicable to one geometrical element at any one time.

	EDIT	DELETE	CREATE	<POINTS>
BLANK	UNBLANK	VERIFY	DISP OPT	MOVE
PAGE 1/3	NUM CLD=5		NEXT	LAST
— — — —	—————	—————	POINTS	

(CLEAR)	=	The Command Zone
(SHADED)	=	The Points Cloud Zone

The Point Cloud Zone

Every point cloud in Re-Enge is represented by an entry in the point cloud zone. This entry is represented by a line of five modals, which provide information about the point cloud. Initially, the point cloud zone contains one entry, namely the Empty Cloud entry.

Switching Pages

The five pages of commands are:

POINTS
MESH
SPLINES
SURFACES
GLOBAL

To Change the Active Page

1. <PICK> the Select Page Modal.
2. Select one of the pages displayed in the pull down menu.
3. The menu page will update automatically.

Basic Interface Operations

Reading a Point Cloud

To read a Point Data file into Re-Eng, pick the FLAGS FIELD modal of the empty Point Cloud Entry.

Type in the filename, or click SUBMENU (right mouse button) for file browser.

Selecting / Deselecting a Cloud

A point cloud may be selected/deselected by picking near one of its points or the bounding box. After picking the corresponding row in the Point Clouds zone, it will be highlighted indicating that this cloud has been selected.

If at least one point cloud is picked and the <SUBMENU> selected, the following popup menu appears:

BLANK
UNBLANK

DELETE CLOUD

The selected option is applied to all selected point clouds in the point cloud zone.

Active / Nonactive Modals

Certain commands, such as the sections command, require a point cloud and a plane set before the command can be executed. The APPLY modal, used to execute the command, will be displayed in highlight mode when sufficient input data to the command has been provided. Until such time, the modal will be displayed in the current modal color.

It is possible to interrupt many commands within Re-Eng while they are executing.

To execute a command, press the I key, both upper and lower case, and the current command will be suspended.

The following commands may be interrupted:

POINTS

- FILTER
- ORDER

MESH

- CREATE >> CREATE
- CREATE >> VERIFY

SPLINES

- CREATE >> CREATE
- CREATE >> VERIFY

SURFACES

- CREATE >> CREATE
- CREATE >> VERIFY

The Page Commands

The maximum number of point clouds which can be loaded at anyone time is 128. The page commands allow for a subset of these clouds to be displayed in the point cloud area of the menu.

There are four commands common to all pages, which deal with the visualization of point clouds entries.

Page 1/3	NUM CLD=5		NEXT	LAST
----------	-----------	--	------	------

- | | |
|-------------|-------------------------------|
| ■ Page 1/3 | Page 1 of 3. |
| ■ NUM CLD=5 | Number of clouds in the page. |
| ■ NEXT | Go to the next page. |
| ■ LAST | Go to the last page. |

Point Cloud Entry

A point cloud entry contains the following information: See Figure 1-1.

- The **Flags Field**
- The **Cloud Name**
- The **Cloud Type**
- **Draw Style**
- **Draw Color**

DP - - -	BASE POINTS	3D RANDOM	POINTS	
Flags Field	Cloud Name	Cloud Type	Draw Style	Draw Color

Figure 1-1: A Point Cloud Entry

Flags Field

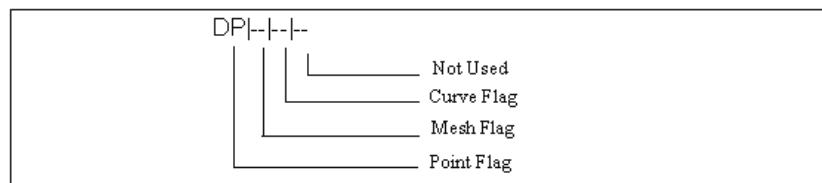


Figure 1-2: The Flags Field

The Flags Field contains information about the status of the point cloud. The modal is divided into the following four fields:

Points Flags

- | | |
|----|--|
| DP | This cloud contains points and these points are visible. |
| -P | This cloud contains points but they are currently blanked. |

Mesh Flags

- | | |
|----|-------------------------------------|
| DM | This cloud contains a visible mesh. |
| -M | This cloud contains a blanked mesh. |

Curves Flags	
DC	This cloud contains curves and these curves are visible.
-C	This cloud contains curves but they are currently blanked.
Surface Flags	
DS	This cloud contains a visible surface.
-M	This cloud contains a blanked surface.

Cloud Name

To aid identification, every point cloud has an option associated label. This label is limited to 16 characters in length.

Cloud Type

Every point cloud in Re-Engage is classified upon the geometrical organization of its points.

There are four main classes:

3D RANDOM	No apparent order to the points.
3D SCAN DATA	The points are organized into scan lines. The start of every scan line is indicated by a small yellow triangle, and the end of a scan line by a small cyan cross.
3D STRING	The points form a sequence of points
2D CLOUD	This class is further divided into the following four self explanatory classes:
2D XY	
2D YZ	
2D XZ	
2D Plane	

Cloud Subtype

3D SCAN DATA clouds have two subtypes:

NOT ORDERED	The start of every Scan Line is random.
ORDERED	The cloud has been ordered using the command EDIT/ORDER, all Scan Lines starts points, are aligned.

Draw Style

A point cloud may be displayed in one of the following four different styles:

POINTS	Every point in the cloud is represented on the screen as a pixel.
LINES	The points are draw as a series of connected lines.
LINES and POINTS	The points are represented by a large point and in addition each point is connected to the next in the cloud by a line.
BIG POINTS	As in the points case but a larger point is drawn.

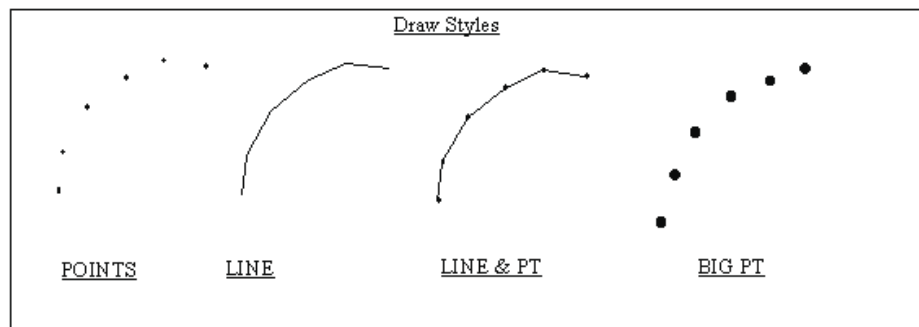


Figure 1-3: Draw Styles

Draw Color

The current draw color of the cloud and all of its associated geometry will be drawn with this color.

The Empty Cloud Entry

Initially, the Empty Cloud Entry is the only point cloud entry and can be identified by an empty flags field.

Multi Commands

Certain commands are classified as multi commands because they operate on more than one point cloud at a time. For example, the BLANK command can blank more than one point cloud in one operation. After selection, a multi command is highlighted and only after the <EXIT> command has been executed is the selected command applied to the selected point clouds. A multi command may be deselected by re-selecting it before the EXIT command is executed.

Each command page may or may not contain multi commands.

Command / Page	POINTS	MESH	SPLINES	SURFACES	GLOBAL
EDIT					
DELETE					X
CREATE					
BLANK	X	X	X	X	X
UNBLANK	X	X	X	X	X
VERIFY					
SAVE					X

Figure 1-4: The Multi Commands

Common Commands

There are three commands that are common in usage and interface to all menu pages:

BLANK	Blanks all geometry relative to the current menu page.
UNBLANK	Unblanks all geometry relative to the current menu page.

The effect of these commands depends on what menu page is active at the given moment. For example the BLANK command, if used from the <POINTS> menu page, will only blank the points of the selected Point Clouds. The command, if used from the <SPLINES> menu, will blank all splines relative to the selected point clouds.

- Note:**
- If the current menu page is the <GLOBAL> page, the current multi command has global scope. For example, the <BLANK> command if used from the <GLOBAL> menu will blank all the clouds and all geometry related to the selected point clouds.

BLANK

Blank the selected point clouds. The geometrical element blanked depends upon the current menu page.

Class Multi Command.

Usage

1. Select the required point clouds entry.
2. Select the **BLANK** command.
3. Confirm with <EXIT>.

Notes:

- The flags corresponding to the selected point clouds will be updated to reflect the new display status.
- After the blank operation the selected clouds will revert to an unselected status.

UNBLANK

Unblank the selected point clouds. The geometrical elements unblanked depends upon the current menu page.

Class Multi Command.

Usage

1. Select the required point clouds entry.
2. Select the **UNBLANK** command.
3. Confirm with <EXIT>.

Notes:

- The flags corresponding to the selected point clouds will be updated to reflect the new display status.
- After the unblank operation the selected clouds will revert to an unselected status.





Chapter 2

Points Menu

Commands relative to points operations.

	EDIT	DELETE	CREATE	<POINTS>
BLANK	UNBLANK	VERIFY	DISP OPT	MOVE

Where:

(SHADED)	=	Multi Commands
(CLEAR)	=	Single Commands

EDIT	This menu contains the point cloud editing commands.
CREATE	This menu contains the commands for creating point clouds.
DELETE	This menu contains the commands for deleting points from the point clouds.
VERIFY	Point verification commands.
DISP OPT	Point cloud display options.
MOVE	This menu contains the commands for moving or copying a point cloud.

EDIT

This menu contains the point cloud editing commands.

Main Options

SELECT / EXIT	BREAK POINTS	PROJECT TO PLANE	OFFSET	SCAN LINE
	FILTER	ORDER CLOUD	FILL SPANS	BLANK PTS

BREAK POINTS	Detect and Clear Break points.
PROJECT TO PLANE	Project point cloud onto plane.
OFFSET	Offset point cloud.
SCAN LINE	Convert Random cloud into Scan Data cloud.
FILTER	Filter point clouds.
ORDER CLOUD	Order the points in a point cloud .
FILL SPANS	Add points to a point cloud.
BLANK PTS	Blank part of a point cloud by a polygon.

EDIT >> BREAK POINTS (BP)

Break Points are the sharp edges of the part represented by the point cloud. The **BREAK POINTS** command allows you to add, delete and clear break points within a point cloud.

During this command the break points are displayed as highlighted points. Upon exiting the command, these highlighted points will be erased from the screen. (To visualize a clouds break points, see **DISP OPT** at the end of this chapter).

PICK CLOUD & EXIT

<PICK>	Indicate the cloud to add/edit/remove break points from the picked cloud will be highlighted
<EXIT>	Confirm the selection

Any break points present in the selected cloud will be displayed, a break point is automatically added to the first and last points in the point cloud.

SELECT / EXIT	ANGULAR BP	MANUAL ADD BP	MANUAL DEL BP
	CLEAR ALL BP	DEL BY POLYGON	

ANGULAR BP	Add break points based on feature angle.
MANUAL ADD BP	Add Break points manually.
MANUAL DEL BP	Delete Break points manually.
CLEAR ALL BP	Clear all Break points from the point cloud.
DEL BY POLYGON	Delete Break points within a given polygon.

BREAK POINTS >> ANGULAR BP

A point is classified as a break point when the angle formed by it and the previous and next point is less than the current alpha value. See Figure 2-1.

SELECT / EXIT	INCREMENT = 5	ALPHA = 140.0		
	<	<<	>>	>

INCREMENT = 5	The value by which the Alpha value will be incremented/decremented.
ALPHA = 140.0	The angular value above which a point is considered a break point.
<<	Increase Alpha by the Increment value.
>>	Decrease Alpha by the Increment value.
<	Increase Alpha by INCREMENT*0.1 degrees.
>	Decrease Alpha by INCREMENT*0.1 degrees.
<EXIT>	Return to the main menu.

Every time one of the modals is changed the current number of break points is updated to reflect the new values.

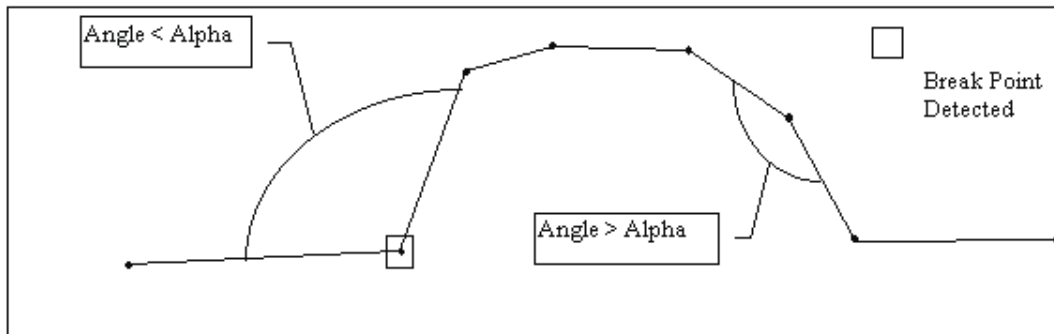


Figure 2-1: Automatic Break Points Detection

BREAK POINTS >> MANUAL ADD BP

Manually add break points to the selected points.

PICK BREAK POINT

Indicate the required break points manually. The indicated points will be displayed as a small red box. Exit to create the break points and return to the previous menu.

BREAK POINTS >> MANUAL DELETE BP

Manually delete break points from the current cloud.

PICK BREAK POINT

Indicate the break points to remove. Exit to return to the previous menu.

Note:

- The first or last break point may not be removed from the point cloud.

BREAK POINTS >> CLEAR ALL BP

Clear all break points from the selected cloud.

CLEAR ALL BPS	YES	NO
---------------	-----	----

YES

Delete all break points.

NO

Exit without deleting break points.

BREAK POINTS >> DEL BY POLYGON

Delete break points that are inside a given polygon from the current cloud.

PICK PT. 1 / EXIT

Pick points to define the polygon. Exit to close the polygon and delete the break points.

- Notes:**
- It is impossible to rotate the model during this command. The only view commands available are ZOOM and REDRAW.
 - It is not necessary to close the polygon: The polygon will automatically close by connecting the first point to the last point by <EXIT>.
 - This command operates in screen space.
 - Maximum number of points in polygon is 4096.

EDIT >> PROJECT TO PLANE

Project the indicated point cloud onto a given plane along the normal to the plane.

PICK CLOUD & EXIT

- | | |
|--------|--|
| <PICK> | Pick the cloud to project. The picked cloud will be highlighted. |
| <EXIT> | Return to the previous menu if no cloud selected else confirm current selection. |

The following menu of options will appear.

XY PLANE	YZ PLANE	ZX PLANE	BEST FIT
----------	----------	----------	----------

- | | |
|-----------------|---|
| XY PLANE | The cloud will be projected on a plane parallel to the XY plane of the MODEL UCS. |
| YZ PLANE | The cloud will be projected on a plane parallel to the YZ plane of the MODEL UCS. |
| ZX PLANE | The cloud will be projected on a plane parallel to the XZ plane of the MODEL UCS. |
| BEST FIT | The best fit plane will be calculated for the points in the point cloud. |

- Notes:**
- The **BEST FIT** plane is a plane that best approximates the points in the point cloud.
 - After projection, the point cloud type will be changed to reflect the new type.

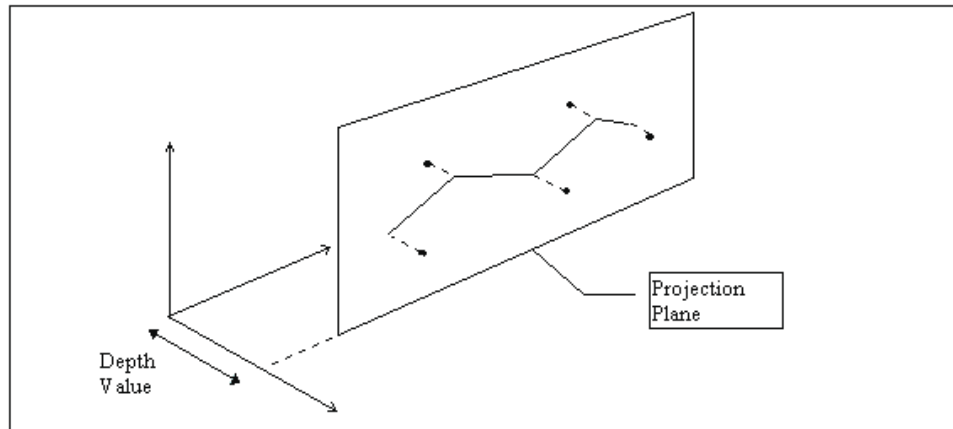


Figure 2-2: Projection to Plane

PROJECT TO PLANE >> XY PLANE, YZ PLANE, and XZ PLANE

In the case of XY,YZ and XZ planes the average of all the coordinate values,of the axis corresponding to the plane normal,is calculated. This is the proposed depth value.

CR TO CONT	DEPTH=0.15
------------	------------

DEPTH=0.15	The project planes depth value.
<RETURN>	The point cloud will be projected on to the selected plane at the indicated depth value.
<EXIT>	Return to the previous menu.

PROJECT TO PLANE >> BEST FIT

After picking the point cloud, the maximum deviation from the best fit plane is displayed.

MAX DEVIATION FROM BEST FIT PLANE: 5.279

PROJECT	YES	NO
---------	-----	----

YES	The point cloud will be projected on to the best fit plane.
NO	Return to the previous menu.

EDIT >> OFFSET

Due to the mechanical nature of many digitizing probes, it is often necessary to offset the point cloud data to obtain the actual part data. Re-Engage can offset 2D planar point clouds and 3D scan data clouds. If the picked cloud is not a 2D planar cloud, an error message is displayed.

PICK CLOUD & EXIT

- <PICK> Indicate the cloud to offset.
- <EXIT> Return to the previous menu if no cloud selected else confirm current selection.

CR TO CONTINUE	CONSTANT	MODIFY CLOUD	TRIM LOOPS	OFFSET=1.0
	VARIABLE	CREATE NEW CLOUD	KEEP LOOPS	BEST FIT*
	CORNER*	OFFSET=1.0	TOL = 0.100*	NO BEST FIT*
	NO CORNER*			

CR TO CONTINUE

- CONSTANT Apply a constant offset.
- VARIABLE Apply a variable offset.
- CORNER* Modify the offset points to introduce sharp corners.
- NO CORNER* No points will be introduced in the new cloud to sharpen the corners.
- MODIFY CLOUD The original point cloud will be modified.
- CREATE NEW CLOUD A new point cloud will be created, containing the offset points.
- TRIM LOOPS Any loops found while offsetting the point cloud will be trimmed.
- KEEP LOOPS Any loops found while offsetting the point cloud will be kept.
- TOL* Offset tolerance.
- BEST FIT* Every scanline will be projected onto the best file plane for this scanline.
- NO BEST FIT* No projection will occur.
- OFFSET=1.0 The offset value.

* Displayed only if the selected cloud is a 3D scan data cloud.

After entering <CR>, the required offset direction must be indicated.

IND OFFSET DIR

- <PICK> Indicate the offset direction.

<EXIT>

Return to the previous menu.

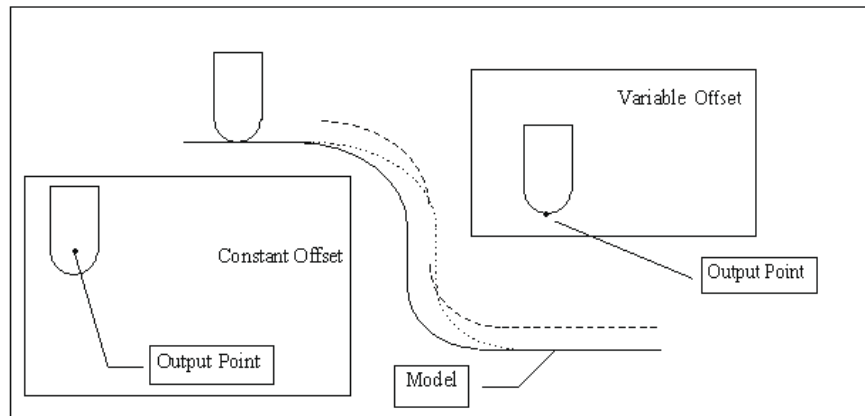


Figure 2-3: Constant & Variable Offsets

EDIT >> SCAN LINE

Convert Random cloud to Scan data.

PICK CLOUD & EXIT

<PICK>

Indicate the cloud to offset.

<EXIT>

Return to the previous menu if no cloud selected else confirm current selection.

CR TO CONTINUE	PLANE	BREAKPOINTS	DISTANCE	REMOVE 3D SCAN
----------------	-------	-------------	----------	----------------

PLANE

Convert random clouds to 3D scan data, based on parallel plane sets.

BREAK POINTS

Convert random clouds to 3D scan data, based on break points.

DISTANCE

Convert random clouds to 3D scan data, based on distance between the scanned lines.

REMOVE 3D SCAN

Convert 3D scan data back to random cloud.

FILTER SCAN

Create a new cloud by selecting a subset of the scan lines.

FLIP SL DIR

Invert the start and end of the selected scanlines.

SCAN LINE >> PLANE >> XY PLANE, XZ PLANE, or YZ PLANE

PICK POINT

- <PICK> Indicate the display point for the interplane delta indicator.
- <EXIT> Return to the EDIT menu.

CR TO CONT / EXIT	INTERPLANE DELTA=1.00
-------------------	-----------------------

- **INTERPLANE DELTA** Enter the interplane delta. See Figure 2-6.

A green segment will be drawn and updated until <RETURN> is entered. This is the width of the interplane delta and helps select the required value for this point cloud. The interplane delta should not straddle consecutive scan lines. It may be thought of as the diameter of a virtual tube which contains all the points in a give scan line

After confirmation the section break points will be calculated and displayed. The start of a scanline is displayed as a yellow triangle, and the end of a scanline is displayed as a cyan cross.

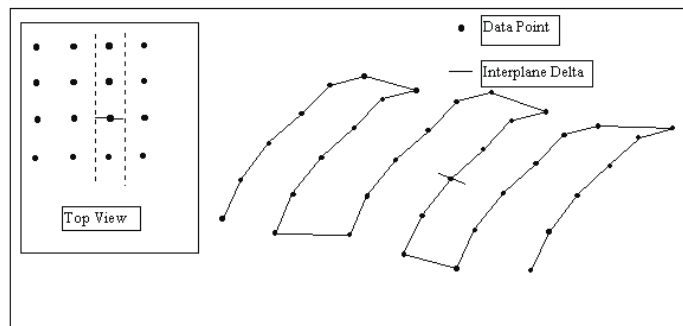


Figure 2-4: The INTER PLANE DELTA

SCAN LINE >> BREAK POINTS

Convert 3D Random cloud into Scan data using the cloud's break points as start and end of a scan line. The first break point found in the point cloud will become the start point of the first Scan Line, the second one will be the end of the line, etc.

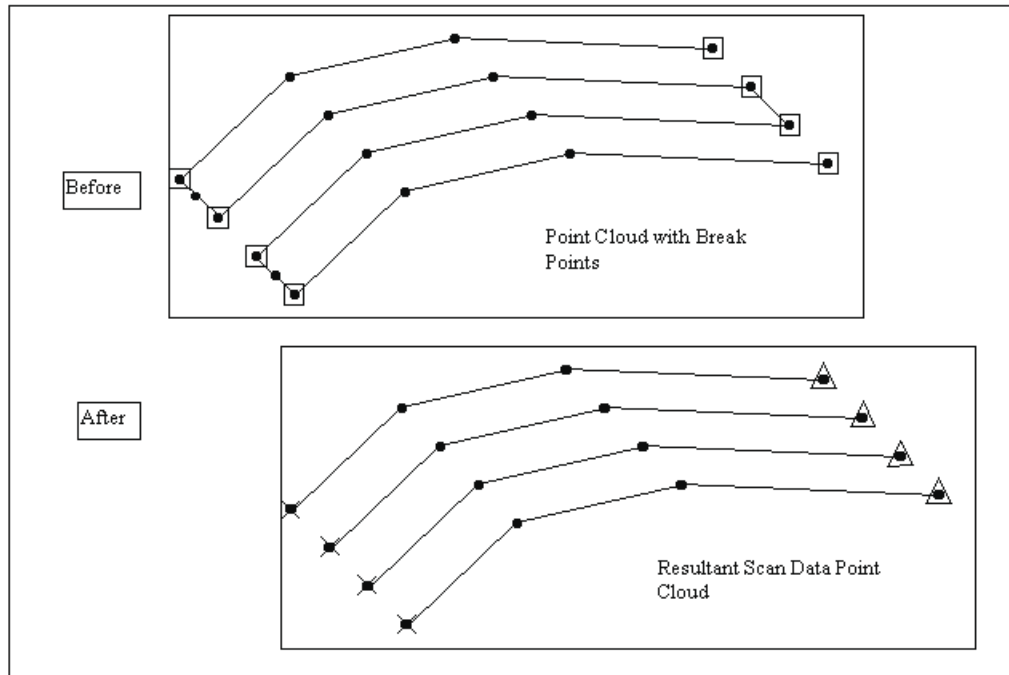


Figure 2-5: BREAK POINTS

PICK CLOUD & EXIT

- | | |
|--------|--|
| <PICK> | Indicate the cloud to translate the break point. |
| <EXIT> | Return to the previous menu if no cloud selected else confirm current selection. |
| <SUBM> | Display all unblanked point clouds. |

SCAN LINE >> DISTANCE

Convert random clouds to 3D scan data, based on distance between the scanned lines.

PICK CLOUD & EXIT

SELECT OPTION	DISPLAY	INCREMENT=10	SPAN SIZE=10	KEEP ORIGINAL	APPLY
	>	<<	>>	>	

DISPLAY	Display or do not display the points to be deleted due to the current setting. Points to be deleted are marked with a green cross.
INCREMENT=10	The value by which the SPAN SIZE value will be incremented/decremented
SPAN SIZE=10	The value under which a point cloud is split.
KEEP ORIGINAL	Keep the original point clouds.
APPLY	Apply the selections.
>	Decrease the SPAN SIZE value by INCREMENT * 0.1.
<<	Decrease the SPAN SIZE value by 10.
>>	Increase the SPAN SIZE value by 10.
>	Increase the SPAN SIZE value by INCREMENT * 0.1.
<CR>	Update parameters and display result.

SCAN LINE >> REMOVE 3D SCAN

Convert 3D scan data back to random cloud.

PICK CLOUD & EXIT

The sections are removed from the cloud, and the cloud becomes 3D random.

SCAN LINE >> FILTER SCAN

Create a new point cloud by selecting one scanline every 'n' from a given point cloud.

PICK CLOUD & EXIT

<PICK>	Pick the cloud.
<REJECT>	Reject the selected cloud.
<EXIT>	Confirm selection.

CR TO CONT	DISPLAY	<<	N=2	>>	APPLY
	NO DISPLAY	<<			

DISPLAY	Update the display automatically.
NO DISPLAY	Do not update the display.

<<	Decrease the number of selected scanlines.
N=2	The number of scanlines to skip in the original cloud.
	Increase the number of selected scanlines.
APPLY	Create the new point cloud using the selected scanlines.

SCAN LINE >> FLIP SL DIR

Invert the start and end point of the selected scanlines

PICK A SCANLINE

<PICK>	Highlight the selected scanline.
<REJECT>	Reject the last selected scanline.
<EXIT>	Invert the selected scanlines start and endpoints.

EDIT >> FILTER

The filter commands provide three tools to remove noises from the input data. These noises are caused by many different factors, such as a poor model, digitizing errors, etc.

SELECT OPTION	MIN DISTANCE	SMOOTH	CHORDAL
---------------	--------------	--------	---------

MIN DISTANCE	The MINIMUM DISTANCE filter deletes all points that are within the given distance from their neighbors.
SMOOTH	Smooth filter removes noise from the data. Noise is defined as sharp peaks.
CHORDAL	Chordal filter deletes all points that have a chordal distance more than the Chordal value only if the distance from their neighbors is less than the MAX DIST value.

FILTER >> MIN DISTANCE

The Minimum Distance filter deletes all points that are within the given distance from their neighbors.

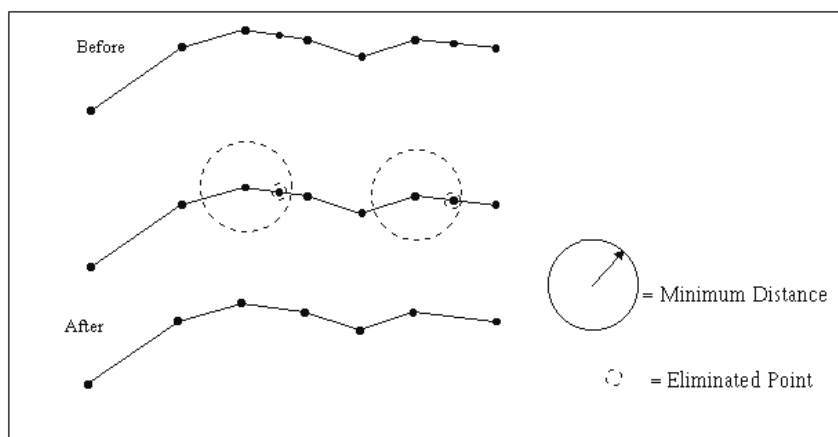


Figure 2-6: MINIMUM DISTANCE

PICK CLOUD & EXIT

<PICK>	Pick the cloud.
<EXIT>	Return to the previous menu if no cloud selected else confirm current selection.

SELECT OPTION	DISPLAY	INCREMENT =1	MIN DIST= 0.1	APPLY
	<	<<	>>	>

DISPLAY/NO DISPLAY	Display or do not display the points to be deleted due to the current setting. Points to be deleted are marked with a green cross.
INCREMENT = 1	The value by which the MIN DIST value will be incremented/decremented.
MIN DIST = 0.1	The minimum distance value under which a point is deleted.
APPLY	Delete all points within the current range.
<<	Decrease the MIN DIST value by 1.0.
>>	Increase the MIN DIST value by 1.0.
<	Decrease the MIN DIST value by INCREMENT * 0.1.
>	Increase the MIN DIST value by INCREMENT * 0.1.
<CR>	Update parameters and display result.

FILTER >> SMOOTH

For many reasons the point cloud data may contain spikes/noise. These stray data points may be caused by many factors,(e.g. dirty model/digitizing errors etc).

Due to the fact that the noise in the point cloud is for all intents and purposes random it is very difficult to identify which data points have to be removed. The smooth filter can be used to identify and remove peaks in the point cloud. See Figure 2-7 for a graphical explanation of the meaning of RATIO.

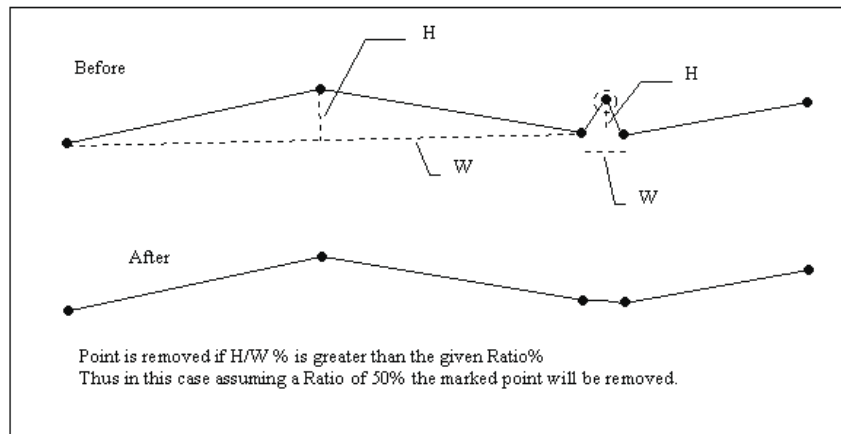


Figure 2-7: SMOOTH FILTER

PICK CLOUD & EXIT

<PICK>	Pick the cloud.
<EXIT>	Return to the previous menu if no cloud selected else confirm current selection.

SELECT OPTION	DISPLAY	INCREMENT =1	RATIO = 20%	APPLY
	<	<<	>>	>

DISPLAY/NO DISPLAY Display or do not display the points to be deleted due to the current setting. Points to be deleted are marked with a green cross.

INCREMENT = 1 The value by which the RATIO value will be incremented/decremented.

RATIO = 20% Points are removed if H/W is greater than the given RATIO value.

APPLY Delete all points within the current range.

<< Decrease the MIN DIST value by 1.0.

>> Increase the MIN DIST value by 1.0.

< Decrease the MIN DIST Value INCREMENT*0.1.

> Increase the MIN DIST value by INCREMENT*0.1.

<CR> Update parameters and display result.

- Note:**
- A yellow triangle is displayed in order to choose a correct SPAN SIZE value. An acceptable value will produce a yellow triangle in the start of every scan line. A non-acceptable value will produce a yellow triangle inside the scan line. See CREATE/SECTIONS for an explanation of SPAN SIZE.

FILTER >> CHORDAL

Chordal filter deletes all points that have a chordal distance more than the CHORD value, only if the distance from their neighbors is less than MAX DIST value.

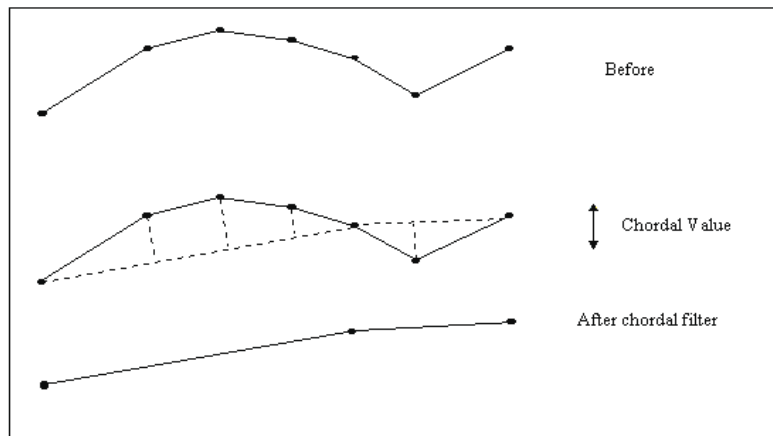


Figure 2-8: CHORDAL FILTER

PICK CLOUD & EXIT

<PICK> Pick the cloud.

<EXIT> Return to the previous menu if no cloud selected else confirm current selection.

SELECT / EXIT	DISPLAY	INCREMENT = 1	MAX DIST = 1	CHORD = 0.1	APPLY
	<	<<	>>	>	

DISPLAY/NO DISPLAY Display or do not display the points to be deleted due to the current setting. Points to be deleted are marked with a green cross.

INCREMENT = 1 The value by which the CHORD value will be incremented/decremented.

MAX DIST = 1 Only points within the Max distance range are deleted.

CHORD = 0.1 The chord value under which a point is deleted.

APPLY Delete all points within the current range.

<< Decrease the MIN DIST value by 1.0

>> Increase the MIN DIST value by 1.0

< Decrease the MIN DIST Value by INCREMENT*0.1

> Increase the MIN DIST value by INCREMENT*0.1

<CR> Update parameters and display result

EDIT >> ORDER CLOUD

Order the points in the point cloud, the result of the order command depends upon the cloud type as follows.

3D SCAN The order of the scan rows are ordered, not the points within them. If ADV USER is set it is possible to order the points within the rows.

ALL OTHER CLOUD TYPES The points in the point cloud are ordered. The system tries to find the shortest path through all the given points.

PICK CLOUD & EXIT

<PICK> Pick the cloud.

<EXIT> Return to the previous menu if no cloud selected else confirm current selection.

CR TO CONTINUE	KEEP OLD CLOUD
	DELETE OLD CLOUD

<RETURN> The cloud will be reordered.

<EXIT> Return to the previous menu.

- Note:**
- This command can be very time consuming if the point cloud contains many points as the best solution is sought.

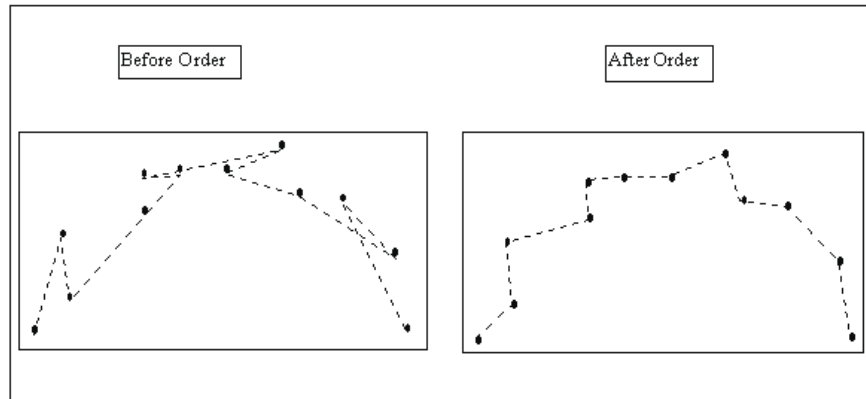


Figure 2-9: ORDER CLOUD

EDIT >> FILL SPANS

Fill gaps in the given 3D SCAN point cloud when the distance from a point to its neighbors is larger than the given value.

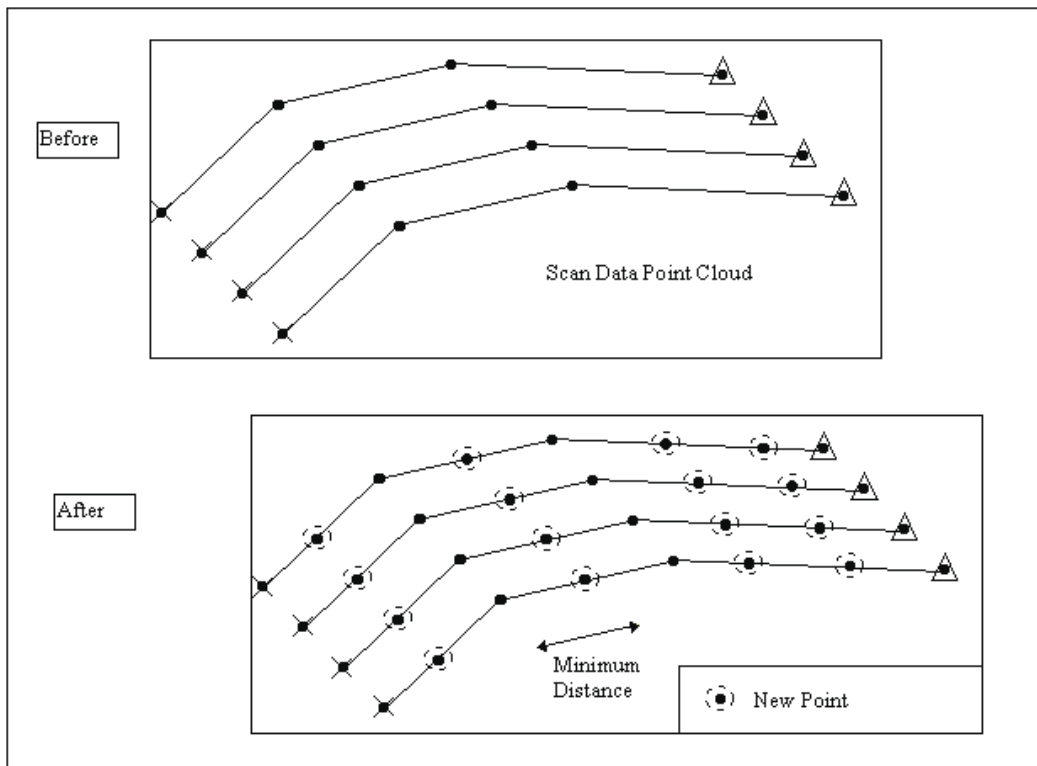


Figure 2-10: FILL SPANS

PICK CLOUD & EXIT

<PICK> Pick the cloud.
 <EXIT> Return to the previous menu if no cloud is selected. selection

CR TO CONTINUE	MIN PT. DIST= 1.00	KEEP OLD CLD
		DELETE OLD CLD

MIN PT. DIST = 1.00 Set the min distance between a point to their neighbors.
 KEEP OLD CLD Keep the original cloud.
 DELETE OLD CLD Delete the original cloud.
 <CR> Execute the command and return to the previous menu.

EDIT >> BLANK PTS

Blank a subset of points from a Point Cloud.

SELECT/EXIT	POLYGON	CURVATURE	UNBLANK ALL
-------------	---------	-----------	-------------

POLYGON	Blank points selected by polygon.
CURVATURE	Blank points based upon curvature.
UNBLANK ALL	Unblank all points.

BLANK PTS >> POLYGON

Blank part of a point cloud by a polygon.

Choose an option to define a polygon, the default is **SCREEN**.

PICK PT. 1 / EXIT	INNER	SCREEN	FREE
	OUTER	ENTITY	HOR/VER
		CURVE	
		BOX	

<PICK>	Indicate a polygon.
<EXIT>	Return to the DELETE menu if no points have been picked.
<EXIT>	Close the polygon if at least two points have been picked.
SCREEN	Pick points on screen to define a polygon.
FREE	Polygon's lines are free.
HOR/VER	Polygon's lines are constrained to be either horizontal or vertical.
ENTITY	Pick a geometric point (END , MID , CLOSE , etc) on an entity, the resultant point will be used to define the polygon.
CURVE	Pick a curve to define a polygon.
BOX	Pick two points to define a box.

- Notes:**
- A new cloud will be created from all points that belong to displayed clouds contained within the polygon.
 - It is not possible to rotate the model during this command. The only view commands available are **Zoom** and **Redraw**.
 - It is not necessary to close the polygon: the polygon will be automatically closed by connecting the first to the last point by <EXIT>.
 - This command operates in the screen space.
 - Maximum number of points in polygon 4096.

BLANK PTS >> CURVATURE

The radius of the curvature is approximated for every point in the point cloud. Points may then be selected based upon the given curvature interval. The radius of curvature is calculated along the scanline. The radius of curvature assigned to each point is that of the imaginary circle that passes through the points $n-1$, n and $n+1$ where n is the point in question.

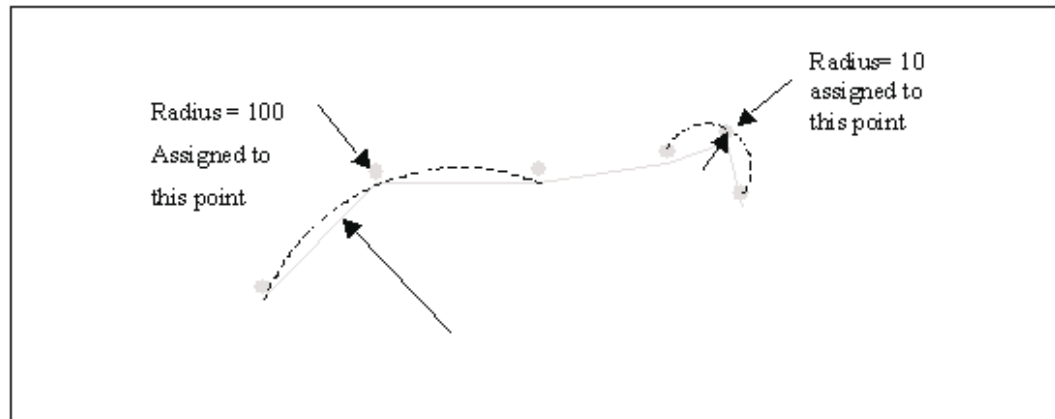


Figure 2-11: BLANK PTS >> CURVATURE

PICK CLOUD & EXIT

<PICK> Pick the point cloud
 <REJECT> Reject the selected cloud
 <EXIT> Confirm the selection

The approximated radius of curvature is calculated and the following menu is displayed.

CR PER DISP/EXIT	MIN RADIUS. — 10.0	MAX RADIUS. = 25708.65	INNER
			OUTER
MIN = 10.0	MAX = 25708.65	MAX =25708.65	APPLY

MIN RADIUS Display the min radius found in a point cloud.

MAX RADIUS Display the max radius found in a point cloud.

Min Radius	Max Radius	Selected Range
10	200	10<Curvature<200
0	200	Curvature<200
10	0	10<Curvature

INNER Select points where the curvature is within selected interval.

MIN. Lower the value for the selection interval.

MAX. Upper limit for selection interval.

APPLY

Calculate the current interval and display selected points by a small red marker.

<EXIT>

Exit – no changes are made to the point cloud.

BLANK PTS >> UNBLANK ALL

Unblank all points blanked in the selected point cloud.

PICK CLOUD & EXIT

<PICK>

Select the point cloud.

<EXIT>

Return to the previous menu if not cloud selected, otherwise unblank all blanked points in this point cloud

CREATE

This menu contains the commands for creating point clouds.

Main Options:

SELECT / EXIT	POLYGON	PICK POINTS	ADD TO CLD	SECTIONS	FROM BP
	CLIP PLANES	EXTRACT SL	SPLIT CLOUD	JOIN CLOUD	CURVATURE
	EXTENSION	XY GRID			

POLYGON	Create a point cloud using a stencil.
PICK POINTS	Create a point cloud by pick points.
ADD TO CLD	Add points to an existing point cloud.
SECTIONS	Create Sections by sectioning point clouds.
FROM BP	Create a point cloud from an existing cloud's break points.
CLIP PLANES	Create a point cloud by clipping planes.
EXTRACT SL	Create a point cloud by extracting Scan Lines from an existing cloud.
SPLIT CLOUD	Split a point cloud into its sub-cloud components, based upon distances between the components.
JOIN CLOUD	Add two or more point clouds together.
CURVATURE	Approximate curvature radius for every point in the point cloud.
EXTENSION	Extend the selected 3DSCAN point cloud to be extended.
XY GRID	Sample the given cloud in X and Y with a constant pitch.
CLD BORDER	Create point clouds from given CLDSCAN borders.

CREATE >> POLYGON

Create a point cloud, the new points may be either the points inside or outside the indicated polygon.

All visible point clouds will be used for this operation. It is possible to automatically delete the points from the original point clouds.

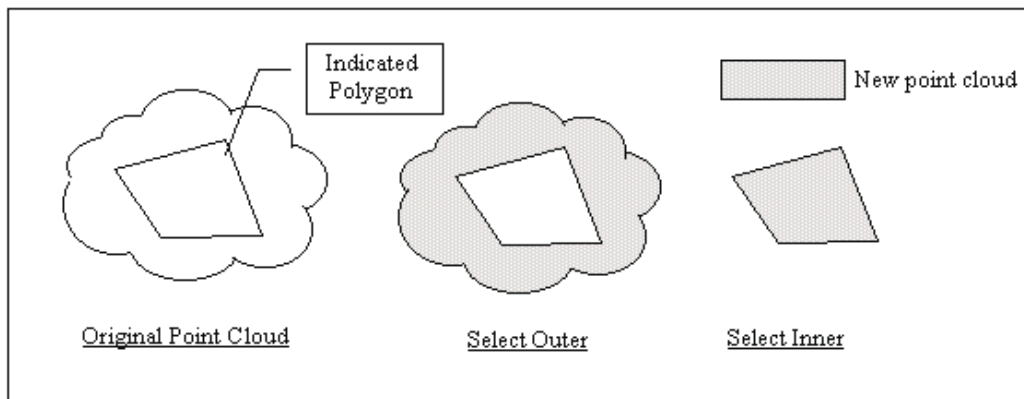


Figure 2-12: SELECT INNER / SELECT OUTER USAGE

Choose an option to define a polygon, the default is **SCREEN**.

PICK PT. 1 / EXIT	INNER	KEEP ORIG.	SCREEN
	OUTER	DELETE ORIG.	ENTITY
			CURVE
			BOX

<PICK> Indicate polygon.

<EXIT> Return to the **DELETE** menu if no points have been picked.

<EXIT> Close the polygon if at least two points have been picked.

SCREEN Pick points on screen to define a polygon.

ENTITY Pick a geometric point (**END**, **MID**, **CLOSE**, etc) on an entity, the resultant point will be used to define the polygon.

CURVE Pick a curve to define a polygon.

BOX Pick two points to define a box.

- Notes:**
- New cloud will be created from all points that belong to displayed clouds contained within the polygon.
 - It is not possible to rotate the model during this command. The only view commands available are Zoom and Redraw.
 - It is not necessary to close the polygon: the polygon will be automatically closed by connecting the first to the last point by <EXIT>.
 - This command operates in screen space.
 - Maximum number of points in polygon 4096.

POLYGON >> SCREEN

When option SCREEN is selected the following modals will appear:

PICK PT. 1 / EXIT	INNER	SCREEN	FREE
	OUTER		HOR/VER

FREE Polygon's lines are free.

HOR/VER Polygon's lines are constrained to be either horizontal or vertical.

POLYGON >> ENTITY

When option ENTITY is selected the following modals will appear:

PICK PT. 1 / EXIT	INNER	ENTITY
	OUTER	

<SUBMENU> The **Cimatron POINT** menu will appear.

Pick the required point. This point will then be projected onto the display plane.

POLYGON >> CURVE

When option CURVE is selected the following table will appear:

PICK PT. 1 / EXIT	INNER	CURVE	1 CURVE	PT ON CRV = 10
	OUTER		2 POINTS	
			PT & DIR	

1 CURVE Create the polygon vertices on the curve.

2 POINTS Create the polygon vertices on the curve between two points.

PT & DIR Create the polygon vertices from the picked point to the end of the curve in the selected direction.

PT ON CRV =10 Number of polygon vertices on the curve.

POLYGON >> BOX

PICK 1ST PT.

<EXIT>	Switch back to screen pick-point mode.
<REJECT>	Return to previous menu.
<PICK>	Pick first corner for the box.

PICK 2ND PT.

<EXIT>	Switch back to screen pick-point mode.
<REJECT>	Reject the first point, return to previous menu.

<PICK>

Pick second corner for the box.
A green box will appear on the screen.

BOX OK ? YES NO

YES Delete points and exit to **DELETE** menu.
NO Reject the second point, return to previous menu.
The new point clouds bounding box will be calculated and displayed. It is possible at this stage to assign a label to the newly created point cloud.

LABEL / CR

<RETURN>	A default label will be assigned to the new point cloud.
<Text>	The input text will be used as the point cloud label.

CREATE >> PICK POINTS

Create a point cloud from the indicated points.

PICK POINT

<PICK>	Indicate the point to add to point cloud.
<EXIT>	Return to the CREATE menu if no points have been picked.
<EXIT>	If one or more points have been picked a new cloud is created. The new point clouds bounding box will be calculated and displayed. It is possible at this stage to assign a label to the newly created point cloud.

LABEL / CR

<RETURN>	A default label will be assigned to the new point cloud.
<Text>	The input text will be used as the point cloud label.

Note: • A maximum of 4096 points maybe picked at any one time.

CREATE >> ADD TO CLD

Add to an existing point cloud points, these points may be points from another point cloud or points obtained by sampling **Cimatron** geometry.

POINTS TO ADD	CLOUD POINTS	GEOMETRIC POINTS
---------------	--------------	------------------

CLOUD POINTS The points to be added will be obtained from existing point clouds

GEOMETRIC POINTS The points to be added will be obtained by sampling **Cimatron** geometry

ADD TO CLD >> CLOUD POINTS

PICK CLOUD

Pick the cloud to add to. If no point cloud is indicated a new empty point cloud will be created. Indicate the points to add to the point cloud.

<EXIT> A new point cloud will be created.

- Notes:**
- The picked points are represented as highlighted points and as a series of connected line segments.
 - The normal <REJECT> and <SUBMENU> commands are also active.

ADD TO CLD >> GEOMETRIC POINTS

The following **Cimatron** geometry types can be sampled:

POINTS
LINES
SPLINES
SURFACES

CR TO CONT	POINTS	CURVES	SURFACES
------------	--------	--------	----------

POINTS Add points.

CURVES Sample splines, arcs, and lines.

SURFACES Sample surfaces.

ADD TO CLD >> GEOMETRIC POINTS >> POINTS

The coordinates of the indicated **Cimatron** geometrical point are used to create a cloud point.

PICK POINT

<PICK> Indicate point to add to cloud.

ADD TO CLD >> GEOMETRIC POINTS >> CURVES

The selected curves are evaluated at fixed intervals and then these points are used to create the cloud points.

CR TO CONT	NUMBER OF POINTS = 10
------------	-----------------------

NUMBER OF POINTS=10 Number of intervals into which the curves will be divided.

PICK CURVES/EXIT

<PICK> Pick the required curves.

<EXIT> Return to the previous menu if no curves picked else create cloud points.

ADD TO CLD >> GEOMETRIC POINTS >> SURFACES

The selected surfaces are evaluated at fixed intervals in U and V and then these points are used to create the cloud points.

CR TO CONT	NUM PTS U = 10	NUM PTS V=10
------------	----------------	--------------

NUM PTS U = 10 Number of intervals in U.

NUM PTS V = 10 Number of intervals in V

PICK SURF / EXIT

<PICK> Pick the required surface.

<EXIT> Return to the previous menu if no surfaces picked else create cloud points.

After exiting from the geometry selection menu the bounding box of the original point cloud will be updated it is also possible to change the cloud label.

CREATE >> SECTIONS

Create Sections by sectioning point clouds.

The section command requires a plane set consisting of one or more planes and a set of point clouds consisting of one or more point clouds. Either the plane set or the point cloud set may be defined first.

Only when the above conditions have been satisfied will the APPLY modal become active (the modal is highlighted).

PLANE SETS

Plane sets are a series of planes which represent the locations of the required sections. By editing the positions of these plane sets the user can interactively decide where the sections should be created.

Figure 2-13 illustrates the various options.

CREATE

SELECT OPTION	PLANE	CLOUDS	APPLY
---------------	-------	--------	-------

PLANE	Define the plane set.
CLOUDS	Select clouds to be intersected with the plane set.
APPLY	Execute command when all parameters are set.

SECTIONS >> PLANE

Define the plane set.

SELECT OPTION	NEW PLANE SET	EDIT PLANE SET	DEL PLANE SET
---------------	---------------	----------------	---------------

SECTIONS >> PLANES >> NEW PLANE SET

Create a new plane set.

SELECT OPTION	ARC/2DCURVE	3 POINTS	UCS	DRIVE CURVE	2 SPINE & PLANE
---------------	-------------	----------	-----	-------------	-----------------

ARC/2DCURVE	Define the plane set by a 2D curve or an arc.
3 POINTS	Define the plane set by 3 points.
UCS	The plane set is parallel to XY, YZ, or XZ plane.
DRIVE CURVE	The plane set is perpendicular to a 3D curve.
2 SPINE & PLANE	The plane set is between 2 spine curves and perpendicular to a plane.

SECTIONS >> PLANES >> NEW PLANE SET >> ARC/2D CURVE

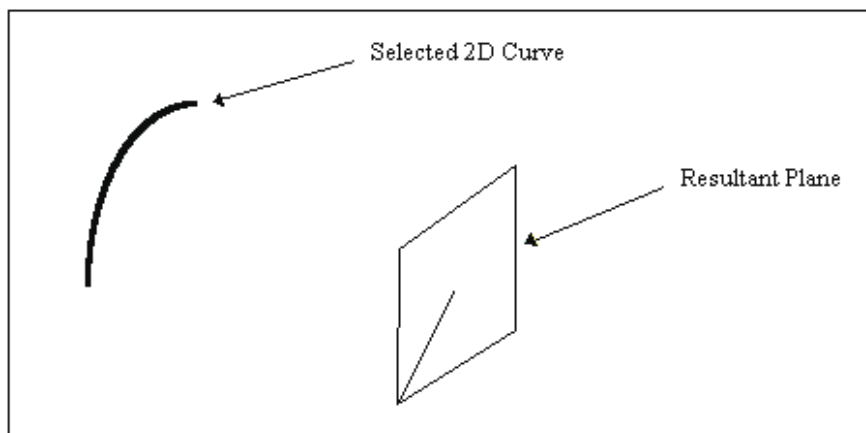
Create a plane parallel to an indicated 2D Curve.

PICK CURVE

<PICK>	Pick a 2D curve to define the plane.
--------	--------------------------------------

<EXIT>

Return to the previous menu.

**Figure 2-13: ARC / 2D CURVE**

SECTIONS >> PLANES >> NEW PLANE SET >> 3 POINTS

Create a plane defined by three points. The three points can either be 3 point cloud points or three **Cimatron** geometric points.

ENTITY PT.
CLOUD PT.

ENTITY PT. Pick **Cimatron** entity points, END,MID, etc.

CLOUD PT. Pick points from any displayed point cloud.

ENTITY POINT

INDICATE PT. 1

<PICK>	Pick the first geometric point.
<REJECT>	Reject the current point and return to the previous menu.
<SUBMENU>	Display the Cimatron point selection menu.
<EXIT>	Return to the previous menu.

INDICATE PT. 2

<PICK>	Pick the second geometric point.
<REJECT>	Reject the current point and return to the previous menu.
<SUBMENU>	Display the Cimatron point selection menu.
<EXIT>	Return to the previous menu.

INDICATE PT. 3

<PICK>	Pick the third geometric point.
<REJECT>	Reject the current point and return to the previous menu.
<SUBMENU>	Display the Cimatron point selection menu.
<EXIT>	Return to the previous menu.

POINTS OK ? YES NO

YES Accept the points.
NO Return to the previous menu.

The plane symbol will be displayed and the principle plane set menu will be displayed.

CLOUD POINT

The same as above but select point cloud points instead of geometric points.

SECTIONS >> PLANES >> NEW PLANE SET >> UCS

Create a plane defined as parallel to one of the MODEL UCS main planes.

XY PLANE
YZ PLANE
ZX PLANE

XY PLANE	Plane will be created parallel to MODEL UCS XY plane.
YZ PLANE	Plane will be created parallel to MODEL UCS YZ plane.
ZX PLANE	Plane will be created parallel to MODEL UCS XZ plane.

INDICATE POINT

<PICK>	Pick cloud point to locate the section plane.
<REJECT>	Reject the current point and return to the previous menu.
<SUBMENU>	Display the Cimatron point selection menu.
<EXIT>	Return to the previous menu.

SECTIONS >> PLANES >> NEW PLANE SET >> DRIVE CURVE

Create a plane set defined as normal to a given 2D/3D curve. The planes in the plane set are defined as being normal to the drive curve.

INDICATE POINT

<PICK>	Pick cloud point to locate the section plane.
<REJECT>	Reject the current point and return to the previous menu.
<SUBMENU>	Display the Cimatron point selection menu.
<EXIT>	Return to the previous menu.

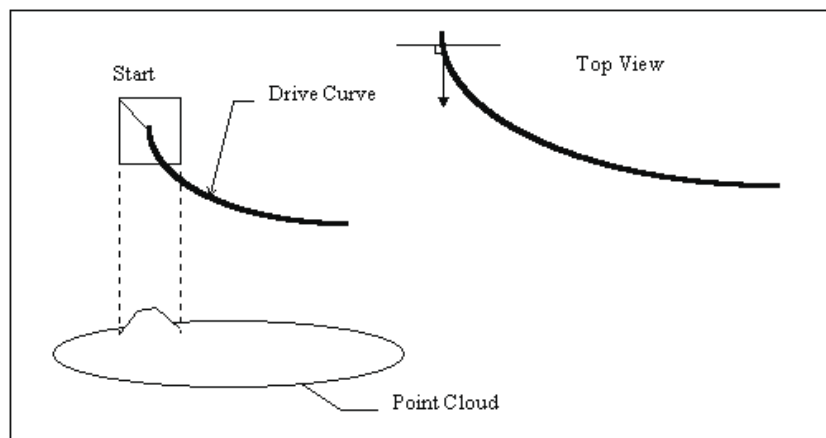


Figure 2-14: DRIVE CURVE

SECTIONS >> PLANES >> NEW PLANE SET >> 2 SPLINE & PLANE

Create a plane set where the planes are defined by 2 points, obtained from the two drive curves and the normal to a given plane.

PICK 1ST SPLINE

<PICK>	Pick is 2D/3D curve.
<REJECT>	Return to the previous menu.
<EXIT>	Return to the previous menu.

PICK 2ND SPLINE

<PICK>	Pick is 2D/3D curve.
<REJECT>	Return to the previous menu.
<EXIT>	Return to the previous menu.

DEFINE PLANE

XY PLANE	MODEL UCS XY Plane.
YZ PLANE	MODEL UCS YZ Plane.
ZX PLANE	MODEL UCS XZ Plane.
3 POINTS	Plane defined by three points either point cloud points or geometrical points.

After defining the plane the plane symbol will be displayed.

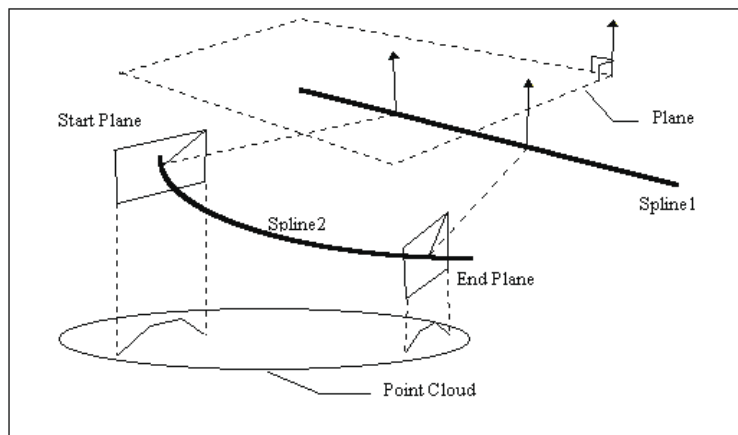


Figure 2-15: 2 SPLINES AND A PLANE

PRINCIPLE SET Menu

SINGLE PLANE

If only one plane has been defined the following table will be displayed:

CR TO CONT	SECTION NO. = 1	REF. POINT
------------	-----------------	------------

SECTION NO =1 Number of sections in the plane set,if changed the multiple planes menu will be displayed.

REF POINT Change the location of the plane.

MULTIPLE PLANES

If more than one plane has been defined one of the following menus will appear.

In the case of DRIVE or 2 SPLINE & PLANE the following menu will be displayed:

CR TO CONT	SECTION NO. = 5	START	END
------------	-----------------	-------	-----

SECTION NO =2 Number of sections in the plane set; initially two.

START Indicate the location of the first section in the set. Green indication.

END Indicate the location of the last section in the set. Red indication.

Otherwise the following table will be displayed:

CR TO CONT	SECTION NO. = 5	DELTA=5	START	END
------------	-----------------	---------	-------	-----

SECTION NO =2 Number of sections in the plane set; (The default is two).

DELTA Enter the distance between the planes.

START Indicate the location of the first section in the set. Green indication.

END Indicate the location of the last section in the set. Red indication.

After making the required modifications press <CR> to return to the main section table.

SECTIONS >> PLANES >> EDIT PLANE SET

Add or delete planes from the current plane set.

SELECT OPTION	DELETE PLANES	ADD PLANES
---------------	---------------	------------

DELETE PLANES Delete planes from the current plane set.

ADD PLANES Add planes to the current plane set.

<REJECT> Return to the previous menu.

<EXIT> Return to the previous menu.

SECTIONS >> PLANES >> EDIT PLANE SET >> DELETE PLANES
PICK PLANE/EXIT

<PICK>	Pick plane to delete the selected plane will be highlighted.
<REJECT>	Reject the last plane selected.
<EXIT>	Delete the selected planes and return to the previous menu.

SECTIONS >> PLANES >> EDIT PLANE SET >> ADD PLANES
PICK 1ST PLANE

<PICK>	Pick the first plane,the plane symbol will be highlighted.
<REJECT>	Return to the previous menu.
<EXIT>	Return to the previous menu.

PICK 2NDPLANE

<PICK>	Pick the second plane,the plane symbol will be highlighted.
<REJECT>	Return to the previous menu.
<EXIT>	Return to the previous menu.

CR TO CONT	PLANES NO. = 0
------------	----------------

PLANES NO	Enter the number of planes to be added.
<CR>	The planes will be created.
<REJECT>	Return to the previous menu.
<EXIT>	Return to the previous menu.

Note: • The initial number of planes is set to the current number of planes between the picked planes.

SECTIONS >> PLANES >> DEL PLANE SET

Delete the entire plane set.

SECTIONS >> CLOUDS

Select the point clouds to be sectioned more than one cloud may be picked.

PICK CLOUD & EXIT

Select cloud to be intersected with the plane set and exit.

SECTIONS >> APPLY

Create the sections, the APPLY modal is active only after a plane set has been defined and at least one point cloud has been defined.

CR TO CONT	SINGLE CLOUD	SPAN SIZE = 10	3D SCAN
	MULTIPLE CLOUDS		3D RANDOM

SINGLE /
MULTIPLE CLOUDS

Create a single cloud, or multiple separate clouds if the number of sections is greater than one.

SPAN SIZE = 10

Set the span size value.

The section command calculates the mathematical intersection between the section plane and the point data. The point cloud data is treated as a series of linear movements in the case of 3D RANDOM point clouds any positioning movements are also taken into consideration when the sections are being calculated this can lead to extra section points being created. See Figure 2-16. By setting the SPAN SIZE to a value less than the repositioning movement these extra points will not be calculated.

If the output result is a single cloud:

3D SCAN/RANDOM

If set to 3DSCAN, the resultant output cloud will be of type 3DSCAN.

<EXIT>

Return to previous menu.

<CR>

Execute the section command.

Notes:

- The section limits are initially calculated in the positive direction, this can be changed by redefining the Start and End Points.

- Changing one of the following modals: SECTION NO., DELTA, START, END causes the remaining modals to be automatically updated.

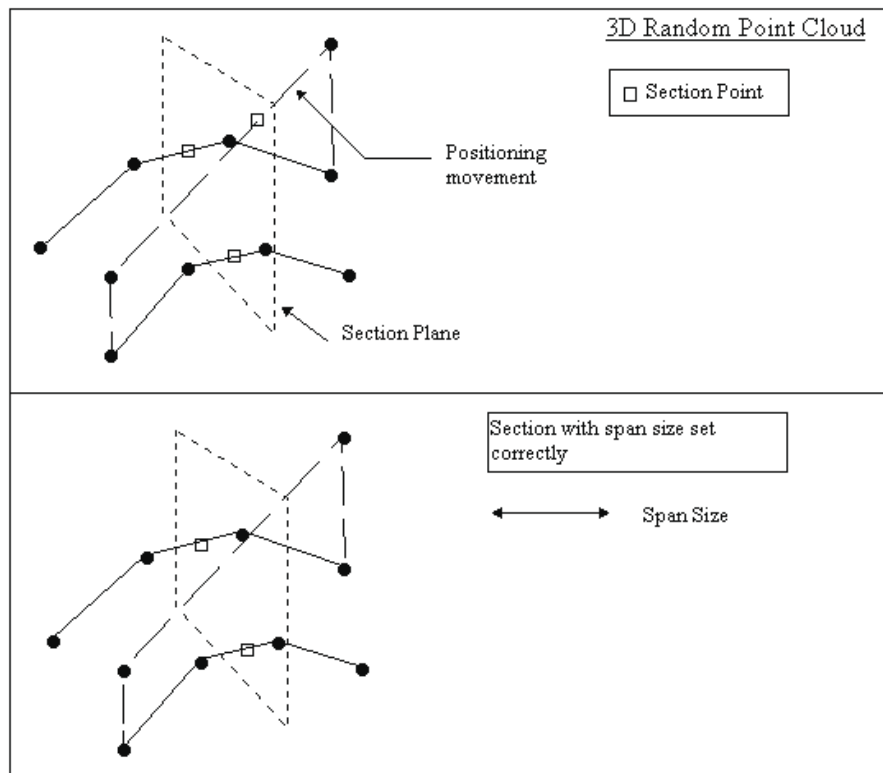


Figure 2-16: SPAN SIZE

CREATE >> FROM BP

Create a point cloud from an existing cloud's break points.

PICK CLOUD & EXIT

- <PICK> Indicate the cloud to translate the break point.
- <EXIT> Return to EDIT menu.

The Break Point in the selected point cloud will be used to create a new point cloud.

CREATE >> CLIP PLANES

Create a new point cloud from the points between or outside of two parallel planes.

SELECT OPTION	XY PLANE	YZ PLANE	ZX PLANE	VECTOR
---------------	----------	----------	----------	--------

XY PLANE	Clip planes are parallel to XY Plane of MODEL UCS.
YZ PLANE	Clip planes are parallel to YZ Plane of MODEL UCS.
ZX PLANE	Clip planes are parallel to XZ Plane of MODEL UCS.
VECTOR	Clip planes are normal to the vector defined by two points.

CLIP PLANES >> XY PLANE, YZ PLANE, ZX PLANE

Clip planes are parallel to XY, YZ, or XZ Planes of MODEL UCS.

1ST PLANE POS.	Pick the base point for the first plane.
<PICK>	Base point.
<REJECT>	Return to the previous menu.
<EXIT>	Return to the previous menu.
2ND PLANE POS.	Pick the base point for the second plane.
<PICK>	Base point.
<REJECT>	Return to the previous menu.
<EXIT>	Return to the previous menu.
Two planes are displayed on the screen. The green plane indicates the start plane the red the end plane. The positions of these planes may be changed with the edit plane modal.	

SELECT OPTION	EDIT PLN	CLOUDS	INTERNAL	EXTEND	APPLY
			EXTERNAL	NO EXTEND	

EDIT PLN	Change the planes position.
CLOUDS	Select the point clouds to clip.
INTERNAL	Select the points between the planes.
EXTERNAL	Select the points outside the planes.
EXTEND	Create extension points to the clipping planes.
NO EXTEND	Do not create extension points.
APPLY	Execute the command. APPLY is active only if at least one cloud is selected.

CLIP PLANES >> XY PLANE, YZ PLANE, XZ PLANE >> EDIT PLN

Edit the plane position.

CR TO CONTINUE	GREEN	MOVE IN	MOVE OUT	D=1.000	MOVE PLN	Z=108.00
	RED	MOVE IN	MOVE OUT	D=1.000	MOVE PLN	Z=60.00

GREEN	Options in the row refer to the green plane.
RED	Options in the row refer to the red plane.
MOVE IN	Move the plane by D value in the direction of the arrow.
MOVE OUT	Move the plane by D value in the opposite direction of the arrow.
D=1.000	Set increment to move the plane.
MOVE PLN	Indicate the new position.
Z=180.00	Type in the position of the plane.(In this case planes are parallel to XY so the position is along the Z axis).

CLIP PLANES >> XY PLANE, YZ PLANE, XZ PLANE >> CLOUDS

PICK CLOUD & EXIT

<PICK>	Indicate the cloud to select points from.
<EXIT>	Return to the previous menu if no cloud selected else confirm current selection.
<SUBM>	Display all unblanked point clouds.

CLIP PLANES >> XY PLANE, YZ PLANE, XZ PLANE >> EXTEND/NO EXTEND

If **EXTEND** is active, additional points will be added to the point cloud. These points are the intersections of the virtual scanlines with the clip planes and serve to create a smooth edge to the new point cloud.

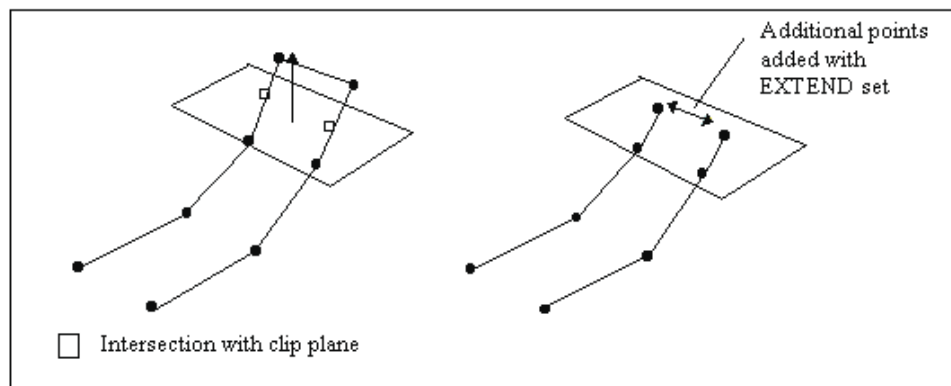


Figure 2-17: EXTEND

CLIP PLANES >> VECTOR

Clip planes are normal to the vector defined by two points.

IND. VECTOR ORIGIN Pick the base point for the vector.

<PICK> Base point.

<REJECT> Return to the previous menu.

<EXIT> Return to the previous menu.

IND. DIRECTION POINT Pick the direction point for the vector.

<PICK> Base point.

<REJECT> Return to the previous menu.

<EXIT> Return to the previous menu.

Two planes are displayed on the screen. The green plane indicates the start plane and the red the end plane.

SELECT OPTION	EDIT PLN	CLOUDS	INTERNAL	EXTEND	APPLY
			EXTERNAL	NO EXTEND	

EDIT PLN Change the planes position.

CLOUDS Select the point clouds to clip.

INTERNAL Delete the points between the planes.

EXTERNAL Delete the points outside the planes.

EXTEND Create extension points to the clipping planes.

NO EXTEND Do not create extension points.

APPLY Execute the command. **APPLY** is active only if at least one cloud is selected.

CLIP PLANES >> VECTOR >> EDIT PLN

Edit the plane position.

CR TO CONTINUE	GREEN	MOVE IN	MOVE OUT	D=1.000	MOVE PLN	MOVE BASE
	RED	MOVE IN	MOVE OUT	D=1.000	MOVE PLN	MOVE BASE

GREEN Options in the row refer to the green plane.

RED Options in the row refer to the red plane.

MOVE IN Move the plane by D value in the direction of the arrow.

MOVE OUT Move the plane by D value in the opposite direction of the arrow.

D=1.000 Set increment to move the plane.

MOVE BASE Indicate the new position. for the base or the direction point

The interaction in option: CLOUDS is the same as in the previous option, (XY PLANE etc).

CREATE >> EXTRACT SL

Create a point cloud from the selected Scanlines.

PICK A SCANLINE

<PICK> Pick a Scanline. The first Scanline picked is used to select the point cloud. Further Scanlines may only be picked from this point cloud.

<REJECT> Reject the last picked Scanline.

<EXIT> Delete the Scanlines.

Note: • The Scanlines may be picked in any order, and they will automatically be ordered.

CREATE >> SPLIT CLOUD

Split a point cloud into its sub-cloud components, based on distances between components.

PICK CLOUD

SELECT OPTION	DISPLAY	INCREMENT=10	SPAN SIZE=10	KEEP ORIGINAL	APPLY
	>	<<	>>	>	

DISPLAY	Display or do not display the points to be deleted due to the current setting. Points to be deleted are marked with a green cross.
INCREMENT=10	The value by which the SPAN SIZE value will be incremented/decremented
SPAN SIZE=10	The value under which a point cloud is split.
KEEP ORIGINAL	Keep the original point clouds.
APPLY	Apply the selections.
>	Decrease the SPAN SIZE value by INCREMENT * 0.1.
<<	Decrease the SPAN SIZE value by 10.
>>	Increase the SPAN SIZE value by 10.
>	Increase the SPAN SIZE value by INCREMENT * 0.1.
<CR>	Update parameters and display result.

The different sub-clouds are displayed in different colors.

CREATE >> JOIN CLOUD

Create one point cloud from two or more input point clouds. The input point clouds may be of any type.

PICK CLOUD NO. 1

Pick a series of point clouds, for every point cloud picked a row will be added to the interaction area below.

Change any required parameters, such as start, end and order of points.

<EXIT> create the new point cloud.

PICK CLOUD NO:	NAME	CLR	CHANGE	CHANGE	ORDER	
	CLOUD1		START	END	INVERT	ROW
	CLOUD2		START	END	INVERT	ROW
	CLOUD3		START	END	INVERT	

<PICK CLOUD NO:>	Select a point cloud to add to the list.
<CLR>	The display color of the point cloud will be displayed. This is for information only.
<START>	Modify the start point of the point cloud.

<END>	Modify the endpoint of the point cloud.
<INVERT>	Invert the start and endpoints.
<ROW>	Only for scandata point clouds, invert the order of the points within the scanlines.

- Notes:**
- The start point of the resultant point cloud is identified by a small cyan cube.
 - The end point of the resultant point cloud is identified by a small red cube.
 - <REJECT> removes the last selected cloud from the list.

CREATE >> CURVATURE

The radius of the curvature is approximated for every point in the point cloud. Points may then be selected based upon the given curvature interval.

PICK CLOUD & EXIT

<PICK>	Pick point cloud.
<REJECT>	Reject selected cloud.
<EXIT>	Confirm selection.

The approximated radius of the curvature is calculated and the following menu is displayed.

CR PER DISP/EXIT	MIN RADIUS. = 10.0	MAX RADIUS. = 25708.65	INNER
			OUTER
	MIN = 10.0	MAX = 25708.65	APPLY

MIN RADIUS	Display the min. radius found in the point cloud.
MAX RADIUS	Display the max. radius found in the point cloud.
INNER	Select points where the curvature is within the selected interval
OUTER	Select points where curvature is outside the given interval
MIN.	Lower the value for the selection interval.
MAX.	Upper limit for the selection interval.
APPLY	All points marked by a red marker will be deleted.
<CR>	Calculate the current interval and display the selected points by a small red marker
<EXIT>	Exit – no changes are made to the point cloud

CREATE >> EXTENSION

Extends the selected 3DSCAN point cloud to be extended. The effect of the extension is to increase the “length” of every scanline. It is not possible to increase the number of scanlines in a cloud.

PICK CLOUD & EXIT

<PICK> Select the point cloud.
 <REJECT> Reject the current selection.
 <EXIT> Continue.

The borders of the selected point cloud will be drawn in green.

SELECT/EXIT	BORDER	CONSTRAINTS	EQUAL	CREATE	APPLY
	NUM. PTS.	NUM. PTS = 10	PARAMETRIC	WGT C	
	DELTA		WGT B		

BORDERS Select the border to extend.

CONSTRAINTS Enter the geometry constraints menu.

EQUAL The points generated along the geometric border are linearly distributed.

PARAMETRIC The points generated along the geometric border are distributed based upon the spacing of the sections in the point cloud.

CREATE Generate a new point cloud. This modal is only active if the current border and geometric data are valid.

NUM. PTS. The number of points to be created to fill in the gap between the point cloud border and the geometric entity.

DELTA In the case of non-zero weights, this value must lie in the range $0 < \text{delta} < 1.0$. The number of points created is $1.0 / \text{delta}$.
 For example, a value of 0.1 will produce 10 new points.

WGT B Border Weight : Changing this value changes the length of the border tangent vector.

WGT C If the WGT C is set to a non-zero value, tangent vectors are displayed along the surface border.

SELECT /EXIT	FREE	NEW CONSTRAINT	LIMITS	AUTO LIMIT
--------------	------	----------------	--------	------------

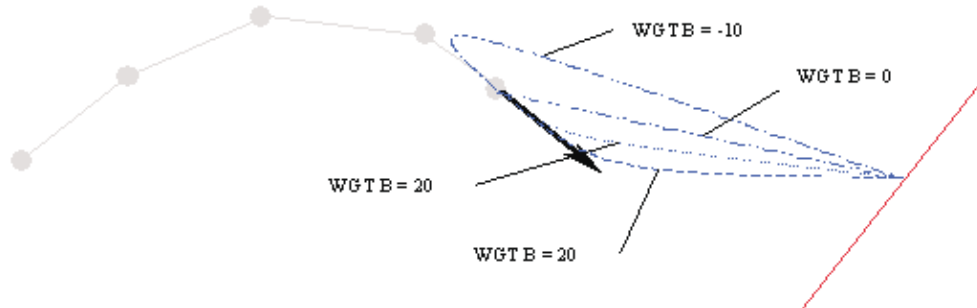
FREE Free any existing geometric constraints.

NEW CONSTRAINT Select a LINE/ARC/SPLINE or SURFACE as a geometric constraint.

LIMITS By picking along the geometric constraints, the limits can be changed.

AUTO LIMITS

Automatically impose the limits, minimizing the distance between the endpoints of the scanlines and the geometric constraint.



Example of the use of WGT B, the value of the modal WGT C produces the same result w.r.t a surface geometric.

Figure 2-18: Using WGT B

CREATE >> XY GRID

Sample the given cloud in X and Y with a constant pitch. A new XY GRID cloud is created. This command requires that the picked cloud is 3DSCAN with the scanlines parallel to the XZ plane as shown below.

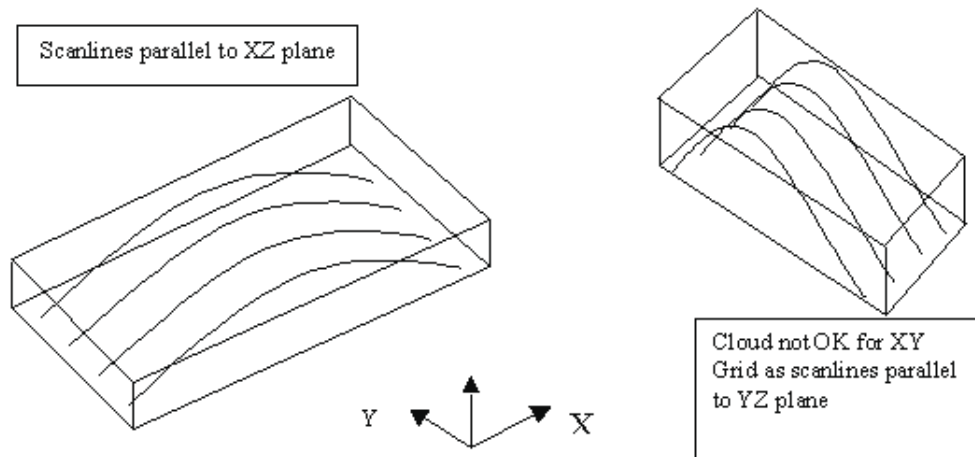


Figure 2-19: Example of the use of WGT B,

PICK CLOUD & EXIT

<PICK>	Select the point cloud.
<REJECT>	Reject the current selection.
<EXIT>	Continue.

The following menu will appear .

CR TO CONT	DX= 0.5	DY=0.5
------------	---------	--------

DX	Specify the step in the X direction.
DY	Specify the step in the Y direction.
CR TO CONT	CR to create the Grid.
<EXIT>	Return to the main menu.

A new cloud will be created. The new cloud will be of type GRIDXY and may be used where a 3DSCAN cloud can be used.

CREATE >> CLD BORDER

Create point clouds from the selected scandata cloud's borders.

PICK CLOUD & EXIT

<PICK>	Pick the point cloud.
<REJECT>	Reject the selected cloud.
<EXIT>	Confirm selection.

PICK A BORDER

<PICK>	Select one or more of the four possible borders.
<REJECT>	Reject the last selected border.
<EXIT>	Confirm selection and create a point cloud for every selected border.



DELETE

This menu contains the commands for deleting points from the point clouds.

Main Options:

SELECT / EXIT	POLYGON	PICK POINTS	CLIP PLANES	DELETE SCANLINE	BREAK POINTS
	CURVATURE				

- POLYGON** Delete points inside or outside a polygon.
- PICK POINTS** Delete indicated points.
- CLIP PLANES** Delete points inside or outside two parallel planes.
- DELETE SCANLINE** Delete a Scan Line from a 3DSCAN Cloud.
- BREAK POINTS** Delete break points
- CURVATURE** Delete points based upon a curvature.

DELETE >> POLYGON

Delete all the points inside or outside a polygon. The polygon can be thought of a stencil, where all points which fall in or outside of this stencil on the screen are deleted.

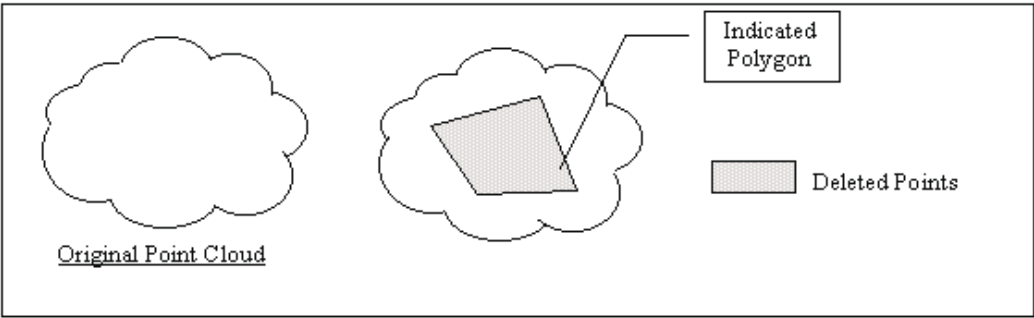


Figure 2-20: LOOP POINTS

Choose an option to define a polygon, the default is SCREEN.

PICK PT. 1 / EXIT	INNER	SCREEN
	OUTER	ENTITY
		CURVE
		BOX

- SCREEN** Pick points on screen to define a polygon.

DELETE

- ENTITY** Pick a geometric point (END, MID, CLOSE etc) on an entity, the resultant point will be used to define the polygon.
- CURVE** Pick a curve to define a polygon.
- BOX** Pick two points to define a box.
- <PICK> Indicate polygon.
- <EXIT> Return to the DELETE menu if no points have been picked.
- <EXIT> Close the polygon if at least two points have been picked.
- Notes:**
- Points from all displayed clouds contained within the polygon will be deleted.
 - It is impossible to rotate the model during this command. The only view commands available are ZOOM and REDRAW.
 - It is not necessary to close the polygon: the polygon will be automatically closed by connecting the first to the last point by <EXIT>.
 - This command operates in screen space.
 - Maximum number of points in polygon is 4096.

POLYGON >> SCREEN

When the SCREEN option is selected the following modals will appear:

PICK PT. 1 / EXIT	INNER	SCREEN	FREE
	OUTER		HOR / VER

FREE Polygon's lines are free.

HOR/VER Polygon's lines are constrained to be horizontal or vertical.

POLYGON >> ENTITY

When option ENTITY is selected the following modals will appear:

PICK PT. 1 / EXIT	INNER	ENTITY
	OUTER	

<SUBMENU> The **Cimatron** Point menu will appear.

Pick the desired point. This point will then be projected onto the display plane.

POLYGON >> CURVE

When option CURVE is selected the following modals will appear:

PICK PT. 1 / EXIT	INNER	CURVE	1 CURVE	PT ON CRV = 10
	OUTER		2 POINTS	
			PT & DIR	

1 CURVE	Create the polygon vertices on the curve.
2 POINTS	Create the polygon vertices on the curve between two points.
PT & DIR	Create the polygon vertices from the picked point to the end of the curve in the selected direction.
PT ON CRV =10	Number of polygon vertices on the curve.

POLYGON >> BOX

Select all points in the given box. The box is created in screen space.

PICK 1ST PT.

<EXIT>	Switch back to screen pick-point mode.
<REJECT>	Return to previous menu.
<PICK>	Pick first corner for the box.

PICK 2ND PT.

<EXIT>	Switch back to screen pick-point mode.
<REJECT>	Reject the first point, return to previous menu.
<PICK>	Pick second corner for the box.

A green box will appear on the screen.

BOX OK ? YES NO

YES	Delete points and exit to the DELETE menu.
NO	Reject the second point, and return to previous menu.

DELETE >> PICK POINTS

Delete the indicated points from their respective point clouds.

<i>PICK POINT</i>	Pick a series of points to delete.
<PICK>	Indicate points to delete.
<EXIT>	Reject the last selected point.
<REJECT>	Reject the last picked point

- Notes:**
- All display commands are available during this command.
 - Selected points are displayed as highlighted points plus a series of line segments.

DELETE >> CLIP PLANES

Delete all the points between or outside of two parallel planes.

SELECT OPTION	XY PLANE	YZ PLANE	ZX PLANE	VECTOR
---------------	----------	----------	----------	--------

XY PLANE	Clip planes are parallel to XY Plane of MODEL UCS.
YZ PLANE	Clip planes are parallel to YZ Plane of MODEL UCS.
ZX PLANE	Clip planes are parallel to XZ Plane of MODEL UCS.
VECTOR	Clip planes are normal to the vector defined by two points.

CLIP PLANES >> XY PLANE, YZ PLANE, XZ PLANE

<i>1ST PLANE POS.</i>	Pick the base point for the first plane.
<PICK>	Base point.
<REJECT>	Return to previous menu.
<EXIT>	Return to DELETE menu.
<i>2ND PLANE POS.</i>	Pick the base point for the second plane.
<PICK>	Base point.
<REJECT>	Return to previous menu.
<EXIT>	Return to DELETE menu.
Two planes are displayed on the screen. The green plane indicates the start plane the red the end plane. The positions of these planes may be changed with the edit plane modal.	

SELECT OPTION	EDIT PLN	CLOUDS	INTERNAL	EXTEND	APPLY
			EXTERNAL	NO EXTEND	

EDIT PLN	Change the planes position.
CLOUDS	Select the point clouds to clip.
INTERNAL	Delete the points between the planes.
EXTERNAL	Delete the points outside the planes.
EXTEND	Create extension points to the clipping planes.
NO EXTEND	Do not create extension points.
APPLY	Execute the command. APPLY is active only if at least one cloud is selected.

CLIP PLANES >> XY PLANE, YZ PLANE, XZ PLANE >> EDIT PLN

Edit the plane's position.

CR TO CONTINUE	GREEN	MOVE IN	MOVE OUT	D=1.000	MOVE PLN	Z=108.00
	RED	MOVE IN	MOVE OUT	D=1.000	MOVE PLN	Z=60.00

GREEN	Options in the row refer to the green plane.
RED	Options in the row refer to the red plane.
MOVE IN	Move the plane by D value in the direction of the arrow.
MOVE OUT	Move the plane by D value in the opposite direction of the arrow.
D=1.000	Set increment to move the plane.
MOVE PLN	Indicate the new position.
Z=180.00	Type in the position of the plane.(In this case planes are parallel to XY so the position is along the Z axis).

CLIP PLANES >> XY PLANE, YZ PLANE, XZ PLANE >> CLOUDS

PICK CLOUD & EXIT

<PICK>	Indicate the cloud to clip.
<EXIT>	Return to the previous menu if no cloud selected else confirm current selection
<SUBM>	Display all unblanked point clouds..

CLIP PLANES >> XY PLANE, YZ PLANE, XZ PLANE >> EXTEND / NO EXTEND

If **EXTEND** is active, a new points will be added to the point cloud. These points are the intersections of the virtual scanlines with the clip planes and serve to create a smooth edge to the new point cloud.

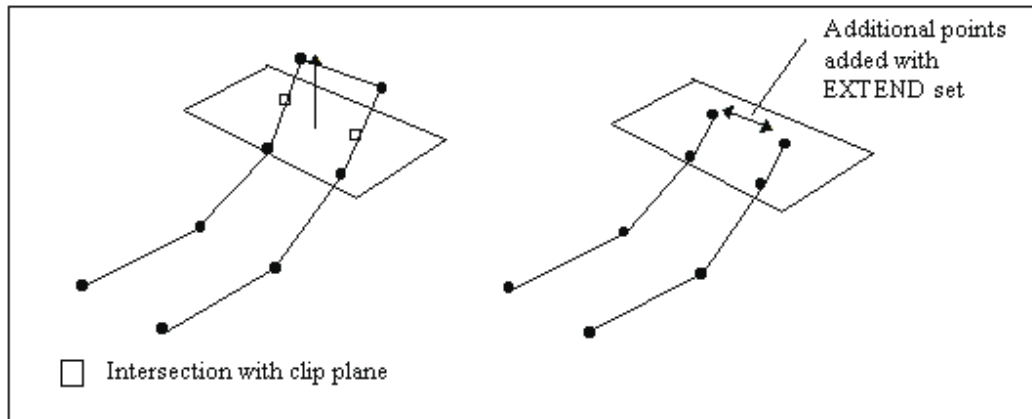


Figure 2-21: **EXTEND**

CLIP PLANES >> VECTOR

IND. VECTOR ORIGIN Pick the base point for the vector.

- <PICK> Base point.
- <REJECT> Return to the previous menu.
- <EXIT> Return to the **DELETE** menu.

IND. DIRECTION POINT Pick the direction point for the vector.

- <PICK> Base point.
- <REJECT> Return to the previous menu.
- <EXIT> Return to the **DELETE** menu.

Two planes are displayed on the screen. The green plane indicates the start plane the red the end plane.

SELECT OPTION	EDIT PLN	CLOUDS	INTERNAL	EXTEND	APPLY
			EXTERNAL	NO EXTEND	

- EDIT PLN Change the planes position.
- CLOUDS Select the point clouds to clip.
- INTERNAL Delete the points between the planes.
- EXTERNAL Delete the points outside the planes.
- EXTEND Create extension points to the clipping planes.
- NO EXTEND Do not create extension points.
- APPLY Execute the command. **APPLY** is active only if at least one cloud is selected.

CLIP PLANES >> VECTOR >> EDIT PLN

Edit the plane's position.

CR TO CONTINUE	GREEN	MOVE IN	MOVE OUT	D=1.000	MOVE PLN	MOVE BASE
	RED	MOVE IN	MOVE OUT	D=1.000	MOVE PLN	MOVE BASE

GREEN	Options in the row refer to the green plane.
RED	Options in the row refer to the red plane.
MOVE IN	Move the plane by D value in the direction of the arrow.
MOVE OUT	Move the plane by D value in the opposite direction of the arrow.
D=1.000	Set increment to move the plane.
MOVE BASE	Indicate the new position for the base or the direction point

The interaction of option **CLOUDS** is the same as in the previous option, (XY PLANE etc).

DELETE >> DELETE SCANLINE

Delete one or more Scan Lines from a point cloud.

PICK A SCANLINE

<PICK>	Pick a Scanline to delete. The first Scanline picked is used to select the point cloud. Additional Scanlines may only be picked from this point cloud.
<REJECT>	Reject the last picked Scanline.
<EXIT>	DELETE the Scanlines.

The picked ScanLine picked will be displayed in green.

DELETE SCANLINE ? YES/NO

- YES** Delete the scanline, return to previous menu.
NO Return to previous menu.

DELETE >> BREAK POINTS

Delete all points marked as break points from the selected cloud. Break points are displayed as small red boxes and can be edited with the **EDIT/BREAK POINTS** command.

PICK CLOUD & EXIT

<PICK>	Pick the cloud from which to cancel the points marked as break points.
<REJECT>	Unselect the current selection.
<EXIT>	Confirm and delete the points marked as break points in the selected cloud.

DELETE >> CURVATURE

The radius of curvature is approximated for every point in the point cloud. Points may then be selected based upon the given curvature interval. See **BLANK/CURVATURE** for more details

PICK CLOUD & EXIT

<PICK>	Pick a point cloud
<REJECT>	Reject the selected cloud
<EXIT>	Confirm the selection

The approximated radius of the curvature is calculated and the following menu is displayed.

CR PER DISP/EXIT	MIN RADIUS. = 10.0	MAX RADIUS. = 25708.65	INNER
			OUTER
	MIN = 10.0	MAX = 25708.65	APPLY

MIN RADIUS	Display the min. radius found in the point cloud.
MAX RADIUS	Display the max. radius found in point cloud.
INNER	Select points where the curvature is within the selected interval
OUTER	Select points where the curvature is outside the given interval
MIN.	Lower value for the selection interval.
MAX.	Upper limit for the selection interval
APPLY	All points marked by a red marker will be deleted
<CR>	Calculate the current interval and display the selected points by a small red marker
<EXIT>	Exit – no changes are made to the point cloud



VERIFY

Point verification commands.

Main Options:

SELECT/EXIT	DISTANCE	COORDS
-------------	----------	--------

DISTANCE Verify distance between points.

COORDS Verify coordinates of points.

VERIFY >> DISTANCE

Verify the distance between two cloud points. The picked points do not have to belong to the same point cloud.

INDICATE 1ST PT

<PICK> Indicate first point.
<EXIT> Return to the previous menu.

INDICATE 2ND PT

<PICK> Indicate second point.
<REJECT> Reject the first point, return to the previous menu.
<EXIT> Return to the previous menu.

CR TO CONT/SUBMENU	DISTANCE=	DX=	DY=	DZ=
--------------------	-----------	-----	-----	-----

<RETURN> Return to the previous prompt.
DISTANCE=10.145 The distance between the indicated points.
DX The difference in X between the two selected points.
DY The difference in Y between the two selected points.
DZ The difference in Z between the two selected points.

If <SUBMENU> is selected, the following table is displayed:

CR TO CONT	DISTANCE=	DX=	DY=	DZ=
	1 ST POINT	X=	Y=	Z=
	2ND POINT	X=	Y=	Z=

VERIFY >> COORDS

Verify the coordinates of a point in a point cloud.

INDICATE POINT

- <PICK> Calculate the coordinates of the indicated point.
- <EXIT> Return to the previous menu.

CR TO CONT	POINT	X=30.012	Y= 30.800	Z=42.770
------------	-------	----------	-----------	----------

- X=30.012 Coordinates of X coord.
- Y= 30.800 Coordinates of Y coord.
- Z=42.770 Coordinates of Z coord. ☐

DISP OPT

Point cloud display options. These options allow for the reduction of the number of points used to represent a point cloud on the screen, as well as toggle the display of the Start and End point indicators, Cloud Label and Break Points.

SELECT / EXIT	SKIP POINTS = 1	MARKERS	BOUND BOX
		NO MARKERS	NO BOUND BOX

SKIP POINTS =n	Number of points to skip while displaying point clouds. Every nth point is displayed.
MARKERS	Display all markers, Break points, and Start and End points.
NO MARKERS	Do not display all markers.
BOUND BOX	Display the bounding box.
NO BOUND BOX	Do not display the bounding box.

Notes:

- **SKIP POINTS**

To speed up display operations on large point clouds, it is possible to modify the number of points used to represent a point cloud on the screen.

When the Skip Points is set to one (1), all points in the point cloud will be displayed. When set to two (2), every other point in the point cloud will be displayed. etc

- **BREAK POINTS**

Show break points as highlighted points. Each break point is appears as a small red box.

- After changing **SKIP POINTS**, the selected point cloud is erased and then redrawn with the new parameter.
- The effect of skip points is **ONLY** visual.
- Break Points may be introduced by the **BREAK POINTS** command.

MOVE

This menu contains the commands for moving and copying a point cloud.

PICK CLOUD

CR TO CONT/EXIT	DELTA	ROT. AXIS	SCALE
-----------------	-------	-----------	-------

DELTA Move clouds according to the delta value

ROT. AXIS Rotate a cloud on an axis.

SCALE Scale a point cloud.

For details about the **MOVE** function see the Chapter 1 in the Modeling Manual.





Chapter 3

Mesh Menu

The MESH Commands.

	EDIT	DELETE	CREATE	<MESH>
BLANK	UNBLANK	VERIFY	SAVE	

Where:

(SHADED)	=	Multi Commands
(CLEAR)	=	Single Commands

- Notes:**
- All single mesh commands affect the current mesh.
 - The current mesh is selected by picking the corresponding point cloud.
 - An error message is output if the selected cloud does not have an associated mesh.

EDIT	This menu contains the mesh editing commands.
CREATE	Create a mesh which approximates the point cloud.
DELETE	Delete a mesh.
VERIFY	This menu contains the mesh verification commands.
SAVE	Save the mesh into a Cimatron SLA surface, or generate an SLA ASCII file.

EDIT

This menu contains the point mesh editing commands.

ClassSingle Command

PICK CLOUD & EXIT Pick a cloud and exit.

SELECT / EXIT	MOVE VERTEX	DELETE FACES	REGION CMDS	DECIMATION
	SWAP	DELDEGFACE		

MOVE VERTEX	Move a Mesh vertex.
DELETE FACES	Delete a face from the current mesh.
REGION CMDS	Operate on a region in the Mesh.
DECIMATION	Delete redundant faces and reconstruct topology.
SWAP	Improve the Mesh by swapping edges.
DELDEGFACE	Delete degenerate faces from the Mesh.

EDIT >> MOVE VERTEX

Move a mesh vertex, the new point can be specified by coordinates, a cloud's point or a **Cimatron** geometric point.

IND. VERTEX / EXIT

<EXIT>	Return to the previous menu.
<PICK>	The Indicated vertex will be highlighted.

<CR>. TO CONT / EXIT	PICK CLOUD POINT
	PICK GEOMETRIC POINT
	ENTER COORDS

PICK CLOUD POINT	Move vertex to indicated cloud's point.
PICK GEOMETRIC POINT	Move vertex to indicated Cimatron geometric point.
ENTER COORDS	Move vertex to entered coordinate values.

Note:

- During any of these commands the screen display may be changed with the **Cimatron** PopUp menu.

EDIT >> DELETE FACES

Delete all the faces around the selected mesh vertex.

IND. VERTEX / EXIT

- | | |
|--------|---|
| <EXIT> | Return to the previous menu. |
| <PICK> | The faces around the selected vertex will be deleted. |

Note:

- During any of these commands the screen display may be changed with the **Cimatron** PopUp menu.

EDIT >> REGION CMDS

Define a region in the mesh. This region may be moved or deleted.

A mesh region is defined as all the faces of the current mesh that have at least one vertex within the selected polygon.

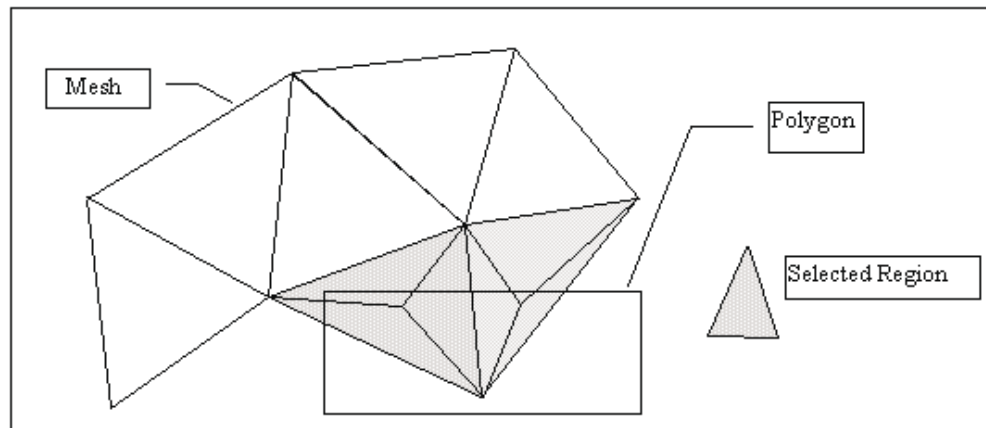


Figure 3-1: DEFINE A REGION

PICK POINT 1 / EXIT

- | | |
|--------|--|
| <EXIT> | Return to the previous menu if no points were picked. |
| <PICK> | Indicated polygon. |
| <EXIT> | Close the polygon if at least three points have been picked. |

Note:

- It is impossible to rotate the model during this command. The only view commands available are **ZOOM** and **REDRAW**.

SELECT / EXIT	DELETE REGION	MOVE REGION	DRAW REGION
---------------	---------------	-------------	-------------

DELETE REGION	Delete the indicate region.
MOVE REGION	Move the indicate region.
DRAW REGION	Draw the indicate region.

REGION CMDS >> DELETE REGION

The selected region will be highlighted in green and deleted upon confirmation.

*CONFIRM DELETE ?
YES/NO*

YES	The region will be deleted.
NO	Return to the previous menu, the region will not be deleted.

REGION CMDS >> MOVE REGION

The selected region to be moved will be highlighted in green.

SELECT / EXIT	Z CONSTANT	VALUE = 0.0
	Y CONSTANT	
	X CONSTANT	

<EXIT>	Return to the previous menu if no points picked.
Z CONSTANT	Move all selected vertices to the same Z value.
Y CONSTANT	Move all selected vertices to the same Y value.
X CONSTANT	Move all selected vertices to the same X value.

The mesh region will be redrawn at the new coordinate value.

REGION CMDS >> DRAW REGION

The selected region will be highlighted in green.

EDIT >> DECIMATION

Delete redundant faces and reconstruct topology.

CR TO CONT / EXIT	Tolerance = .100
-------------------	------------------

<EXIT>	Return to the previous menu.
TOLERANCE = 0.1	Maximum deviation required.
<RETURN>	Start decimation.

During the decimation process a message will indicate the process progress. When iteration is completed, the following table appears:

SELECT / EXIT	IMPROVE DECIMATION	FACES DELETED = 27%	TOLERANCE = 0.1
	DISPLAY MESH		

<EXIT> Return to the previous menu and keep the current mesh.

IMPROVE DECIMATION Another iteration is performed.

FACES DELETED= 27.2% Percent of deleted faces.

TOLERANCE = .100 Tolerance used in for the last iteration, can be changed for the next one.

DISPLAY MESH Draw the current mesh.

- Notes:**
- During this command the screen display may be changed with **Cimatron** PopUp menu.
 - If in the original mesh there are faces whose distance from point cloud is larger than the tolerance required, the new mesh could not respect the tolerance in the specific area.
 - The effect of a decimation is a mesh which covers the point cloud with the same approximation but much less face (typically 30% less) than the original mesh. The new face will be larger and the error will be uniformly distributed.
 - The command returns to the previous menu automatically when no more faces can be deleted.

EDIT >> SWAP

Each two adjacent mesh faces define a quadrangle and the common edge is one of its diagonals. The command swaps the common edge with the other diagonal every time it improves point cloud approximation.

EDIT >> DELDEGFACE

Deletes degenerate faces from the current mesh. A degenerate face is a triangle with a very small angle. ☐

CREATE

Create a mesh which approximates the point cloud. A mesh is an approximation to the points contained in the point cloud. The mesh is guaranteed not to contain holes.

There are two different methods to create a mesh:

- Mesh from a scan data cloud by a user defined tolerance.
- Mesh from a random data cloud by a user defined mesh level (triangle average size).

Notes:

- A mesh created is not saved to the **Cimatron** part file. To save the mesh to an SLA file, or an SLA surface, use the **SAVE** command.
- Each point cloud can consist of one mesh.

PICK CLOUD & EXIT

<PICK>

Pick the point cloud and exit.

In case a Scan Data cloud was picked, the following table appears:

SELECT / EXIT			VERIFY	CREATE
	TOL = 0.10	MIN DIM=0.2	3DSCAN	

VERIFY Verify the distance between the point cloud to the mesh.
 TOL = 0.10 Set the tolerance between the points and the mesh.
 MIN DIM = 0.2 Minimum dimension of any triangle.
 3DSCAN/RANDOM Type of mesh, for RANDOM option, see next section.
 CREATE Create a mesh with the given parameters.

In case a Random Data cloud was picked, the following table appears:

SELECT / EXIT	LIMITS		VERIFY	CREATE
	(2) 1.2			

LIMITS Define the border polygon of the mesh. A polygon has to be defined.
 (2) 1.2 Level which controls the average size of the faces in the mesh and therefore the quality of approximation. See Figure 3-2.
 VERIFY Verify the distance between the point cloud to the mesh.
 CREATE Create the mesh with the given parameters. **CREATE** is not active unless the limits of the mesh are defined.

SELECT / EXIT	CALC DIST	DRAW NORMALS
---------------	-----------	--------------

The **VERIFY** option within the **CREATE** command is identical to the **VERIFY** command.

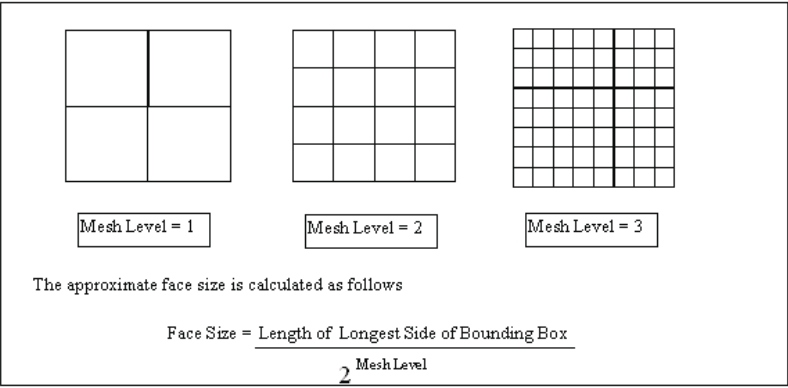


Figure 3-2: MESH LEVEL

DELETE



Delete a mesh.

PICK CLOUD & EXIT

DELETE MESH ? YES / NO

<EXIT>

Return to the previous menu.

YES The mesh will be deleted.

NO The mesh will not be deleted.

VERIFY

This menu contains the point mesh verify commands.

PICK CLOUD & EXIT

- <PICK> Pick a Point Cloud.
- <EXIT> If no cloud is selected, return to the previous menu

Main Options:

SELECT / EXIT	DISTANCE	COORDS	CALC DIST	DRAW NORMALS	INFO FACE
---------------	----------	--------	-----------	--------------	-----------

- DISTANCE** Verify distance between mesh vertices
- COORDS** Verify the coordinates of a vertex
- CALC DIST** Calculate and display the distance between points and mesh
- DRAW NORMALS** Draw the normals to the mesh faces
- INFO FACE** Draw points covered by the selected mesh face and the max distance to them.

VERIFY >> DISTANCE

Calculate the distance between two mesh vertexes, the picked vertexes must belong to the same mesh.

PICK 1ST VERTEX

- <EXIT> Return to the previous menu.
- <PICK> Pick the vertex.
- <REJECT> Reject the picked vertex.

PICK 2ND VERTEX

- <EXIT> Return to the previous menu.
- <PICK> Pick the vertex.
- <REJECT> Reject the picked vertex.

CR TO CONT / SUBMENU	DISTANCE = 10.32
----------------------	------------------

- <EXIT> Return to the VERIFY menu
- <CR> Return to the previous prompt

VERIFY >> COORDS

Verify the coordinates of the selected mesh vertex.

PICK VERTEX

- <EXIT> Return to the previous menu
- <PICK> Calculate the coordinates of the picked vertex.

CR TO CONT / SUBMENU	POINT	X = 10.134	Y = 23.345	Z = 17.231
----------------------	-------	------------	------------	------------

VERIFY >> CALC DIST

Calculate and display the distance between the mesh to the point cloud.

SELECT / EXIT	DISPLAY
---------------	---------

<CR> or DISPLAY to display the distance between the mesh to the point cloud.

VERIFY >> DRAW NORMALS

Draw Mesh normals.

CR TO CONT / EXIT	NORMAL LENGTH = 1.0
-------------------	---------------------

NORMAL LENGTH = 1.0 The length of the displayed normals.

- <EXIT> Return to the previous menu.
- <CR> Displayed the normals.

VERIFY >> INFO FACE

Verify max distance between the points and a selected face.

PICK 1ST VERTEX/EXIT

- <PICK> Pick a vertex of the mesh face required.
- <EXIT> Return to the previous menu.

Pick the 2nd and 3rd vertices. The maximum distance is displayed. □

SAVE

Save the mesh into a **Cimatron** SLA surface, or create an SLA ASCII file.

PICK CLOUD & EXIT

<PICK> Pick the cloud to indicate the mesh.
<EXIT> Return to the previous menu.

CR TO CONT / EXIT	SLA SURFACE
	SLA FILE

SLA SURFACE Create a **Cimatron** SLA Surface in the current PFM.

SLA FILE Create a SLA ASCII file.

<EXIT> Return to the previous menu.
<RETURN> SLA Surface or SLA File will be created.

SAVE >> SLA SURFACE

During the creation of the SLA Surface a message will be output for every fifty vertexes.

SAVE >> SLA FILE

NAME OF THE SLA FILE:

Enter a file name. If the output file exists the following message will appear:

‘ THE OUTPUT FILE <filename> ALREADY EXISTS ‘

Change the name of the output file or overwrite the existing file. ☐



Chapter 4

Splines Menu

Commands relative to spline operations.

		DELETE	CREATE	<SPLINES>
BLANK	UNBLANK	VERIFY		

Where:

(SHADED)	=	Multi Commands
(CLEAR)	=	Single Commands

CREATE	Create Bezier NURBS or ARC that approximate the current point cloud with the required precision.
DELETE	Delete the picked curve, or a curve associated to a point cloud.
VERIFY	This menu contains the verification commands of splines.

CREATE

Create Bezier, NURBS or arc that approximate the current point cloud with the required precision. No restrictions exists about cloud type or dimension.

Re-Enge creates a single spline from a Random cloud. In a Scan Data cloud, a spline is created from each scanned line.

A cloud can consist of more than one spline.

PICK CLOUD & EXIT

When the cloud is selected, a green polygon which connects the points of the cloud appears, together with the following table:

SELECT / EXIT	LIMITS	TANGENT	VERIFY	CREATE
	TOLERANCE = .10	BEZIER	BREAK POINTS	
		NURBS	NO BREAK POINTS	
		CIRCLE		

LIMITS	Define the extremes of the curve, i.e. the extreme of the green polygon. The command is always active.
TANGENT	Define the tangent at the end point of the curve. The command is always active.
VERIFY	Verify the distance from a curve to the point cloud. Active only if some curves exit.
CREATE	Create a curve with the current parameters and geometric bonds.
TOLERANCE =0.1	Max deviation between the spline and points. The command is always active.
BEZIER / NURBS	Define the type of curve to create.
BREAK POINTS / NO BREAK POINTS	See further explanation.
CIRCLE	The curve will be the best fit circle for the selected points. Available only for a 2D cloud.

CREATE >> BREAK POINTS / NO BREAK POINTS

Break points allow for the introduction of points of discontinuity in the created splines, Break points are introduced into the point cloud by using the <POINTS>/EDIT/BREAK POINTS command. See **BREAK POINTS (BP)**.

While fitting a point cloud it is possible using this option to specify if the break points will or will not be taken into consideration during the fitting process.

If the break points are present and the break point command is active, then the point cloud will be treated as a series of smaller point clouds, one for every series of points between break points. Separate splines will be created.

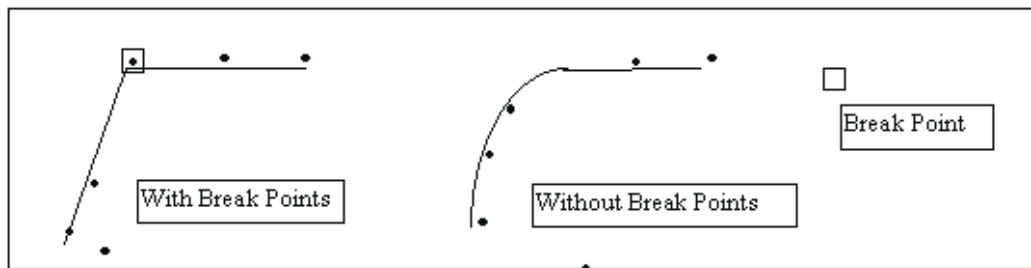


Figure 4-1: BREAK POINTS AND SPLINES

CREATE >> LIMITS

This command permits to limit the range of points (when just a part of the point cloud is required to be approximated) or to force the start and the end points of the curve to stay on other geometry.

SELECT / EXIT	SCAN LIMITS	GEOM LIMITS
---------------	-------------	-------------

<EXIT>	Return to the previous menu.
SCAN LIMITS	Shift an extreme on the selected point of the cloud.
GEOM LIMITS	The extreme will be the point selected on another geometry.

LIMITS >> SCAN LIMITS

PICK POINT

<EXIT>	Return to the previous menu
<PICK>	On a point of the cloud to choose the new extreme. The green polygon will be immediately updated.

LIMITS >> GEOM LIMITS
PICK END PT

- <EXIT> Return to the previous menu
- <PICK> On the end point to edit. The point will be highlight.

SELECT / EXIT	FREE	POINT	CURVE	SURFACE
---------------	------	-------	-------	---------

- <EXIT> Return to the previous menu.
- FREE Free the point from any geometric bond.
- POINT Define the new endpoint using **Cimatron** Point Menu.
- CURVE The new extreme will be a point on the selected curve nearest to the old end point.
- SURFACE The new extreme will be a point (SURF-B, SURF, SURF-X) on the selected surface nearest to the old end point.

CREATE >> TANGENT

Tangent at the extremes can be controlled.

PICK END PT. / EXIT

- <EXIT> Return to the previous menu.
- <PICK> Pick one of the end points of the green polygon.

SELECT END COND	FREE	CURVE	SURFACE	2 POINTS	VECTOR
-----------------	------	-------	---------	----------	--------

- <EXIT> Return to the previous menu.
- FREE** Free the end point from any tangent condition
- CURVE** Define the tangent selecting a point on a curve.
- SURFACE** Define the tangent selecting a point on a surface.
- 2 POINTS** Define the tangent choosing two **Cimatron** points.
- VECTOR** Define the tangent by the coordinates of a vector.

TANGENT >> CURVE
PICK CURVE

- <PICK> Pick a curve.
- <REJECT> Reject the selected curve.

IND. POINT

Indicate a point on the curve to define the tangent line. A double arrow will be displayed on the selected point.

SEL. DIR.

Select direction by indicating on an arrow to complete tangent's definition.

TANGENT >> SURFACE

PICK SURFACE

- <EXIT> Return to the previous menu.
- <PICK> Pick a surface. Three arrows (u-dir, v-dir, Normal) indicate the three possibilities for the tangent.

IND. DIR.

Select direction by indicating on an arrow to complete tangent's definition

TANGENT >> 2 POINTS

POINT 1

- <EXIT> Return to the previous menu.
- <PICK> Indicate first point using the **Cimatron** POINT Menu.
- <REJECT> Reject selection.

POINT 2

- <EXIT> Return to the previous menu.
- <PICK> Indicate first point using **Cimatron** Point Menu.
- <REJECT> Reject selection.

TANGENT >> VECTOR

CR TO CONT	DX = 0.000	DY = 0.000	DZ = 1.000
------------	------------	------------	------------

- <EXIT> Return to the previous menu.
- <RETURN> Confirm vector's definition.
- DX = 0.000 Delta in X with respect to the indicated end point of the green polygon.
- DY = 0.000 Delta in Y with respect to the indicated end point of the green polygon.
- DZ = 1.000 Delta in Z with respect to the indicated end point of the green polygon.

Note:

- A red arrow at the selected end point will indicate the new defined tangent. Use the modal **INVERT** to invert it.

CREATE >> VERIFY

Once created the spline it's possible to verify the distance from the point cloud. First the distance of each point to the spline is calculated.

SELECT / EXIT	SCALE = 1.00
---------------	--------------

CREATE

A message of the maximum distance between the spline and the points appears.

<EXIT> Return to the previous menu.

SCALE = 1.00 Scale of the colored vectors' length.

- Note:**
- During this command the screen displayed may be changed with the **Cimatron** POPUP menu. ☐

<EXIT>	Return to the previous menu
PICK SPLINE	Delete the picked splines.
PICK CLOUD	Delete the splines associated to the picked cloud.

PICK SPLINE & EXIT

DELETE >> PICK CLOUD

Pick a cloud to delete its splines (After a cloud is selected, it is highlight) and exit.

VERIFY

This menu contains the verification commands of splines.

SELECT / EXIT	CRV / CLD DIST	CURVE DATA
---------------	----------------	------------

<EXIT>	Return to the previous menu.
CRV/CLD DIST	Calculate and display the distance between the points and the curve. The same as option VERIFY in the CREATE function. See CREATE/VERIFY.
CURVE DATA	Information about curve data. <input type="checkbox"/>



Chapter 5

Surfaces Menu

Commands relative to operations on surfaces.

		CREATE	DELETE	<SURFACES>
BLANK	UNBLANK	VERIFY		

Where:

(SHADED)	=	Multi Commands
(CLEAR)	=	Single Commands

CREATE Create a NURBS surface that approximates the current point cloud with the required precision. The point cloud must be 3D Scan and ordered i.e. the start points of the scan lines must lie on the same side.

DELETE Delete the picked surfaces, or the surfaces associated to a point cloud.

VERIFY This menu contains the verification commands of surfaces.

Note: • All single commands affect the picked surface.

CREATE

Create a NURBS surface that approximates the current point cloud with the required precision. The point cloud must be 3D Scan and ordered i.e. the start points of the scan lines must lie on the same side.

To convert a random cloud into a 3D scan cloud use the option **SECTION CLOUD** in function <POINTS>/EDIT.

PICK CLOUD & EXIT Pick cloud (cloud is highlight) and exit..

When the cloud is selected, a green polygon which indicates the border of the cloud appears, together with the following menu:

SELECT / EXIT	LIMITS		VERIFY	CREATE
	TOL BORDER=	TOL INNER=		

SELECT / EXIT

LIMITS Define the border of the surface i.e. the green polygon. The command is always active.

VERIFY Verify surface deviation from the points. Active only if a surface exists.

CREATE Create a NURBS surface within the current parameters

TOL. BORDER = Maximum deviation between surface borders and the green polygon. It's always active.

TOL. INNER = Maximum deviation between surface and the inner points of the point cloud.

CREATE >> LIMITS

The border polygon is formed by the start points of the scan lines, last scan line, the end points and the first scan line (4 edges at all).

SELECT / EXIT	SCAN LIMITS	GEOM LIMITS
---------------	-------------	-------------

SELECT / EXIT Return to the previous menu.

SCAN LIMITS Shift an edge on another ScanLine.

GEOM LIMITS Fit an edge on a curve.

LIMITS >> SCAN LIMITS

PICK NEW LIMIT Pick a new limit for the surface. Only the two edges that are parallel to the scan lines can be moved by this option.

LIMITS >> GEOM LIMITS

PICK THE BORDER Pick a border to edit, selected border will be highlighted in red.

<EXIT> Return to the previous menu

SELECT / EXIT	FREE	CURVE	SURFACE
---------------	------	-------	---------

SELECT / EXIT Return to the previous menu

FREE Free the border from any geometric bond.

CURVE Fit the selected edge on a geometric curve.

SURFACE Fit the selected edge on a surface edge.

LIMITS >> GEOM LIMITS >> CURVE

PICK CURVE / EXIT

Pick the curve required. The border polygon will be immediately updated while the old one will be displayed in yellow.

<EXIT> Return to the previous menu

LIMITS >> GEOM LIMITS >> SURFACE

PICK SURFACE / EXIT Pick the surface edge required. The border polygon will be immediately updated while the old one will be displayed in yellow.

<EXIT> Return to the previous menu

If two adjacent edges are edited the menu will expand as follow:

SELECT / EXIT	FREE	CURVE	SURFACE	EDIT CORNER
---------------	------	-------	---------	-------------

The option EDIT CORNER allows to define the surface corner if no geometric intersection is found between the two adjacent edges. The editable corners are displayed with a small white cross. The table will be as follows:

PICK CORNER / EXIT Pick the corner to modify.

<EXIT> Return to the previous menu.

SELECT / EXIT	PICK POINT	KEY-IN
---------------	------------	--------

SELECT / EXIT

<EXIT> Return to the previous menu.

PICK POINT Define the new corner using **Cimatron** point menu.

KEY-IN Define the new corner entering a delta value in X,Y, or Z.

- Notes:**
- During this command the screen displayed may be changed with the **Cimatron POPUP** menu.
 - The higher the degree and the number of control points the more flexible is the surface, but also the complexity of the surface data becomes higher. Its not easy to find the best solution so it's not recommended to change the default value if there isn't a good reason.
 - When a surface is displayed the **CREATE** option is not active while the **VERIFY** option is active.
 - After creating surfaces, the surface flag for the selected point cloud will be set to DS.
 - The surfaces are automatically created in the current **Cimatron** PFM file. Unless explicitly deleted, these files will remain upon exiting Re-Eng.

CREATE >> CREATE

The modal **CREATE** starts surface generation with the current parameters and border conditions. There are three phases the current of which is displayed in the prompt area of the screen.

The NURBS surface defined by a control polygon which is a rectangular grid of control points. The best control polygon to satisfy the required precision is automatically settled. An "Advanced User" will be able to change it after the completion of the first phase.

CR TO CONT	ORDER U = 4	ORDER V = 4
------------	-------------	-------------

- ORDER U = 4 Define the surface degree along the U- parameter that are indicated by a yellow arrow.
- ORDER V = 4 Define the surface degree along the V- parameter that are indicated by a cyan arrow.
- <RETURN> Go on to the next phase.

CR TO CONT	CTRL PTS U = 19	CTLR PTS V = 11
------------	-----------------	-----------------

- CTRL PTS U = 19 Define the number of nodes (control points) along the U- parameter that are indicated by a yellow arrow.
- CTLR PTS V = 11 Define the number of nodes (control points) along the V- parameter that are indicated by a cyan arrow.
- <RETURN> Go on to the next phase.

- Notes:**
- The higher the degree and number of control points, the more flexible the surface and the complexity of the surface data. Its not easy to find the best solution, therefore it is recommended to change the default value.
 - When a surface is displayed, the **CREATE** option is inactive while the **VERIFY** option is active.

- After creating surfaces, the surface flag for the selected point cloud will be set to **DS**.
- The surfaces are automatically created in the current **Cimatron** .pfm file. Unless deleted, these files will remain upon exiting Re-Enge.

CREATE >> VERIFY

Once created the surface it is possible to verify the distance from the surface to the point cloud. The distance of each point to the surface is calculated. A prompt on the screen will describe it. The following table will be displayed:

SELECT / EXIT	SCALE = 1.00	MAXD =0 .025
---------------	--------------	--------------

<EXIT> Return to the previous menu.

SCALE = 1.00 Scale the length of the colored vectors.

MAXD = 0 .025 The maximum distance between the points and the surface.

- Note:**
- During this command the screen displayed may be changed with the **Cimatron** POPUP menu. ☐

DELETE

Delete the picked surfaces or the surfaces associated to the picked point cloud.

CR TO CONT / EXIT	PICK SURFACE	PICK CLOUD
-------------------	--------------	------------

<EXIT> Return to the previous menu.

PICK SURFACE Delete the picked surfaces.

PICK CLOUD Delete the surfaces associated to the picked cloud.

PICK SURFACE

PICK SURF & EXIT Pick surfaces and exit.

<EXIT> Return to the previous menu.

PICK CLOUD

PICK CLOUD & EXIT Pick cloud (cloud is highlight) and exit to confirm deletion.

<EXIT> Return to the previous menu.

Notes:

- As long as there is one surface linked to the selected point cloud the surface flag for the point cloud will be set.
- Only geometry created by Re-Eng my be deleted with this command.



VERIFY

This menu contains the verification commands of surfaces.

SELECT / EXIT	SURFACE DATA	SURF / CLD DIST
---------------	--------------	-----------------

- <EXIT> Return to the previous menu.
- SURFACE DATA** Verify information about surface data.
- SURF/CLD DIST** Calculate and display distances between the points and the surface.

VERIFY >> SURFACE DATA

Verify information about surface data.

PICK SURFACE & EXIT

- <EXIT> Return to the previous menu.

NURBS	U START : 0.00	U END : 43.919	V START : 0.00	V END : 24.521
-------	----------------	----------------	----------------	----------------

- <EXIT> Return to the previous menu.
- U START : 0.00 The U-parameter assumes all values such that $0.00 < U < 43.919$
- U END : 43.919
- V START : 0.00 The V-parameter assumes all values such that $0.00 < V < 24.521$.
- V END : 24.521

VERIFY >> SURF / CLD DIST

See the VERIFY option in the CREATE function. ☐



Chapter 6

Global Menu

Commands relative to global operations.

		DELETE	RELEASE	<GLOBAL>
BLANK	UNBLANK	CONFIG	SAVE	EXIT

Where:

(SHADED)	=	Multi Commands
(CLEAR)	=	Single Commands

DELETE	Delete point clouds.
RELEASE	Provides the Re-Enge version and release information.
CONFIG	Control Re-Enge configuration parameters.
SAVE	Save all point clouds or selected point clouds.
EXIT	Exit Re-Enge.

DELETE

DELETE

Deletes the selected point clouds.

- 1 Select the required point clouds.
- 2 Select the DELETE command.
- 3 Execute the DELETE command with <EXIT>.

The selected point clouds will be highlighted one by one.

DELETE CLOUD? YES / NO

YES The point cloud will be deleted. All associated geometry is not deleted.

NO The point cloud will not be deleted.

Notes:

- If the selected point cloud contains some geometry a warning message will appear to this effect.
- Once deleted it is not possible to recover the point cloud information unless this was previously saved in MDA or MDB format. ☐

RELEASE

Provides program version, release, and build-date information.

Upon selection

<CR> TO CONT	VERSION: 2	RELEASE: 0	BLDDATE: 349
--------------	------------	------------	--------------

Note:

- This information will be requested by the technical support engineer if you need to report a problem with Re-Eng. ☐

CONFIG

Control Re-Enge configuration parameters.

CR TO CONT	FULLDF:TRUE	LANGUAGE:ENGLISH	SER SIZE:1280
	UNITS: MM	Adv User: FALSE	Ver Level: 2

FULLDF:TRUE Display all clouds after any operation.
 LANGUAGE:ENGLISH Select language.
 SER SIZE:1280 Set the screen size to 1280 or 1024
 UNITS: MM Set the units.
 Adv User: FALSE More options is this field is selected TRUE. See the Appendix.
 Ver Level: 2 The version level. ☐

SAVE

Save all point clouds, or the selected point clouds. The file may be saved in ASCII (MDA), or binary (MDB) format.

Upon selection.

CR TO CONT	SAVE ALL CLOUDS	BINARY
	SAVE IND CLOUDS	ASCII

SAVE ALL CLOUDS Save all point clouds.
 SAVE IND. CLOUDS Save only those point clouds that have been selected.
 BINARY Binary format is more compact in file size but is system dependent.
 ASCII ASCII format is human readable and system independent.

FILE NAME: Enter the name of the file in which to save the point clouds.
 If the output file already exists, the following prompt will appear:

THE FILE <filename> ALREADY EXISTS

CONFIRM REPLACE?
YES / NO

YES The output file will be replaced.
NO The output file will not be replaced. ☐

EXIT

Exit Re-Enge.
☐



RAP (Re-Eng ASCII file Processor)

There are many ASCII data formats used to output point data from digitizers. By creating a suitable configuration file, Re-Eng is capable of reading any ASCII data file.

This section deals with the configuration and use of these input filter configuration files. Due to fact that the configuration files provide extreme flexibility, their use requires some experience and the occasional user may well need the help of his local provider to correctly produce a suitable configuration file. If properly configured it is possible to read multiple point clouds and create automatically 3DSCAN data from the input point data.

This section is divided into the following sub sections

1. Location and Installation of the RAP Configuration Files
2. Syntax of RAP Commands
3. Examples

1. Location and Installation of RAP Configuration Files

- All RAP files are ASCII files located in the directory filter under **<cim_root>\var\re_eng\filter**
- Filenames must be in lowercase
- The following naming convention must be used for RAP files:

config.xxx

- where xxx is a three letter extension indicating the extension of the data files this configuration file is set to read.
- For example the config.iso configuration file is set to read generic ISO G-Code data.

These configuration files are then used to read in points from the ASCII output of the digitizers. For example the config.iso will be used to read all file that have the extension .iso. Another example, config.vda will be used to read all VDA files, extension .vda, containing PSET data.

2. Syntax of RAP configuration files

- Blank lines are ignored in the configuration file.
- All keywords must be in UPPER case.

For example:

- SKIPHEAD is legal
- SkipHead is illegal
- Any line that starts with the # character will be treated as a comment line and all characters until a LF or CR LF sequence is found are ignored.
 - #This is comment
- Between the keyword and its value the = character must be present:
 - START_S = NULL is legal
 - START_S NULL is illegal

The = character must be preceded and followed by at least one space

- START_S = G01 is legal.
- START_S= G01 and START_S =G01 are illegal.
- <string> is any combination of the characters from the set [0-z], ie 0-9, A-Z and a z the maximum length is 16 characters.
- G01 is legal.
- THIS_IS_A_VERY_LONG_STRING is illegal.
- To indicate a false value the string NULL should be used.
- To indicate a true value the string TRUE should be used.
- <integer> is any number of characters from the set [0-9].
- Where a variable integer value should be read use the sequence %d.

Keywords

Name	Required	Type	Description
SKIPHEAD	Yes	<integer>	The number of lines that should be skipped at the start of the file.
L_TRIM	Yes	<integer>	Number of characters that should be ignored from the start of every input line
R_TRIM	Yes	<integer>	Any characters found after this position on the input line will be ignored.
START_S	No	<string> or NULL	String that indicates the start of a new point cloud
END_S	No	string> or NULL	String that indicates the end of the current point cloud
START_L	No	<string> or NULL	String that indicates the start of a new scan line
END_L	No	<string> or NULL	String that indicates the end of the current scan line
PTONSCAN	No	NULL or %d	When set to %d the RAP reads an integer value then reads this number of lines from the input file.
X_COORD 1	No	<string> or NULL	The number that follows this string will be read as the X coordinate
Y_COORD1	No	<string> or NULL	The number that follows this string will be read as the Y coordinate
Z_COORD1	No	<string> or NULL	The number that follows this string will be read as the Z coordinate
INCREMENTAL	No	TRUE or NULL	If TRUE indicates that all coordinates read from the input file apart from the first will be considered relative and not absolute
COMMENT	No	<string>	String that indicates a comment line
COMMENT_POSITIONS	No	<integer>	Position of comment string in input line

Notes:

- The X_COORD,Y_COORD and Z_COORD keywords must all be present or neither of them.

3. Examples

The following example files are provided with Re-Enge:

config.iso	Generic G-code configuration.
config.snk	SNK ASCII format.
config.vda	VDA can only read PSET data from VDA files.

Advanced Users

If the advanced user is set to TRUE then the following additional options are available. ADV USER can be set from the GLOBAL/CONFIG command.

POINTS

EDIT / ORDER

If the selected point cloud is 3D Scan data it is possible to order the points within the rows as well as the rows of points themselves.

After picking the point cloud to order, the following interaction will appear:

CR TO CONTINUE	KEEP OLD CLD	ROWS
	DELETE OLD CLD	ROWS+WITHIN

<RETURN>	Order the point cloud.
KEEP OLD CLD	Keep the original point cloud.
DELETE OLD CLD	Delete the original point cloud.
ROWS	Order only the rows of points.
ROWS+WITHIN	Order first the points within the rows and then the rows themselves.

If the ROWS+WITHIN option is selected, the following interaction will appear:

CR TO CONTINUE	KEEP OLD CLD	ROWS	X DIRECTION
	DELETE OLD CLD	ROWS+WITHIN	Y DIRECTION
			Z DIRECTION

X DIRECTION	The initial point of the rows will be chosen to be either at X min or X max.
Y DIRECTION	The initial point of the rows will be chosen to be either at Y min or Y max.
Z DIRECTION	The initial point of the rows will be chosen to be either at Z min or Z max.

When ordering the point within the rows it is necessary to know where the start point is located, by indicating one of the principle axis Re-Eng can calculate a suitable start point. The choice is very important if acceptable results are to be obtained.

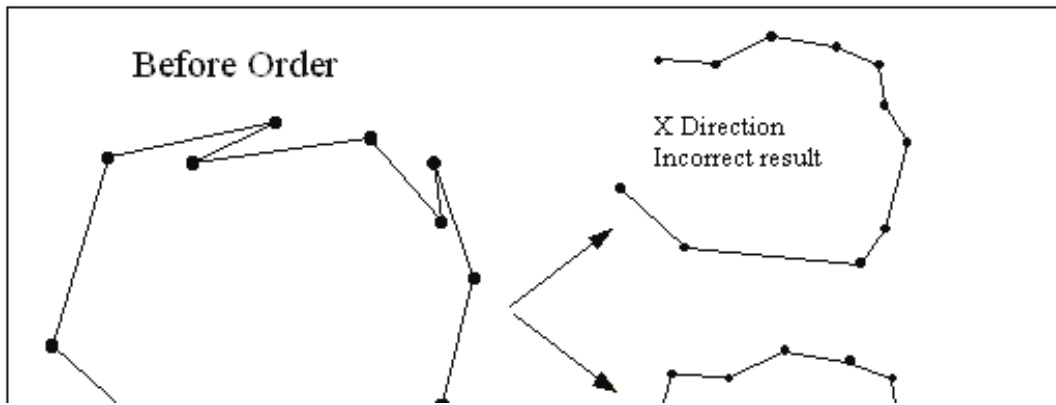


Figure A-1: ORDER POINTS

- Note:
- Re-Eng tries to find the best order for the given points in the cloud, this process can be very time consuming.

SURFACES

CREATE

During the surface creation process it is possible to modify the surface order and number of control points in both U and V.

After selecting the CREATE modal the following interaction is presented.

CR TO CONTINUE	ORDERU=4	ORDERV=4
----------------	----------	----------

- <RETURN>

Continue creating the surface.
- ORDERU

Change the surface order in the U direction.
- ORDERV

Change the surface order in the V direction.
- <EXIT>

Return to the main surface creation interaction.

CR TO CONTINUE	CTRL PTS U = 14	CTRL PTS V = 16
----------------	-----------------	-----------------

- <RETURN>

Continue creating the surface.
- CTRL PTS U

Change the number of control points in the U direction.
- CTRL PTS V

Change the number of control points in the V direction.
- <EXIT>

Return to the main surface creation interaction.

Translation to Other Languages

Re_Enge offers the possibility to translate all the messages, error messages and prompts to any language.

In order to do so, the three files - **errors.txt**, **msg.txt**, **prmt.txt** under directory **<cim_root> \ var \ re_enge \ msg** should be rewritten in your own language.

A new directory - **msg.***** (***) could be any 3 characters) should be created in **<cim_root> \ var \ re_enge**.

The translated files - **errors.txt**, **msg.txt**, **prmt.txt** should be placed under directory **msg.*****.

Re-Eng configuration file - **<cim_root> \ var \ re_enge \ re_enge.cfg** - should be changed as follows:

set variable **LANG** to *******.

For example, to translate Re-Eng messages, error messages and prompts to German do the following:

Create a new directory - **msg.ger** and place it under **<cim_root> \ var \ re_enge**.

Copy the translated files - **errors.txt**, **msg.txt**, **prmt.txt** into directory **msg.ger**.

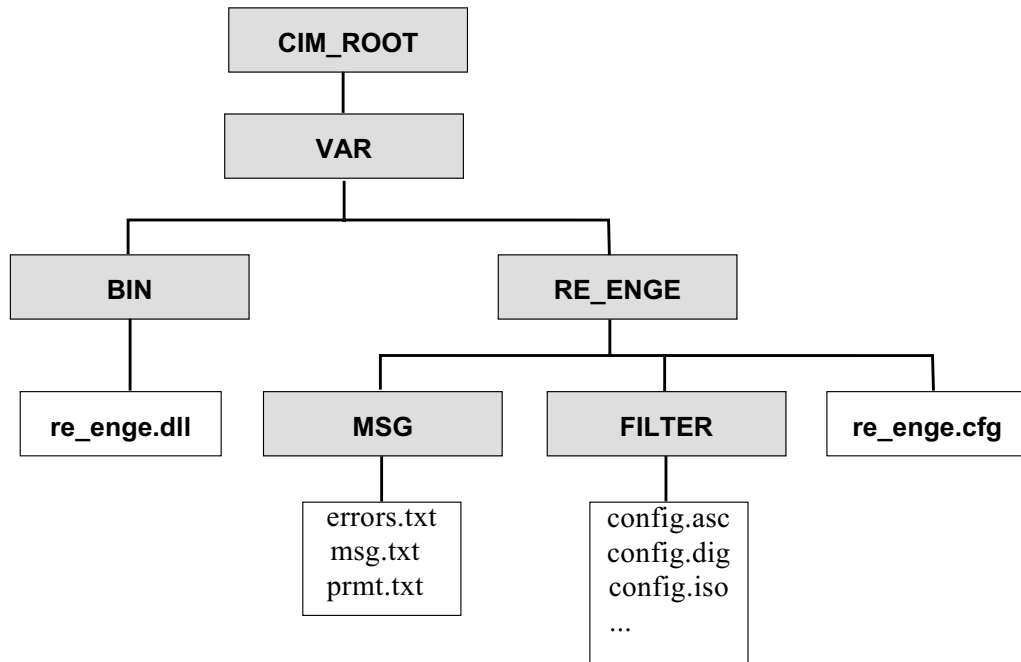
Change in file **<cim_root> \ var \ re_enge \ re_enge.cfg** : **LANG ger**.

Sample MDA File

<pre># ----- Re-Eng 1 2 # ----- # Creation Date: 31/10/1995 # Creation Time: 11:29:16 # ----- CLOUD : NumPts Name 5850 BASE POINTS ATTR : Color Style Type 1 1 6 BOUNDS : Min Max -13.9 -93.30 -0.55 60.10 23.00 59.4198 MATRIX : 1.000000 0.000000 0.000000 0.000000 1.000000 0.000000 0.000000 0.000000 1.000000 POINTS ----- 60.020000 0.010000 39.259998 0 60.109997 0.480000 39.239998 0 60.090000 5.520000 39.200001 0 60.090000 10.440000 39.129997 0 60.099998 15.400000 39.040001 0 60.049999 20.459999 38.910000 0 . . -13.920000 -50.969997 45.969997 0 -13.910000 -46.509998 48.360001 0 -13.920000 -41.989998 50.520000 0 -13.920000 -37.410000 52.410000 0 -13.920000 -36.149998 52.939999 0 -13.920000 -31.500000 54.559998 0 END # ----- End of cloud <BASE POINTS> -----</pre>	<div>File Header</div> <div>Cloud Header</div> <div>Data Points</div>
---	---

Re-Enge Files Structure Tree

(SHADED)	=	DIRECTORIES
(CLEAR)	=	FILES



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