

Gear Production Suite

Overview of Latest version

5.0-5.1-5.2



Presented by
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December 2015

Contents

Current Functionality

- V5.0
- V5.1 May 15
- V5.2 Dec 15

Under development (V5.3 Mar 16)

- Future release and modules under development

Gearbox Concept Tool

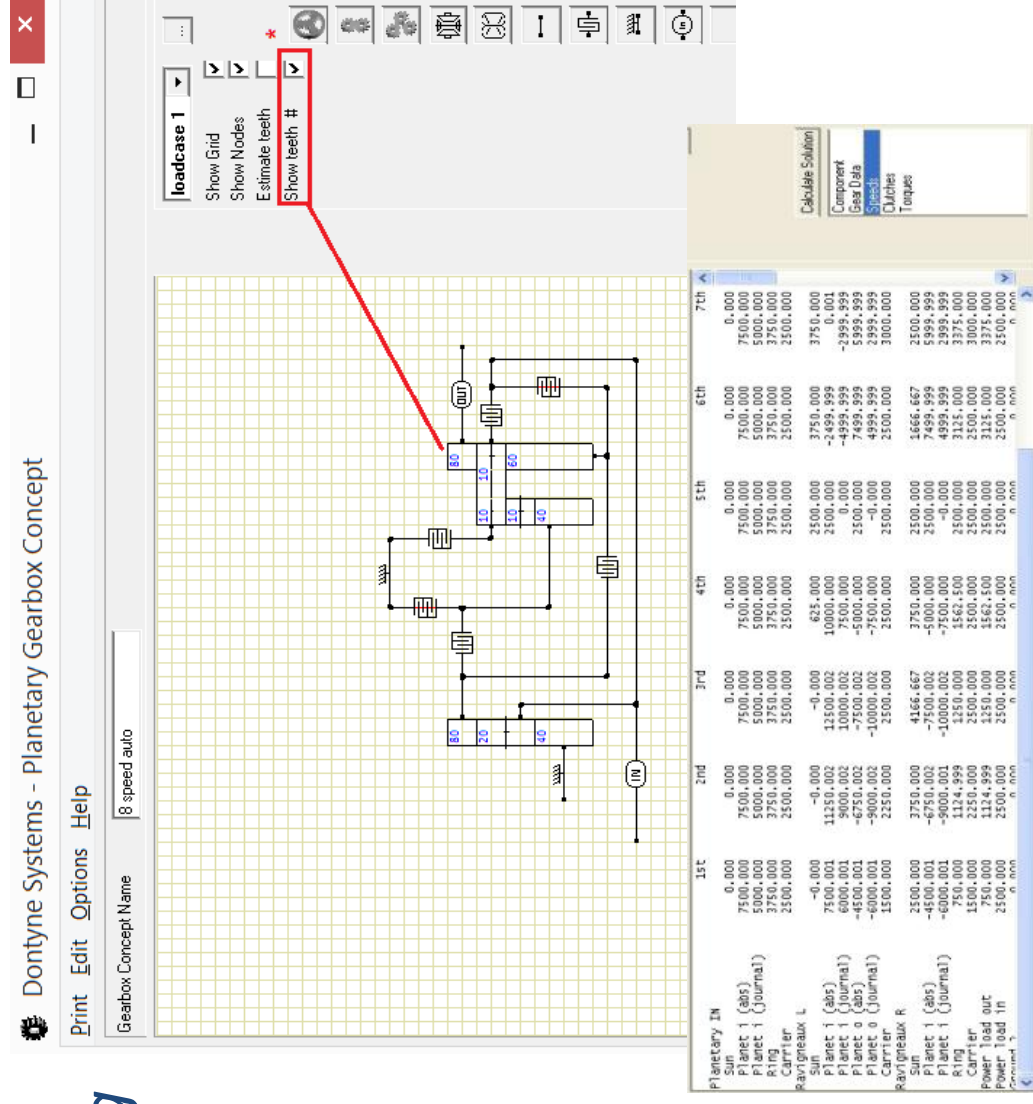
- Rapid Layout And Testing of Planetary Type Gearbox

Input

- Drag & Drop Components and Connections
- Multiple Power Input/Output
- Estimated Ratio Sizing
- Live Testing of Power Flow

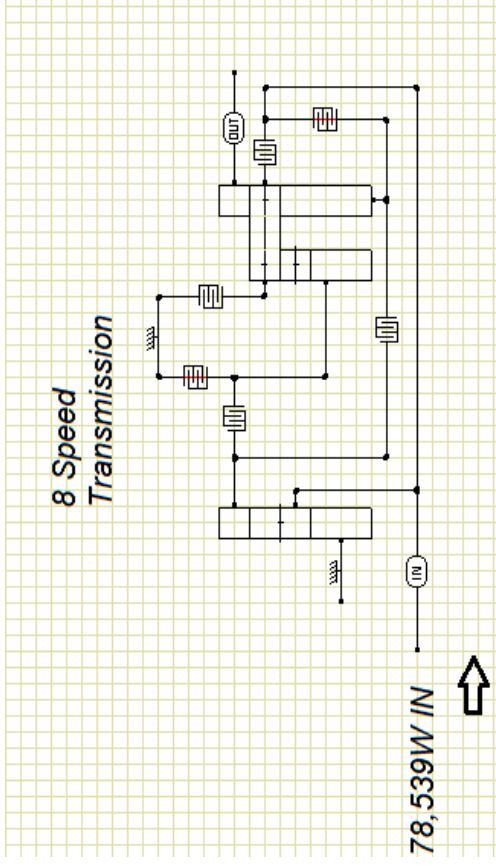
Output

- Speeds
- Torques
- Cycles
- Validity Check



Gearbox Concept Tool

- Mesh power assessment for **ECO design***
- Shows mesh power inc. Recirculating Effect
- Allows designer to immediately recognise an inefficient arrangement
- Prevents mistakes in layout before progressing to detailed design stage
- Allows most Efficient Eco. Arrangement



	1st	2nd	3rd	4th	5th	6th	7th	8th	rev
Planetary IN									
Sun to planet i	0.000	26179.938	0.000	47123.879	0.000	15707.963	20362.176	26179.938	0.000
Planet i to ring	0.000	26179.938	0.000	47123.879	0.000	15707.963	20362.176	26179.938	0.000
Ravigneaux L									
Sun to planet i	109955.773	109955.781	78539.828	0.000	0.000	15707.959	12217.303	0.004	0.000
Planet i to planet	109955.773	109955.781	78539.828	0.001	0.000	15707.959	12217.301	0.004	0.000
Ravigneaux R									
Sun to planet i	31415.930	31415.932	0.000	47123.883	0.002	0.000	3490.656	0.002	78539.820
Planet i to ring	78539.828	78539.844	78539.828	47123.887	0.002	15707.961	8726.643	0.004	78539.828
Total System Power	329867.312	382227.219	235619.484	188495.531	0.000	78539.805	77376.250	52359.887	157079.656
System Power/Power In	4.200	4.867	3.000	2.400	0.000	1.000	0.985	0.667	2.000

direct

4.2 x Input Power Transferred Across Gear Meshes

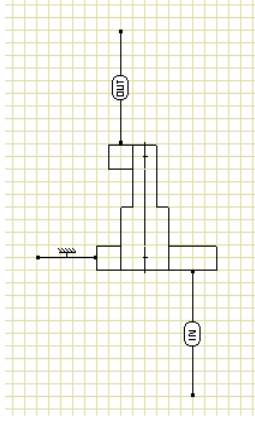
0.667 x Input Power Transferred Across Gear Meshes

Calculate Solution
 Component
 Gear Data
 Speeds
 Clutches
 Torques
 Cycles
 Power In/out
Power Gears

Gearbox Concept Tool

- Example ratio 80:1
Gearbox

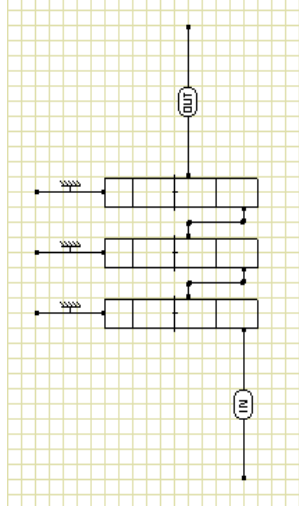
[1]



System Power
Power/Power In

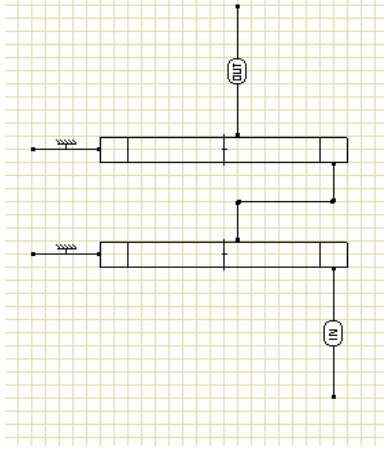
26890
19.77

Compact but
Almost 20 x
Input Power due
to recirculating
Effect !



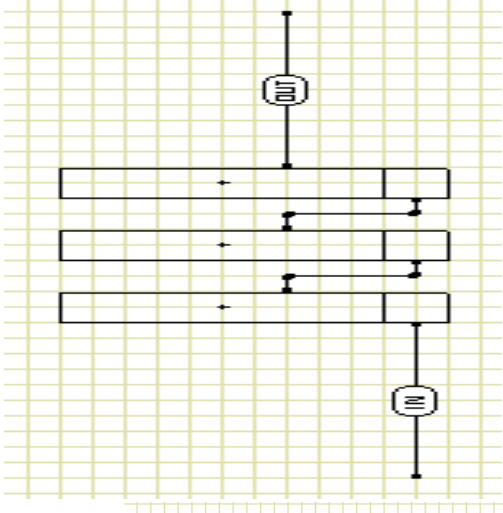
6277
4.61

Compact and reasonable
efficiency



4089
3.56

Non Planetary,
Efficient in this case
but large size gearbox



4080
3.00

Design and Rating to ISO and AGMA Standards

Gear Design Pro

Dontyne Systems - Gear Designer (Open for Editing)

GearSet Units Print Rating Advanced LoadAnalysis Manufacture Inspection Constraints Graphics Report Options Help

WHEEL PINION WHEEL

Design Data:

Name: default_input_file

Mode: Normal (Input) Enter Module & Center Distance

Module: 2.250 mm

Pressure Angle: Normal (Normal) 20.000 degrees

Helix Angle: (double) L 27.880 R degrees

Centre Distance: (Input) 70.000 mm

Face Width: 18.000 mm

Desired Ratio: (actual) (Fix) 1.391

Number of Teeth: 23 32 Rack

Basic Rack Data:

Defined By: Input

Basic Rack Addendum	1.000	/module
Basic Rack Dedendum	1.350	/module
Basic Rack Root Radius (Tool Tip)	0.300	/module
Basic Rack Module	2.250	mm
Basic Rack Pressure Angle	20.000	degrees
Basic Rack Protuberance	0.000	mm

Basic Rack Options:

Allow O.D. Reduction: Pinion and Wheel Same

Tight Mesh Data:

Sum of Addendum Mod. Coeff. (Fix) 0.0000 /module

Enter Distribution: _____

Finished Data Instead of Tight Mesh: _____

Nominal Addendum Mod. Coeff. 0.2500 -0.2500 mm

Pre-Finished Data:

Allowance on Normal Circ. Thickness	0.000	mm
Nominal Normal Circular Thickness	3.893	mm

Finished Data:

Normal Backlash	0.100	mm
Nominal Normal Circular Thickness	3.893	mm

Tooth Height:

Outside Diameter (Consider Blank)	64.170	mm
Root Diameter	53.595	mm

Defined By Data: Tight Mesh Pre-Finished Finished

Design Variant: (Total 0) < Back Forward > 0

Filename: default_input_file

Rating: ISO 6336 - 2006 AGMA 2101-D04

OK Cancel

GearDesignPro version 5.10a advanced_build 15

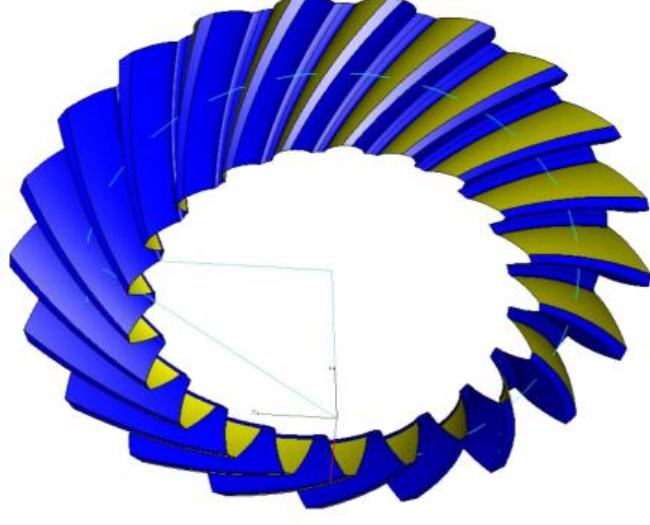
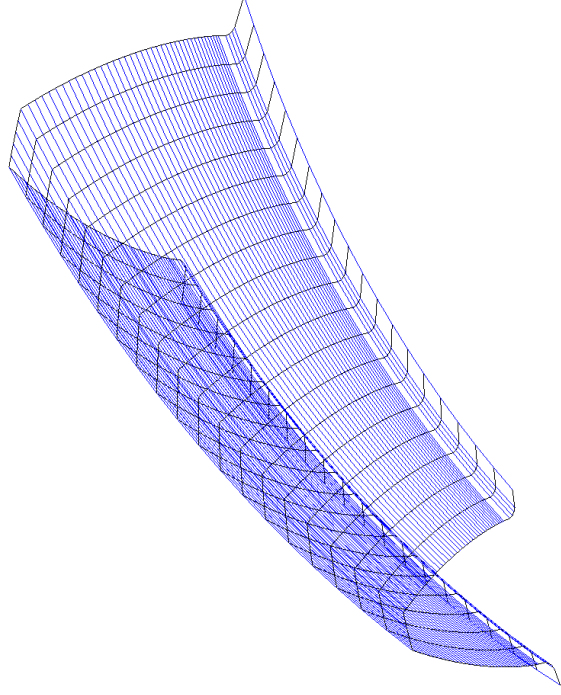
Gear Design Pro

- Export Options

DXF 3D line grid

IGES B-Spline surface

ASCII X,Y,Z Co-ordinates



Gear Design Pro

PINION		WHEEL	
Basic Rack Data			
Defined By	Input		
Basic Rack Addendum	0.361	1.000	/module
Basic Rack Dedendum	2.102	1.350	/module
Basic Rack Root Radius (Tool Tip)	0.314	0.300	/module
Basic Rack Module	2.147	2.250	mm
Basic Rack Pressure Angle	10.000	20.000	degrees
Basic Rack Protuberance	0.000	0.000	mm
Basic Rack Options			
Allow O.D. Reduction	<input type="checkbox"/>	Pinion and Wheel Same	<input type="checkbox"/>

Consider tool pressure angle

Fillet Shape changes – Dontyne software considers effect on root strength

Gear Design Pro

Balance Options: *

- Safety
- Stress
- Sliding
- Slide Roll

Balanced sliding or slide roll can lead to lower maximum sliding velocity and lower losses for ECO design

The screenshot displays the Gear Design Pro software interface, divided into several sections for configuring gear parameters and analyzing results.

- Design Data:** Includes fields for Name, Mode, Module (Normal), Pressure Angle (Normal), Helix Angle (double), Centre Distance (input), Face Width (18,000 mm), Desired Ratio (actual), and Number of Teeth (23).
- Basic Rack Data:** Defines rack parameters such as Addendum, Dedendum, Root Radius, Module, Pressure Angle, and Protuberance.
- Basic Rack Options:** Includes checkboxes for Allow O.D. Reduction and Pinion and Wheel Same.
- Tight Mesh Data:** Configures meshing options like Addendum Mod. Coeff. (Fix), Estimate Dist (Balanced Sliding), Enter Distribution, Estimate Dist (General Applications), Estimate Dist (Balanced Safety), Estimate Dist (Balanced Stress), Estimate Dist (Balanced Sliding), Estimate Dist (Balanced Slide/Roll), Allowance on Normal Circ. Thickness, and Normal Normal Circular Thickness.
- Finished Data:** Sets parameters for Normal Backlash, Normal Normal Circular Thickness, and Tooth Height.
- Meshing Options:** Includes checkboxes for Tight Mesh, Pre-Finished, and Finished.
- Results:** A table comparing Pinion and Wheel values for various metrics:

Metric	PINION	WHEEL
Contact Safety Factor SH	1.093	1.104
Minimum Specified Safety SFmin	1.000	1.000
Nominal Stress (Mpa)	918.581	918.581
Contact Stress Number	1500.000	1500.000
Actual Cont. Stress	1178.798	1178.798
Stress Limit	1288.343	1301.460
Permissible Stress	1288.343	1301.460
Power rating (cont. SH=1.0) (kw)	50.035	51.059
Contact life (cycles)	1.576e+10	1.576e+10
Contact damage (percent)	3.521	3.969
Bending Safety Factor SF	2.621	2.655
Minimum Specified Safety SFmin	1.000	1.000
Nominal Stress (Mpa)	185.238	184.280
Contact Stress Number	461.000	461.000
Actual Bend. Stress	305.053	303.474
Stress Limit	799.440	805.816
Permissible Stress	799.440	805.816
Power rating (bend. SF=1.0) (kw)	109.774	111.225
Bending life (cycles)	6.660e+29	9.219e+29
Bending damage (percent)	1.306e-19	6.783e-20
Tip sliding velocity (m/s)	3.673	3.673
Slide roll ratio (SAP)	-1.451	-1.173
Slide roll ratio (EAP)	0.540	0.592
Contact Ratio (Transverse)	1.380	1.380
Contact Ratio (Axial)	1.191	1.191

Gear Design Pro

- Geometry with tolerances: - *

Geometry calculations include the combined effect of tolerances

The screenshot displays the 'Additional Tolerances and Settings' dialog box in the Donyne Systems - Gear Designer software. The dialog is divided into several sections:

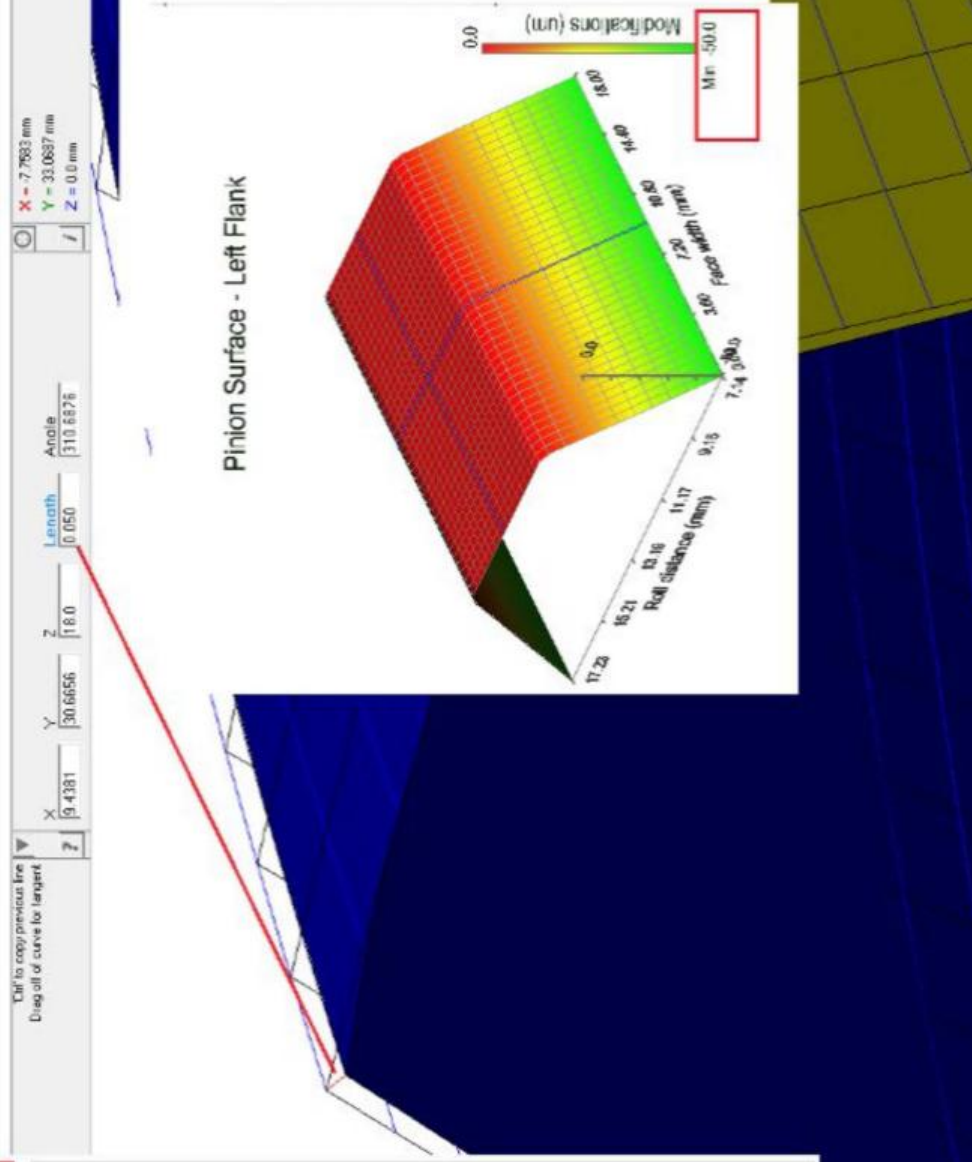
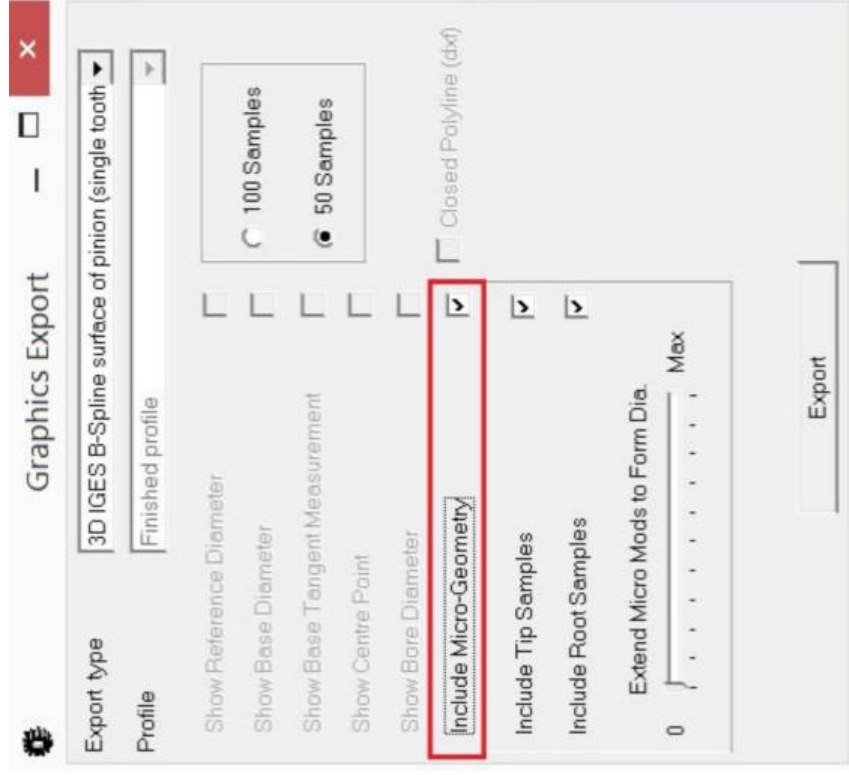
- Additional Tolerances and Settings:** Contains input fields for Pinion and Wheel tolerances for Outside Diameter (max/min), Outside Diameter Chamfer, Centre Distance, and Runout.
- Tooth Thickness and Manufacture Tolerances:** Includes fields for Nominal Addendum Mod. Coeff. and Tooth Thickness.
- Pre-Finished Data:** Fields for Allowance Normal to Flank (One Side) and Nominal Normal Circular Thickness.
- Finished Data:** Fields for Normal Backlash, Normal Normal Circular Thickness, and Tooth Height.
- Design Variant:** Includes 'Total 1', 'Back', 'Forward', and 'Warnings!' buttons.

The background window shows a detailed gear specification table with the following data:

Parameter	Pinion (23)	Wheel (32)
Number of Teeth	23	32
Normal Module (mm)	2.250	2.250
Pressure Angle (degrees)	20.000	20.000
Helix Angle (degrees)	27.880	
Reference Diameter (mm)	Left: 58.545, Right: 81.455	Left: 85.575, Right: 88.425
Addendum Mod. Coeff.	0.0844	0.0844
Outside Diameter (mm)	63.425	85.575
Outside Diameter Chamfer (mm)	0.000	0.000
Root Diameter (mm)	52.850	70.000
Centre Distance (mm)	0.000	70.000
Face Width (mm)	17.622	17.622
Edge Chamfer (mm)	0.000	0.000
Form Diameter (nominal) (mm)	54.993	77.083
Form Diameter (max) (mm)	54.992	77.085
Base Diameter (mm)	54.136	75.319
Normal Circular thickness Thickness (nominal/tight) (mm)	3.672	3.396
Thickness (pre-finished) (mm)	3.672	3.396
Thickness (finished nominal) (mm)	3.672	3.396
Thickness (finished max) (mm)	3.672	3.396
Thickness (finished min) (mm)	3.672	3.396
Meas. Over Balls (fin. nom) (mm)	64.729	87.162
Meas. Over Balls (fin. max) (mm)	64.729	87.162
Ball Diameter (mm) (fin. nom)	2.000	2.000
Ball Diameter (mm) (fin. max)	2.000	2.000
Base Tangent (mm) (fin. max)	24.407	31.192
Base Tangent (mm) (fin. min)	24.407	31.192
Number of Teeth to Span	4	5
Addendum Mod. coef (finished nom)	0.0844	-0.0844

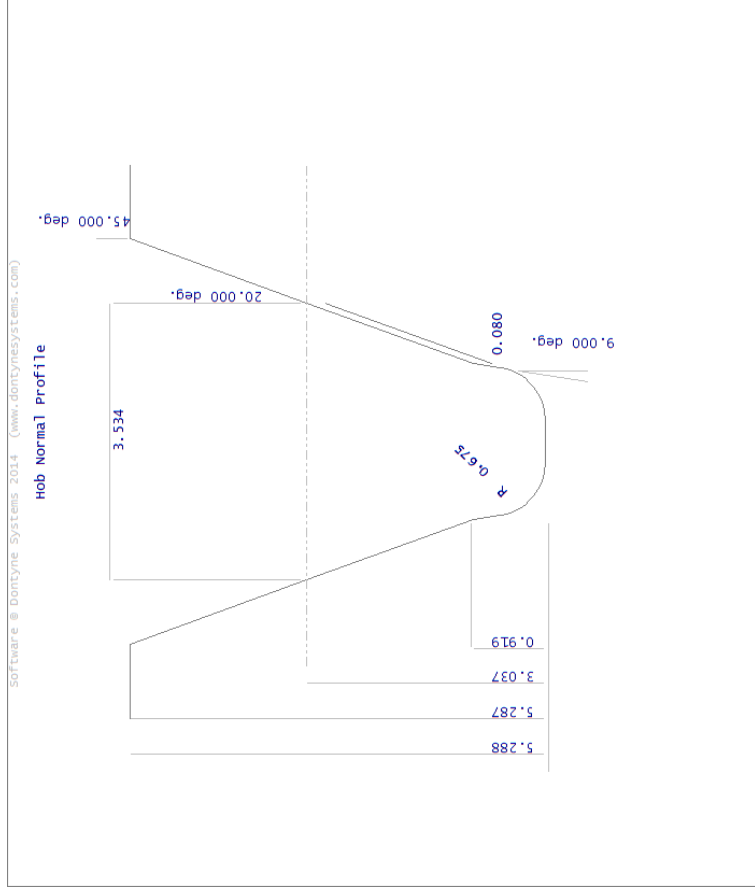
Gear Design Pro

- Export IGES B-Spline Surface with Micro-Geometry Included:- *

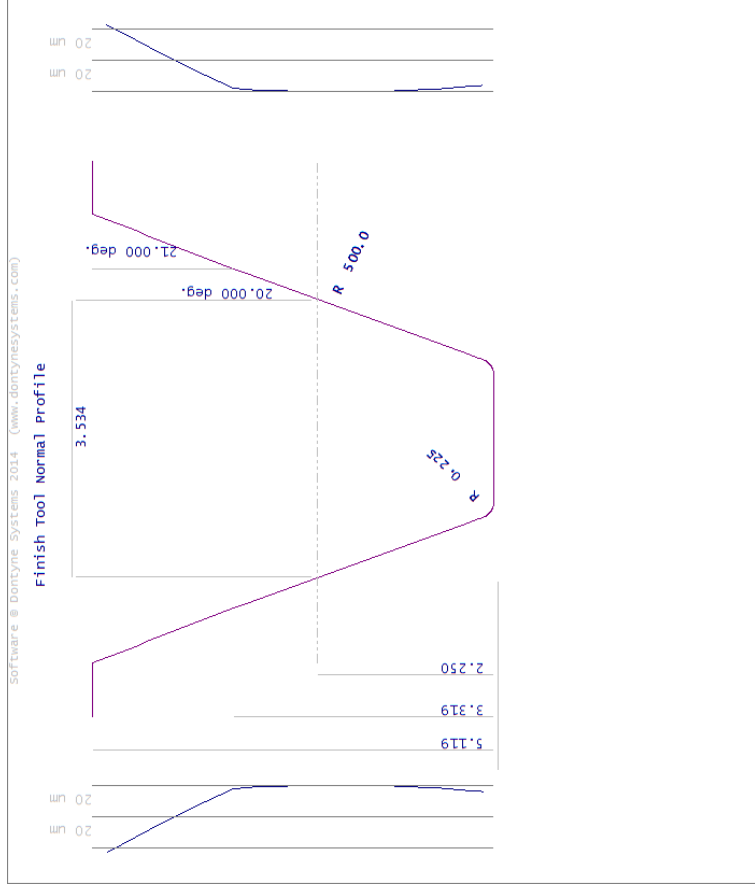


Gear Manufacture

Define Hob



Define Finish Tool



Gear Manufacturing

Gear Manufacturing

Data Thickness Report Options Export

Gear Data Limits

Blank Dia: 64.170 SAP Dia: 55.987
 Required TIF: entered SAP Dia: 55.487

Pre-Finish Hob: Pre-Finish Shaper

Normal Module (mm)	2.250
Normal Pressure Angle	20.000
Hob Tooth Thickness	3.534
Addendum	3.037
Depth to Chamfer	5.287
Chamfer Angle	45.000
Whole Depth	5.288
Tip Radius	0.675
Protuberance	0.080
Protuberance Angle (to vertical)	9.000
Cutter Ref. Line from Ref. Dia.	Calc

Finish Worm Grind/Hob: Finish Shaving

Normal Module (mm)	2.250
Normal Pressure Angle	20.000
Tooth Thickness	3.534
Addendum	2.250
Whole Depth	5.119
Tip Radius	0.225
Cutter Ref. Line to Ref. Dia.	Calc
Tip Relief Angle	21.000
Root Relief Angle	20.000
Crown Rad. Top	500.000
Crown Rad. Bottom	500.000

Gear Hobbed Base Tangent (4T)	24.708	Gear Finished Base Tangent (4T)	24.614
Gear Root Diameter	53.732	Gear Outer Diameter	64.170
Gear EAP (start of chamfer) Diameter	64.170	Gear Radial Tip Chamfer (Finished)	0.000
Gear Fore to Sap Radial Clearance	-0.058	Gear Form Diameter Finished	56.104
Gear Base Diameter	54.136	Gear Start of Active profile Diameter	55.987

Hob Tool Hob Profile Hob Generation Making Gear Conjugation Pinion
 Finish Tool Finished Profile Finished Generation Profile Error Plot Wheel
 Finish From Solid No fill

All values in mm and angles in degrees unless stated otherwise

OK Cancel

Generate the gear

Machine Centre

The screenshot displays the 'Machine Centre' software interface. At the top, there are tabs for 'Data', 'Thickness', 'Report', 'Options', and 'Export'. Below these are several input fields for 'Custom Report' and 'Pre-Finish Hob'. The main area is divided into several sections:

- Gear Data:**
 - Number of Teeth: 23
 - Module: 2.250
 - Pressure Angle: 20.000
 - Helix Angle: 27.880
 - Major Dia: 63.425
 - Minor Dia: 53.318
- Drawing Data:**
 - Process Data: Grinding Data
 - Grinding Data: Pinion worm grind
 - Starts: 1
- Hob Data:**
 - Hob: 1
 - Starts: 1
 - 3.037
 - 0.675 +/- 0.000
- Condition:**
 - Thick, Hob/grind Nom
 - TIP Rad Nom.

Below these sections are two large tables of parameters:

Parameter	Value	Unit/Notes
Normal Module (mm)	2.250	
Normal Pressure Angle	20.000	
Thickness	3.534	max / min
Addendum	3.037	
Depth to Chamfer	5.287	
Chamfer Angle	45.000	
Whole Depth	5.287	
Tip Radius	0.675	max / min
Protuber.	0.070	max / min
Protuberance Angle	12.000	To Vertical
Cutter Ref. Line from Ref. Dia	0.4237	Calc

Parameter	Value	Unit/Notes
Normal Module (mm)	2.250	
Normal Pressure Angle	20.000	
Tooth Thickness	3.534	1 start
Addendum	2.250	
Whole Depth	5.119	
Tip Radius	0.225	
Cutter Ref. Line to Ref. Dia	0.1898	Calc
Tip Relief Angle	20.000	Depth
Root Relief Angle	0.296	Depth
Crown Rad. Top	0.000	Depth
Crown Rad. Bottom	0.000	Depth

At the bottom of the interface, there are checkboxes for 'Hob Tool', 'Finish Tool', 'Finish From Solid', 'Hob Profile', 'Finished Profile', 'No fill', 'Hob Generation', 'Finished Generation', 'Mating Gear Conjugation', 'Profile Error Plot', 'Pinion', and 'Wheel'. A legend on the right side of the 3D model lists various diameters and clearances, such as 'Gear Root Diameter 53.318', 'Gear Outer Diameter 63.425', and 'Trochoid Breakout (TP) 55.192'. A note at the bottom states: 'All values in mm and angles in degrees unless specified otherwise'.

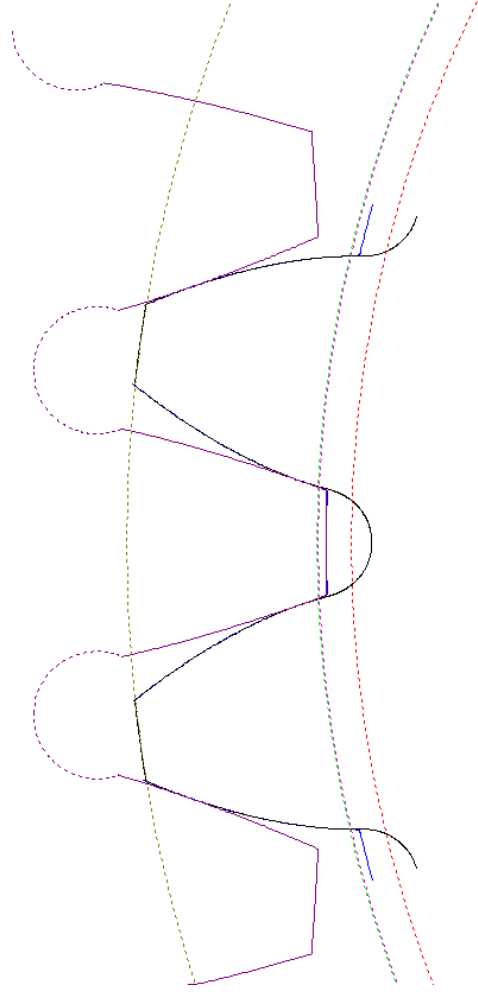
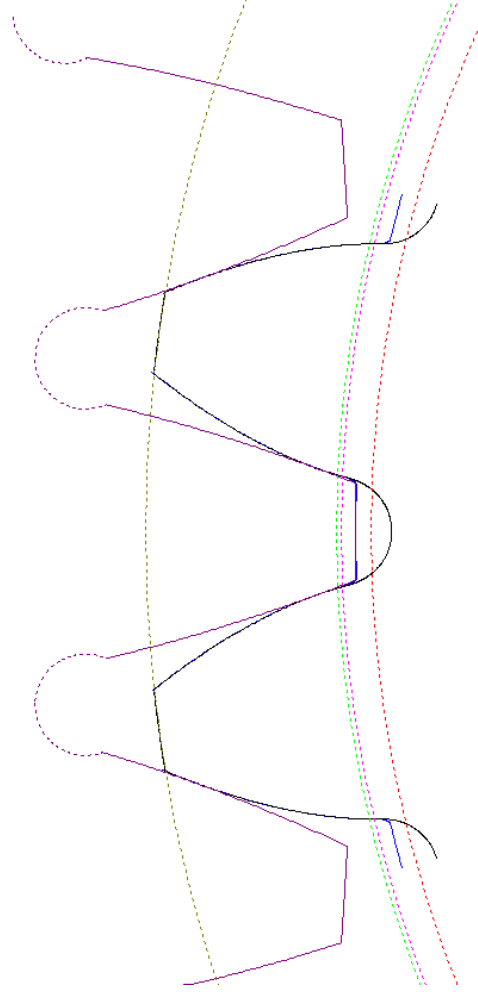
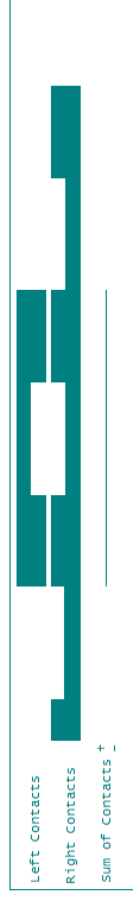
Manufacture Custom Reporting*

Machine Centre Gear Shaving

copyright Dontyne Systems 2010 (www.dontynesystems.co.uk)
Transverse section



copyright Dontyne Systems 2010 (www.dontynesystems.co.uk)
Transverse section



Calculate balance of forces for optimum quality and tool life for resharping

Machine Centre

Gear Shaving Automatically Find Balance Point*

The screenshot displays the 'Gear Manufacturing' software interface. The main window shows a 3D model of a gear tooth with various parameters labeled, such as 'db', 'dtrn', 'dsap', 'JEAP', and 'stock 0.030'. The interface includes several panels for setting parameters and options.

Shaver Options Panel:

- Normal Module (mm): 2.250
- Normal Pressure Angle: 20.000
- Thickness: 3.534
- Addendum: 3.037
- Depth to Chamfer: 5.287
- Chamfer Angle: 45.000
- Whole Depth: 5.288
- Tip Radius: 0.675
- Protuber.: 0.000
- Protuberance Angle: 9.000
- Center Ref. Line from Ref. Dia: 0.5609

Finish Worm Grind/Hob/Finish Shaving Panel:

- Normal Module (mm): 2.250
- Normal Pressure Angle: 20.000
- Helix Angle: 17.880
- Number of Teeth: 101
- Normal Circular Thick: 1.856
- Outside Diameter (Auto): 237.876
- Working Depth: 5.000
- Cutting Centre Distance: 146.768
- Crossed Axis Angle: 9.868

Shaver Parameters Table:

Parameter	Value	Parameter	Value
Gear Hobbed Base Tangent (4T)	24.674	Gear Finished Base Tangent (4T)	24.614
Gear Root Diameter	53.632	Gear Outer Diameter	64.170
Gear EAP (start of chamfer) Diameter	64.170	Gear Radial Tip Chamfer (Finished)	0.000
Gear Form to SAP Radial Clearance	0.000	Gear Form Diameter Finished	55.992
Gear Base Diameter	54.136	Gear Start of Active Profile Diameter	55.987
Shaver Min Wk Depth to SAP Clearance	1.701	Shaver Start of Active Profile Diameter	231.276
Shaver Outer Diameter for Gear SAP	237.876	Shaver Tip to Gear Root Clearance	1.014
Shaver Form Diameter	227.876	Shaver Normal Tip Width	2.174
Fillet Top Diameter	55.688	Amount of Fillet Clearance	0.129

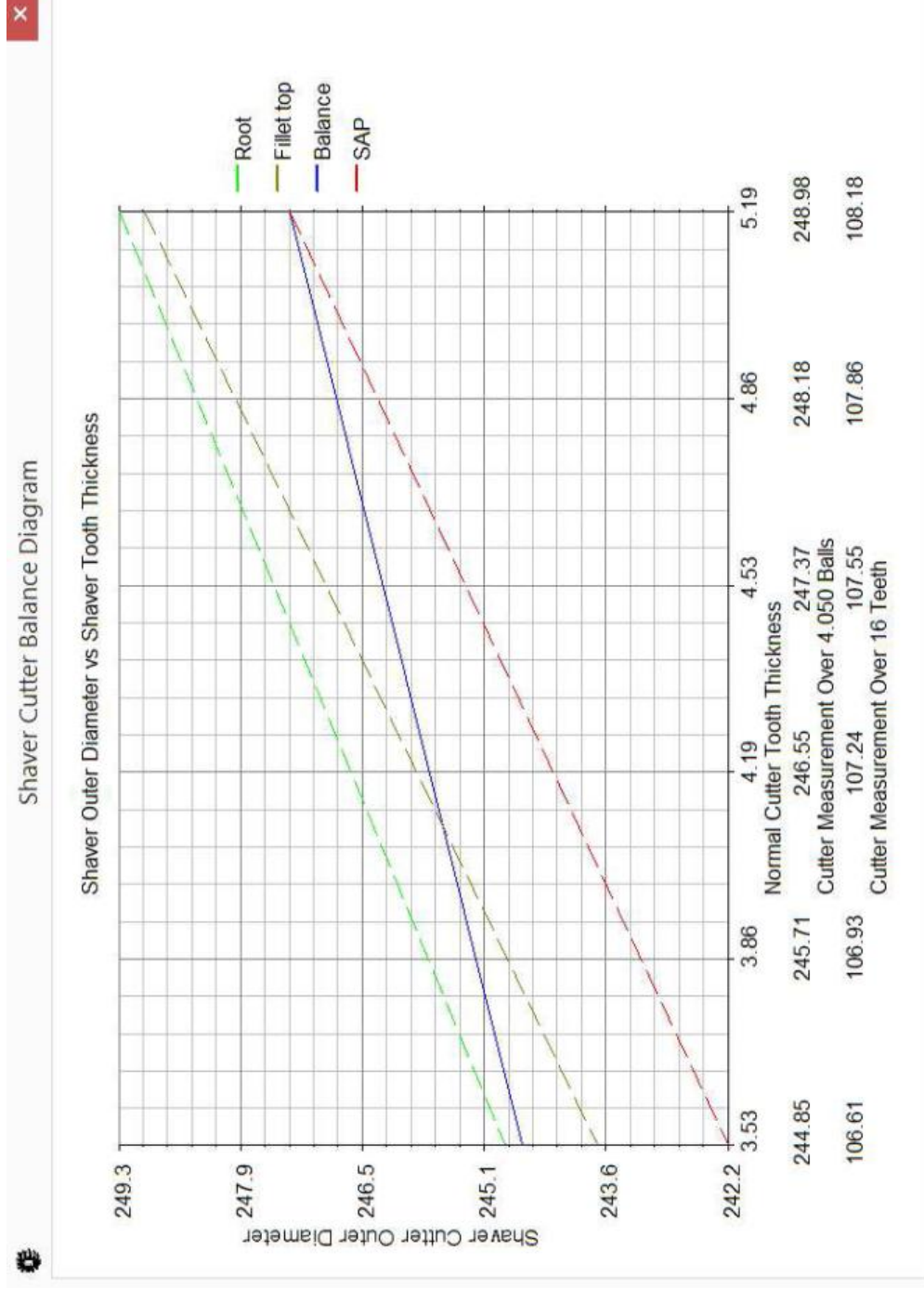
Shaver Options:

- Hob Tool
- Hob Profile
- Hob Generation
- Finish Tool
- Finished Profile
- No fill
- Hobbing Gear Conjugation
- Pinion
- Wheel

Buttons: OK, Cancel

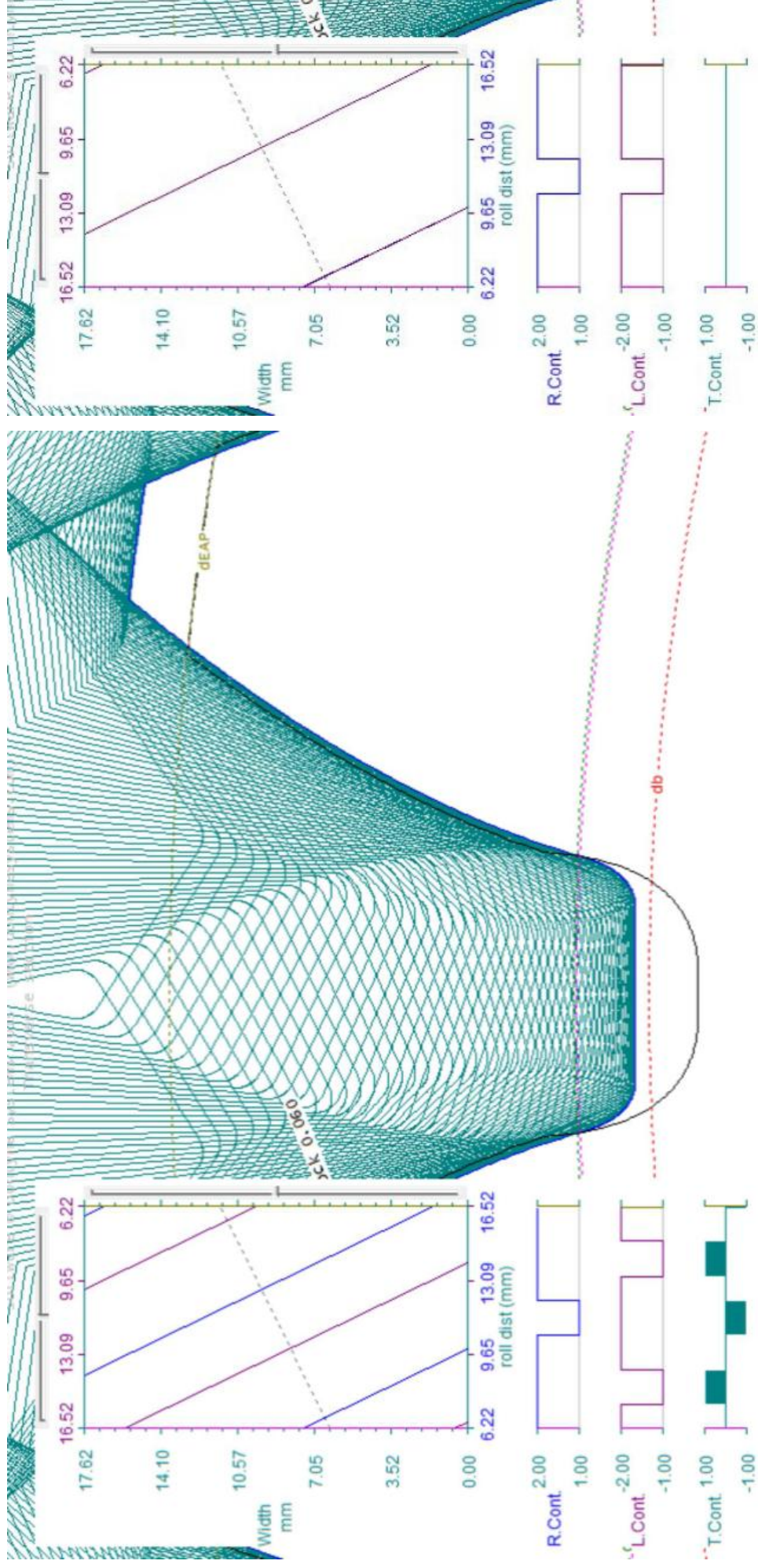
Footnote: All values in mm and angles in degrees unless stated otherwise.

Machine Centre Gear Shaving Balance Sharpening Diagram*

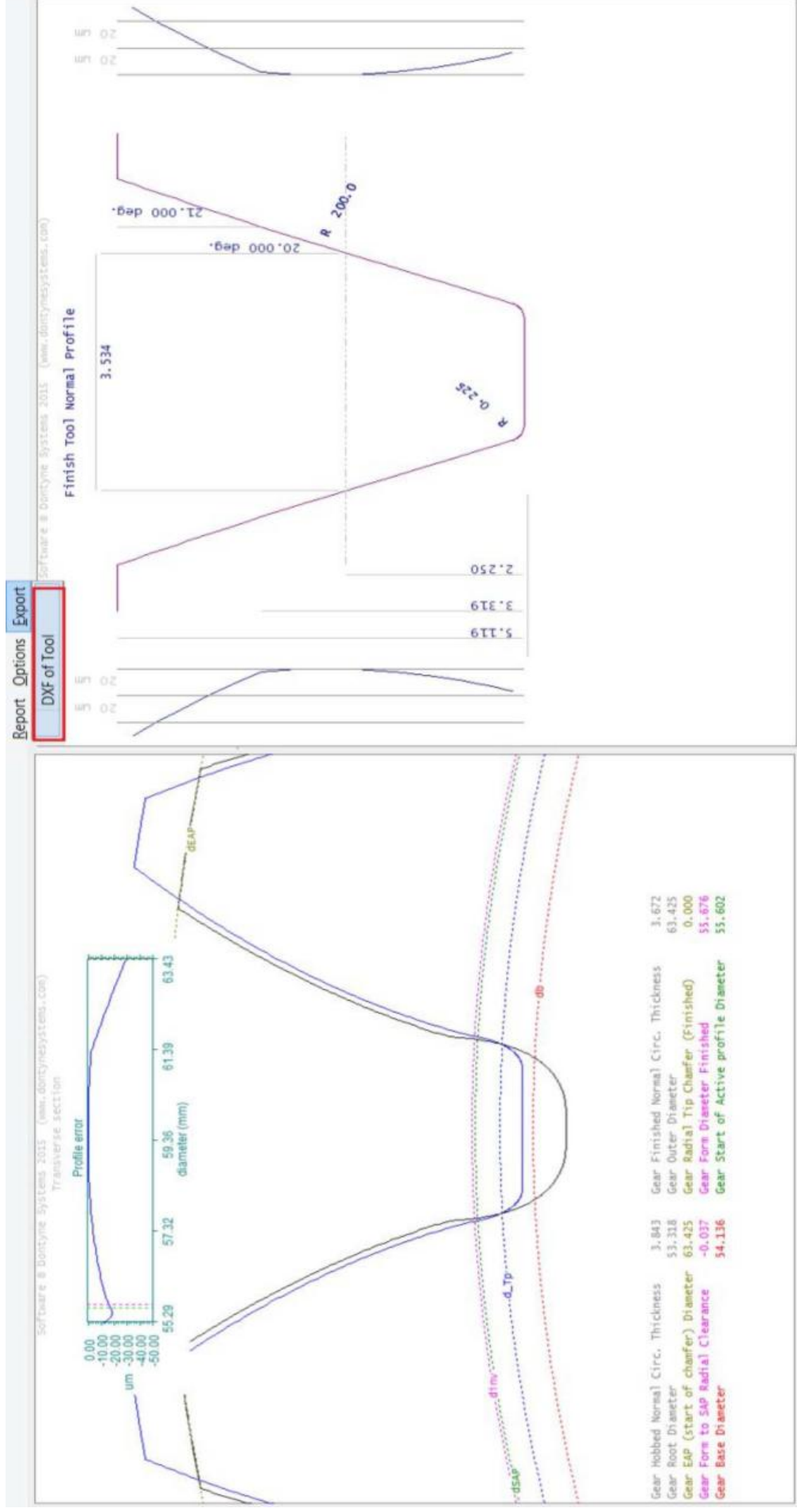


Gear Manufacture

Find Balance Point Extended to Hobbing & Grinding Simulations*



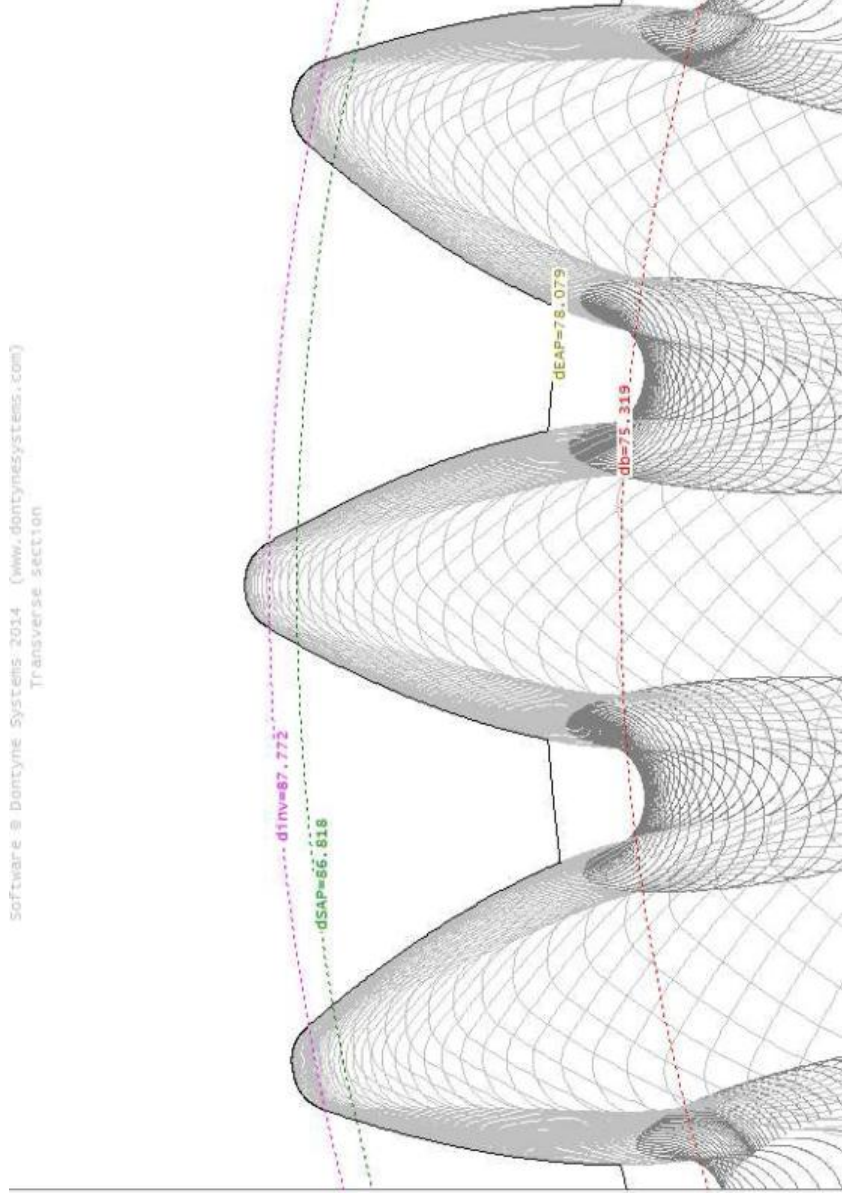
Gear Manufacture Export Grind Wheel or Dressing Profile



Gear Manufacture

Gear Shaping

Software © Dontyne Systems 2014 (www.dontynesystems.com)
Transverse section

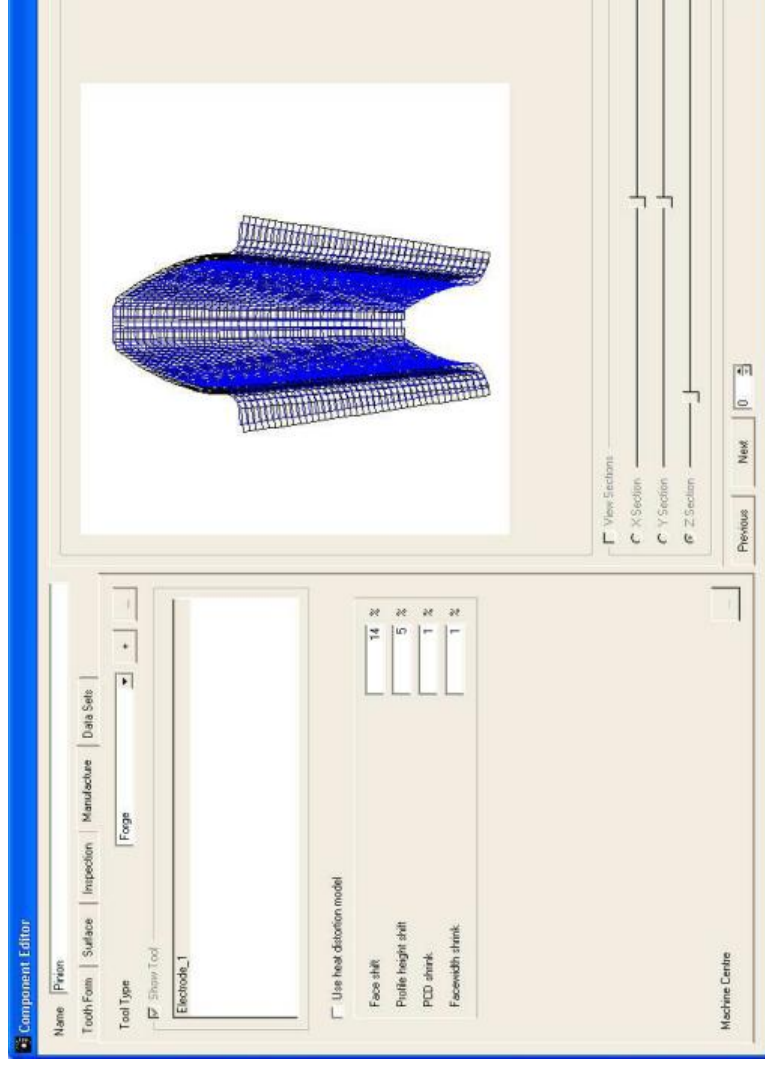


Machine Centre

Create die tool : modifying gear surface form

Different models for forging, sintering, or injection molding to compensate for heat distortion, elastic deformation, or shrinkage

Custom model can be created utilising customers knowledge base on the process for 'right first time' production



Machine Centre

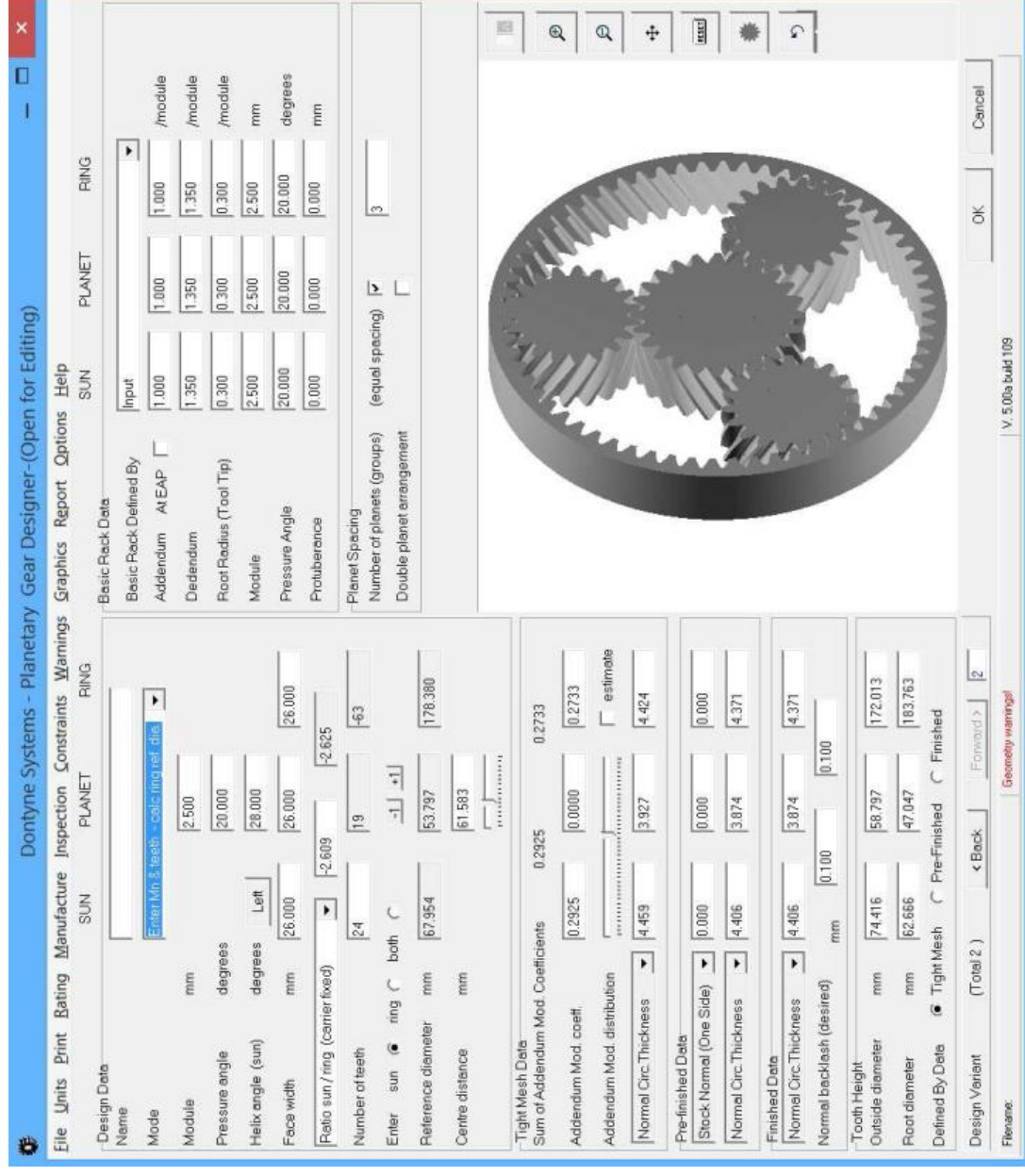
Model deformation for 'right first time' production

- Factors such as design parameters, material, force, and temperature will form model
- Model will be compared to existing data for validation (propose correct 50% as initial target)
- Considerable savings in time if avoidance of iteration to tool surface

Gear Design Pro - Planetary Gears

Features:-

- Assembly Check
- Tip Clearance Checks
- Multi planet Design
- Phasing calculations
- ISO Rating

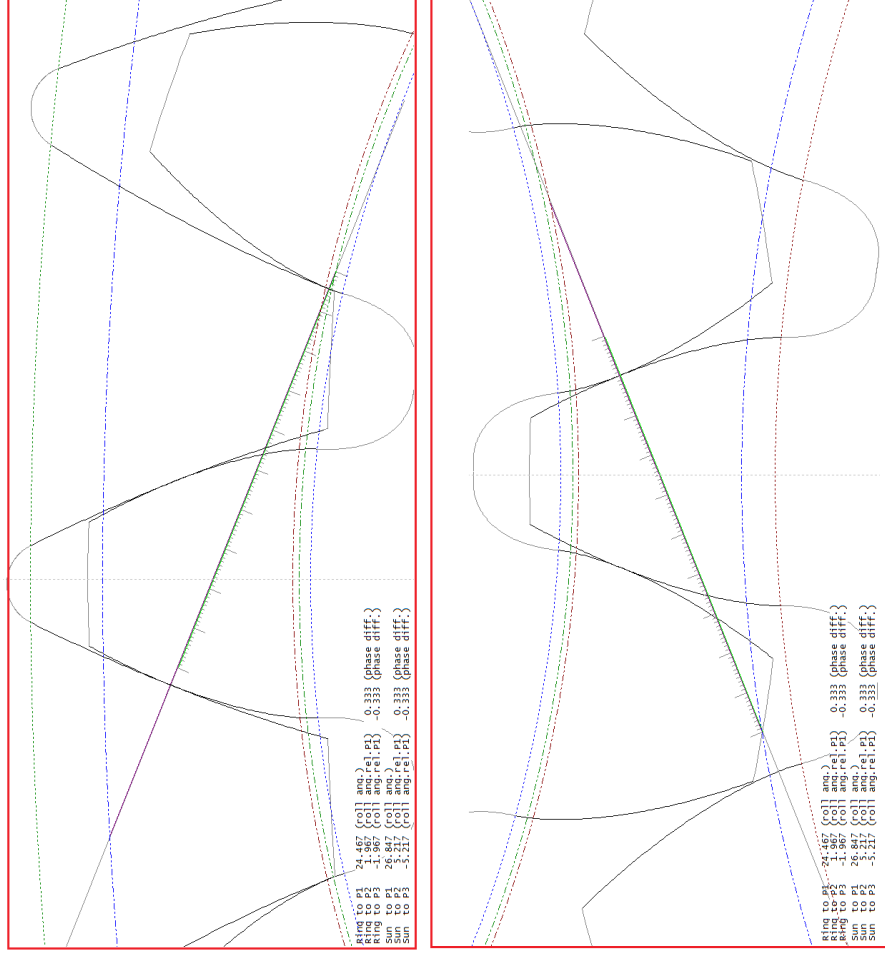


Load Analysis Model - Planetary Gear *

Features:-

- Phasing
- Load Sharing
- Transmission

Error



Connections - Spline Design

Standards

- ISO
- ANSI
- DIN

Spline Type: ISO 4156/ANSI B92.2M 30 deg. fil.

Class: 6

Fit: h

Manufacturing Type: 1.000 mm

Normal Module: 22

Number of Teeth: 26.000 mm

Length of Spline: 0.0000 mm

Addendum Modification Coefficient: 22.000 mm

Pitch Diameter: 22.000 mm

Diameter for Thickness Specification: Pitch Dia.

	MIN	MAX
External Spline		
Major Diameter	22.870	23.000
Minor Diameter	20.266	20.500
Actual Tooth Thickness	1.486	1.539
Effective Tooth Thickness	1.518	1.571
Machining Tolerance	0.053	mm
Variation Allowance	0.032	mm
Root Radius	0.200	mm
Internal Spline		
Major Diameter	23.500	23.734
Minor Diameter	21.104	21.234
Actual Space Width	1.603	1.655
Effective Space Width	1.571	1.623
Machining Tolerance	0.053	mm
Variation Allowance	0.032	mm
Root Radius	0.200	mm

File: Units: Print: Rating: Inspection: Graphics: Report: Options: Help

Version 5.00 advanced demo build 24 © Dontyne Systems 2014

Connections - Spline Design

ANSI Strength Calculation *

ANSI Spline Rating

Torque: 100,000 Nm
 Speed: 100,000 Rpm
 Mounting: Flexible Fixed
 Loading: Uni-directional Fully Reversed
 Material: Steel 160-200 BHN
 Driving Machine Characteristic: Uniform
 Driven Machine Characteristic: Uniform
 Misalignment mm/mm: 0.001
 Cycles (millions): 0.01
 Cycles (starts): 1000
 External Shaft Bore: 0.000 mm
 Internal Sleeve: 27.734 mm

Calculate

ANSI Spline Rating	Value
No. of Teeth	22
Module (normal) (mm)	1.000
Pressure angle	30.000
Pitch Circle Diameter (mm)	22.000
External Minor Diameter (mm)	20.383
External Major Diameter (mm)	22.935
Internal Minor Diameter (mm)	21.169
Internal Major Diameter (mm)	23.617
Bore for hollow shaft (mm)	0.000
Sleeve for internal spline (mm)	27.734
Length of spline (mm)	26.000
Effective length of spline (mm)	26.000
Allowable shear stress (Mpa)	137.900
Allowable Compressive Stress (Mpa)	10.340
Allowable Tensile Stress (Mpa)	151.680
Application Factor Ka	1.000
Load Distribution Factor Kf	1.000
Fatigue Life Factor Kw	1.800
wear Life Factor	4.000
Specified Torque (Nm)	100.000
External spline	412.726
Max Torque Shear stress under root (Mpa)	33.412
Shear Stress under the root (Mpa)	1226.635
Max Torque Shear Stress at PCD	11.242
Shear stress at the pitch diameter	412.726
Max Limit Torque Shear Stress at PCD	412.726
Flexible spline	229.843
Max Torque Contact Stress (Mpa)	4.499
Contact Stress at Flank (Mpa)	229.843
Max Torque limit for External spline	229.843
Internal spline	30.746
Tensile Stress for radial load	21.191
Tensile Stress for Beam load	0.000
Tensile Stress for centrifugal load	525.680
Max Torque Tensile Stress internal	28.854
Tensile stress tending to burst rim	229.843
Max Torque limit for internal spline	229.843

Override: 0.200 mm

Filename: Version 5.00 advanced demo, build 24 © Dontyne Systems 2014

Spline Design

Non-standard
pressure angle of
helical splines *

Dontyne Systems - Spline Designer

File Units Print Rating Inspection Warnings Graphics Report Options Help

Window Sizes
Report Font Size
Helical / Non-standard Pressure Angle Spline
Alternate Teeth

Internal

Helix Angle: 0.000 Pressure Angle: 20.000
 Class: 6 Fit: H
 Manufacturing Type: 1.000 mm
 Normal Module: 22
 Number of Teeth: 26.000 mm
 Addendum Modification Coefficient: 0.0000
 Pitch Diameter: 22.000 mm
 Diameter for Thickness Specification: Pitch Dia: 22.000 mm

External Spline

	MIN	MAX
Major Diameter	22.870	23.000
Minor Diameter	20.128	20.500
Actual Tooth Thickness	1.486	1.539
Effective Tooth Thickness	1.518	1.571
Machining Tolerance	0.053	mm
Variation Allowance	0.032	mm
Root Radius	0.200	mm

Internal Spline

Major Diameter	23.500	23.872
Minor Diameter	21.260	21.390
Actual Space Width	1.603	1.655
Effective Space Width	1.571	1.623
Machining Tolerance	0.053	mm
Variation Allowance	0.032	mm
Root Radius	0.200	mm

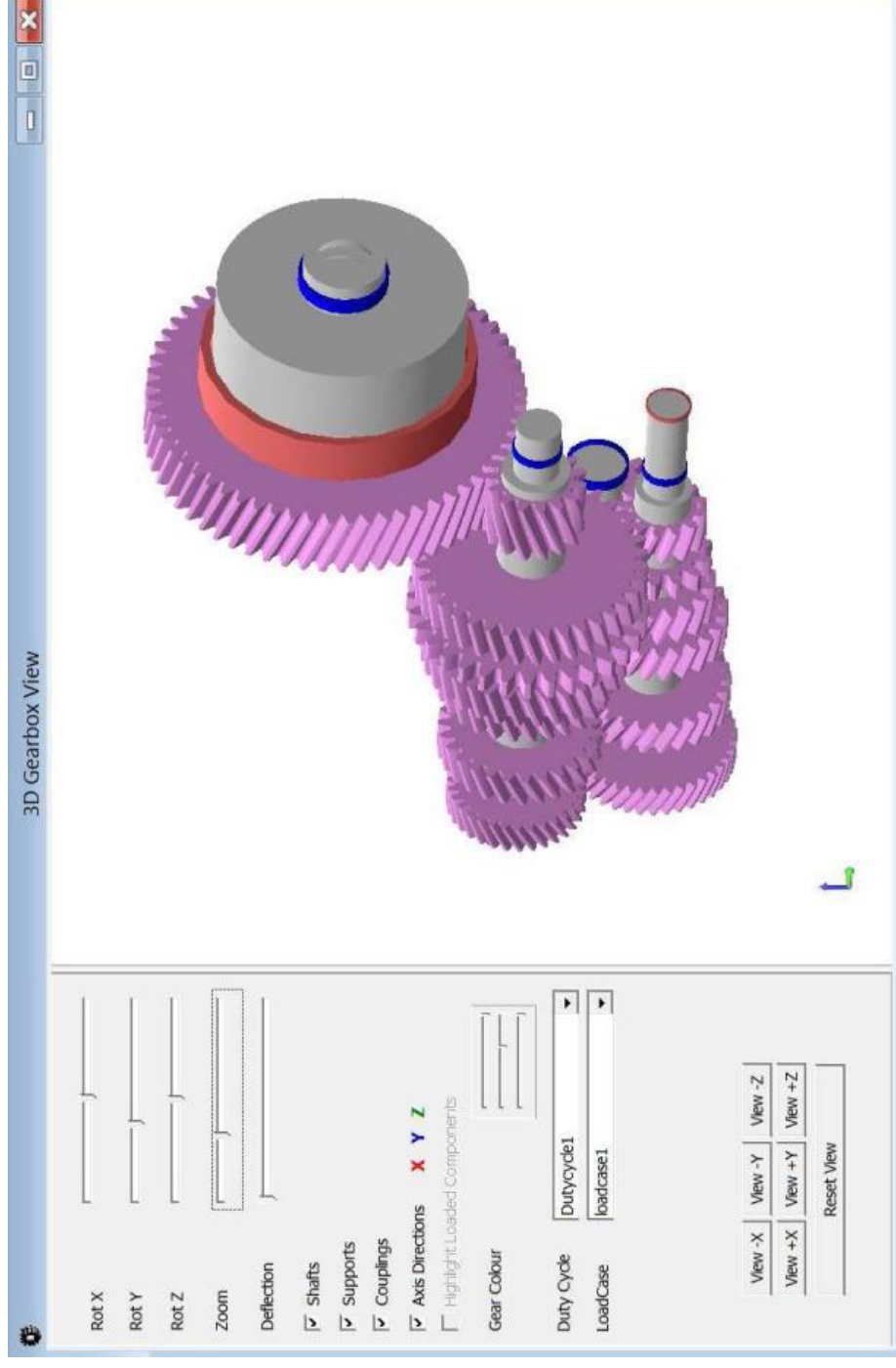
Helical Tooth Thickness Dimensions are Transverse

Filename: Geometry warnings! Version 5.00 advanced demo build 24 © Dontyne Systems 2014

Gearbox Modeller*

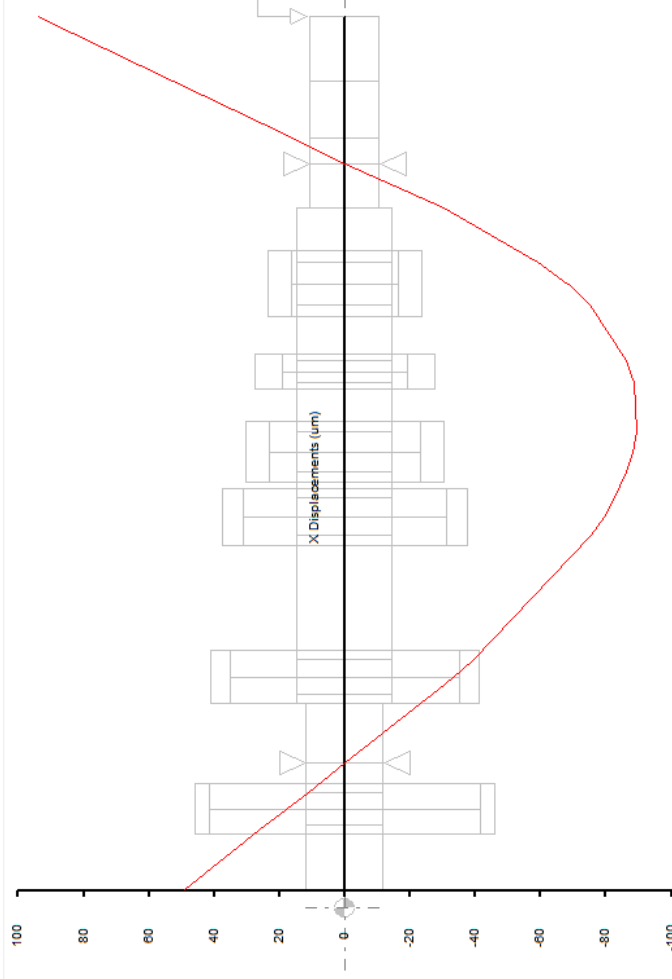
Features :-

- Power flow
- Gear Misalignments
- Shaft deflections and stresses
- Links directly to Gear Load Analysis model

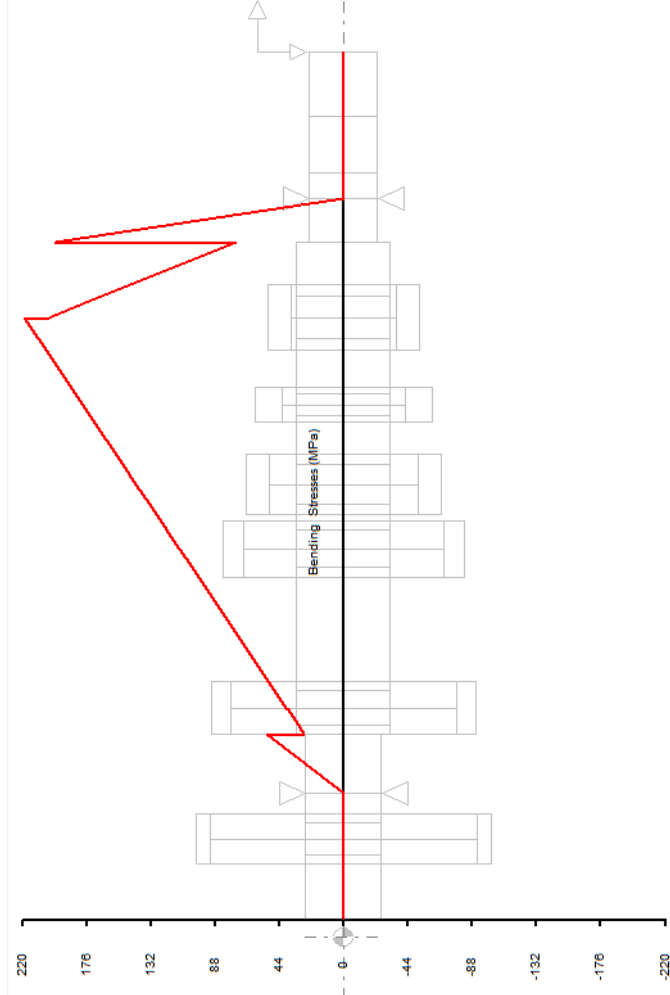


Gearbox Modeller

Shaft Deflections

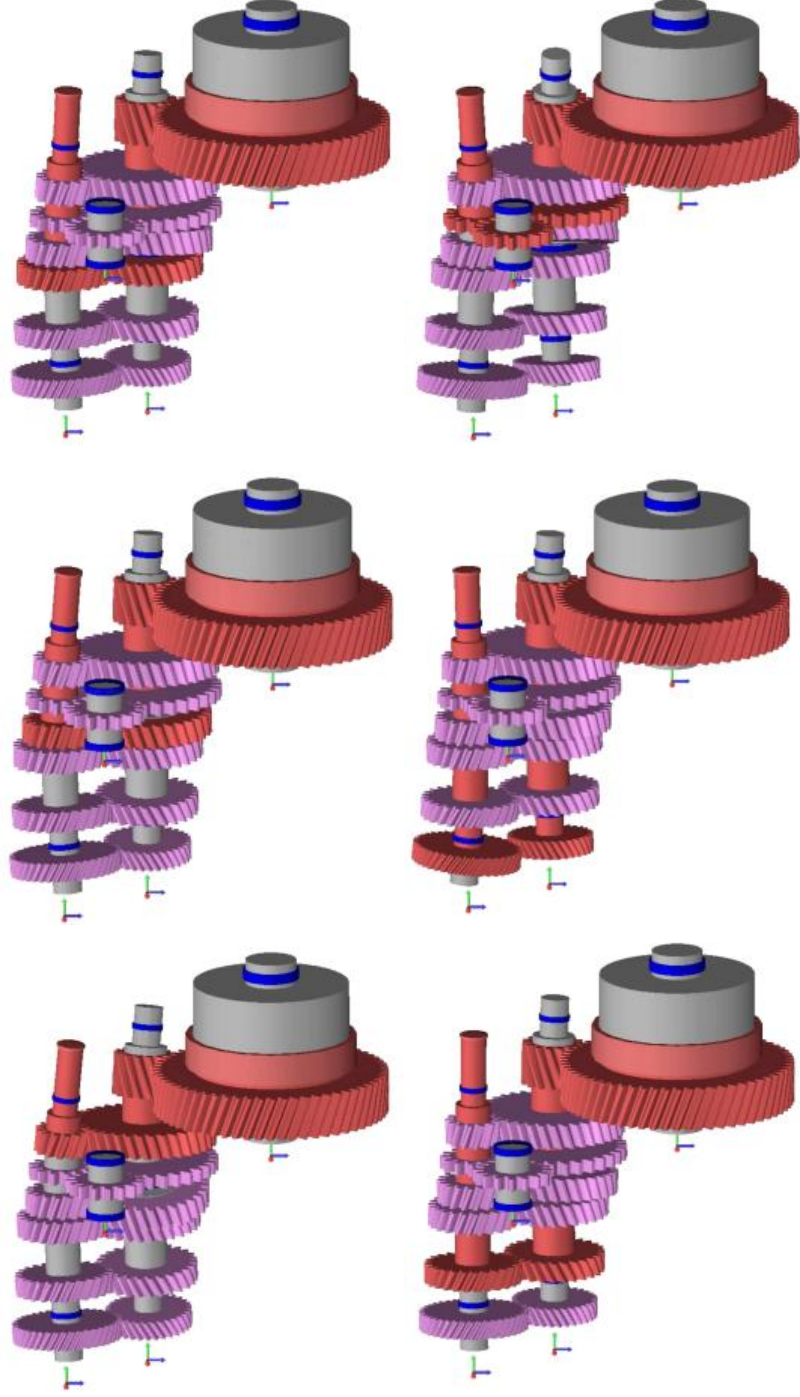


Shaft Stresses



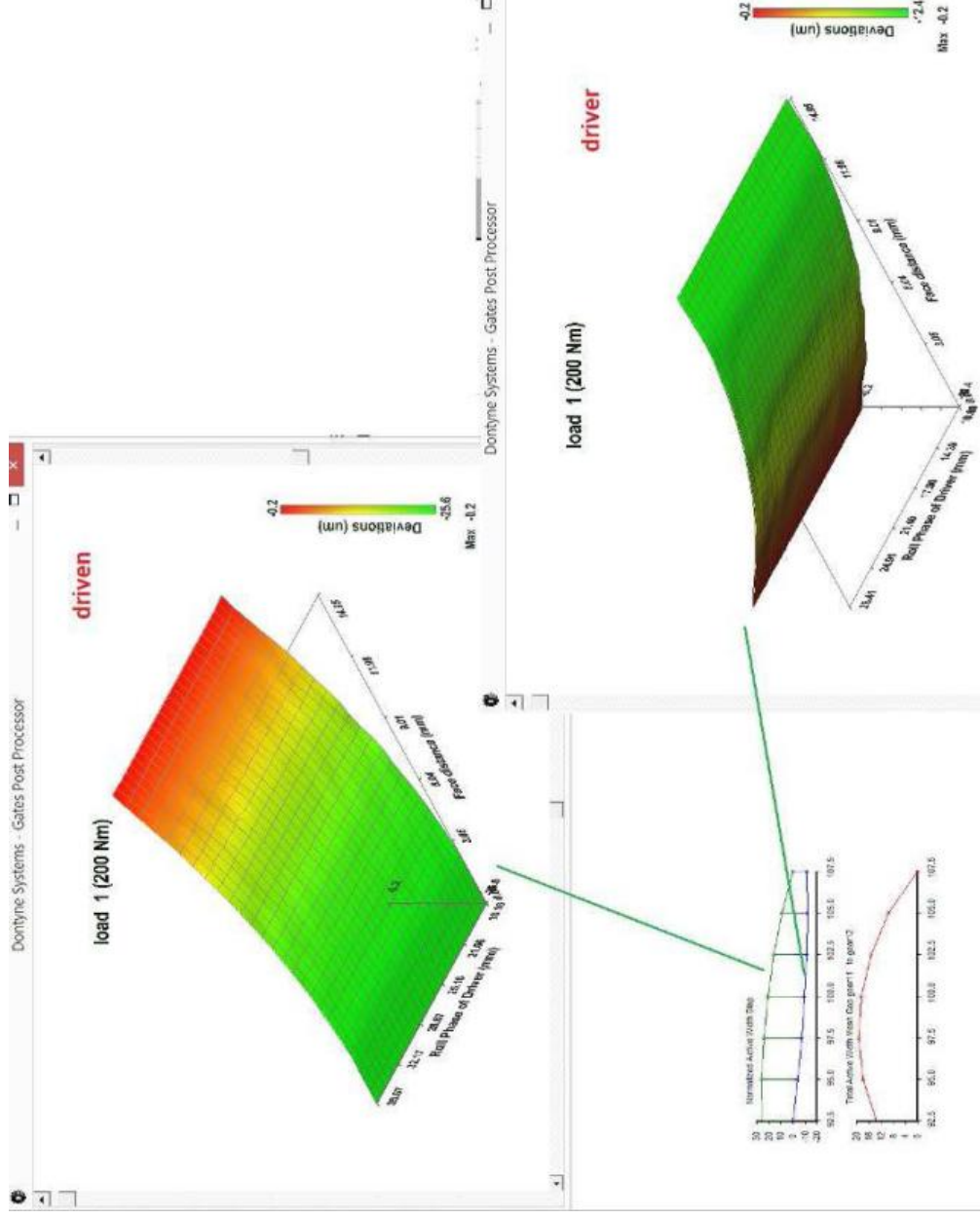
Gearbox Modeller

Powerflow diagrams



Gearbox Modeller

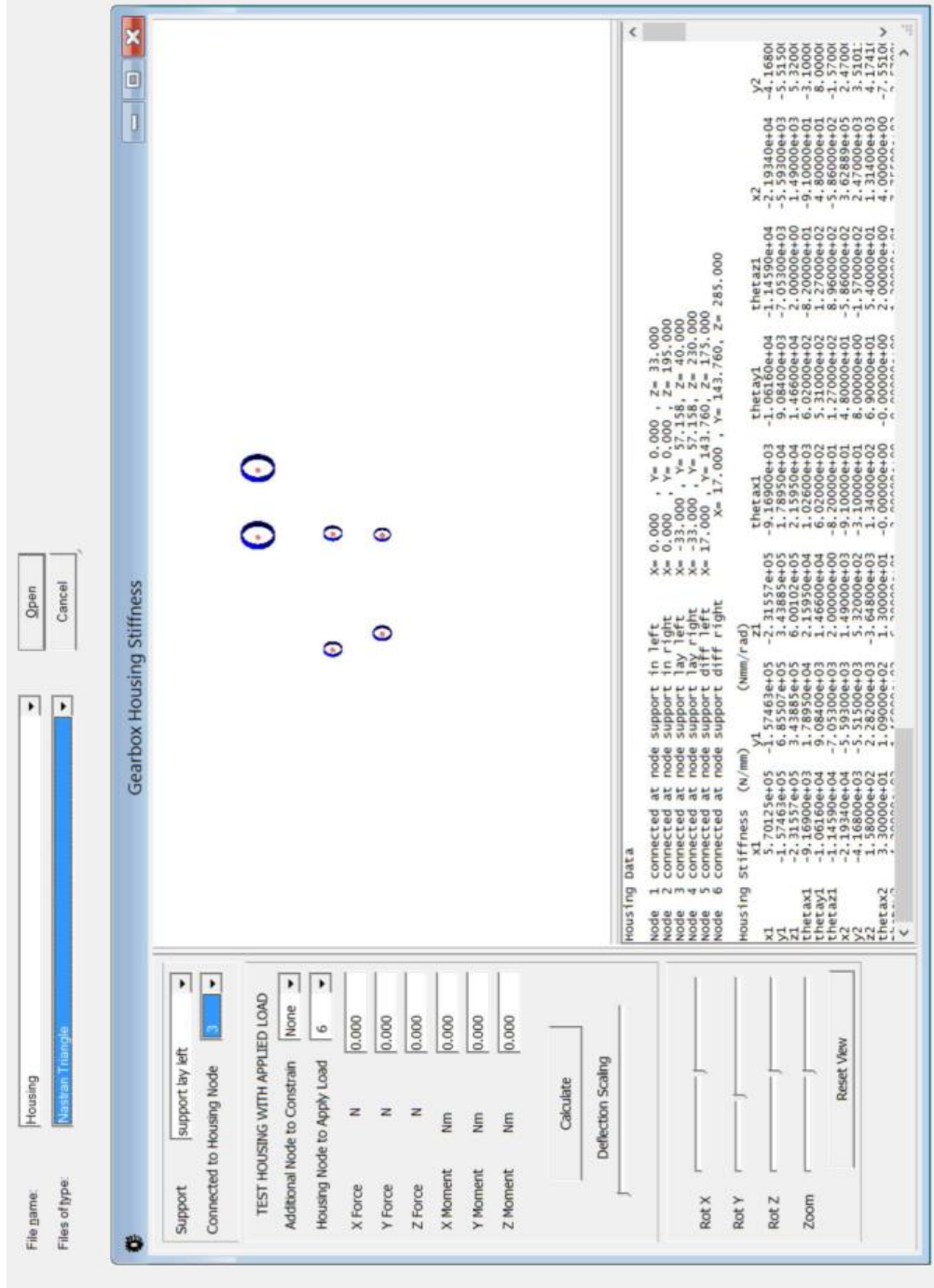
Gear Misalignment Form Deviations



Full form
 deviations across
 tooth passed to
 LAM *

Gearbox Modeller

Import NASTRAN file formats for Housing Stiffness



Load Analysis Model Surface Optimization*

- Batch running option available release 5.0
- Many cases can be analyzed and the desired surface chosen from up to 20,000 variants
- Surface modifications include tip relief, crowning, bias and helix corrections for multiple loads
- Plots of results links directly to existing 3D graphics in the GATES program

Load Analysis Model Surface Optimization

Up to 10 increments for each parameter

Available surface Modifications

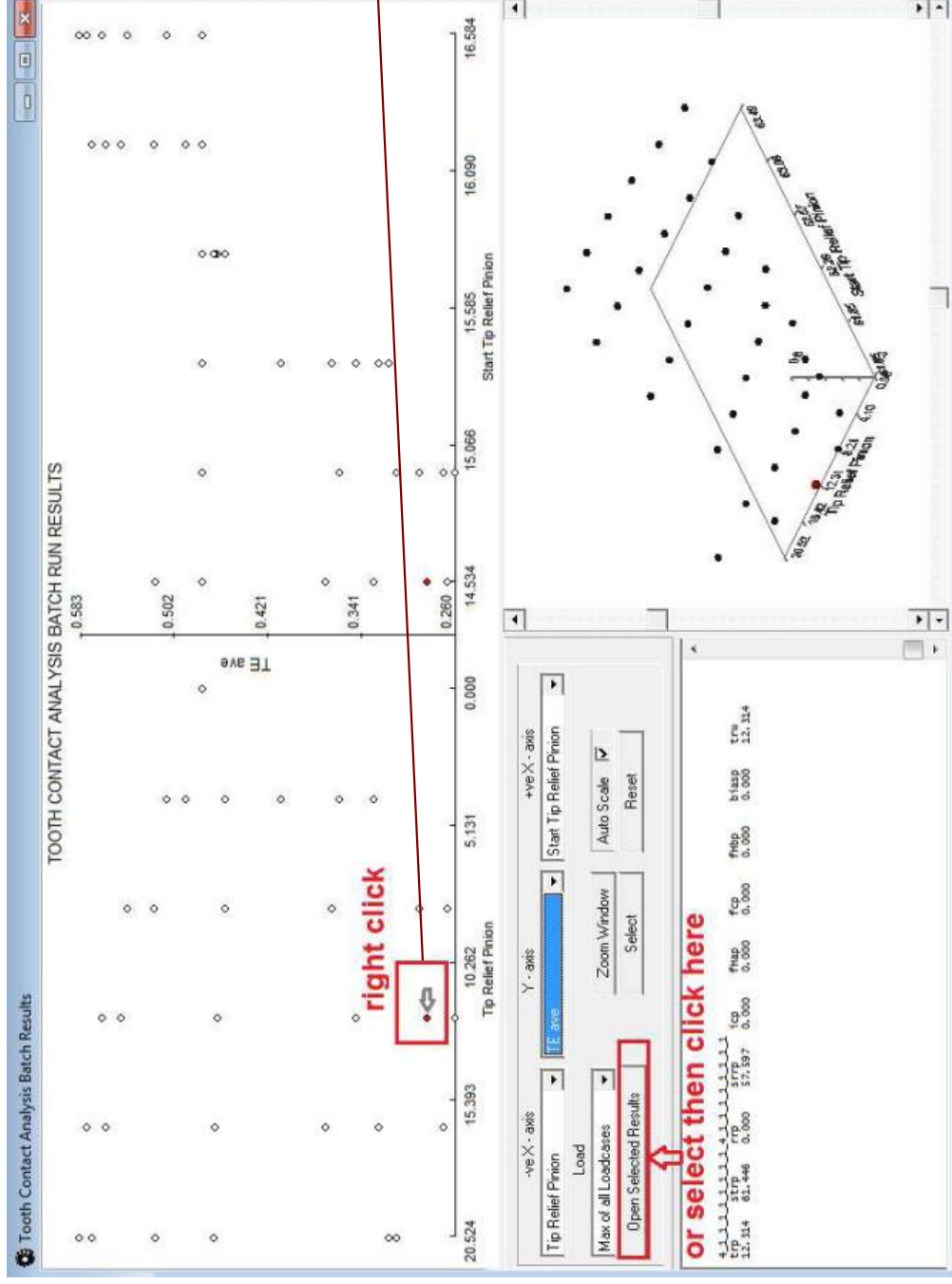
Pinion and wheel can be linked so that steps change together

Modification	Limit1	Limit2	Steps	Link To
Pinion				
1. Tip Relief	0.000	20.525 um	6	<input checked="" type="checkbox"/>
2. Start of Tip Relief	14.534	16.584 mm	6	<input checked="" type="checkbox"/>
3. Root Relief	0.000	0.000 um	1	<input type="checkbox"/>
4. Start of Root Relief	9.833	9.833 mm	1	<input type="checkbox"/>
5. Involute Crown	0.000	0.000 um	1	<input type="checkbox"/>
6. Profile Error (Hta)	0.000	0.000 um	1	<input type="checkbox"/>
7. Lead Crown	0.000	0.000 um	1	<input type="checkbox"/>
8. Helix Error (HtB)	0.000	0.000 um	1	<input type="checkbox"/>
9. Bias	0.000	0.000 um	1	<input type="checkbox"/>
Wheel				
10. Tip Relief	0.000	20.525 um	6	<input type="checkbox"/>
11. Start of Tip Relief	16.820	18.870 mm	6	<input type="checkbox"/>
12. Root Relief	0.000	0.000 um	1	<input type="checkbox"/>
13. Start of Root Relief	12.119	12.119 mm	1	<input type="checkbox"/>
14. Involute Crown	0.000	0.000 um	1	<input type="checkbox"/>
15. Profile Error (Hta)	0.000	0.000 um	1	<input type="checkbox"/>
16. Lead Crown	0.000	0.000 um	1	<input type="checkbox"/>
17. Helix Angle (HtB)	0.000	0.000 um	1	<input type="checkbox"/>
18. Bias	0.000	0.000 um	1	<input type="checkbox"/>

Up to 9 loads for each modification

Load Analysis Model Surface Optimization

Graphical display allows user to select a particular design

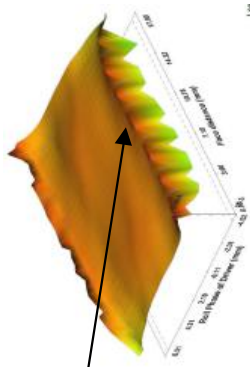


Tooth surface stress

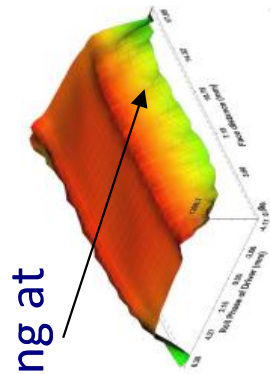
Transmission Error (TE)

Load Analysis Model Surface Optimization

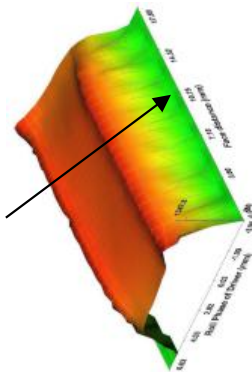
What is optimum amount of tip relief?



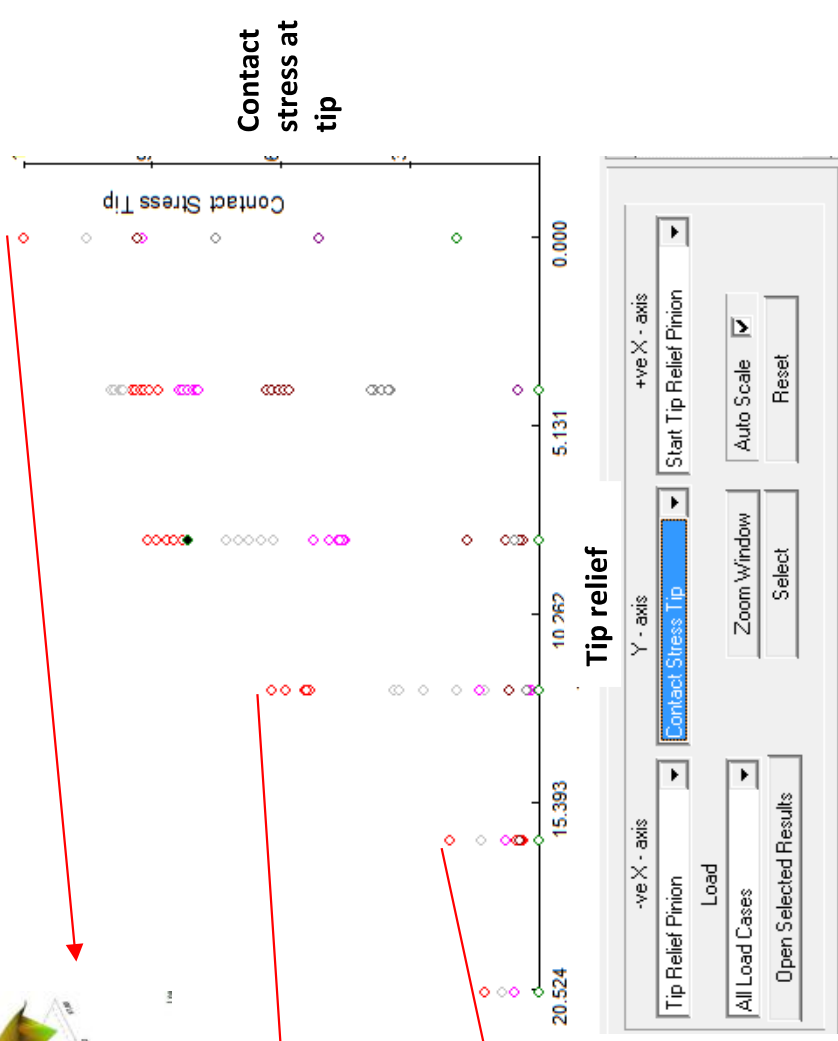
High stress at tip



Stress reducing at tip at tip

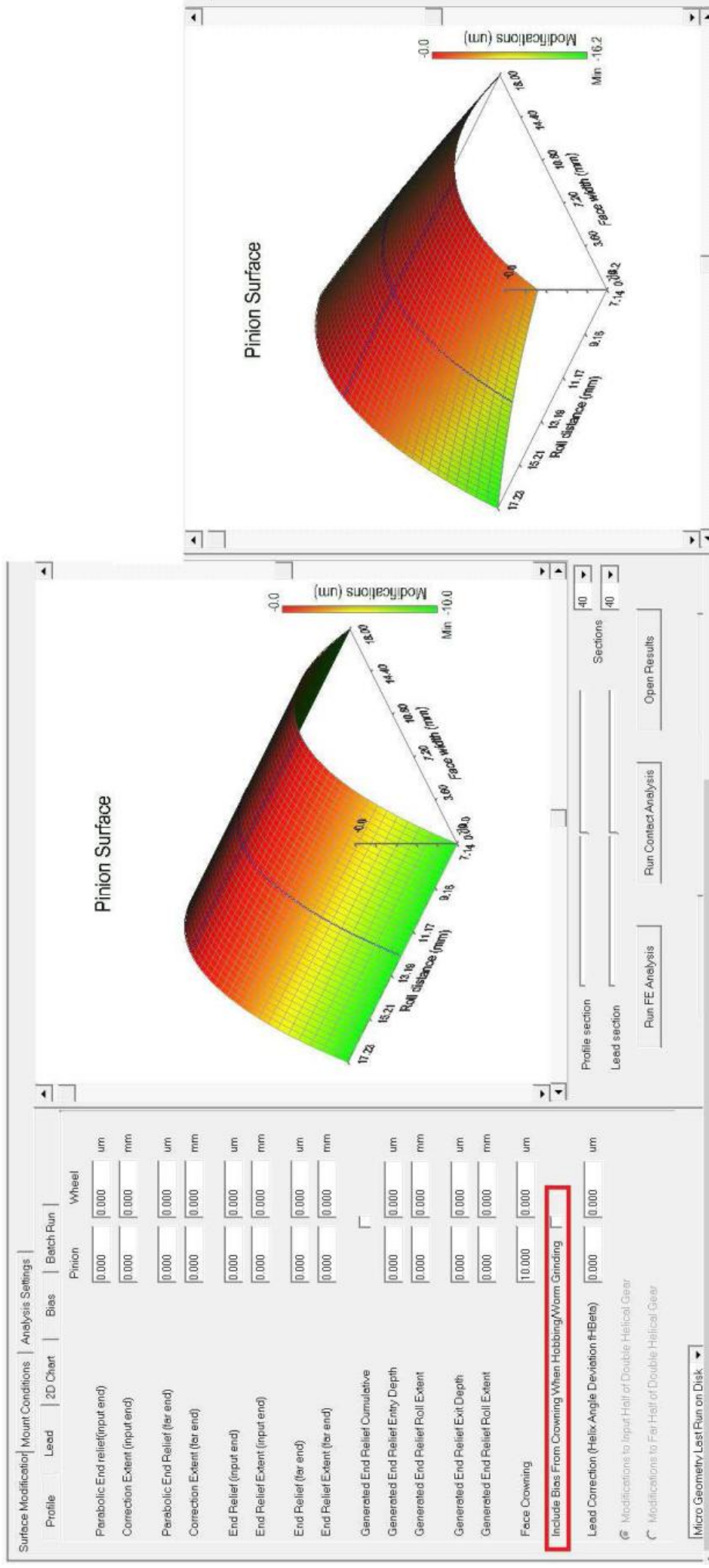


Low stress at tip



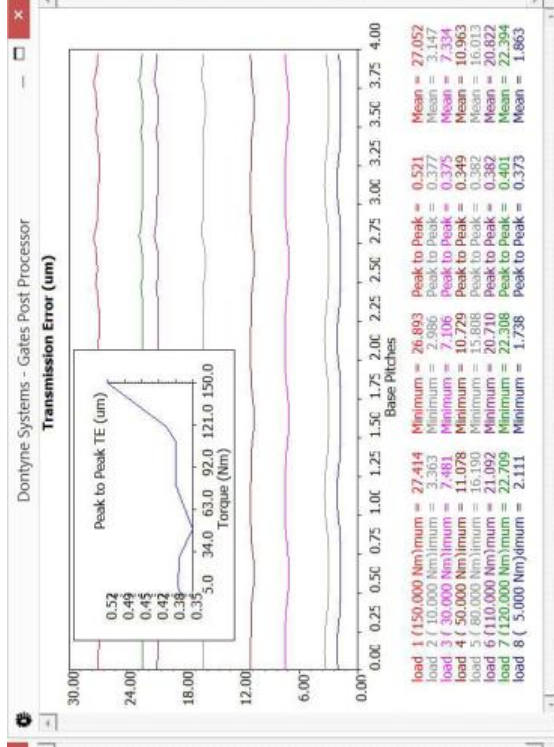
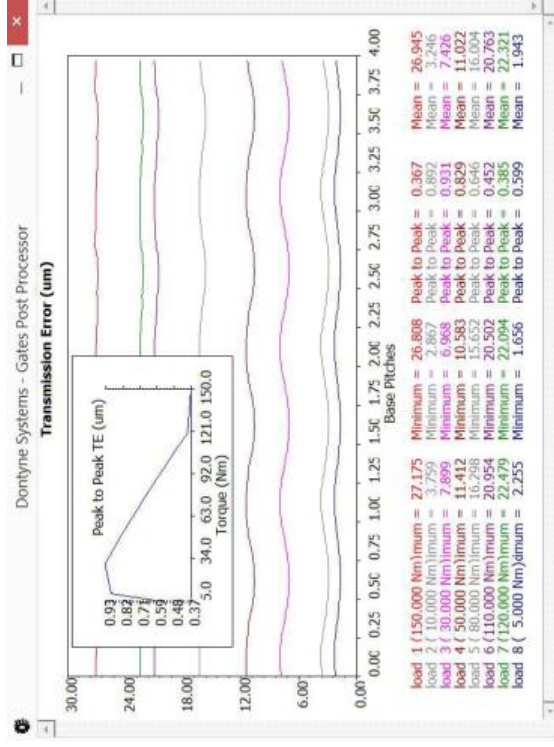
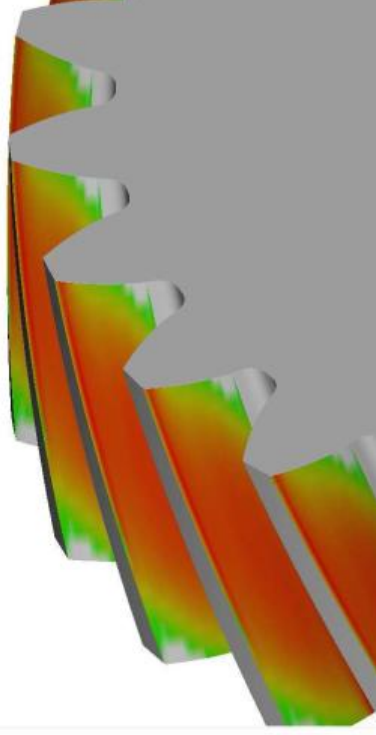
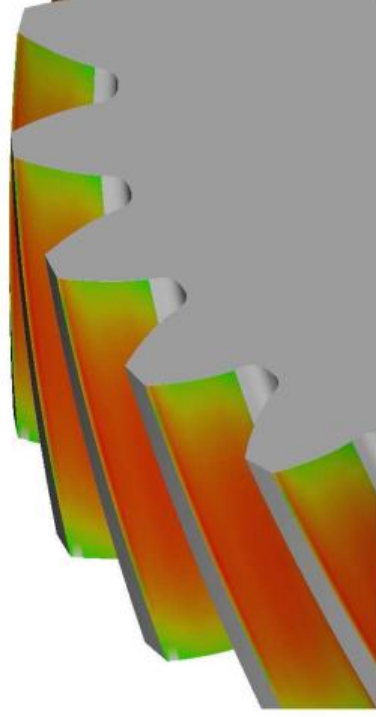
Load Analysis Model Bias From Crowning*

The twisting of the surface due to manufacturing effect of crown



Load Analysis Model Bias From Crowning

The twisting of the surface due to manufacturing effect of crown



Load Analysis Model Multiple-Surfaces*

Dontyne Systems Tooth Contact Analysis (3 parabolic multiple load)

Surface Modification | Mount Conditions | Analysis Settings | Batch Run

Profile | Lead | 2D Chart | Bias

	Pinion	Wheel
Tip relief	10.000	10.000 um
Start of Tip Relief	14.534	16.819
Root relief	0.000	0.000 um
Start of Root Relief	9.833	12.119
Involute Crown Tip	0.000	0.000 um
Start of Involute Crown Tip	14.534	16.819
Involute Crown Root	0.000	0.000 um
Start of Involute Crown Root	9.833	12.119
Profile Angle Error (Helpline)	0.000	0.000 um
Wear Band Depth	0.000	0.000 um
Start of Wear Band Depth	7.139	9.425
End of Wear Band Depth	9.833	12.119

Linear
 Parabolic

Centre

Modifications to Root Half of Double Helical Gear
 Modifications to Face Half of Double Helical Gear

Equation for Involute Crown Parabola

$y1 = [0.000] x^4 + [0.000] x^3 + [-0.000] x^2 + [0.000] x + [0.000]$
 $y2 = [0.000] x^4 + [0.000] x^3 + [-0.000] x^2 + [0.000] x + [0.000]$

Profile specified as: [Roll Distance (mm)]

Pinion Surface

Modifications (um)

0.0 -15.0 Min -15.0

Roll distance (mm)

7.25 7.14 9.16 11.17 13.19 15.21

Profile section: [] Sections: 40

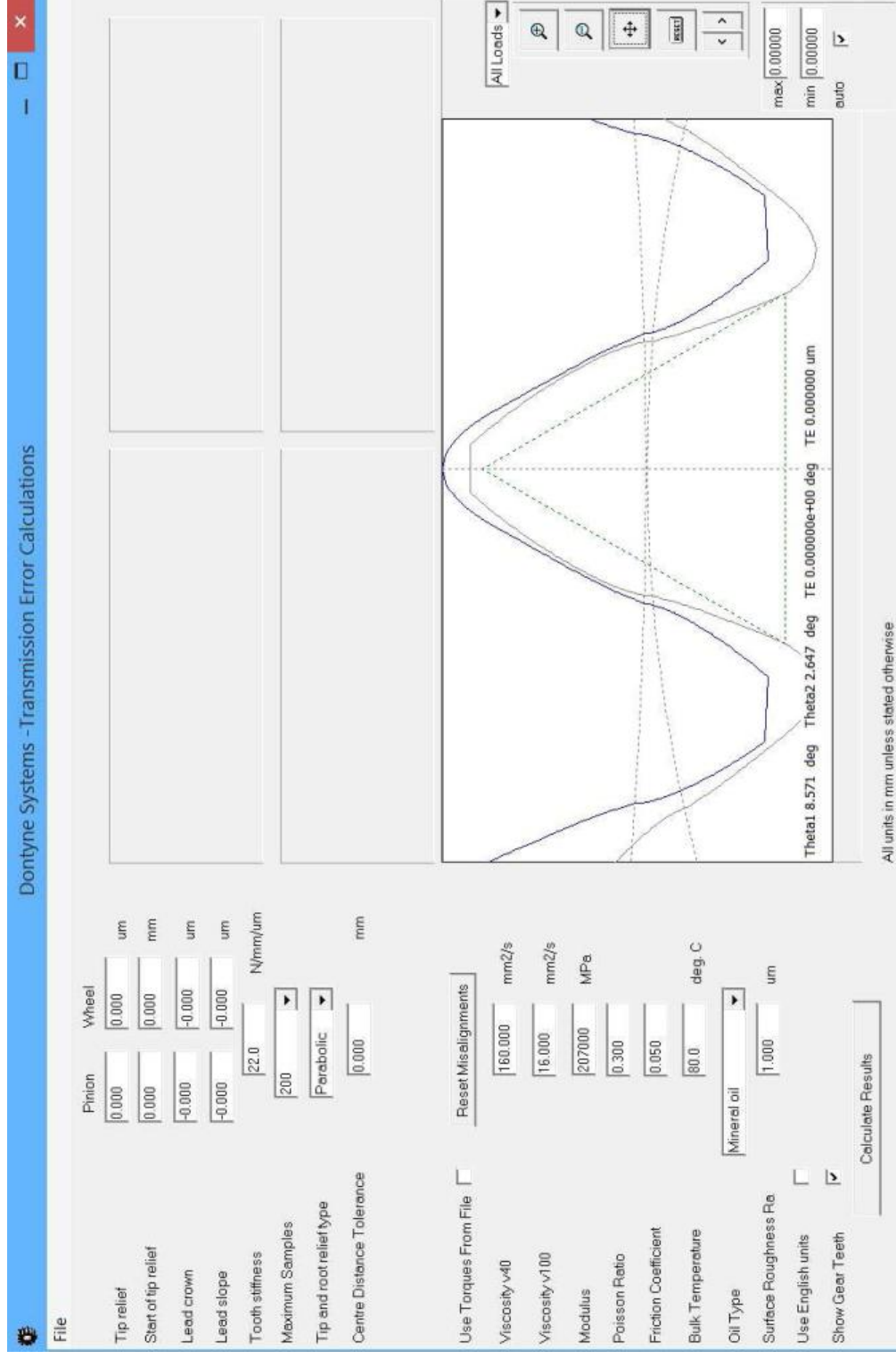
Lead section: [] Sections: 40

Up to 4 different surfaces

Non-Involute Load Analysis Model*

- The Dontyne Generic load analysis model allows non-involute spur or helical gear profiles to be analysed
- This profile could be involute, cycloidal, Convoloid® or any new customer specific gear shape
- Results are provided for transmission error, load, stress and powerloss etc.

Non-Involute Load Analysis Model



Bevel Gear Surface Design for 5-Axis Milling*

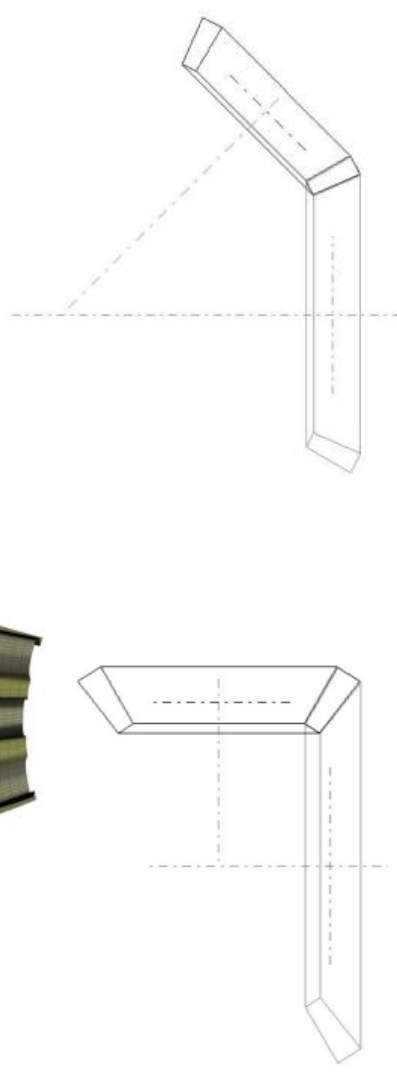
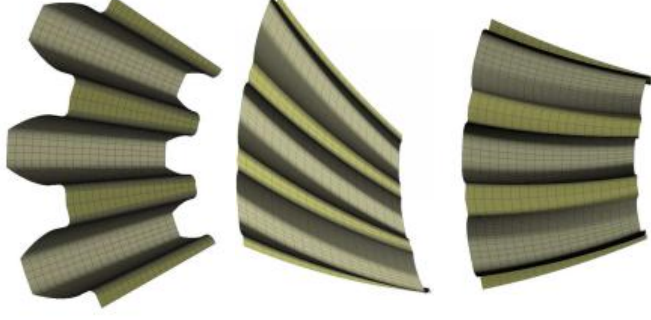
- The Dontyne Generic Spiral bevel gear program can produce the mathematically complex gear tooth surface data
- The co-ordinates can be exported in ASCII (x,y,z) format or DXF and IGES 3D grid forms.
- The gears can be roll checked to visualize the correct conjugation of the gear pair

Bevel Gear Surface Design for 5-Axis Milling

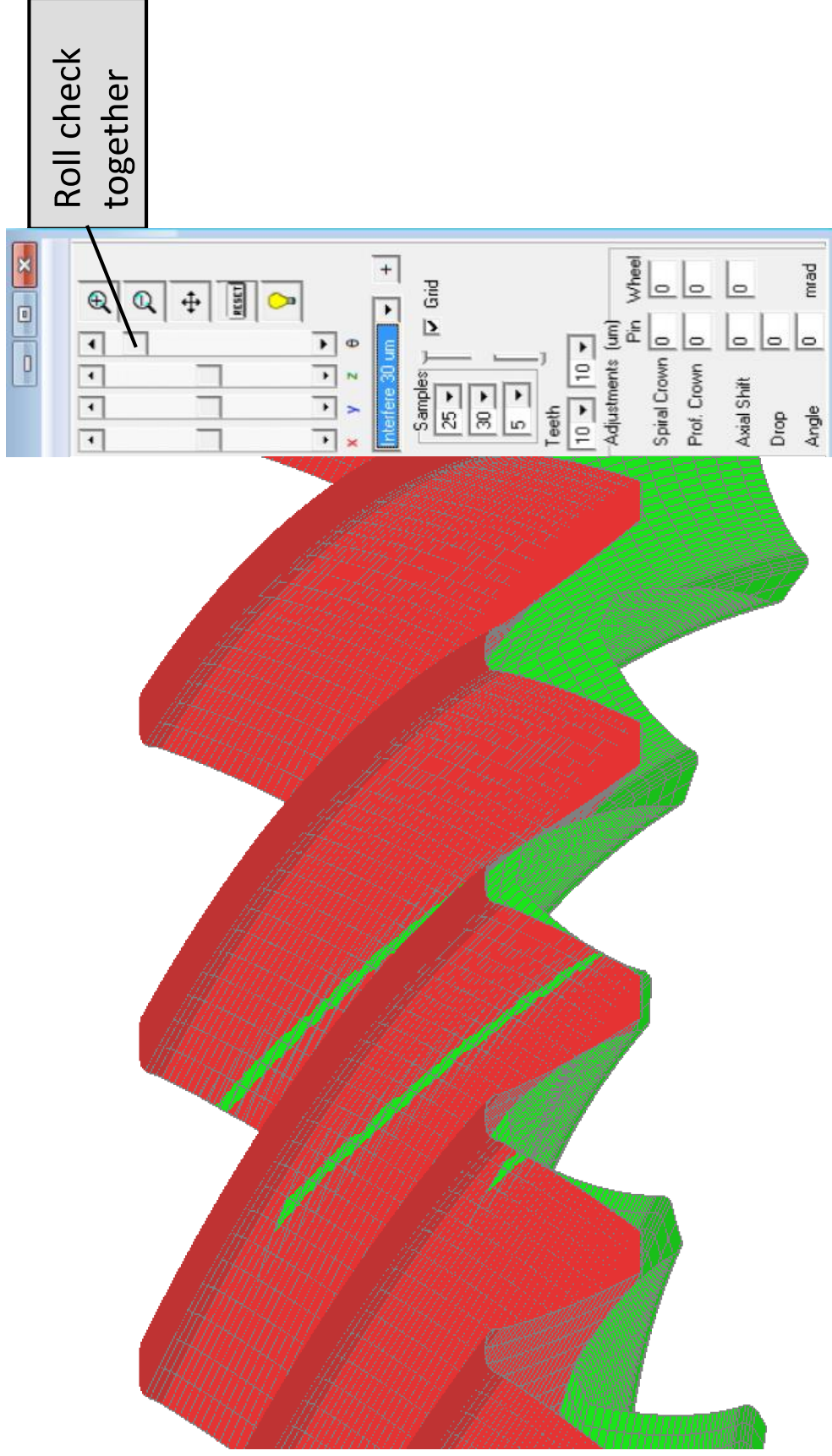
- Is the Gear an Approximate Virtual Gear?
- Some programs employ “Tredgold’s” approximation which substitutes a conical surface that is tangential to the actual spherical surface
 - This surface in the back cone is an approximation to the exact spherical surface
 - The Dontyne program uses the exact spherical involute with no approximation or virtual spur gear in the back cone

Bevel Gear Surface Design for 5-Axis Milling

- Straight bevel
- Spiral Bevel
- Zerol Bevel
- 90 degree or other

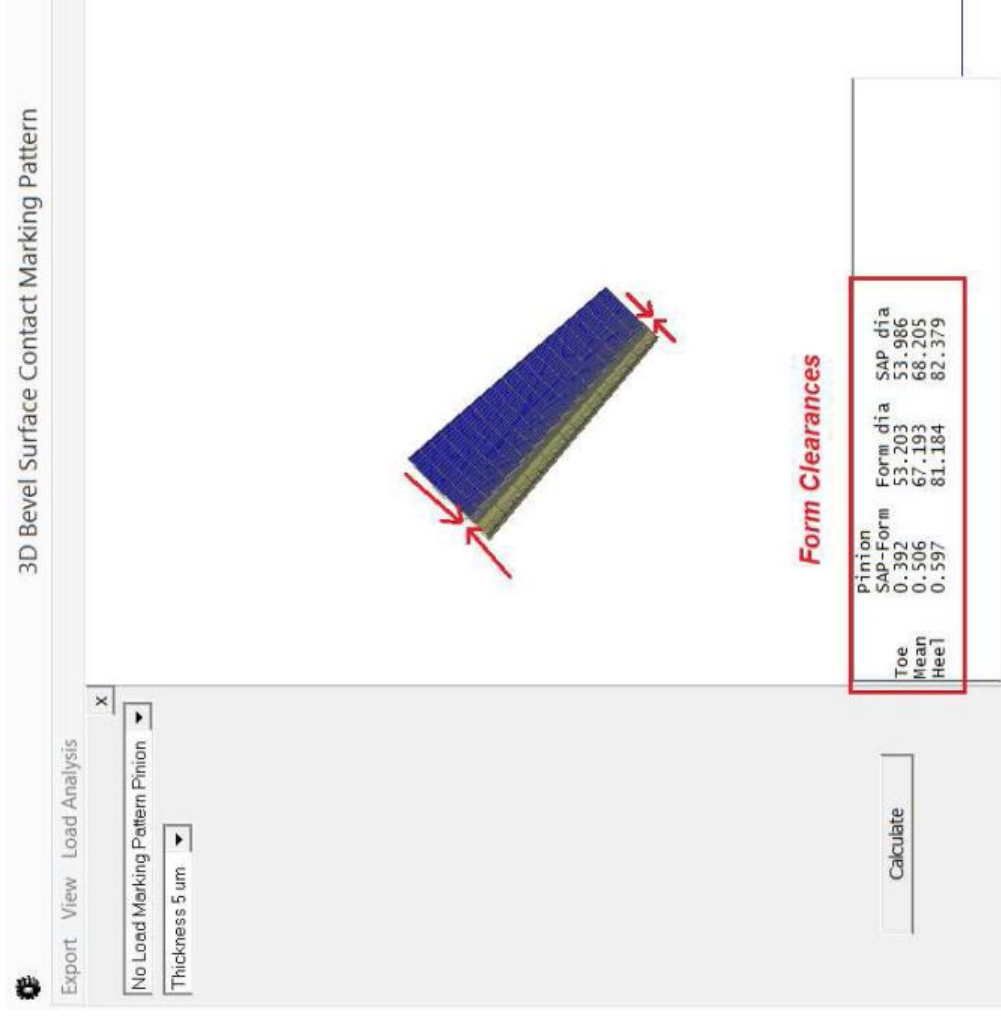


Bevel Gear Surface Design for 5-Axis Milling



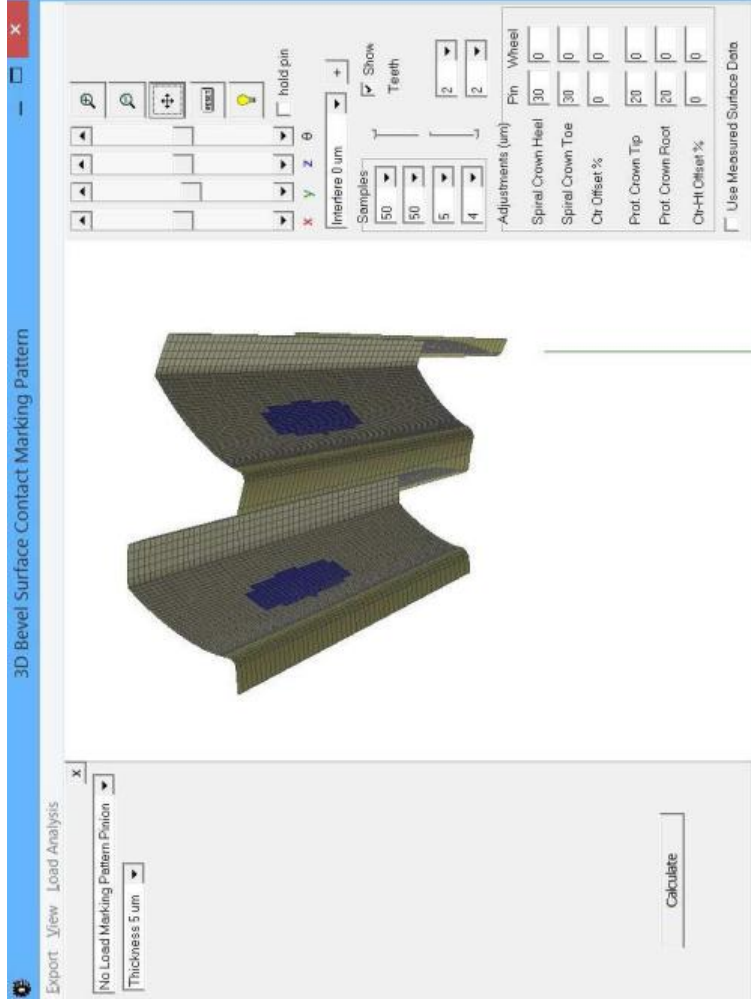
Bevel Gear Interface Additions

PINION		WHEEL	
Shaft Angle	<input checked="" type="checkbox"/> deg.min.sec. 90° 0' 0"		
Number of Teeth	21	21	
Module (outer transverse)	4.193		
Pitch Diameter (outer)	88.048	88.048	
Face Width	22.225		
Pressure Angle	20° 0' 0"		
Spiral Angle (mean)	Equi-eng (log) R	0° 0' 0"	L
Radius for Spiral			
Pitch Angle	45° 0' 0"	45° 0' 0"	
Face Angle	48° 51' 10"	48° 51' 10"	
Root Angle	40° 33' 0"	40° 33' 0"	
Circ. Thickness (outer trans)	6.586	6.586	
Backlash (outer transverse)		-0.000	
Outer Addendum	4.193	4.193	
Outer Dedendum	4.849	4.849	
Root Fillet Coeff. (rho/fm_mm)	0.200	0.200	
Root Fillet Coeff. (rho/fm_mm)			<input type="checkbox"/> Use English Units
Root Fillet Radius			

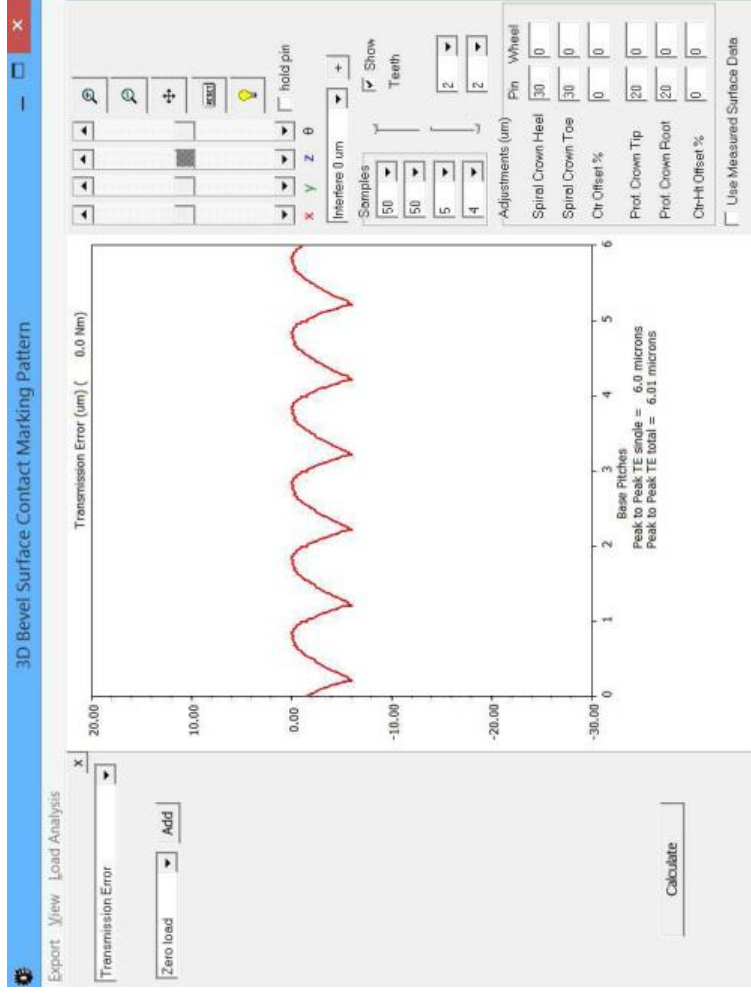


Bevel Gear – No Load Analysis

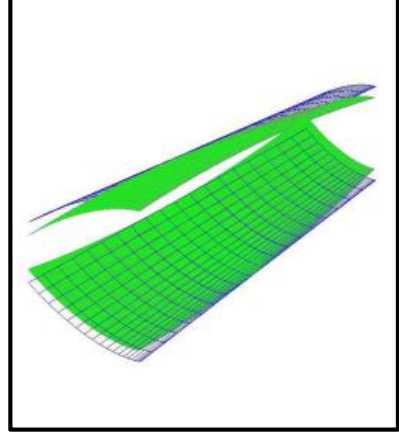
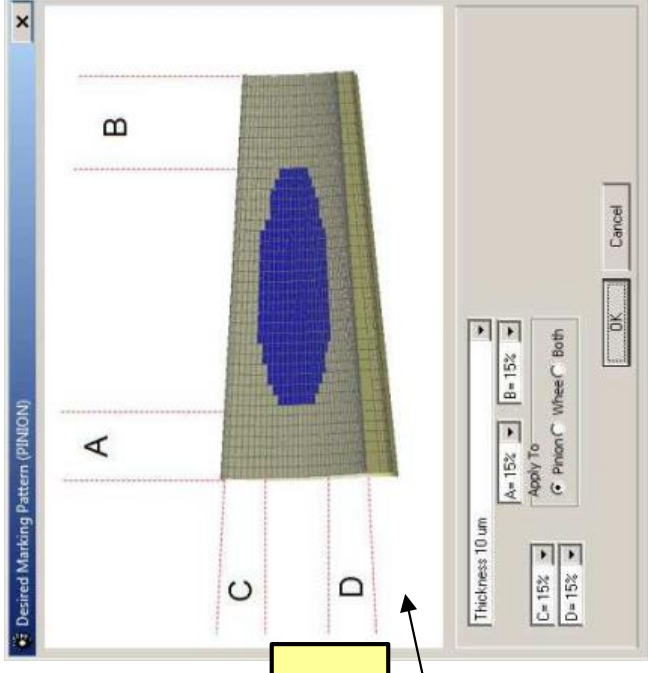
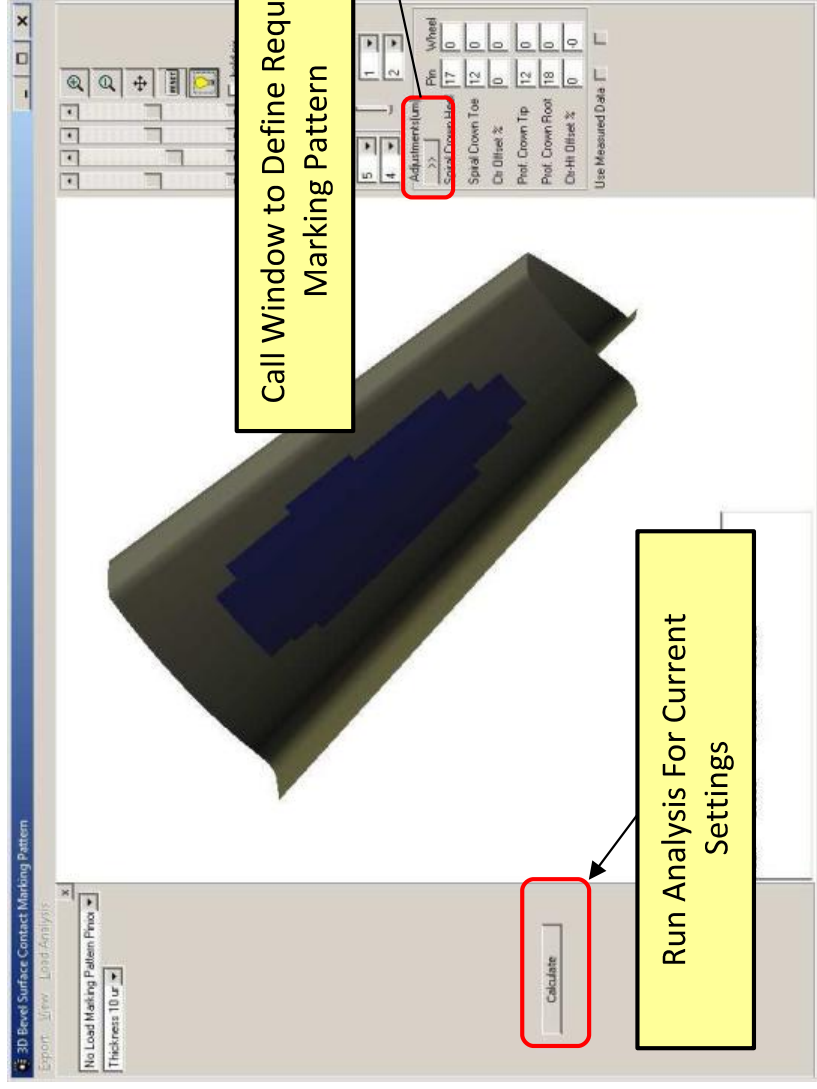
Marking Pattern*



Transmission Error*



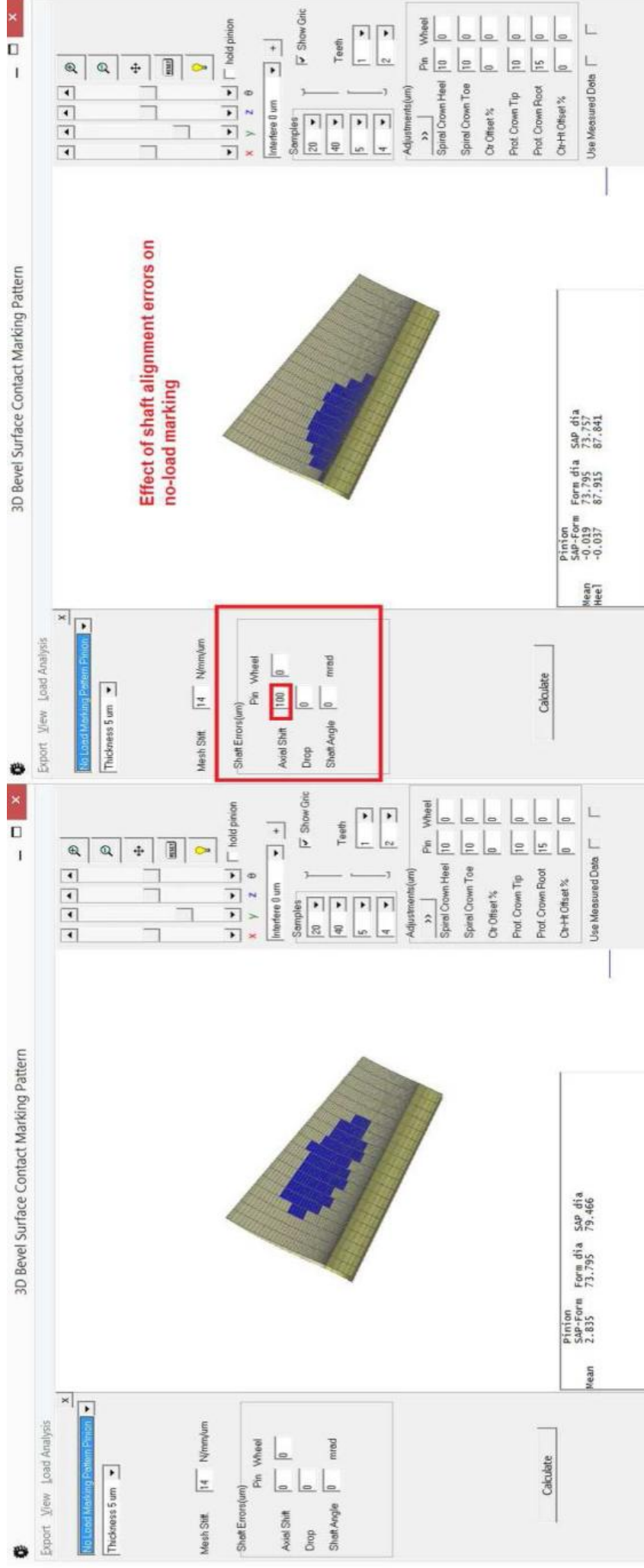
Bevel Gear Definition of Micro Geometry



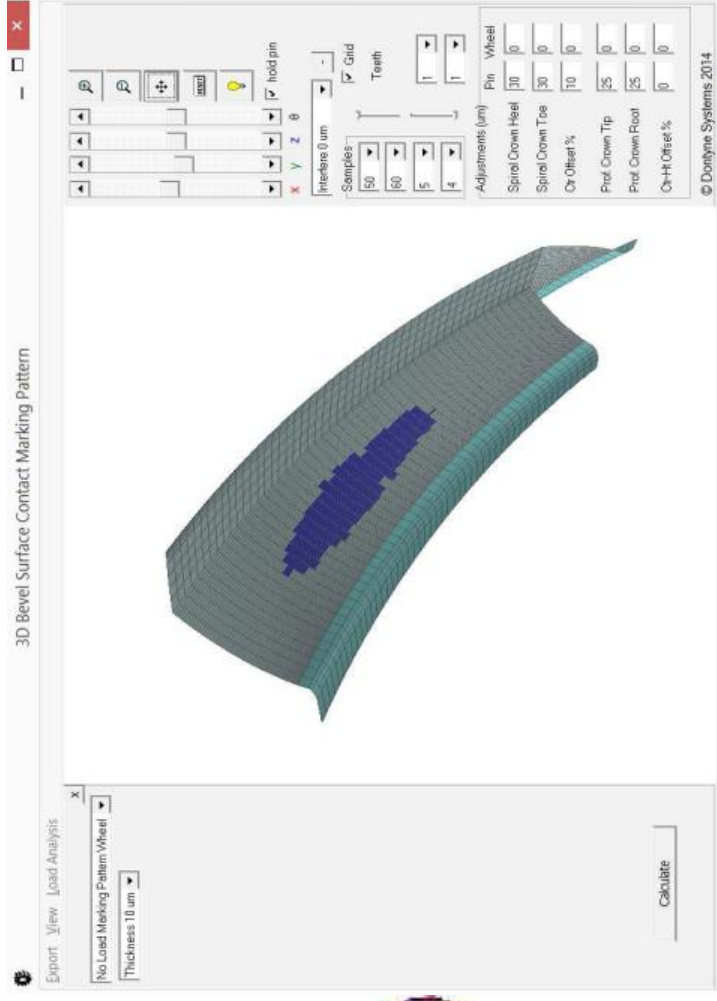
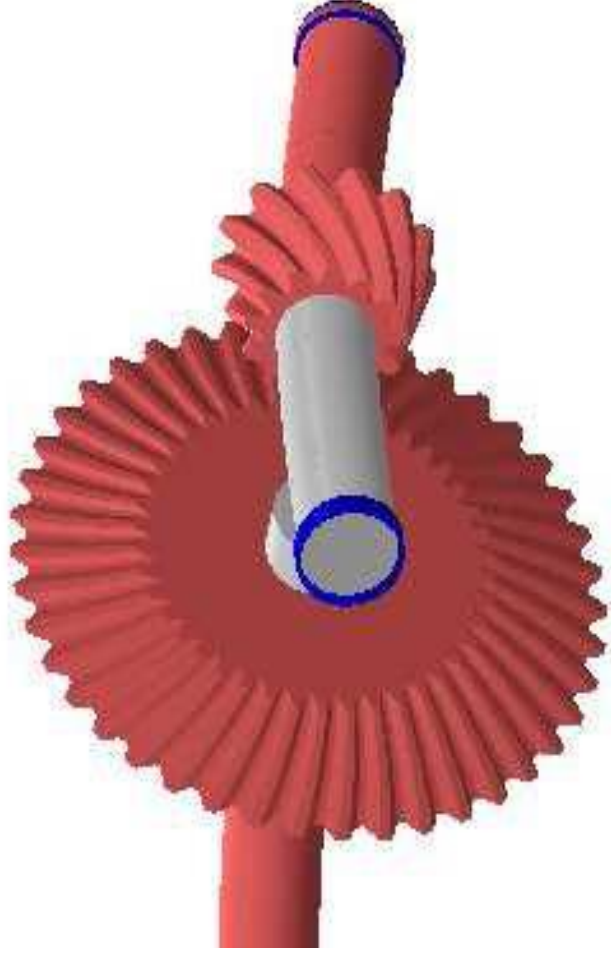
Modification can be viewed relative to the theoretical surface

Bevel Gear – No Load Analysis

Effect of Alignment Error*



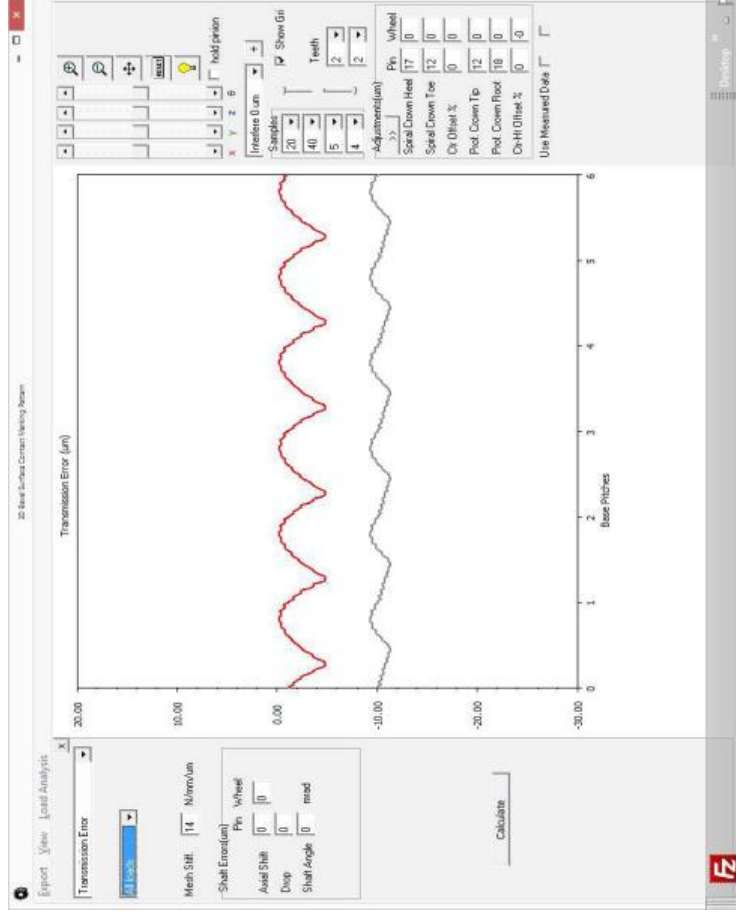
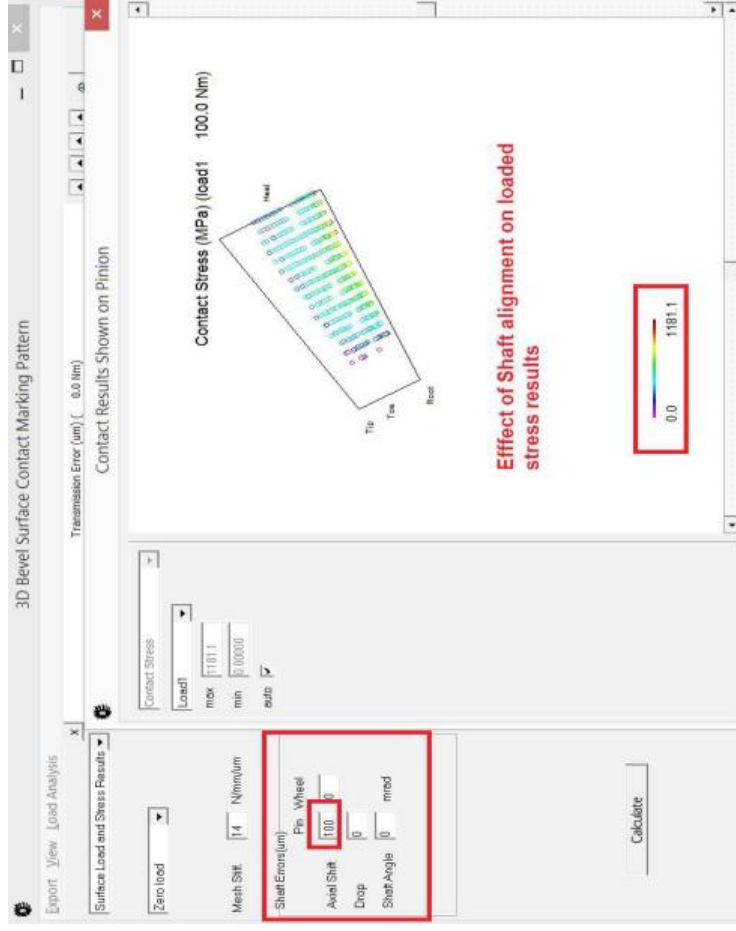
Bevel Gear – Load Analysis Model



Bevel Gear – Load Analysis Model

Contact Stress Pattern*

Harris Map - Transmission Error*



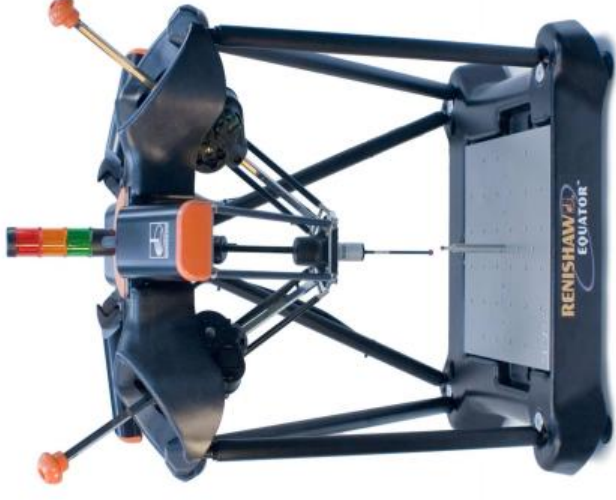
Links To Inspection



Gear Checking Machine
OSK



CMM
Wenzel



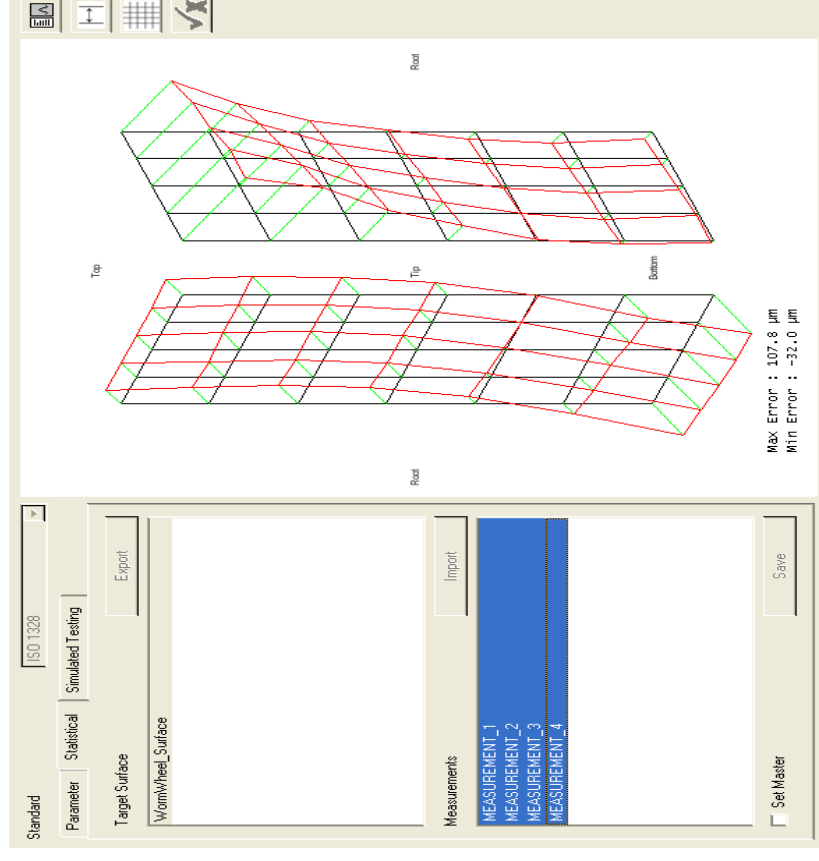
Gauging devices
Equator (Renishaw)

The Gear Production Suite has links to many measuring devices some of which embed Dontyne Systems software in their own applications

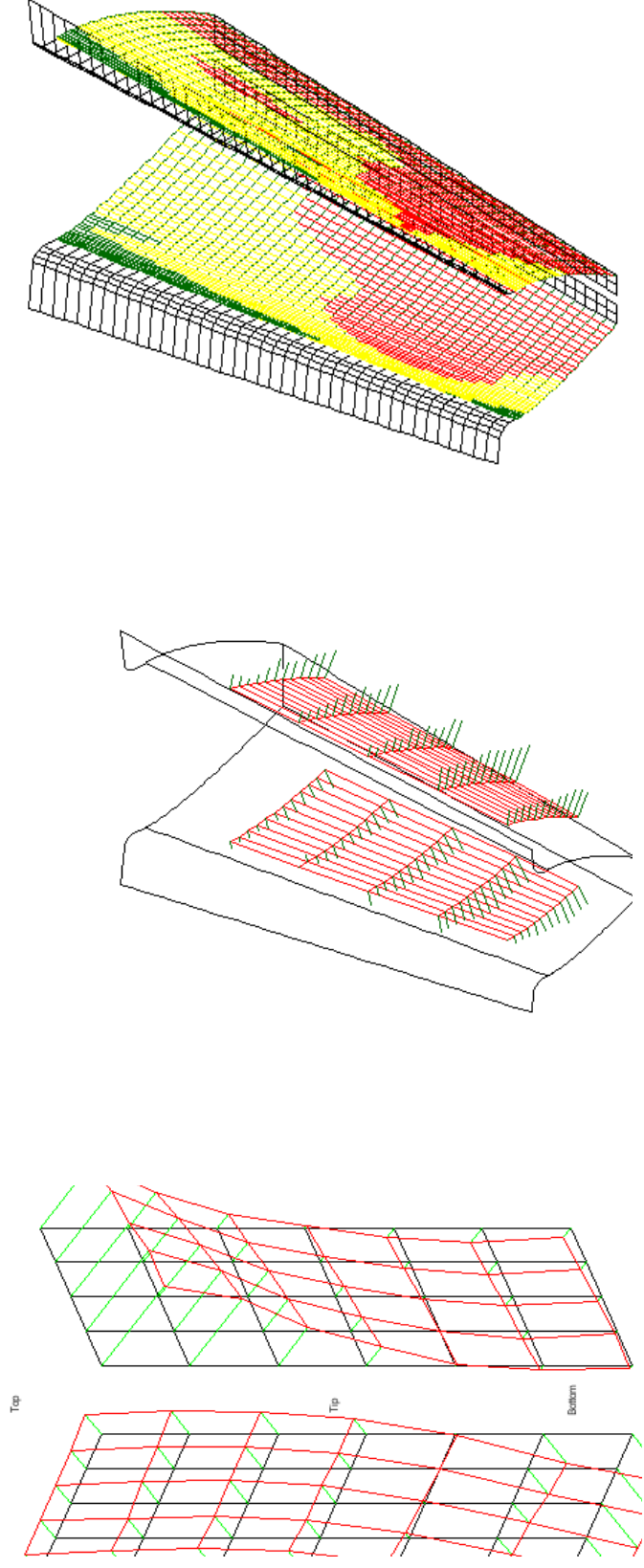
Links To Inspection

Tooth surface measured data can be imported and evaluations used for

Statistical analysis of several teeth
Creating master tooth form
Tooth contact analysis

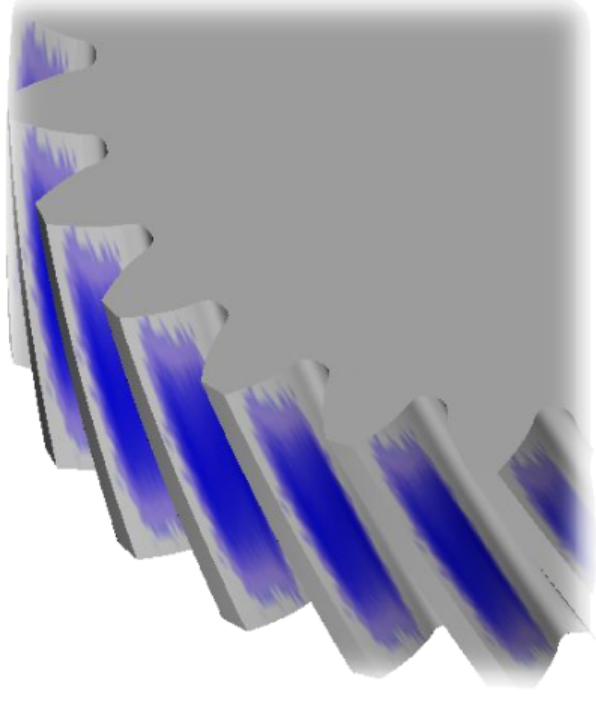
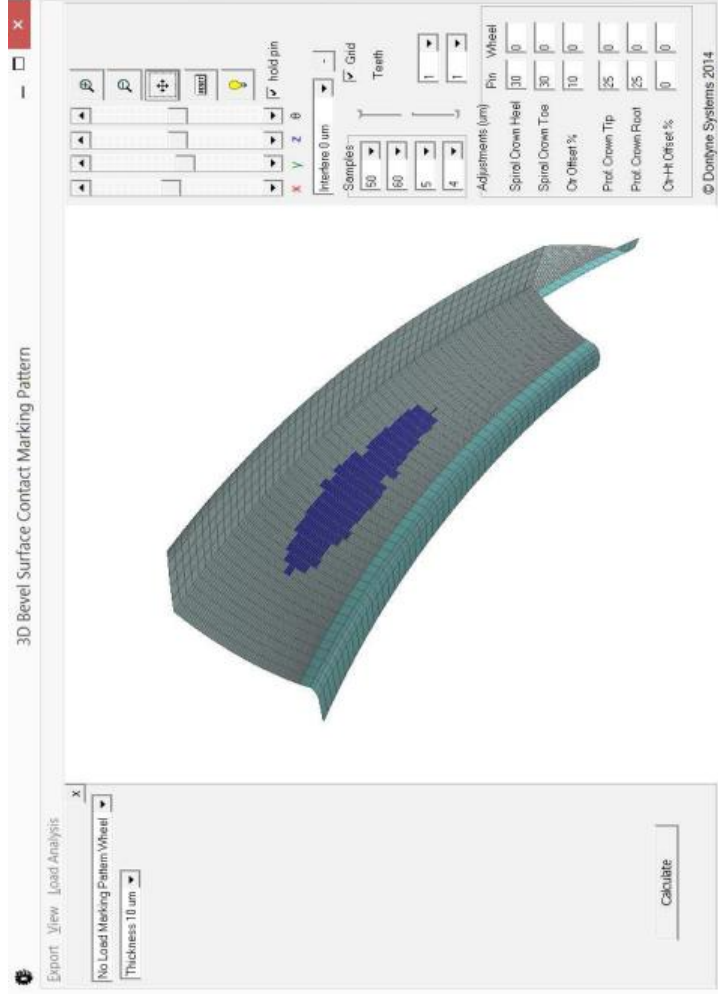


Links To Inspection



Various formats available to illustrate error on whole tooth or flanks only

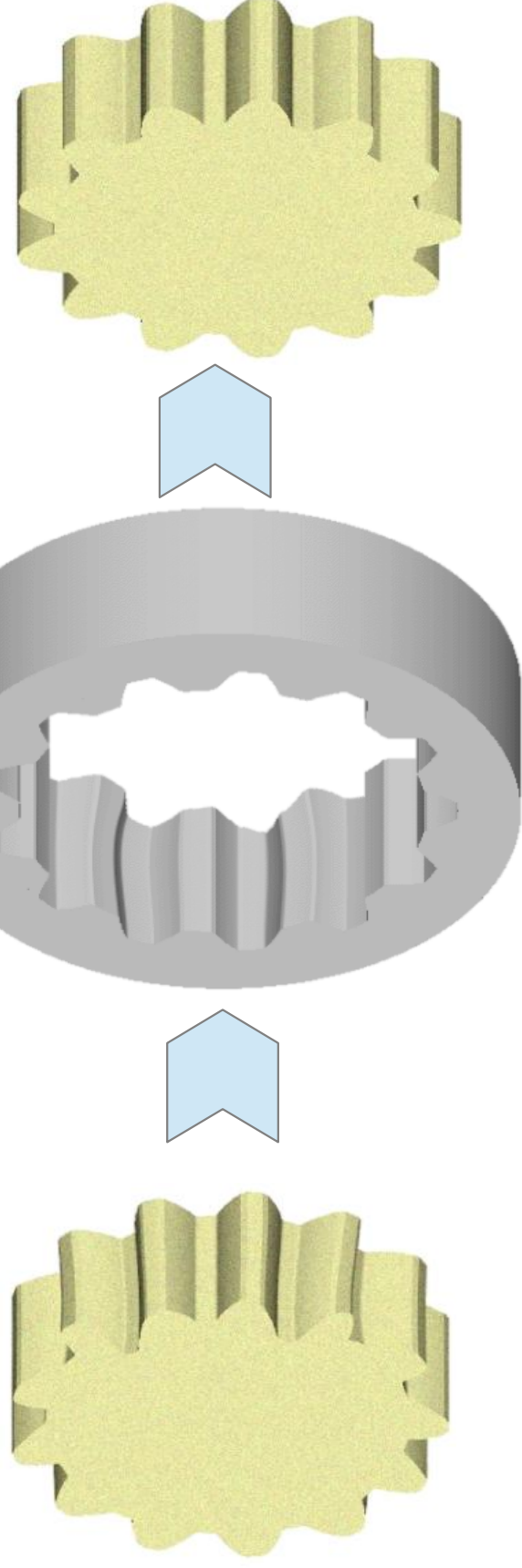
Links To Inspection



Tooth surface measurement data can be used to simulate no-load bearing/marking pattern and transmission error

Optimal

Tooth surface measured data can be used to make correction to tool/process



**Measure error in gear
(e.g. due to shrinkage)**

Invert errors on tool/machine

Improved quality gear

Current Development

Manufacturing

- Shaper cutter with protuberance
- Form Grinding
- Advanced surface effects from reduced diameter continuous grinding wheel diameter

Current Development

Bevel Gear Module

- Gleason Face Milling Surface in addition to Spherical Involute
- Face milled Hypoid gears
- G-code output for CNC manufacture

Current Development Gearbox Designer

- Include ISO 281 bearing calculations in System Model
- Bearing database direct access from System model

Bearing Database

type in partial name and click search for individual or sort for all with name starting with

type in dia and /or width /and or bore selecttol for search then click sort

ADD BEARING EDIT BEARING DUPLICATE BEARING DELETE BEARING

Bearing Designation: NUJ106

Bearing Type: Cylindrical roller bearings (single-row)

Bore: 6 Outer Dia: 17 Width: 6

SPEC	TYPE	ROWS	BORE	OUTER DIA	WIDTH	OUTER RACE DIA	INNER RACE DIA	ELEMENT DIA	PITCH DIA	ELEMENT LENGT	ROLLING_ELEME	CON
NUJ102	3	1	2	7	2.8	5.8875	3.1125	1.3875	4.5	1.4	9	0
NUJ103	3	1	3	9	3	7.665	4.335	1.665	6	1.5	10	0
NUJ104	3	1	4	12	4	10.22	5.78	2.22	8	2.2	10	0
NUJ105	3	1	5	14	5	11.9975	7.0025	2.4975	9.5	2.9	11	0
NUJ106	3	1	6	17	6	14.5525	8.4475	3.0525	11.5	3.6	11	0
NUJ107	3	1	7	19	6	16.33	9.67	3.33	13	3.6	11	0
NUJ108	3	1	8	22	7	18.885	11.115	3.885	15	4.3	11	0
NUJ109	3	1	9			20.6625	12.3375	4.1625	16.5	4.3	11	0
NUJ1000	3	1	10			22.44	13.56	4.44	18	5	11	0

double click to populate above