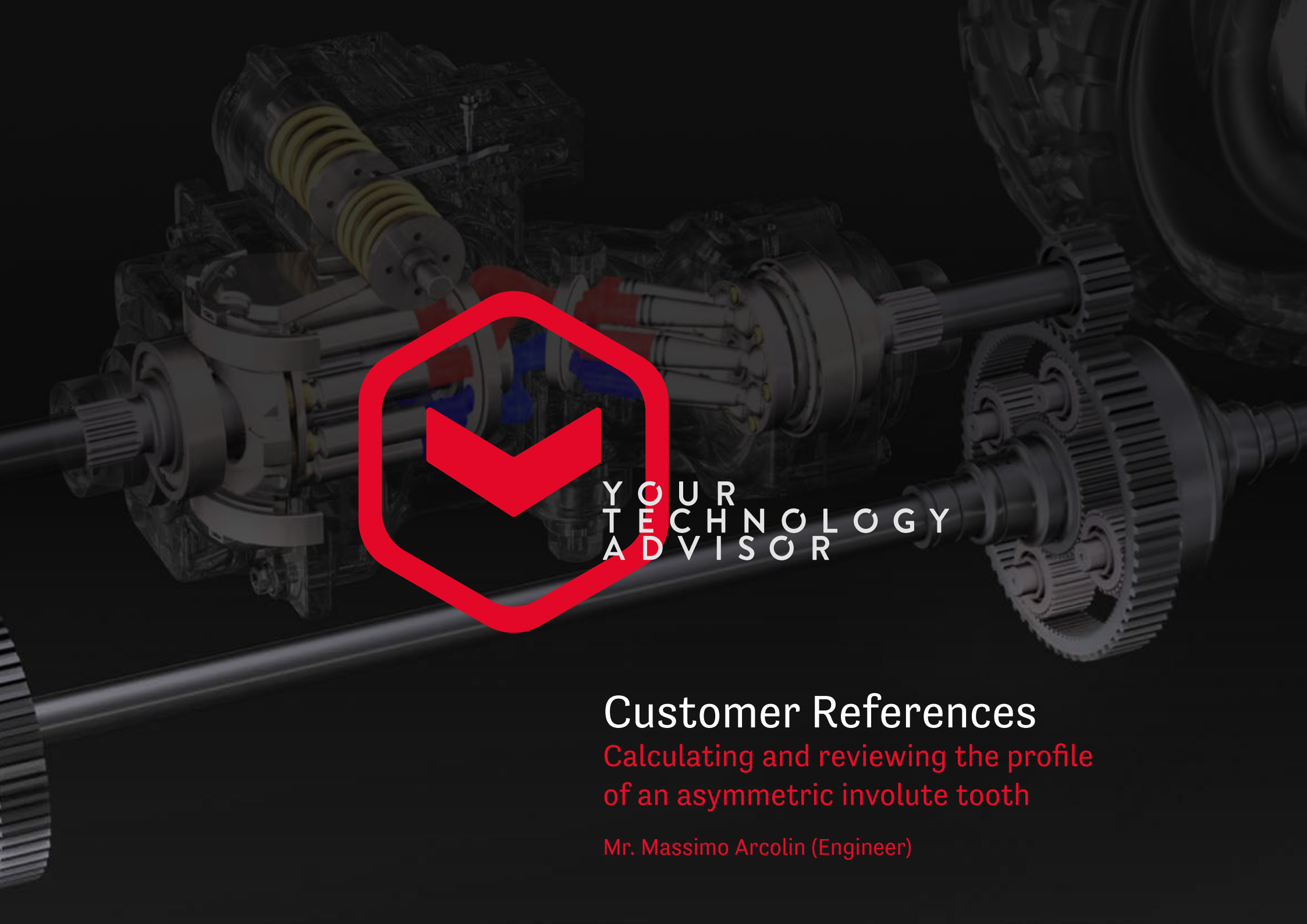

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Customer References

Calculating and reviewing the profile of an asymmetric involute tooth

Mr. Massimo Arcolin (Engineer)

The purpose of the spreadsheet is to generate the complete profile of the tooth of a cylindrical gear with straight teeth. The spreadsheet allows the dimensions of a cylindrical gear with asymmetric profile (where pressure angle and left hand base connection differ from pressure angle and right hand base connection) to be determined, and for any correction/shift between the pitch line of the hob and the pitch line of the wheel introduced during the cutting phase to be taken into account.

Figure 1 shows the plot of the hob profile:
the spreadsheet contains the mathematical description of the hob profile. Note that a different colour is used for each of the six lines that represent the hob.

The two broken lines, representing the cutting pitch line and the hob reference line respectively, should also be noted (these coincide if the correction is 0).

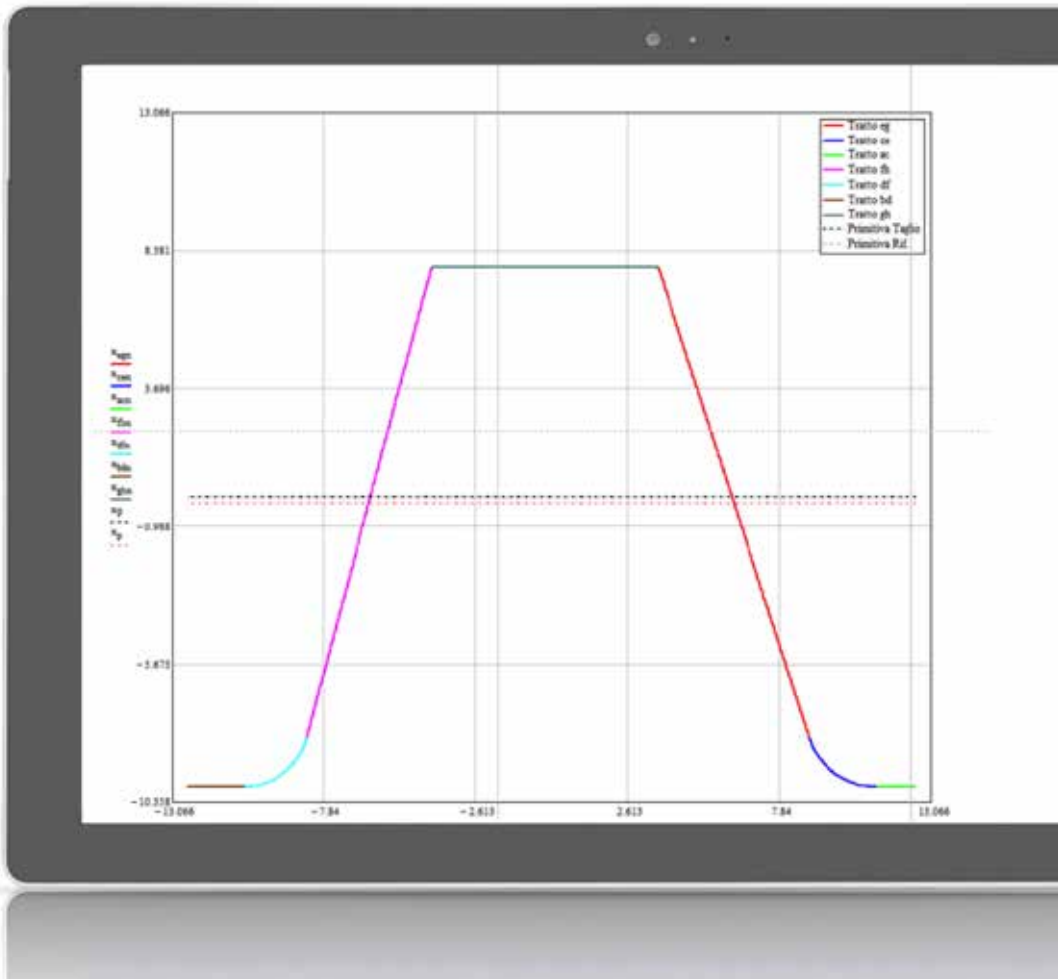


Figure 1

Figure 2 shows the plot of the gear tooth obtained using the hob referred to in figure 1. Note that the colour of each line of the profile corresponds to the profile of the hob used to produce it. The asymmetry of the flanks of the tooth profile obtained through the asymmetry of the hob should also be noted (with regard to calculating the tooth profile, see Litvin 1994 Gear geometry and applied theory).

The tooth profile shows the gear cutting diameter and the pitch line of the wheel.
Note that the calculation method used to obtain a straight tooth can also be applied (making the appropriate modifications to the spreadsheet) to obtain the tooth profile of a cylindrical gear with helical teeth.

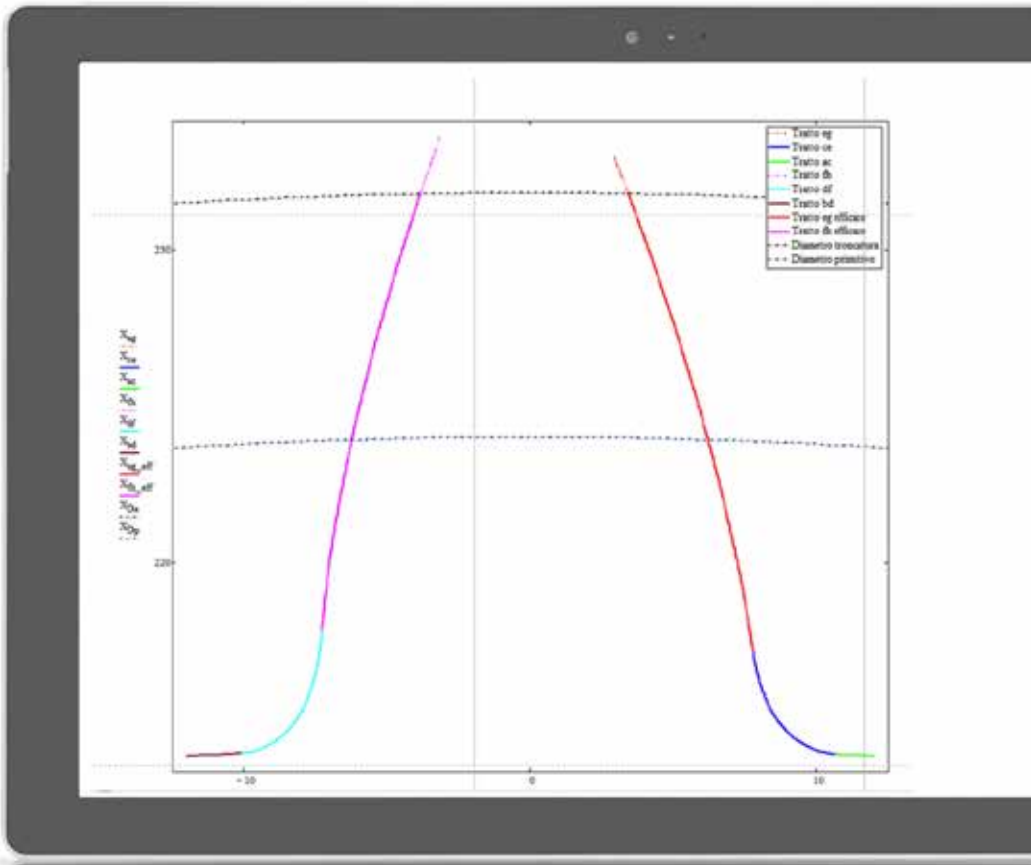
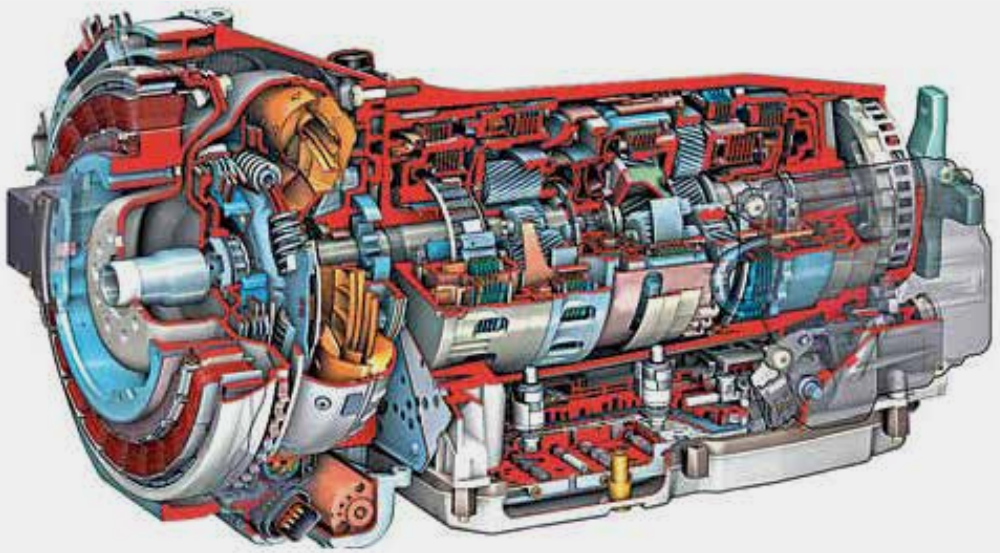


Figure 2

Some of the spreadsheet input parameters are visible. The input areas are the only areas that can be edited by the spreadsheet user.

The input parameters used to define the hob profile are set out here below:
note how the value entered for the base connection and tooth height can be expressed as a percentage or as an absolute value, depending on the selection made

Module: (in mm)	8
Number of teeth:	56
Flank 1 pressure angle: (in degrees)	18
Flank 2 pressure angle: (in degrees)	15



With regard to the value of the hob base connection and the tooth height, the user can choose whether to enter a value standardised based on the module or an absolute value.

Methods for entering flank 1 connection:

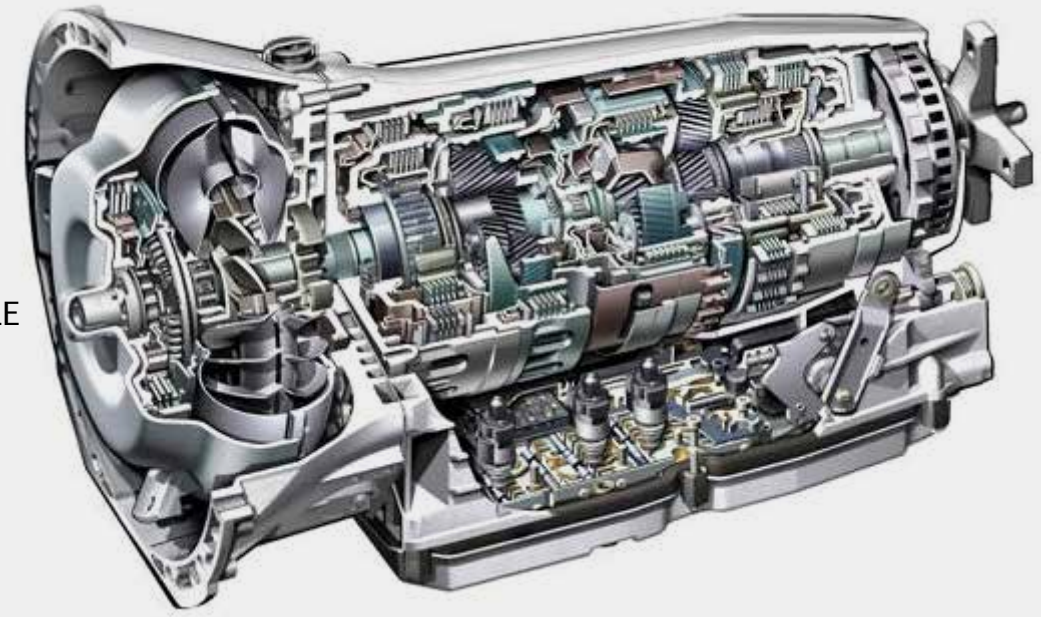
- (●) % BASED ON THE MODULE
- ( ) VALUE

Flank 1 connection: 0.3

Methods for entering tooth height:

- (●) % BASED ON THE MODULE
- ( ) VALUE

Hob tooth height: 1



The methods for managing the correction are presented here.
The input area allows a positive or negative value to be entered (the caption describes the conventions regarding signs). The programme calculates the minimum correction value that must be entered to prevent tooth undercutting. The user is notified via a video message box

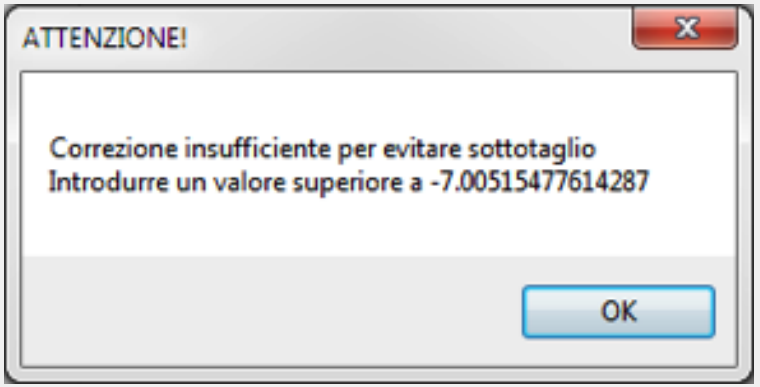
Conventions regarding the correction:
-Positive: if the hob is shifted and placed in a position that is “more external” than the pitch diameter of the wheel;
-Negative: if the hob is shifted and placed in a position that is “more internal” than the pitch diameter of the wheel;

Correction:
(in mm) -7.1

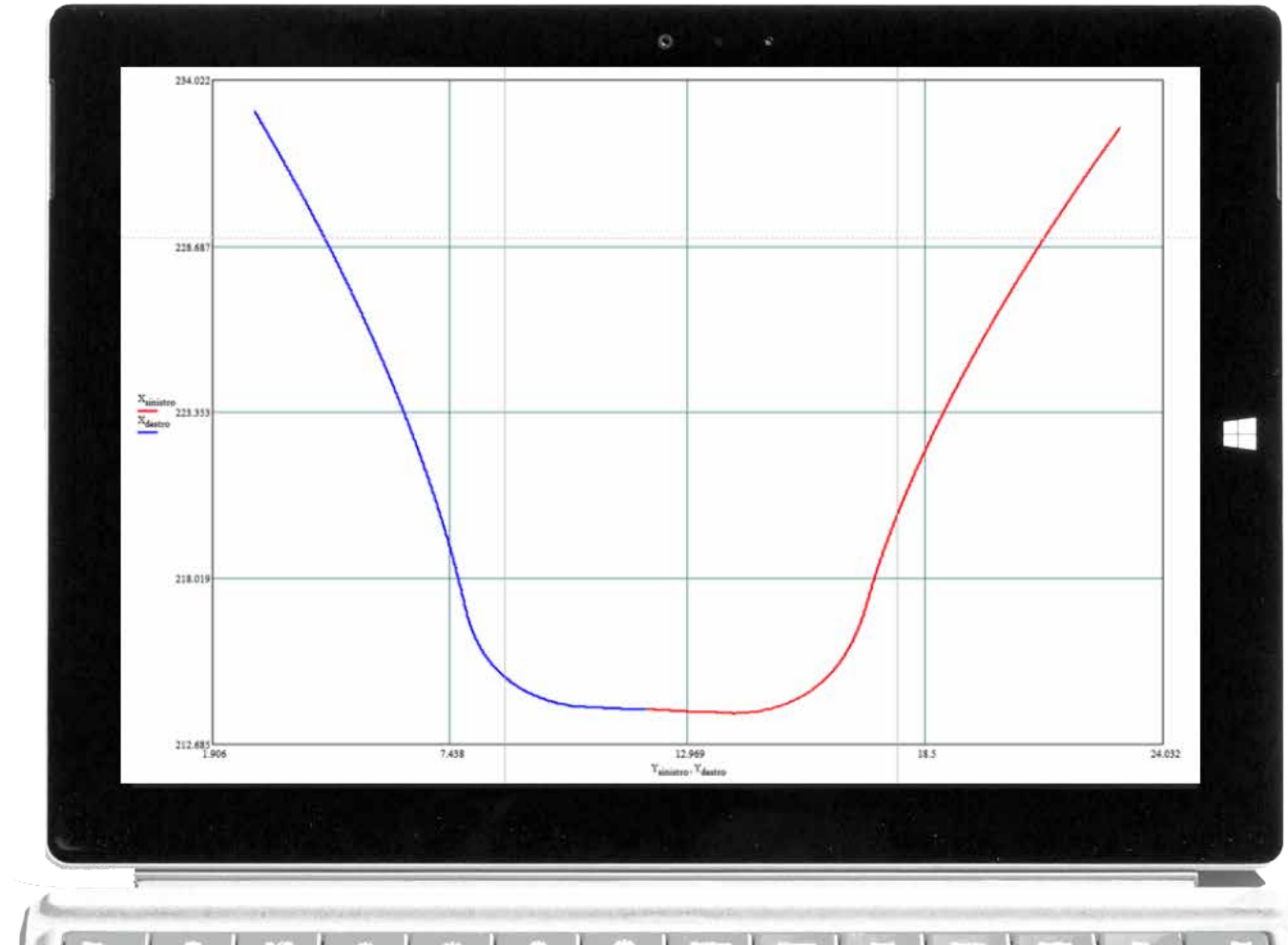
Minimum_Correction = -7.005155

Correction insufficient to prevent undercutting

Gear_Thickness := Input_Gear_Thickness



The figure shows the two profiles of the tooth, including appropriate flanking to assess continuity in the connection area. An identical reconstruction of the full curve is then performed at a certain offset distance along the z axis, equal to the thickness of the gear, in order to produce a surface to export into Creo. That surface is then used to generate a 3D model of the gear.



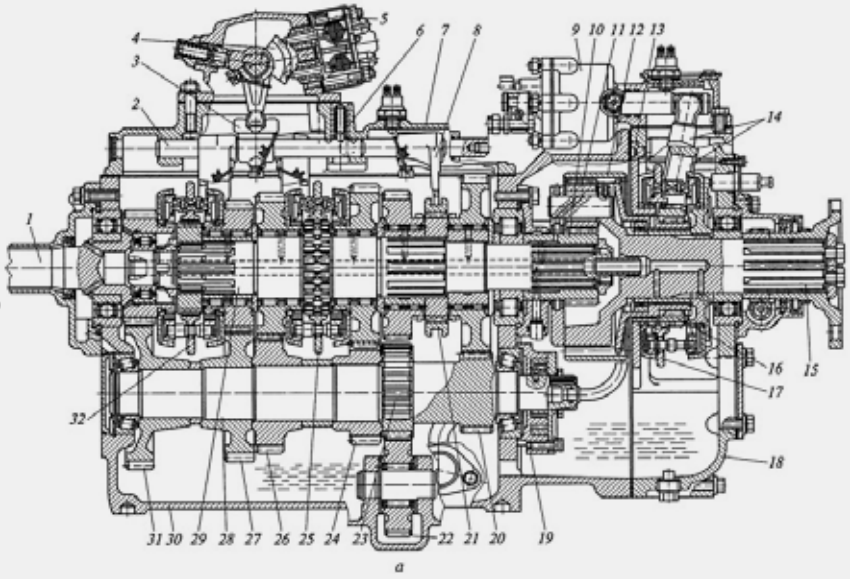
When ultimately generating the cutting surface in Creo, the user can choose whether to use a percentage of the number of points used by Mathcad to produce the profile, or to manually input a number of points.

Total_No_Points := rows $(X_{profile})$ - 1 = 514674

Point_Exportation_Criterion :=

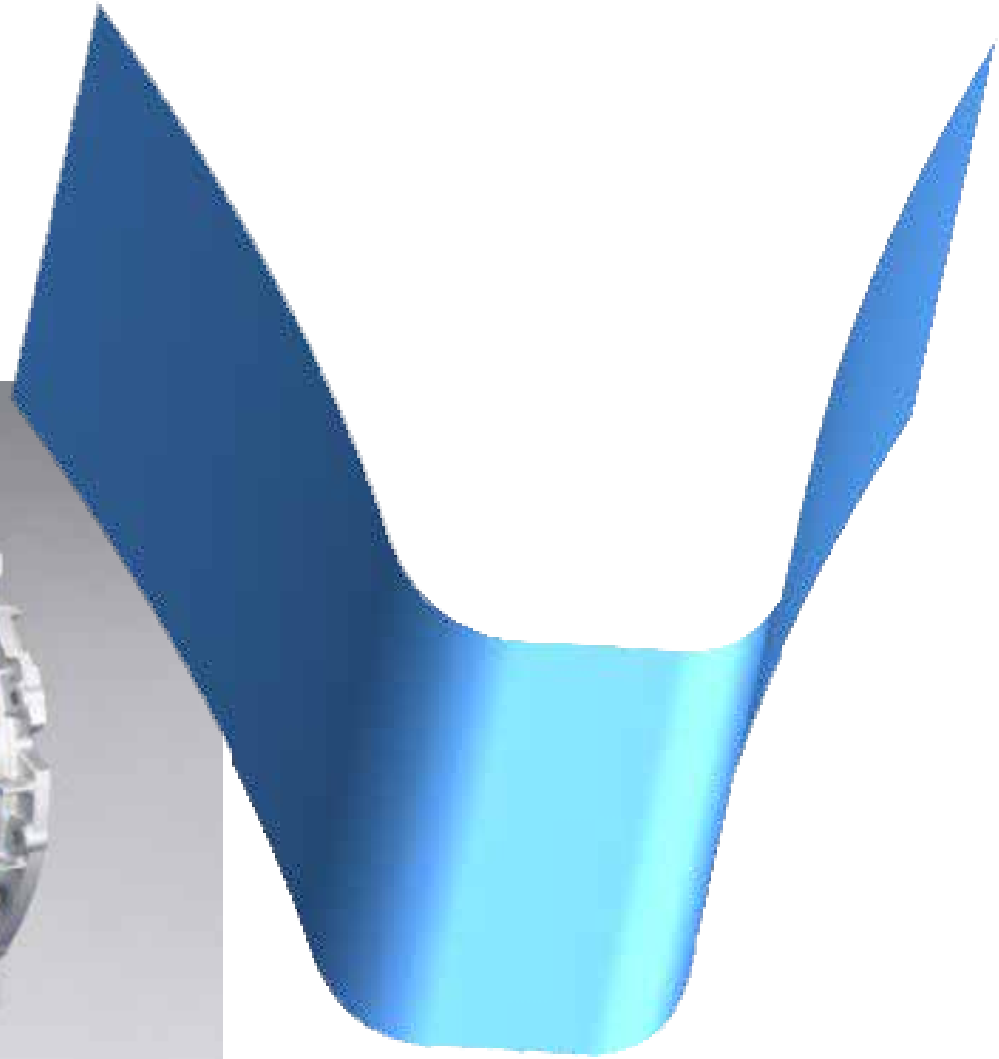
- ○ 1% OF THE TOTAL POINTS
- ◉ NUMBER OF POINTS DEFINED

Simplified number of profile points: 200

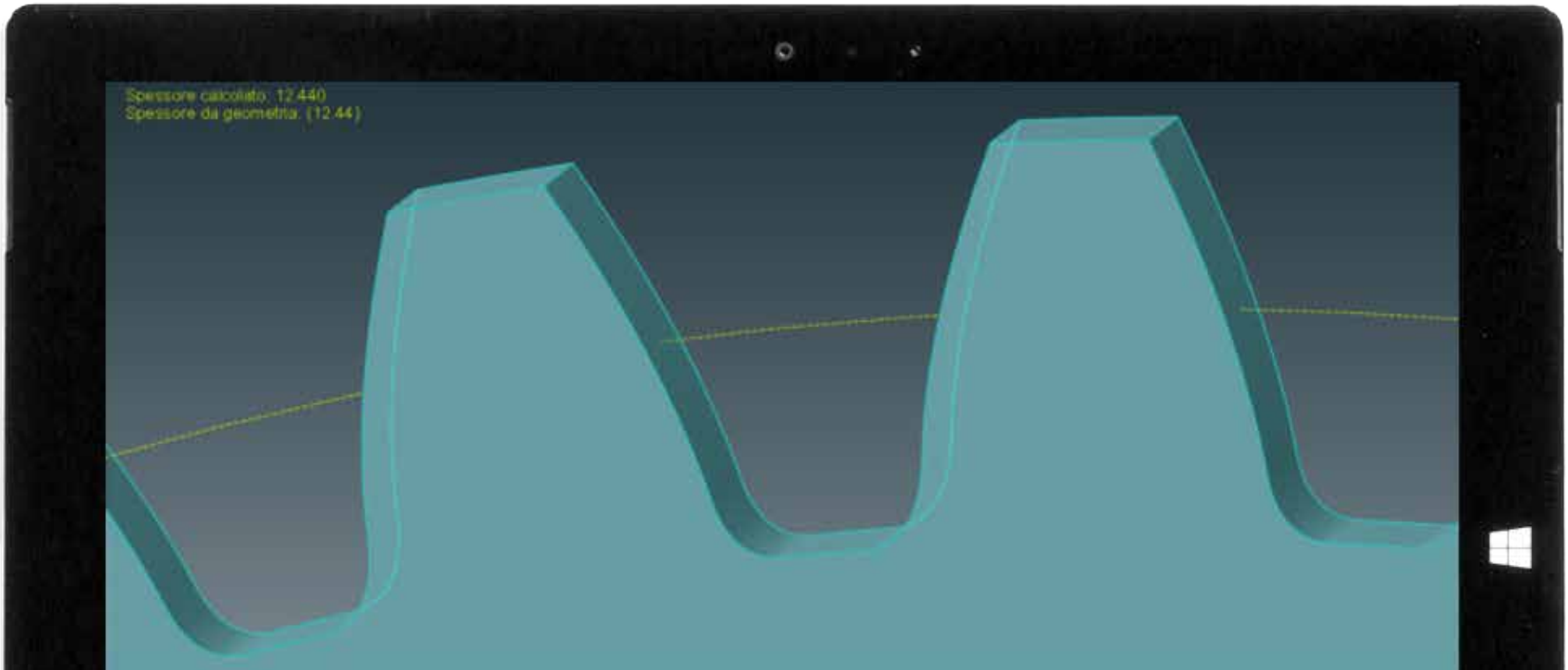


The 3D reconstructed surface is presented here; this allows the gear to be modelled. The surface is linked to the spreadsheet

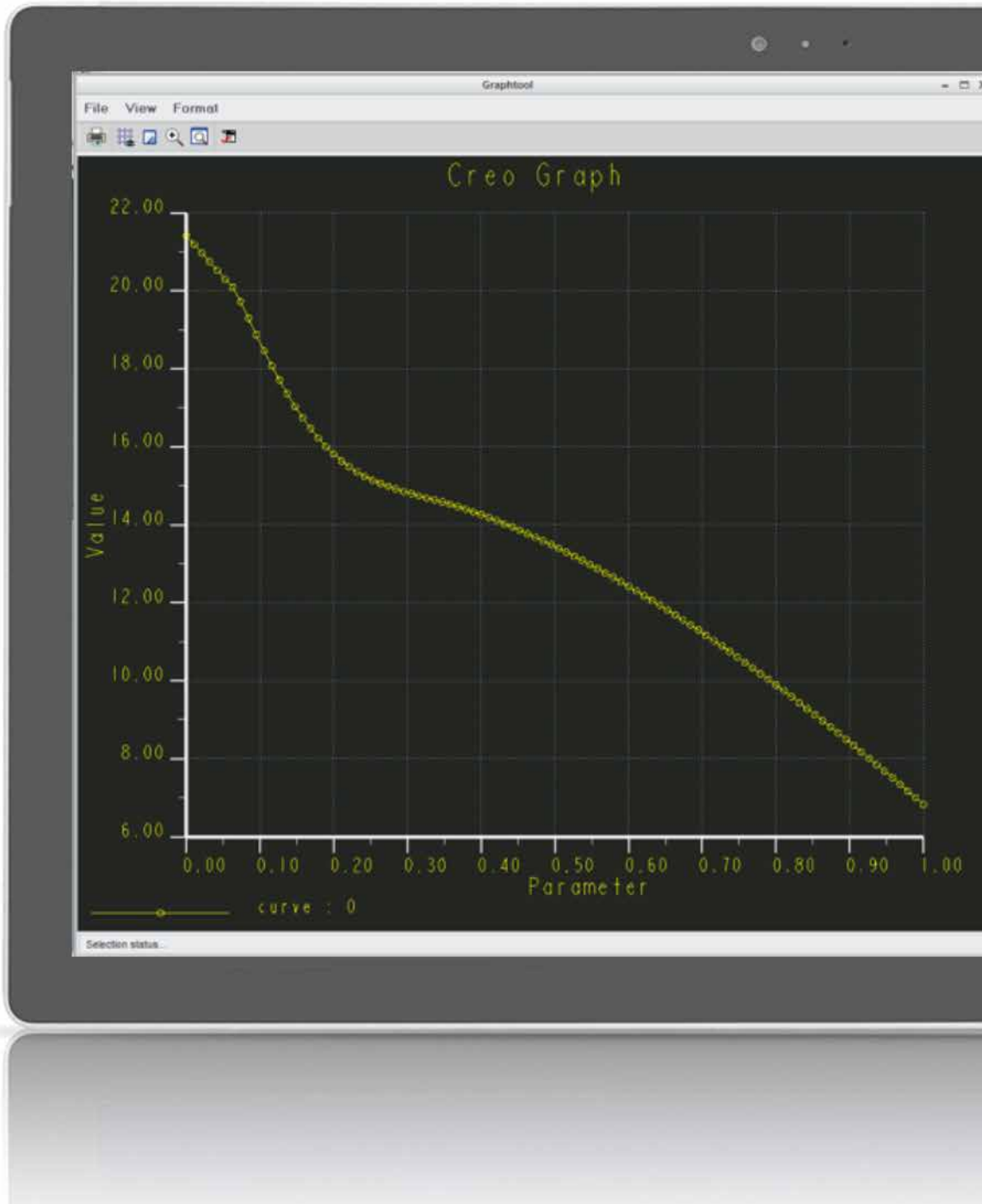
(if the sheet is modified,
the 3D model will be immediately
updated).



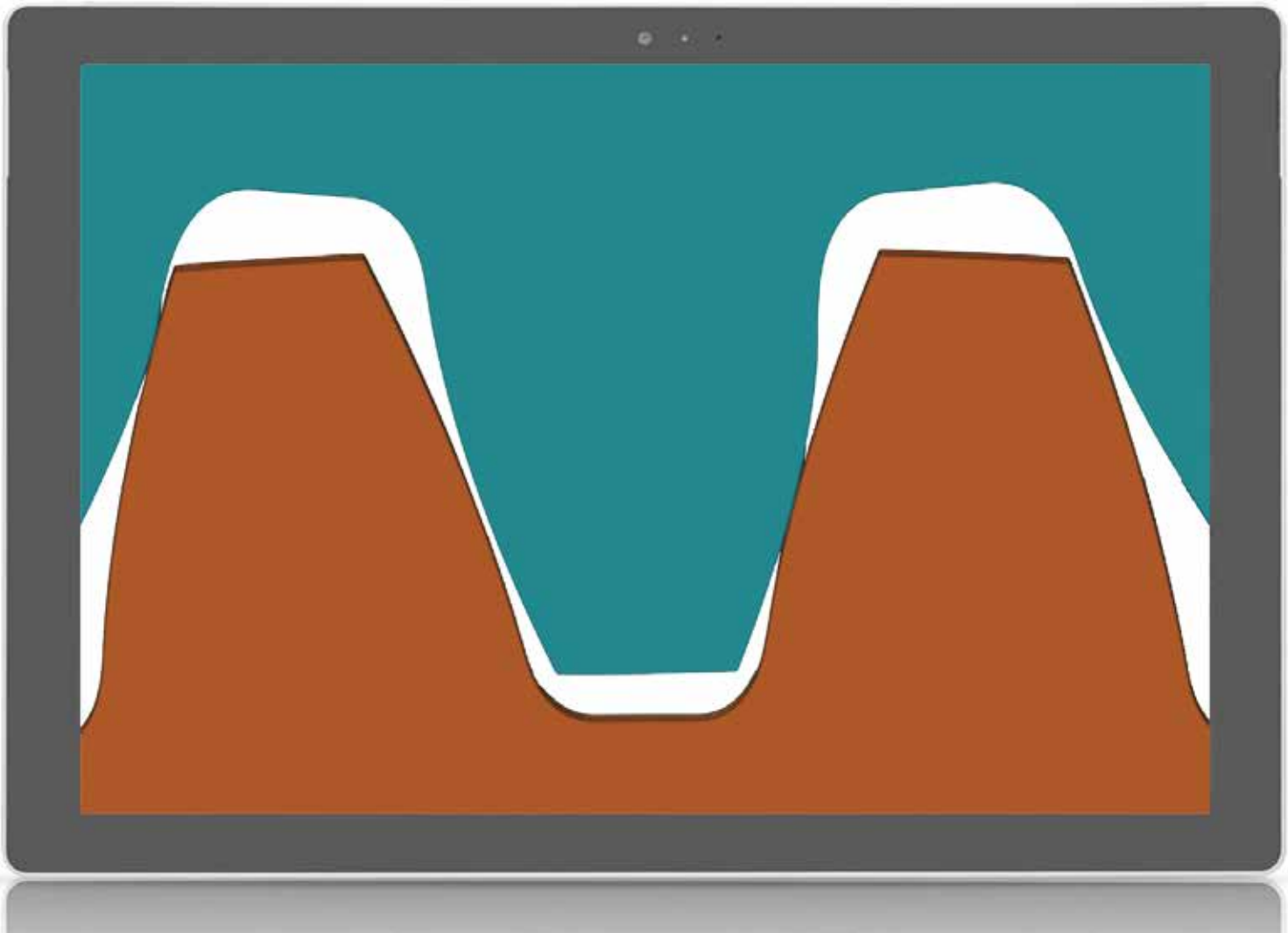
A detail of the two teeth obtained using the mathematical spreadsheet calculation is presented here. Note the text in the top left section of the screen: this indicates the thickness of the tooth on the pitch line of the wheel based on the calculations performed by Mathcad and the value obtained using 3D geometric calculations: if these correspond, the dimensions of the tooth have been correctly determined.



The figure shows the tooth thickness plotting: the x-axis shows the curvilinear abscissa of the tooth profile, while the y-axis shows the thickness value.



One possible application for the gear correction: to obtain the desired play between the two teeth (or to eliminate any interference).



After the calculation has been performed, an FEM calculation can be carried out to obtain the contact analysis

Thank you!

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