Presentation of Filengrene

Filengrene is a CAD/CAM software specific to gears. The aim of this application is to allow a company - even not specialized in gear manufacturing - to design any kind of gear and to manufacture it with a 5 axis milling machine or a wire EDM machine.

Filengrene is a Visual Basic application with different forms (sheets). Each form corresponds to a specific activity :

- gear design
- wire EDM machining (not presented here)
- end milling
- grinding (not presented here)
- metrology

Gear design

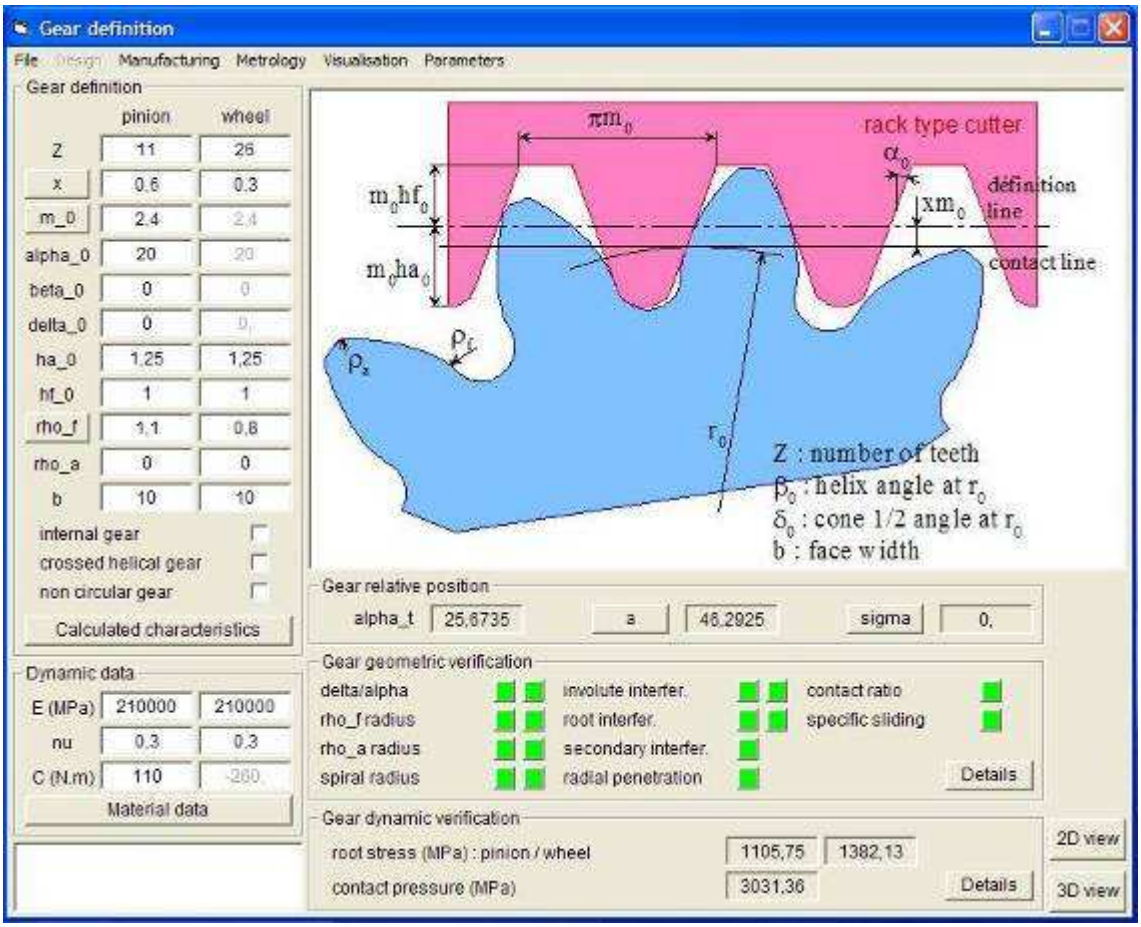

fig. 1

With this form gear can be defined with a set of 2 x 11 parameters (in the gear definition frame [top/left]). Every kind of gear can be defined : spur/helical, external/internal, bevel, spiral and even non circular gear.
The software then calculates the relative pinion/wheel position : centre distance and shaft angle (in the gear relative position frame [middle/right]).

It also verifies the gear geometrical correctness and assists the user with the optimization of the gear design. For example if the chosen parameters give a gear that presents an interference (*fig. 2*), the corresponding button becomes red ; a click on this button explains the problem and helps the user to solve it. More details can be obtained (calculated values of different criteria : backlash, contact ratio, specific sliding…) when the user clicks on the "Details" button.

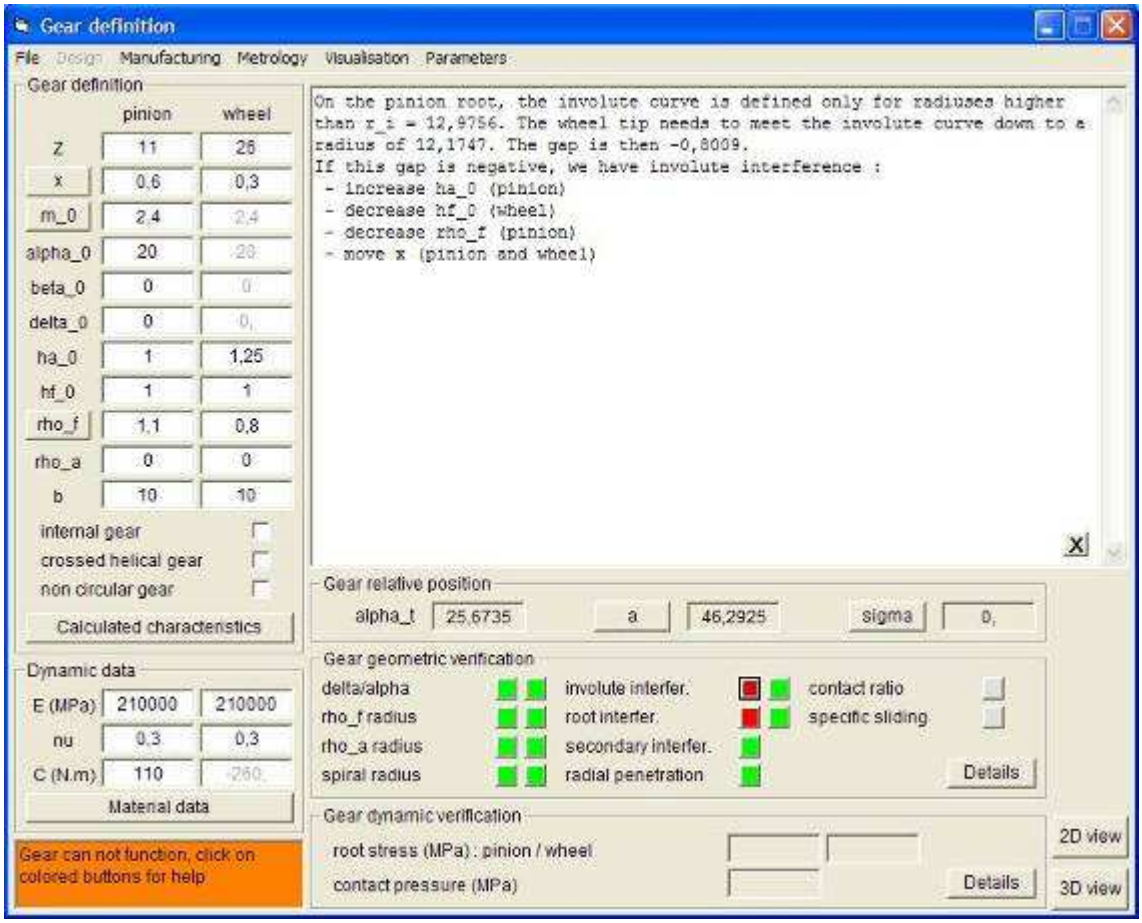

fig. 2

If material data of the gear and torque are given (in the dynamic data frame [bottom/left]), the software also estimates the root stress and the contact pressure (in the gear dynamic verification frame [bottom]). More details can be obtained (compression stress, bending stress, deflections, contact pressure evolution graph, static transmission error graph) when the user clicks on the "Details" button.

The gear can then be visualized by clicking on the "2D view" or "3D view" button. This button opens a Cosmoplayer window (*fig. 3*) and the gear can be inspected (rotations, zoom…) and animated (gearing motion).


Visualisation VRML
vue ensemble
COSMO

fig. 3

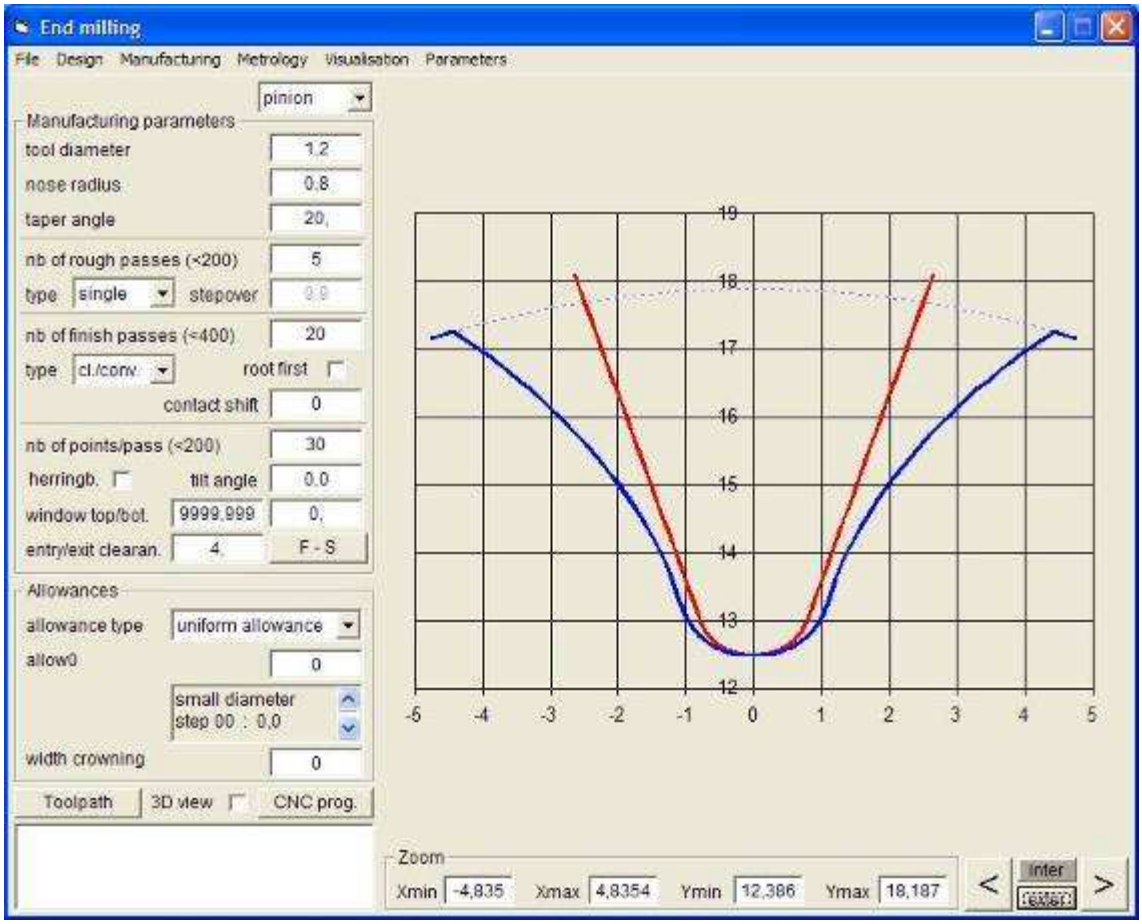
End milling
File Design Manufacturing Metrology Visualisation Parameters
pinion
Manufacturing parameters
tool diameter 1,2
nose radius 0,8
taper angle 20,
nb of rough passes (<200) 5
type single stepover 0,9
nb of finish passes (<400) 20
type cl./conv. root first
contact shift 0
nb of points/pass (<200) 30
herringb. tilt angle 0,0
window top/bot. 9999,999 0,
entry/exit clearan. 4, F - S
Allowances
allowance type uniform allowance
allow0 0
small diameter
step 00 : 0,0
width crowning 0
Toolpath 3D view CNC prog.
19
18
17
16
15
14
13
12
-5 -4 -3 -2 -1 0 1 2 3 4 5
Zoom
Xmin -4,835 Xmax 4,8354 Ymin 12,386 Ymax 18,187
Inter
Extern

fig. 4

End milling

This form allows to define a rough and a finish milling operation with a given end mill.
The mill geometry is given with 3 parameters (tool diameter, nose radius and taper angle). This tool is drawn in red on the graphic [right] and the pinion tooth is drawn in blue (*fig 4*).

Rough operation

The rough operation allows to clear out the space between 2 teeth. Different strategies (single, ramp, pocket) the stepover and the number of passes can be chosen.

Finish operation

This operation gives the geometry and the surface quality to the tooth. The tool makes a given number of passes. For each pass the tool is positioned so that its flank is always tangent to the tooth surface (*fig. 5 and fig. 6*). Several parameters (type, number of passes, point number, tilt angle…) can be used to adapt the operation to the requested surface quality.

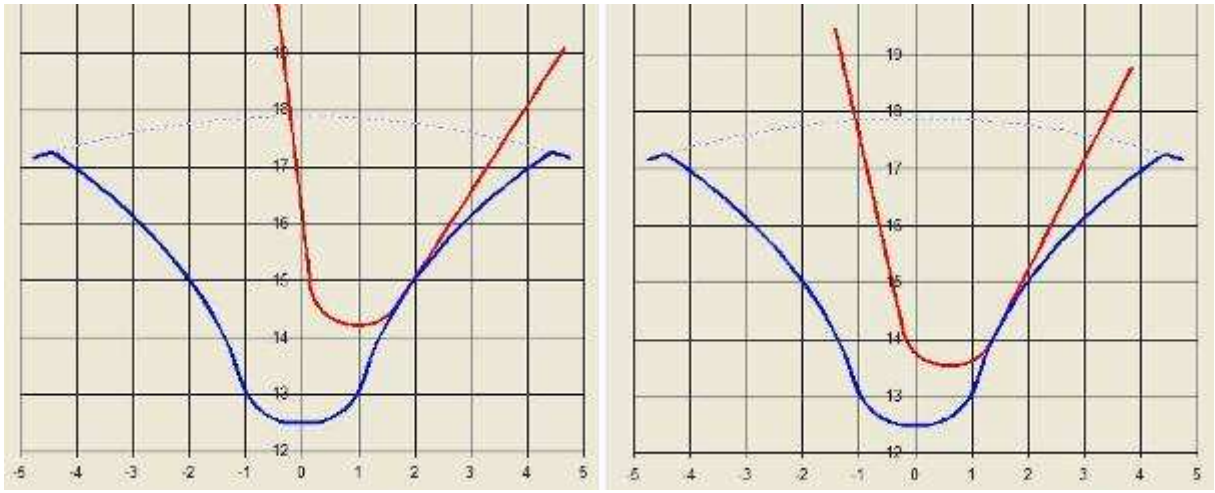

fig. 5

Allowances

Several types of allowances (uniform, involute crowning, interpolation) make it possible to do every kind of correction of the spline geometry (to optimize STE). Width crowning can also be defined.

Visualization

The milling operation can then be visualized by clicking on the “3D” button. This button opens a Cosmoplayer window (*fig. 6)* and the tool path can be inspected (rotations, zoom…) and animated (displacement of tool).

CNC program

When the user clicks on the “CNC prog” button, the software outputs the tool path in an APT program or in a Heidenhain, Fanuc or Siemens G-code program.

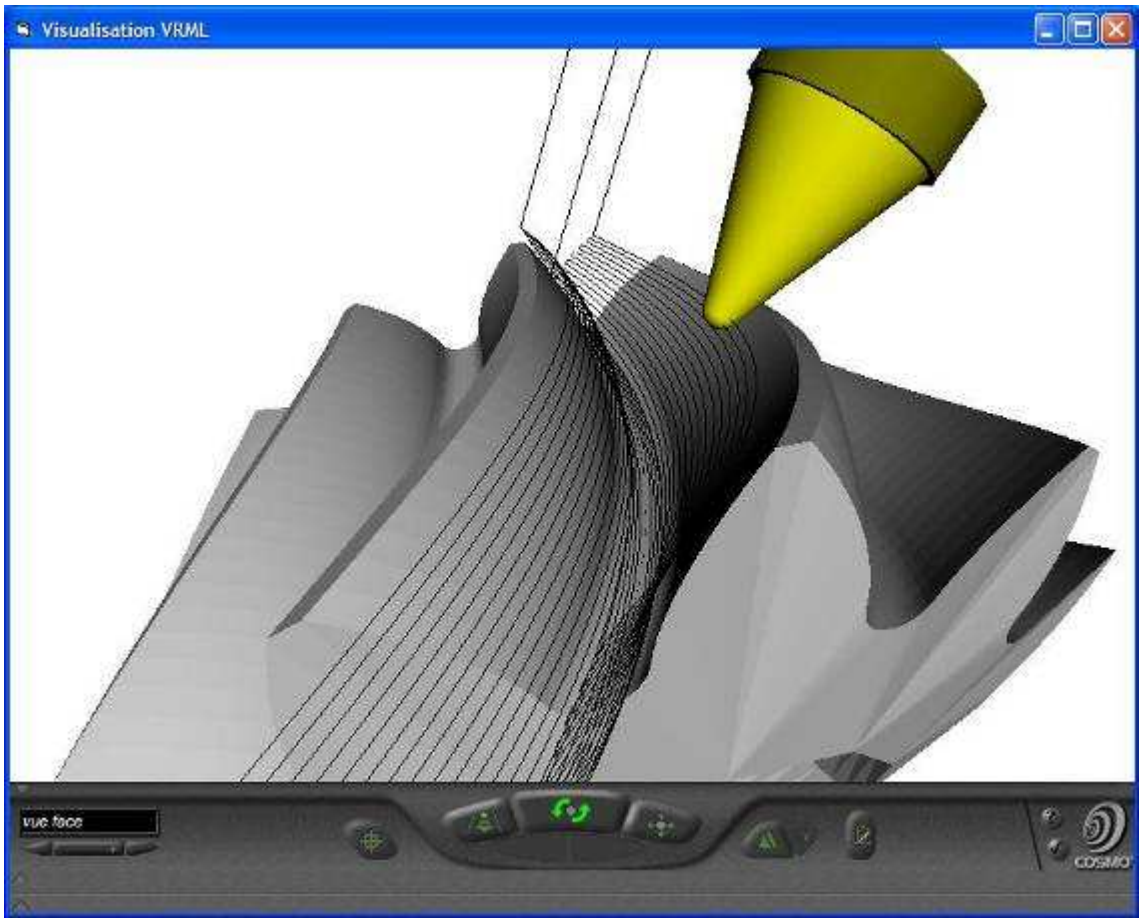

fig. 6

Examples

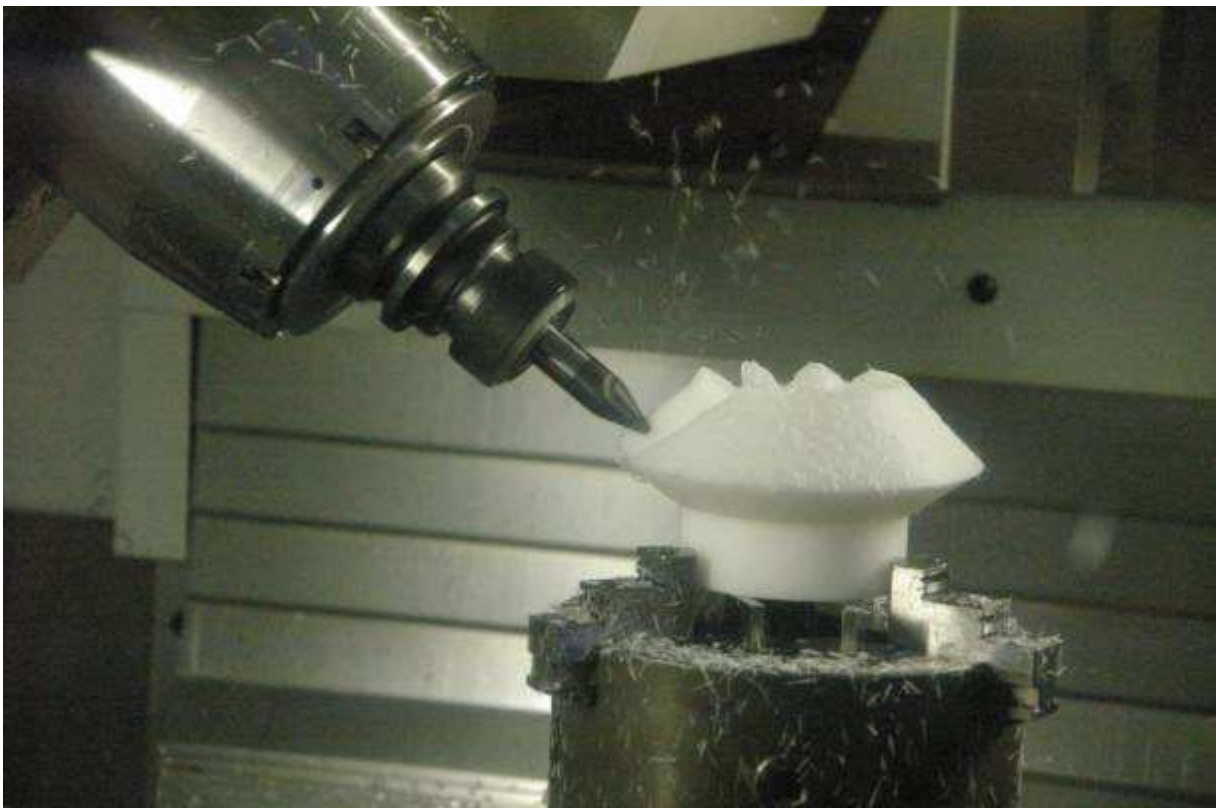
fig. 7 : plastic spiral pinion milling

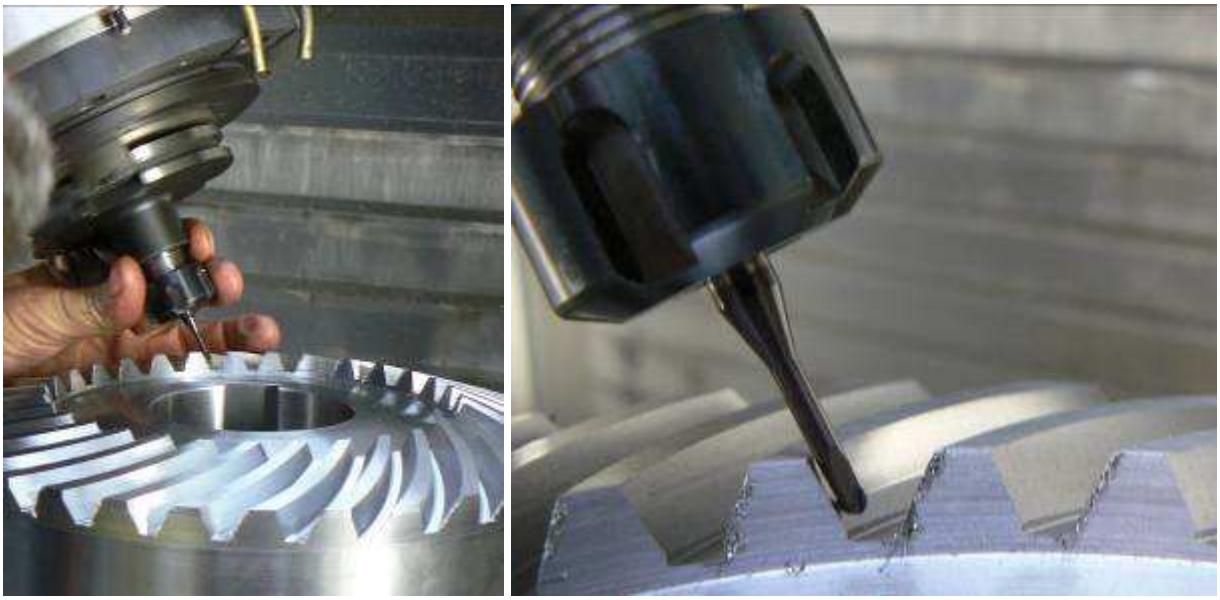

fig. 8 : steel spiral wheel milling

fig. 9 : different steps of bevel pinion milling

Metrology

This module does not perform a complete control of the tooth geometry. The purpose of this module is just to allow the operator to control, on production machine, the correctness of the machine setting.

Cylindrical gear

For cylindrical gears, traditional measurements (span measurement, pin gauges measurement) can be calculated. These calculations take into account the declared allowances.
Measured profiles (for example on CMM) can also be loaded. Filengrene adjusts and compares them to the nominal profile (*fig. 10*).

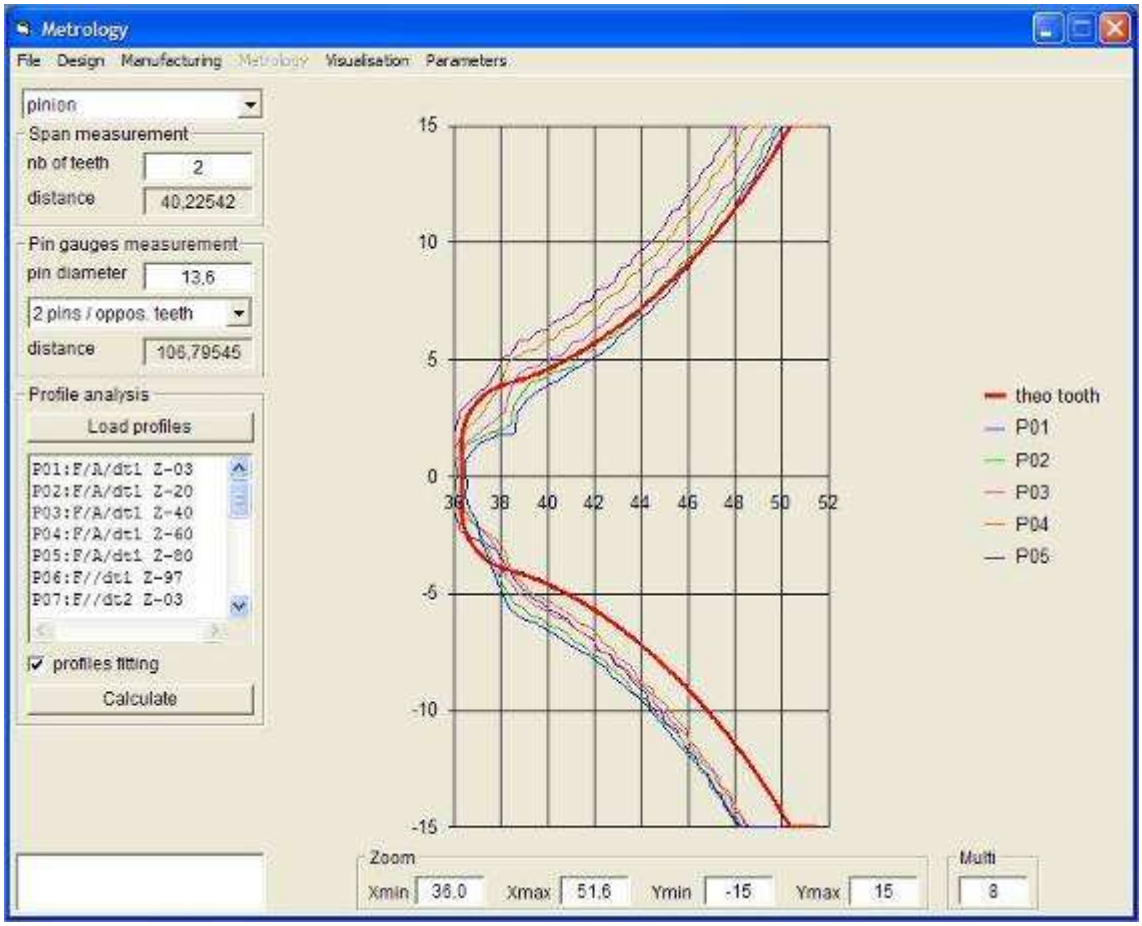

fig. 10

Bevel and spiral gears

For bevel and spiral gears, Filengrene calculates the positioning of a ball gauge on the involute spline ; the operator chooses the ball diameter and the axial or the radial position, Filengrene computes then the other (radial or axial) position and the angular position
This positioning can be controlled on the machine with a dial indicator or a 3D acquisition sensor (*fig. 11*).


fig. 11