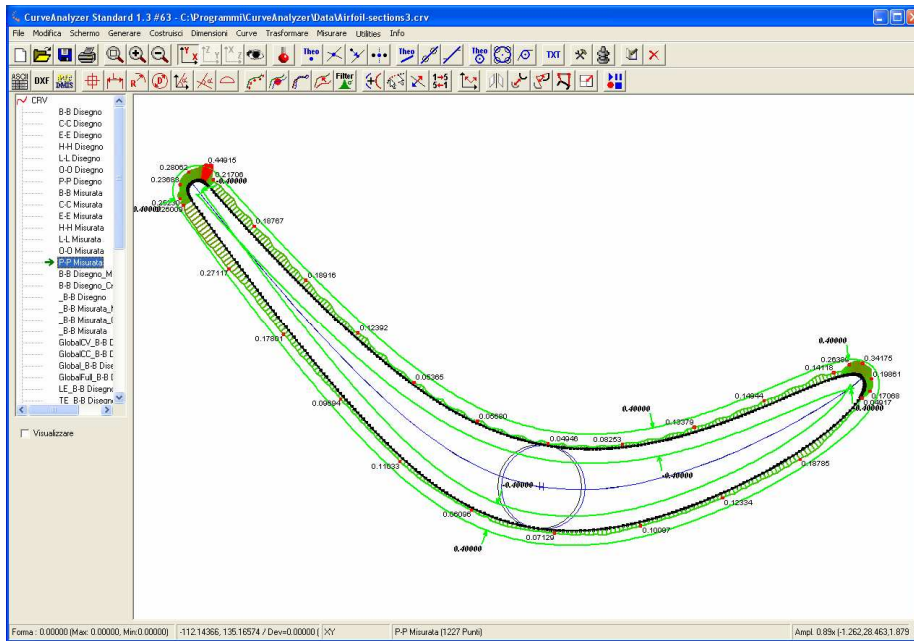


Curve Analyzer

Airfoil calculation functions



Updated : 26.07.2010

(CurveAnalyzer version 1.3.103)

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1. General Description

CurveAnalyzer software implements:

- various single functions, that can be used for specific airfoil evaluations
- a special “all-in-one” function for automatic evaluation of a single airfoil section.
- special tool for generating measurement path when using PC-DMIS measurement s/w

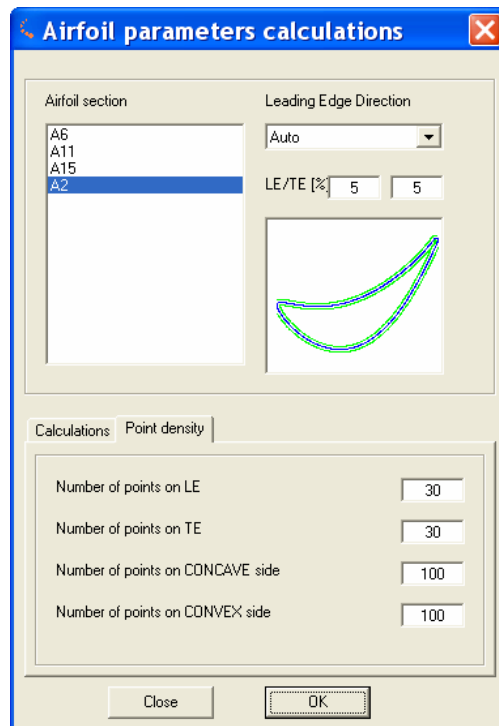
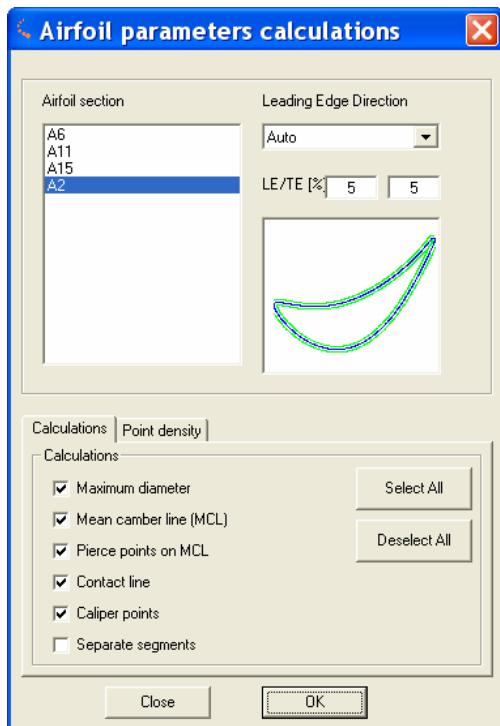
2. Single functions for specific airfoil calculation

The usage of this functions is generally for “manual” analysis of a section or for a preparation of the nominal data. They can be also included in a CA “macro”, but it is definitely easier to use the special “all-in-one” function, that allows to perform the evaluation task, including the preparation of the report with few clicks.

The single functions for specific airfoil calculations are:

2.1 Airfoil parameters calculation

| Function | Access |
|--------------------------------|---|
| Airfoil parameters calculation | Curve -> Airfoil calculations -> Airfoil parameters calculation |



Airfoil Section – here all available CRV object in CA are shown. You are allowed to select one or more curves.

Leading Edge direction – here we can select the direction of the LE. It is possible to leave it on “auto” or to select explicitly the direction of the LE respect to the co-ordinate axes. If leaving on “auto” the following rule will be applied : CA will calculate the MCL nad the Max. Thickness position. The edge that results to be closer to the postion of the Max. Thickness will be the LE. As this rule is not valid for all airfoil sections, in those cases you must use the explicit indication of the direction of the TE.

LE/TE % - this input regards the length of the LE/TE, expressed as percentage of the length of the MCL.

Calculations

Different Calculatios - the following calculation can be selected:

| | |
|------------------------|--|
| Maximum diameter | Calculates the postion of the Max. Thickness and its value, so a CIR object will be created with the diameter that is equal to the max. thickness. |
| Mean camber line (MCL) | Creates a CRV object with a fixed number of 100 points on the MCL |
| Pierce points on MCL | Creates two points (PNT objects) – one on the LE and another one on the TE, build on the imaginary “pierce” point of the MCL with the profile |
| Contact line | Creates contact line (LIN object) on the concave side of the profile |
| Caliper points | Creates two points (PNT objects), that are build respect to the calculated contact line and that determine the chord length |
| Separate segments | If enabled, this option will create four new CRV objects, each of them will contain point on the LE, TE, concave side and convex side. |

Note on usage: The usage of this functions is supposed to be in the manual analysis /checking of airfoil sections, or for reverse engineering purposes.

Select All / Deselect all – two buttons used for fast selection/deselction of all options

Point density

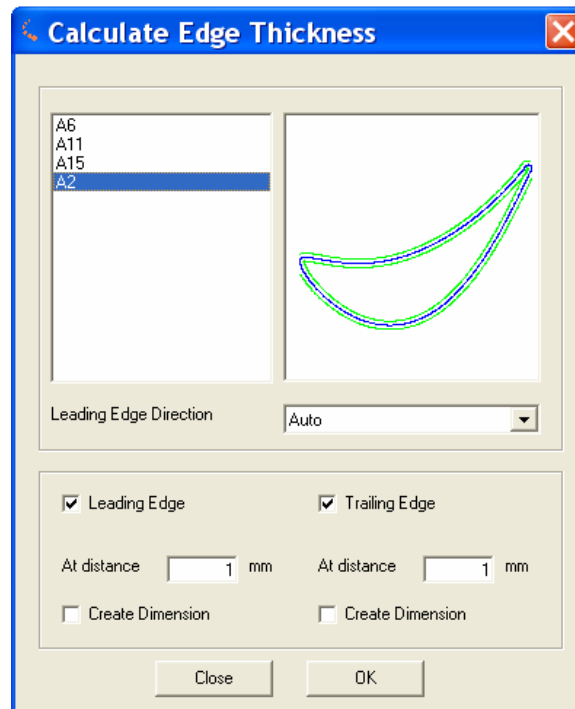
Point density re-calculation:

If using this tab it will be possible to re-generate points on the spline build through the given points, assigning to each part of the sections (LE, TE, concave and convex side) certain ammount of points. This function is not guaranteed to produce the exact number of points, working with tolerance of +/- 1 point.

Notes on usage: The usage of this functions is supposed to be in the preparation of the nominal sections. The calculation may take significant time!

2.2 Edge thickness

| Function | Access |
|----------------------------|---|
| Edge thickness calculation | Curve -> Airfoil calculations -> Calculate Edge Thickness |

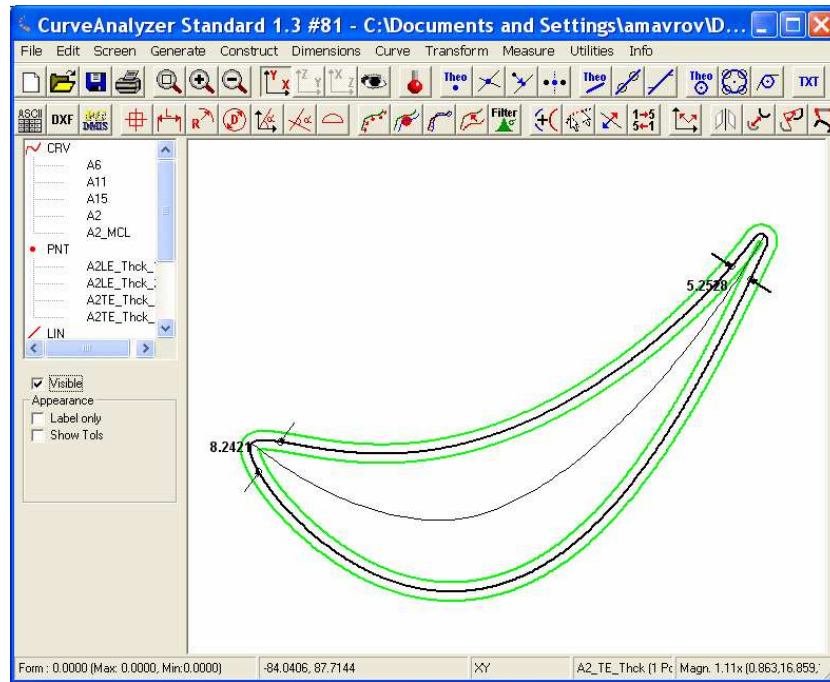


Airfoil Section – here all available CRV object in CA are shown. You are allowed to select one or more curves.

Leading Edge direction – here we can select the direction of the LE. It is possible to leave it on “auto” or to select explicitly the direction of the LE respect to the co-ordinate axes. If leaving on “auto” the following rule will be applied : CA will calculate the MCL nad the Max. Thickness position. The edge that results to be closer to the position of the Max. Thickness will be the LE. As this rule is not valid for all airfoil sections, in those cases you must use the explicit indication of the direction of the TE.

Options – you can select which thickness will be calculated and at which distance (expressed in the current unit). If selecting also “Create dimension” check box, corresponding dimension will be created. The internal procedure of calculating the thickness is as following : the MCL is calculated, so the LE/TE points are found. On the LE/TE points circles with given radius are calculated (using the distance input from the interface), then the MCL line is intersected with these circles. On the intersection points a line is created that is orthoganal to the MCL curve for that point. Using this line and the profile, two intersection points on the profile are calculates. The 2D distance between those points is the edge thickness.

Note on usage: The usage of this functions is supposed to be in the manual analysis /checking of airfoil sections, or for reverse engineering purposes.



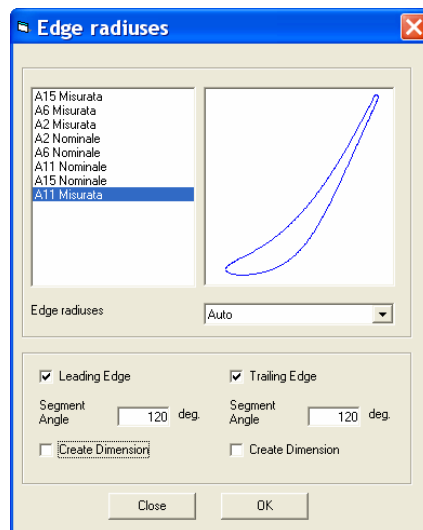
2.3 Edge radius

Function

Edge radius calculation

Access

Curve -> Airfoil calculations -> Calculate Edge radius



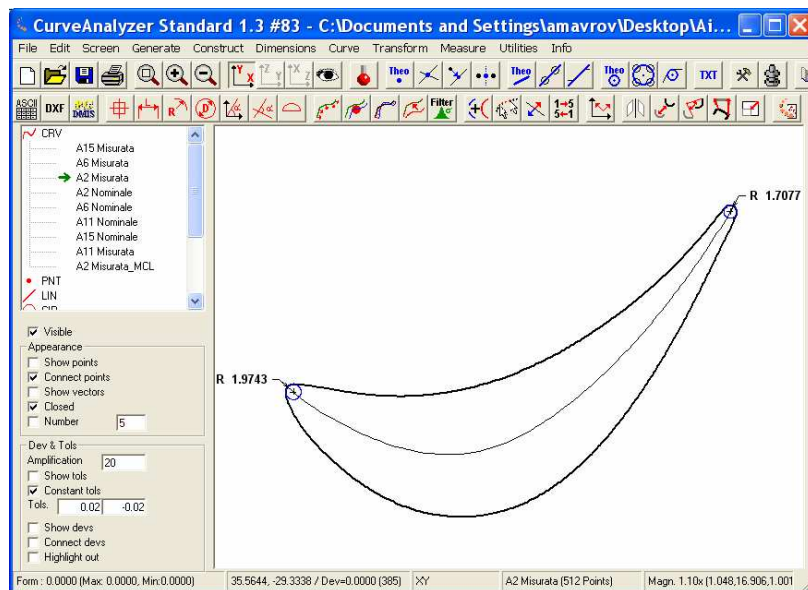
Airfoil Section – here all available CRV object in CA are shown. You are allowed to select one or more curves.

Leading Edge direction – here we can select the direction of the LE. It is possible to leave it on “auto” or to select explicitly the direction of the LE respect to the co-ordinate axes. If leaving on “auto” the following rule will be applied : CA will calculate the MCL nad the Max. Thickness position. The edge that results to be closer to the position of the Max. Thickness will be the LE. As

this rule is not valid for all airfoil sections, in those cases you must use the explicit indication of the direction of the TE.

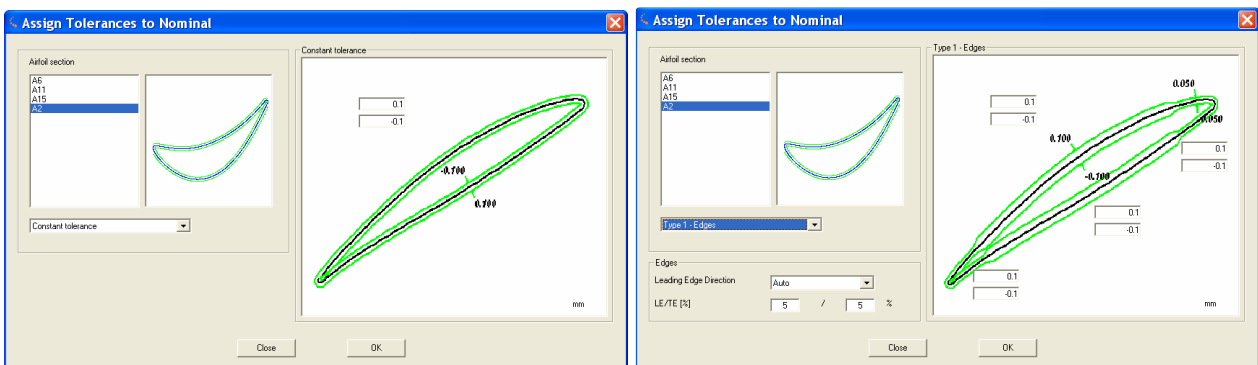
Options – you can select which radius will be calculated and what arc segment do you want to use (expressed in degrees). If selecting also “Create dimension” check box, corresponding dimension will be created. The internal procedure of calculating the radiuses is as following : the MCL is calculated, so the LE/TE points are found. Iterations are performed, with points that are symmetrically disposed arround the LE or TE, until the calculated circle results to be constructed with points that have arc segment above the limitr set by the user. This last circle is retained to be valid for the edge radius.

Note on usage: The usage of this functions is supposed to be in the manual analysis /checking of airfoil sections, or for reverse engineering purposes.



2.4 Assign tollerances to nominal

| Function | Access |
|------------------------------|---|
| Assign tolerances to nominal | Curve -> Airfoil calculations -> Assign tolerances to nominal |



The purpose of this function is to assign fixed or variable tolerance to the airfoil section in extremely fast way. Note that this is essential step, when preparing the nominal sections that will be later used in the “all-in-one” function. Keep in mind that if needed you can use the general methods of assigning tolerance for the curves, those you are allowed to create any possible tolerance filed.

This function also automatically declares the CRV to be “closed” and calculates the vectors as for external curve.

Airfoil Section – here all available CRV object in CA are shown. You are allowed to select one or more curves.

Leading Edge direction – here we can select the direction of the LE. It is possible to leave it on “auto” or to select explicitly the direction of the LE respect to the co-ordinate axes. If leaving on “auto” the following rule will be applied : CA will calculate the MCL nad the Max. Thickness position. The edge that results to be closer to the postion of the Max. Thickness will be the LE. As this rule is not valid for all airfoil sections, in those cases you must use the explicit indication of the direction of the TE.

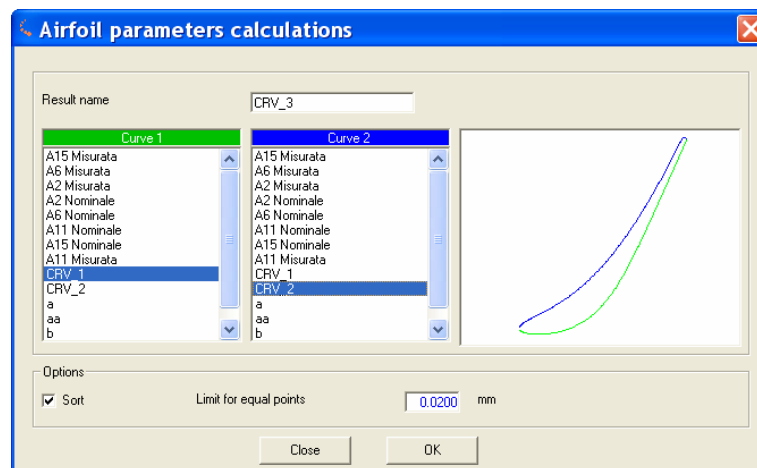
LE/TE % - this input regards the length of the LE/TE, expressed as percentage of the length of the MCL.

Tolerance values : to be inserted according to the selected tolerance type

Note on the usage: The usage of this functions is supposed to be in the preparation of the nominal sections.

2.5 Collect airfoil scans

| Function | Access |
|-----------------------|--|
| Collect airfoil scans | Curve -> Airfoil calculations -> Collect airfoil scans |



This function collects two measured curves (typically with overlay), producing as output one profile. This method is the most common one when working with measured sections. If the section is composed by more scans (as it happens in MBR’s), you would use the common “Curve -> Collect curves function, using probably also the sorting option)

Curve 1 / Curve 2 : List of the all available curves in CA. You must select two curves that belong to the same section. The graphical field nearby will help you to check if you have selected the sections correctly.

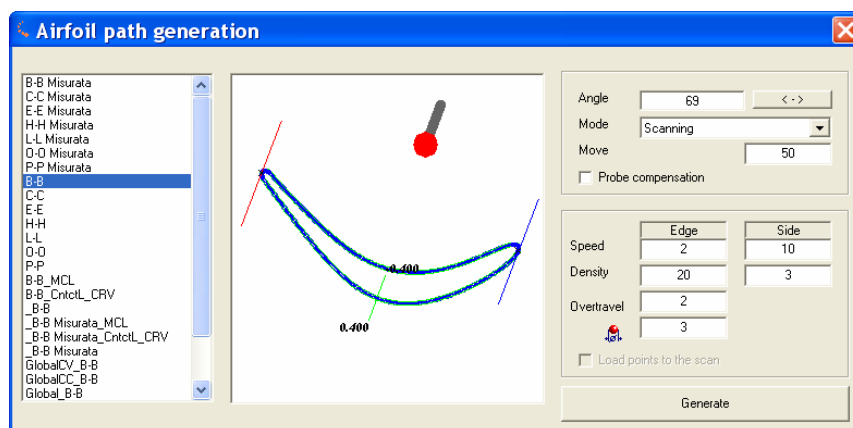
Options : In this field you can select to “sort” the points (that is to re.order them to avoid loop-backs) and eventually to remove very close points. It is strongly recommended that you use this function when having high point density. If the data arrive from a measuring device with low point density, it may happen that the sorting will order badly some points. In this cases you should not use the “sorting” option.

Note on the usage: The usage of this functions is supposed to be in the preparation of the measured section from two scans on the concave and convex side. It is a usual step to be recorded in CA evaluation” macro”.

2.6 Generate Meas. Path on airfoil

| Function | Access |
|-------------------------|--------------------------------------|
| Airfoil path generation | Measure -> Generate path for airfoil |

Attention : this function can be used ONLY if using CA with PC-DMIS measuring s/w. It allows to generate scans in a opened PC-DMIS PP, from the side indicated by the user. This simplifies extremely the preparation of the PP. The pre-requisite for doing this operation is the presence of the nominal section in CA and opened PC-DMIS PP with the alignment already done.



In the interface window you can select the position of the probe (in the PC-DMIS PP you must use accordingly some MOVE commands and some RECALL TIP commands in order to prepare the CMM for the measurement). Then you can select the measurement mode (by scan or single points). The “MOVE” option creates 2 moves before and after the scan at the distance indicates along the direction of the tip (as indicated in the interface window!).

If scan is selected it is possible to adjust the scan speed and point density separately for the edges and for the sides. The “overtravel” value indicates the amount of the scan “extension” over the physical limit of the section (this guarantees that the 2 scans will intersect well).

In the List box you can select one or more section. Clicking on GENERATE commands will be generated at the current cursor position in PC-DMIS.

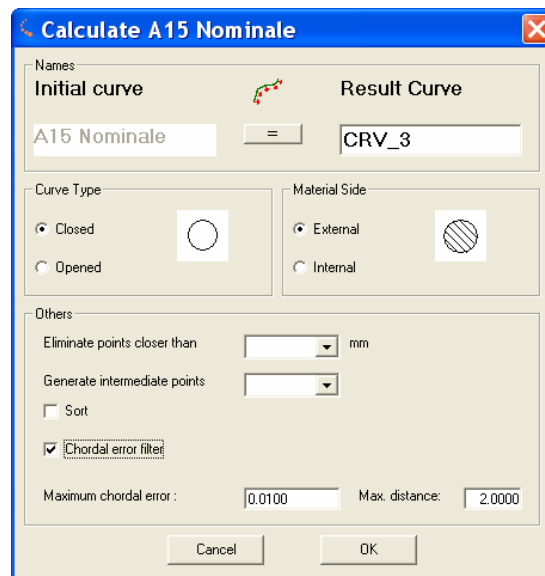
Typically after finishing one side, we move the CMM manually to the other side, then just reverse the direction of the probe (you can use the “<->” button) and generate the rest of scans.

3. Generic functions having relation to the airfoil calculation

There are also some general purpose functions, often used when working with Airfoils sections. In this section we list some of them.

3.1 Curve calculation

| Function | Access |
|-------------------|-------------------------------|
| Curve calculation | Curve -> Curve 2D calculation |



The mostly interesting options in this function are the following :

Eliminate points closer than – allows to remove “equal” points performing a “cleaning” action over the curve

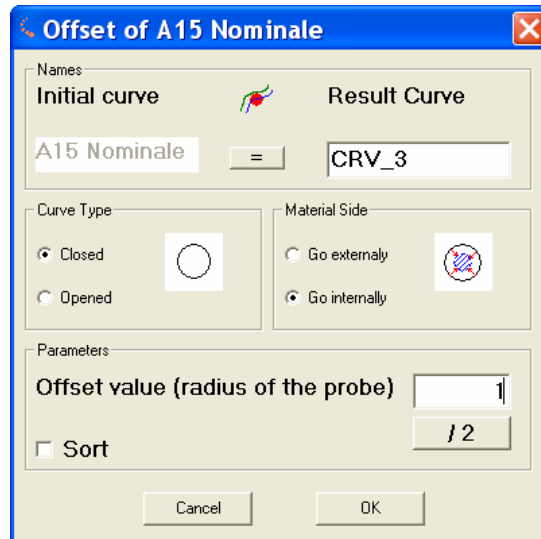
Chordal error filter – applies chordal filter on the points. Usually this function is used to reduce the amount of the nominal points. The points with chordal error lower than the indicated one will be removed, but only in case that they are a distance smaller than the indicated “Min distance” value. Typical input for “medium size” airfoil section (chord 100 mm) would be : chord error = 0.001, Min distance = 1.

For more info on that function refer to the on-line help of CA

Note on the usage: The usage of this functions is supposed to be in the preparation of the nominal sections.

3.2 Radius correction

| Function | Access |
|---------------------|-----------------|
| Radius compensation | Curve -> Offset |



Used to offset the curve in case that it is not radius compensated. Please refer to the on-line help for details on this function.

Note on the usage: The usage of this functions is supposed to be in the preparation of the measured section from a not radius compensated scan.. It can be a step to be recorded in CA evaluation "macro". It is anyway not absolutely necessary, because the "all-in-one" function already has this option in the "pre-processing" option.

4. The "all-in-one" function for evaluating of airfoil sections

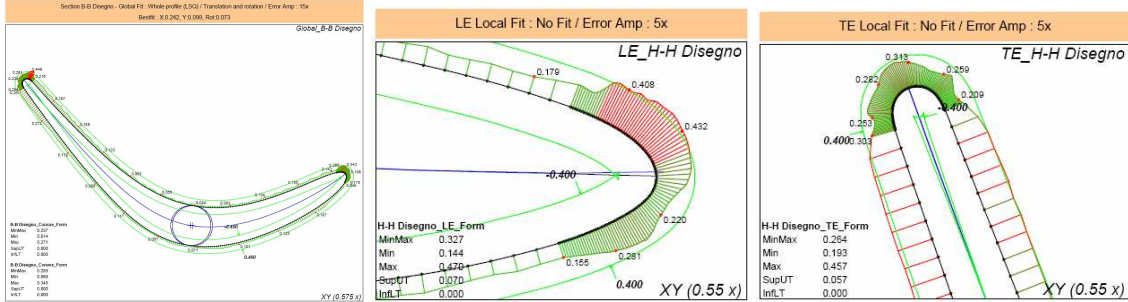
| Function | Access |
|---------------------|---|
| Airfoil evaluations | Utilities -> Calculation Utilities -> Airfoil evaluations |

The "all-in-one" functions allws to perform complete evaluation on airfoil section, producing also reporting page of it. In order to be recalled you musthave in CA the following curves:

- nominal sections
- measured sections (can be radius corrected or not), must be complete sections

The function will perform all necessary

- **form error evaluation** (examples for the complete profile, LE, TE)



- **airfoil parameter calculations** listed as dimension with their tolerances

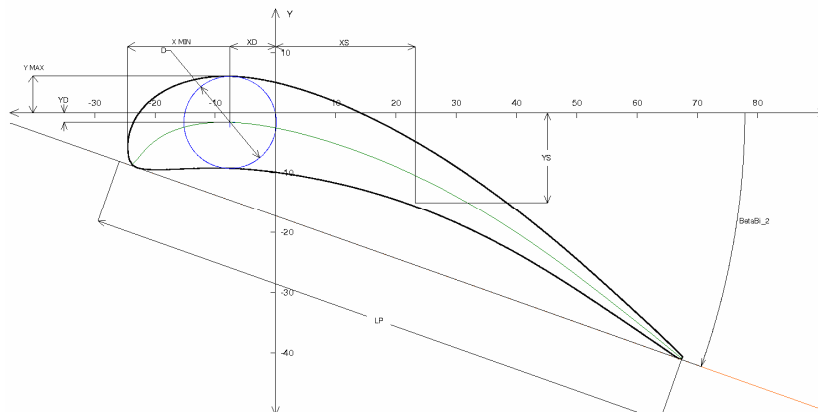
| Airfoil parameters | | | | | | |
|------------------------------|----------|---------|---------|----------|--------|-----|
| Axis | Nominal | Up. Tol | Low. To | Measure | Dev. | OOT |
| H-H Disegno Maximum Diameter | | | | | | |
| Dia | 18.368 | | | 18.700 | 0.331 | |
| H-H Disegno XD | | | | | | |
| X | 17.221 | | | 15.719 | -1.502 | |
| H-H Disegno YD | | | | | | |
| Y | -35.119 | | | -35.141 | -0.022 | |
| H-H Disegno_Rotation-AM | | | | | | |
| Ang | -49.9396 | | | -49.9348 | 0.0050 | |
| H-H Disegno_Chord | | | | | | |
| DistCD | 220.170 | | | 220.798 | 0.627 | |
| H-H Disegno_LE_Thck | | | | | | |
| DistCD | 9.878 | | | 10.055 | 0.177 | |
| H-H Disegno_TE_Thck | | | | | | |
| DistCD | 3.818 | | | 4.675 | 0.857 | |
| H-H Disegno_LERad-R | | | | | | |
| Rad | 1.789 | | | 2.208 | 0.419 | |
| H-H Disegno_TERad-R | | | | | | |
| Rad | 1.601 | | | 2.908 | 1.307 | |
| H-H Disegno_Best-Fit_Data | | | | | | |
| BF-Off X | | | | 0.834 | | |
| BF-Off Y | | | | 0.307 | | |
| BF-Rot | | | | 0.0765 | | |

Regarding the available Best-fit algorithms, the following fits are available:

- no fit
- LSQ on the whole profile
- LSQ on the profile without TE
- LSQ on the whole profile without LE/TE
- 2 points fit on 10% of the MCL

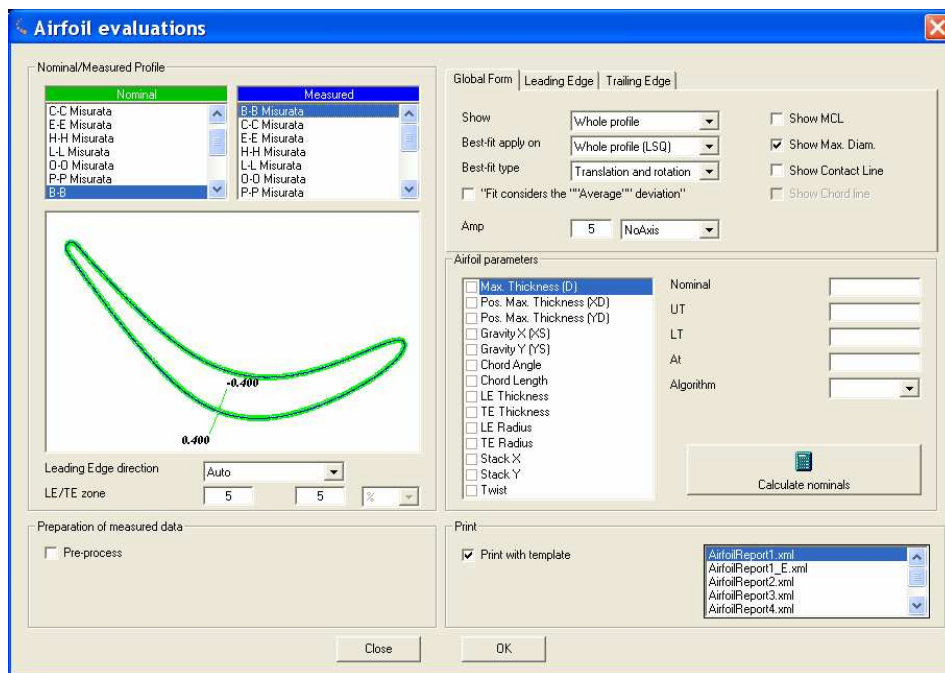
The edges can be evaluated using the global fit, or applying a local LSQ fit.

The following parameters can be calculated and reported



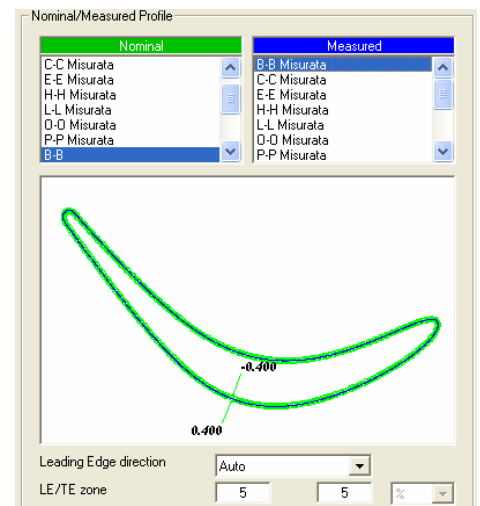
- Maximum thickness value D
- Position of the maximum thickness XD, YD
- Point of the gravity of the section XS, YS
- Chord length (with different algorithms) LP
- Angle of the chord Beta_Bi2 (with different algorithms)
- Edge thickness (LE/TE)
- Stack X/Y and rotation values, resulting from the fit
- Max/Min points respect to the axes (in the example X MIN / Y MAX)
- True position of the stack axis

Options present in this function:



Nominale/Measured profiles - Here you are allowed to select the nominal and the measured curve (in the lists all available curves in CA are shown). Both curves must describe fully the profile. The selected curves will be shown in the graphical field below

Leading Edge direction – here we can select the direction of the LE. It is possible to leave it on “auto” or to select explicitly the direction of the LE respect to the co-ordinate axes. If leaving on “auto” the following rule will be applied : CA will calculate the MCL and the Max. Thickness position. The edge that results to be closer to the position of the Max. Thickness will be the LE. As this rule is not valid for all airfoil sections, in those cases you must use the explicit indication of the direction of the TE.



Pre-processing of the measured data – according to the status of the measured data we can request different pre.processing options:

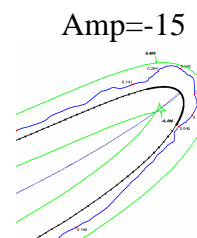
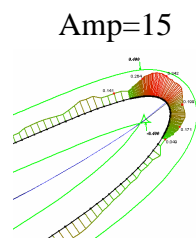
- **Sorting of points** – will re-order the points. Typically it is not needed and in any case, if having low point density should not be done
- **Removing “equal” points** – will remove point closer than the value indicated

Note: if the measured data are obtained by “Collect Airfoil sections” function, it is not needed to activate any of the above options.

- **Radius compensation** – if the measured data are not radius compensated, input the value for the radius compensation (radius of the probe)

Global Form options – set-up the parameter for the form evaluation of the complete profile:

- **Show** – allows to select which part of the airfoil section will be shown in the “Global” view. You can select between showing the whole profile, the profile without TE (suitable for thick profiles with thin TE), or the profile without TE and LE (suitable for very thin profiles, or whenever the evaluation of the LE/TE is not desired, because the edges are “square”).
- **Best-fit apply on** – here you can select which type of best-fit to use for the “Global” fit. The current options are : No Fit, LSQ fit on the whole profile, LSQ fit on the profile without TE, LSQ fit on the profile without TE, fit on 2 points on MCL (10%)
- **Best-fit type** – visible only if some fit is selected – allows to select between Rotate&Translate, Rotate only, Translate only options
- **Fit considers the avreage deviation** – This check-box actiavtes a special function that will fit the measured profile not on the nominal one, but will first look for the average deviations, then will build internally a new nominal for fitting, that will be offsetted respect to the original nominal at the value of the average deviation found. This option is usefull for “thick” profiles, where the length of the convex side is significantly longer than the length of the concave side, and at the same time we have measured profile that has significant “excess” of material.
- **Amp / Zoom** – amplification applied on the deviations and the zoom factor applied to the profiles.
* For the Amplification:If inserted with “-“ sign will not show spikes. See the examples bellow:



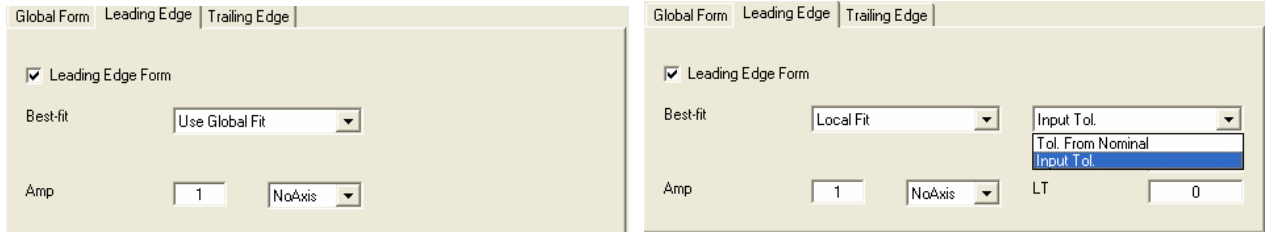
Anyway for the color coding (colouring of the deviations) the general setting of the color schema will be used. This setting can be changed from “Edit” -> “Preferences”

* For the Zoom : If set to “0” (standard setting) the zoom will be automatic, in order to fit the profile inside of the available view. Otherwise you can input the desired zoom factor (negative numbers are not allowed and will cause the zoom to be automatic)

- **Axis display** – you can select between not showing the axes, or showing them in the origin point, or in the lower right corner of the graphical field

- Other display options – you can request that the MCL line, the Max. Thickness circle and/or the contact line must be shown

Edge Form options – set-up the parameter for the form evaluation of the complete profile:



Here we can select how the edges will be evaluated (generally we can de-activate this calculations at all – for example in case that the edges do not need to be evaluated at all)

- Best-fit – you can select between using the “Global” fit (in this case the form error will be essentially the same as in the global view, but the edge will be just “zoomed”), or you can use a local fit option (that will detach the edge and will fit it independently to the nominal). In this second case, the user can select between using the tolerance from the nominal, or type a specific tolerance. This option is used when over the whole profile we have a tolerance field that considers also the “chord” length tolerance and is quite large in the edge areas. Using the local fit in this case we would input significantly smaller tolerance from the form error.
- Amp / Zoom – amplification applied on the deviations and the zoom factor to be applied to the profile. For more info look at the description of the same setting for the “Global form options”.
- Axis display – you can select between not showing the axes, or showing them in the origin point, or in the lower right corner of the graphical field

Esiste la possibilità di non effettuare questi calcoli (può rendersi necessario disattivare questi calcoli se per esempio il bordo per il suo carattere non è stato misurato bene – esempio: bordi non raggiati)

Airfoil parameters – here we can select which kind of calculation is needed, and eventually the requested algorithm and some additional parameters. After selecting those parameters you can click on “Calculate Nominals” – this will launch a procedure that calculates the parameters from the nominal section selected. If needed you can correct those nominals manually.

The screenshot shows a dialog box titled "Airfoil parameters". On the left, there is a list of 15 parameters, each with an unchecked checkbox: Max. Thickness (D), Pos. Max. Thickness (XD), Pos. Max. Thickness (YD), Gravity X (XS), Gravity Y (YS), Chord Angle, Chord Length, LE Thickness, TE Thickness, LE Radius, TE Radius, Stack X, Stack Y, and Twist. On the right side, there are five input fields: "Nominal", "UT", "LT", "At", and "Algorithm" (which is a dropdown menu). At the bottom center, there is a button labeled "Calculate nominals" with a small calculator icon above the text.

Max Thickness D : value of the max. thickness

Position of the Max Thickness XD – XPosition of the maximum thickness circle

Position of the Max Thickness YD – Y Position of the maximum thickness circle

Gravity XS – YPosition of the point of gravity,calculated on the section

Gravity YS – Y Position of the point of gravity,calculated on the section

Chord angle – chord angle calculation (linee between LE/TE points or on the contact line). It is also possible to insert offset angle, that will be added to the calculated ones.

Chord Length – calculates the chord length accordingto the selected algorithm

Edge thickness – calculates the edge thickness at certain dostance from the edge

Edge radius – calculates the edge radiis, taking into account points that are symmetrically disposed along the direction of the range, that will fall into the segment angle indicated.

Stack X – best-fit X Translation

Stack Y – best-fit Y Translation

Twist – rotation obtained by the best-fit

Max X, MinX, Max Y, Min Y – extremum points on the profile are found and reported



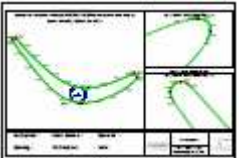
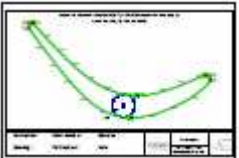
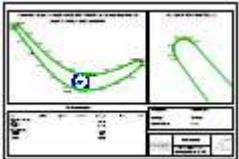
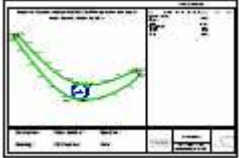

Stack TP – true position of the stack axis (calculated from StackX and StackY values)

Print – here we can select which kind of print template will be used. According to your need you can also de-activate this field. The evaluation will anyway create automatically different views, that

can be later combined in a personalized report “template”. The original templates can be also modified or new once can be added.

Report Comment : Allows to insert a string that may be shown on the report (depending on the template). The template must contains a filed for TXT, with the name of TXT:CommentAirfoil

The already available templates are :

| | | |
|---------------------------|--|---|
| AirfoilReport1.xml | Gloibal View LE View TE View Airfoil parameters table Concave side |  |
| AirfoilReport1E.xml | Coonvex side TE View LE View Airfoil parameters table |  |
| AirfoilReport2.xml | Gloibal View LE View TE View |  |
| AirfoilReport3.xml | Global View |  |
| AirfoilReport4.xml | Gloibal View TE View Airfoil parameters table |  |
| AirfoilReport5.xml | Gloibal View Airfoil parameters table |  |
| AirfoilReport6.xml | Gloibal View TE View LE View Linearized graph Airfoil parameters table |  |
| AirfoilReportMaxGraph.xml | Global View | |

If desired a summary report can be created. For doing this just select the “summary report”, then check the list of the sections to be reported and the list of the parameters to be reported (the Summary report will report the list of the parameters that you select in this moment, and will not refer to the existing dimensions!)

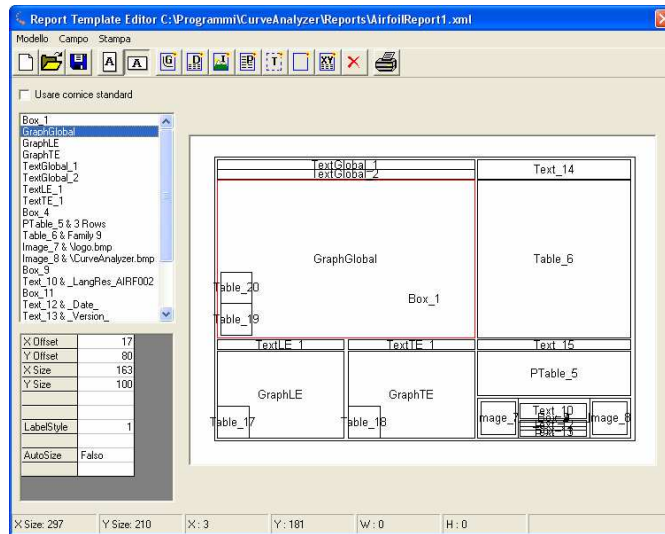
Notes about the modification/ creation of templates : Creating a new template, we must include in that template componenst (graphical fields, texts and dimension tables) in the desred position and with desired size. These componenst must have certain names (as long as it regards the graphs and the texts) and must be related to certain “family” as long as it regards the dimension tables. Here you find the necessary info:

| Graphs | Texts |
|---|---|
| <i>GraphGlobal – complete profile (According to what has been selected in the “show” combo box)</i> <i>GraphGlobaCC – concave side</i> <i>GraphGlobalCV – convex side</i> <i>GraphTE – TE</i> <i>GraphLE – LE</i> <i>GraphGlobalLinear – Lienarized profileof the complete profile (pls. Set the AutoAdjust property to 1)</i> | <i>TextGlobal_1 – Info best-fit and ampl. error</i> <i>TextGlobal_2 – Data best-fit</i> <i>TextLE_1 – Info best-fit and ampl. error</i> <i>TextLE_2– Data best-fii</i> <i>TextTE_1 – Info best-fit and ampl. error</i> <i>TextTE_2– Data best-fit</i> <i>CommentAirfoil – comment on the report</i> |

| Dimension tables (any name, attention on the family!) | |
|---|--|
| <i>Family5 (Stile 1) – Valori forma TE</i> <i>Family6 (Stile 1) – Valori forma LE</i> <i>Family7 (Stile 1) – Valori forma CC</i> <i>Family8 (Stile 1) – Valori forma CV</i> <i>Family9 (Stile 0) – Tabella parametri foglia</i> | |

All other compnents may have any name

View of the template editor with the template AirfoilReport1.xml



5. Step-by-step guide for performing “blade” analysis with PC-DMIS and CA

There are 4 important steps to execute

Creation of the NOMINAL file

- Create off-line scans in PC-DMIS applying high point density (using version 2009, you can use the new “Cut Section” option)
- Import the scan in CA (File -> Import -> Read from PC-DMIS)
- Use eventually the “chord filetr error” (Menu Curve -> Curva 2D calculaion)
- Assign tollerance (Menu Curve -> Airfoil calculation -> Assign tollerance)
- Change the name of the profiles (the neames will be shown in the reports!) and delete evntually unnecessary objects
- Save the file (Menu File -> Save)

Creation of the measurement path on the PC-DMIS PP

- In PC-DMIS: execute the alignment
- In PC-DMIS Activate the probe for measurement of the CONVEX side and position the probe on that side. Put the cursor on the bottom.
- In CA: ensure having opened the nominal file, then go to “Measure” -> “Airfoil path generation”, Selectthe sections, then Select the position of the probe according to what you see in the CMM. (the physical position of the probe, not reffered to some axes), check the “move out value” (default is 50), and the probe diameter value, and click on Generate. Wait until the scans are generated. (Keep the generation window opened).
- In PC-DMIS : Execute the scans created by CA
- In PC-DMIS : change the probe and add the necessary moves to go to the other side. Put the cursor on the bottom.
- In CA: (we still have activated the “Airfoil path generation”), change the probe position (there is apecial button to invert the probe position “<->”) and clik on Generate. Wait until generation finisces adn close the window.
- In PC-DMIS : Execute the scans created by CA
-

Creation of the macro

- Go to CA:
- Clean all (Menu “File” -> “New”)
- Activate the MACRO registration
- Import the scans form PC-DMIS (Menu “File” -> “Import” -> “From PC-DMIS” (accordingto thepart program size may be needed to wait a bit, running the macro this time will be absent)
- Collect the scans Menu “Curve” -> “Airfoil calculations” -> “Collect airfoil scans” Attention: for scans with low point density non use the “Sorting” option!
- Load the nominals : Menu “File“ -> “Open”, respond with “No” on the question if the present data must be deleted and indicate the position of the nominal file
- Execute the airfoil evaluations : Menu “Utilities” -> “Special calculations” -> “Airfoil evaluations”. Be careful on :
 - o Names of Nominal and Measured

- Pre-processing data (enable the Radius compensation and indicate the RADIUS of the probe – for trigger point sensors, insert the “dynamic” radius of the probe)
- Once you select the airfoil parameters you want to calculate, click on “Calculate nominals” and check the calculated nominals
- Select the desired plot format
- Click on OK for generating the evaluation

Repeat this sequence with another section, clicking on OK for creating a new page

- Go in “Page Viewer” and select the PDF file name for the report (Menu “File” -> “Set printer or PDF file name”). Select the name and eventually add to the name the part data..
- Being in “Page Viewer” go to “File” -> “Print all” (this action will create the PDF)
- Turn back in CA go to “File” -> “exit” -> You will be asked for the name of the macro. Input some name.

(Testing : If you make now File -> New, then access the macro, open the macro you just created, and run it – notet hat having recorder the “Exit” command in the macro CA will be closed at the end)

Inserting recall to CA from PC-DMIS PP

- In PC-DMIS: Ensure having some variables in PC-DMIS PP, that for example hold the part number or other important data
- In PC-DMIS: Move the cursor to the bottom
- In CA: go to menu “Utilities” -> “PC-DMIS Utilities” and select “Recall CA...”. Wait the window to be shown. Select the script option. Select the correspondance of the PC-DMIS variables and the part data table in CA, select also the macro to run. Click on OK. This will create a command in PC-DMIS that will run CA, executing the macro.

(Testing : Put the cursor on the script command and press CTRL+U – CA will be opened and the macro will be executed)

6. The “all-in-one” function for evaluating of parameters of airfoil sections for airscrews

| Function | Access |
|-------------------------------|---|
| Airfoil evaluations propeller | Utilities -> Calculation Utilities -> Airfoil evaluations propeller |

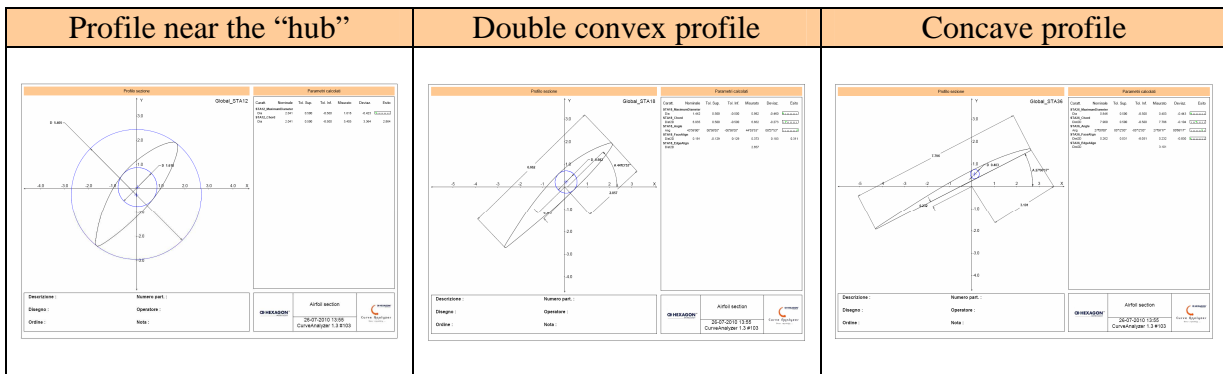
The “all-in-one” functions allow to perform complete evaluation on airfoil section of airscrew, producing also reporting page of it. It calculates only some parameters, that are used mainly for checking of Airscrews for maintenance purposes. In order to be recalled you must have in CA the following curves:

- measured sections (can be radius corrected or not), must be complete sections

The evaluations are performed section per section (possible to create one page for report), and it is possible to select one of 3 possible profile types (sections near the hub, double convex sections, concave sections). Here is the list of the evaluated parameters

| Parameters | Profile near the hub | Double convex profile | Concave profile |
|--------------|----------------------|--|--|
| Max. Width | Max Width (airfoil) | Max Width (airfoil) | Max Width (airfoil) |
| Chord length | Outscribed circle | 2D Distance from TE to LE | 2D Distance of extremum point, parallel to the contact line |
| Angle | NA | Line from TE to LE | Contact Line |
| Face Align | NA | 2D Distance from origin, to the pierce point of a line passing through the origin (perp. to LE/TE Line) with the profile | 2D Distance from origin, to the pierce point of a line passing through the origin (perp. to Contact Line) with the profile |
| Edge Align | NA | 2D Distance from origin to the extremum point of the LE | 2D Distance from origin to the extremum point of the LE |

And here are the examples of produced report pages:



At the end of the evaluation it is also possible to create a summary table like shown bellow

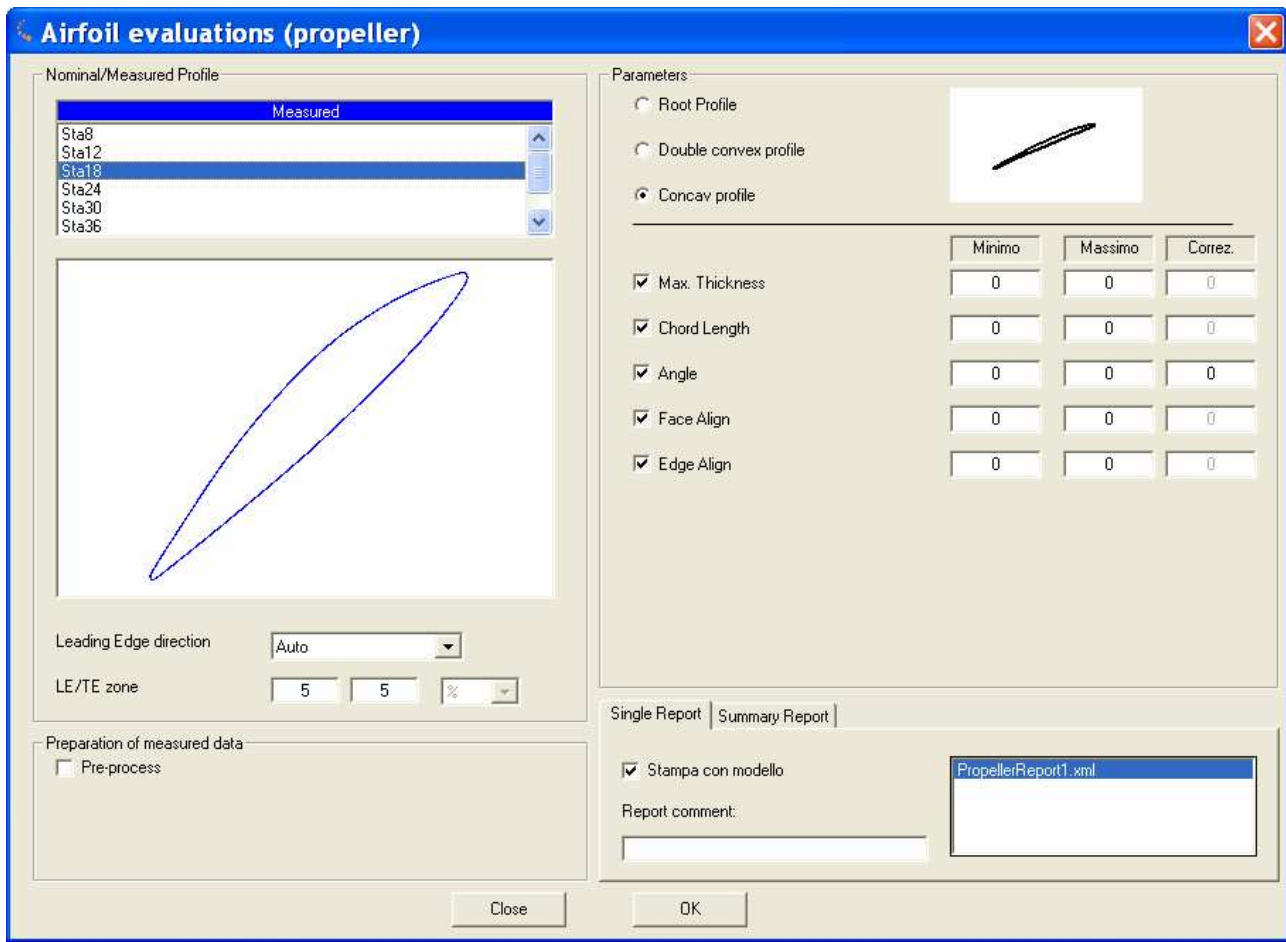
| Stazione | Max. Dia. | Chord | Angle | Face Align | Edge Align |
|----------|------------|------------|-------------|-------------|------------|
| STAB | 3.029 2301 | 4.064 2071 | | | |
| STA12 | 1.618 2341 | 0.405 2341 | | | |
| STA18 | 0.662 3942 | 6.662 7432 | 44.26451100 | 0.3732 0202 | 2.882 0200 |
| STA24 | 0.662 3960 | 7.267 3900 | 36.02312000 | 0.1462 0151 | 3.016 0200 |
| STA30 | 0.629 3980 | 7.622 3940 | 30.02020000 | 0.071 0401 | 3.089 0200 |
| STA36 | 0.463 3980 | 7.796 4400 | 27.10272000 | 0.232 0201 | 3.101 0200 |
| STA42 | 0.291 3203 | 7.790 3130 | 24.84232000 | 0.318 0151 | 3.014 0200 |
| STA48 | 0.184 3103 | 7.171 2200 | 22.18222000 | 0.448 0201 | 2.483 0200 |

Descrizione: Orbita
 Design: Numero part.
Operatore
Data

HEXAGON **Profilo 2D**

Interface

Here is the interface window:



- Select the section desired (will be shown immediately in the pre-view)
- In some rare cases (very thin profiles where the automatic LE/TE recognition may fail) the indication of the LE direction is necessary. Normally the automatic recognition works fine.
- In the “Preparation” of measured data, a radius correction may be executed, or some “Clean-up” of the source point can be requested.
- In “Parameters” it is operator responsibility to indicate the type of the section and to compile the min/max values of all parameters needed. For the “angle” dimension also “correction” value may be input (this value will be added to the calculated one).
- In the “single report” you may check or uncheck the generation of the single report.
- Click on OK – if the “single reports” was enabled then In “Page Viewer” a report page will be inserted.
- Proceed with next section...

After the last section, without exiting the window, you can access the “summary” report window and a summary table may be created.

All this commands are usually saved to a macro, so that the execution is automated. To edit the macro, please use the usual mode, opening the macro, then selecting a command and accessing the “edit window” with F9. After making the changes save the macro pressing F10 (while having focus on the “macro window”)