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Nominal-Actual comparison of optical measured pump impellers within CAESES

Nominal-Actual comparison of optical
measured pump impellers within CAESES!
Klemm | September 2019



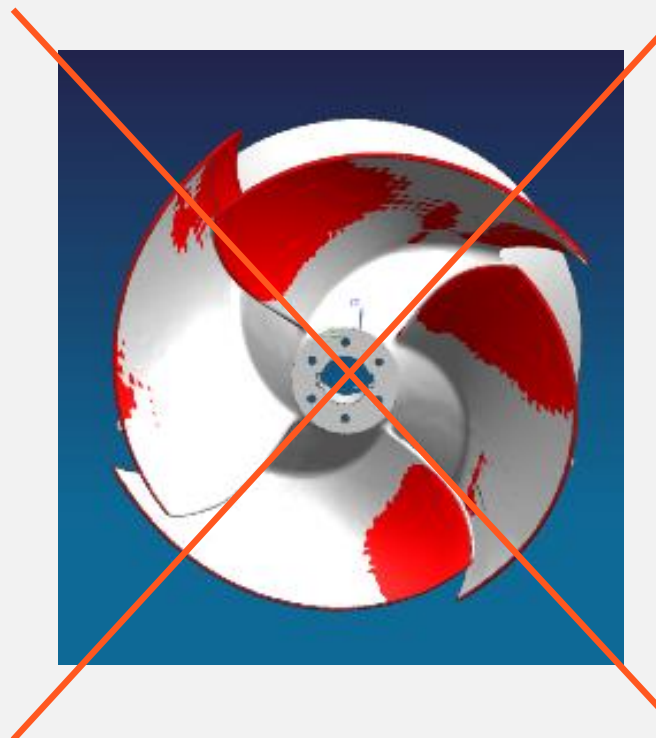
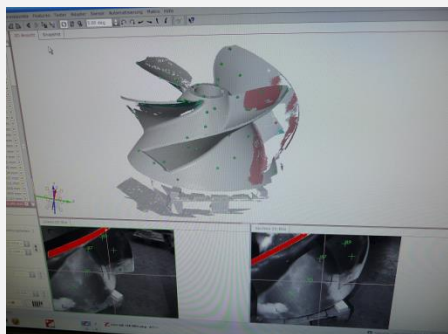


Nominal-Actual comparison of optical measured pump impellers within CAESES

1. Introduction
 - Problem Description
 - Aim
2. Procedure
3. Analysing scanned pump data
4. Work flow integration
5. Conclusion



Fast simple colour mapping
comparisons of nominal and
scanned geometries not sufficient



Problem Description

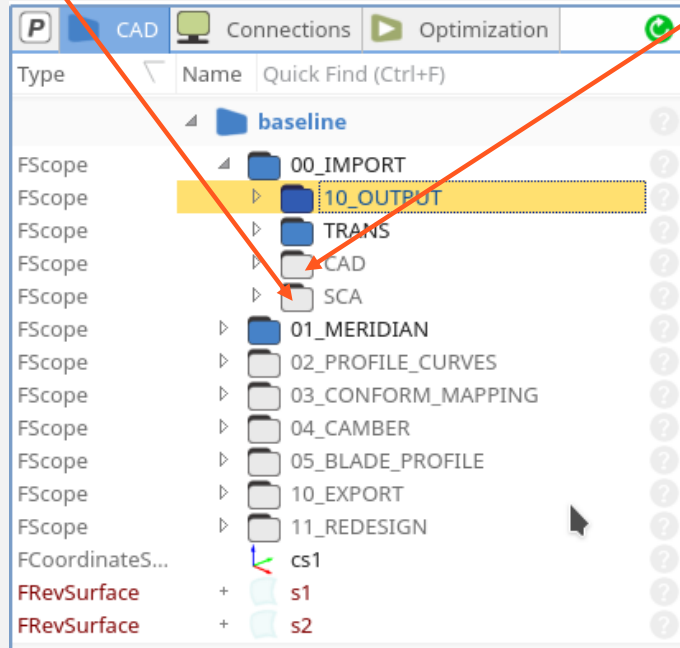
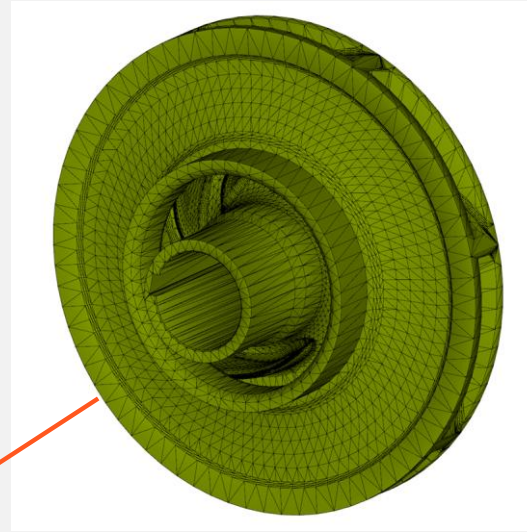
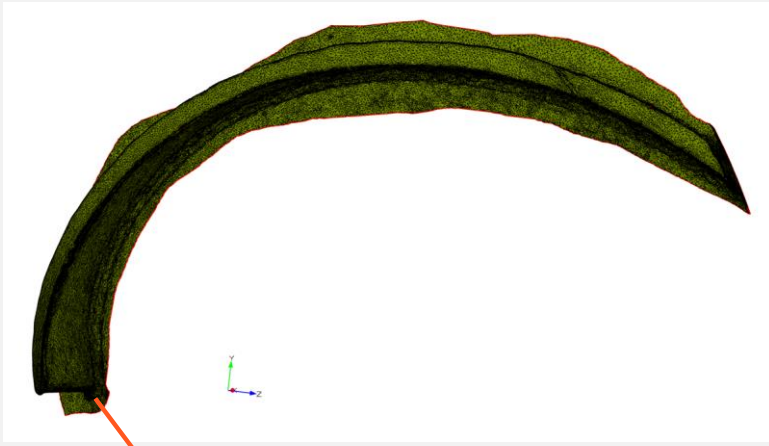
Applications

- Quality check of manufactured parts, especially of casted hydraulic pump components.
- Reverse engineering of non available pump spare parts of run out products or of products of not any longer existent manufacturer

Related Demands and Tasks

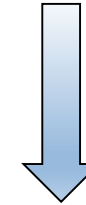
- Evaluation of geometrical differences regarding hydraulic performance
- Hydraulic redesign of impeller geometry is currently still extremely time consuming

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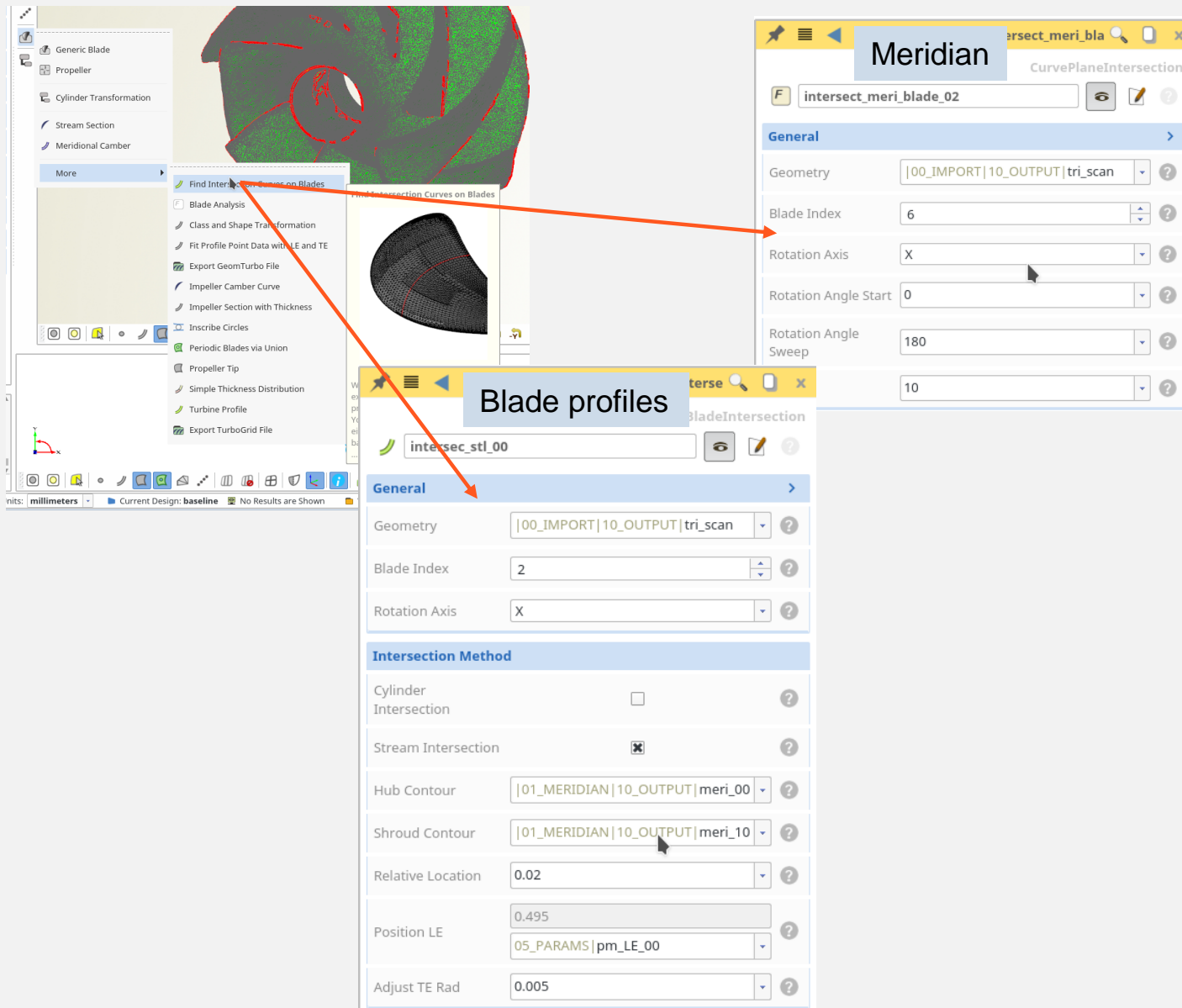
Main Aim

Fast quantitative description
of hydraulic design data of
any kind of imported STL data



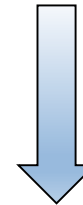
Development of an automated
workflow within CAESSES for
analysing STL formatted
impeller data and their surface
reconstruction

Nominal-Actual comparison of optical
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Gain required data Procedure

- Using new CAESSES possibility to intersect STL formatted data with internal surfaces
- Generate blade profiles with intersection of meridional surface of revolution
- If no meridional contour data available or also different to nominal curves - redesigning them with help of adapted STL intersection feature

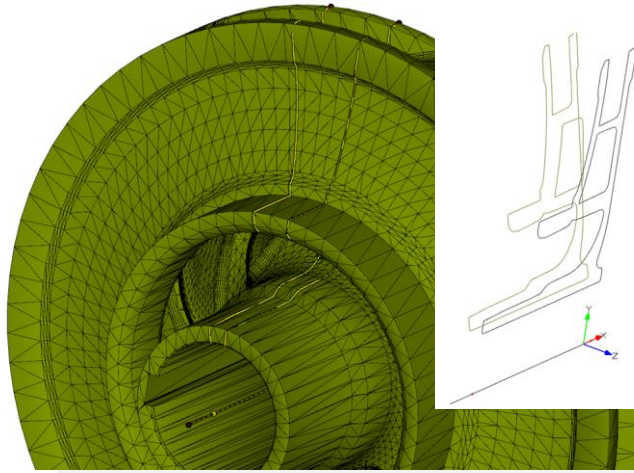
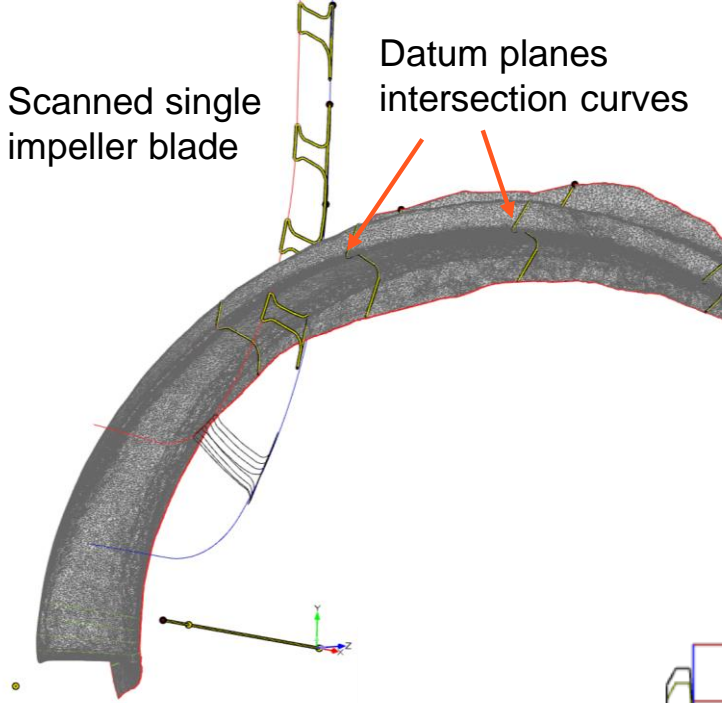


- Start analysing and further data handling

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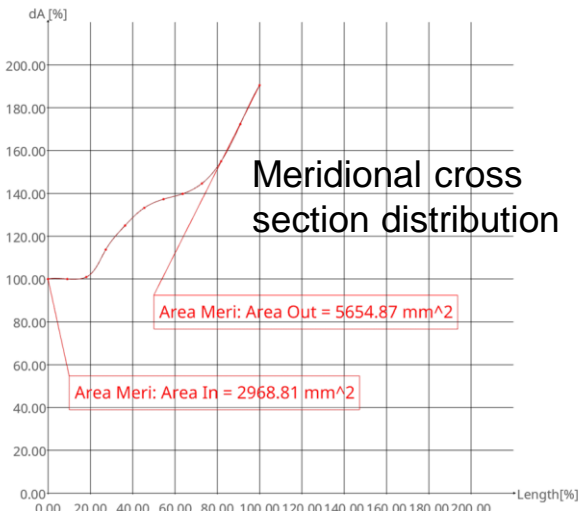
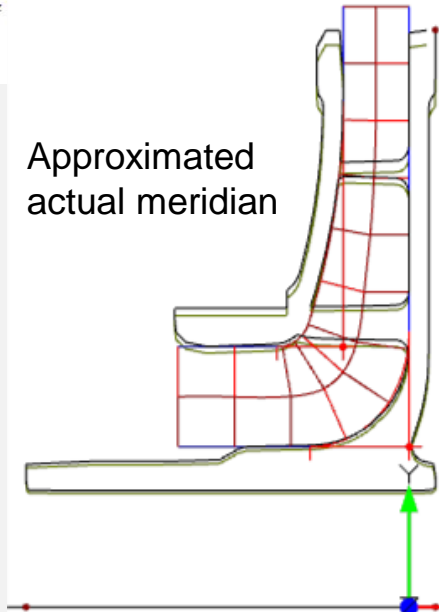
Scanned single
impeller blade

Datum planes
intersection curves



CAD impeller
solid model

Approximated
actual meridian

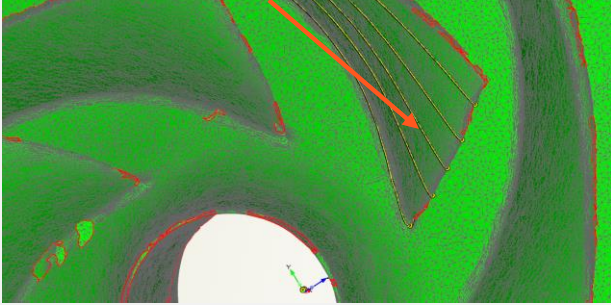


Extraction of meridian contour Procedure

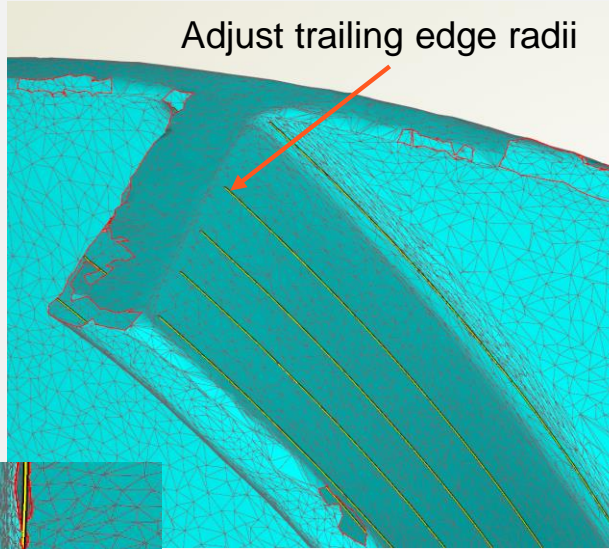
Intersection of STL data with
rotated datum planes

- Transform resulting radial
single intersection curves
into meridional plane for
superposition
- Redesign meridian with tool
of your choice

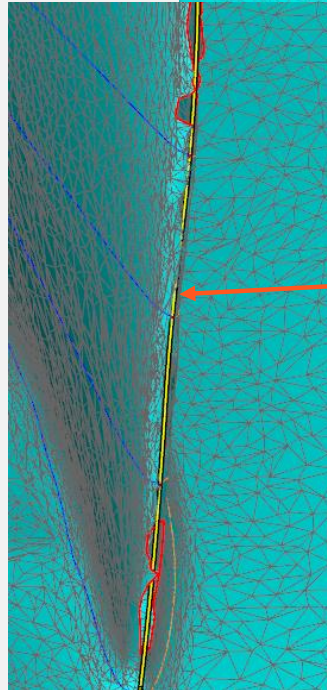
Find spanwise positions
without holes
Interpolation possible for
small holes?



Adjust trailing edge radii



Define leading edge
positions by curve
parameter

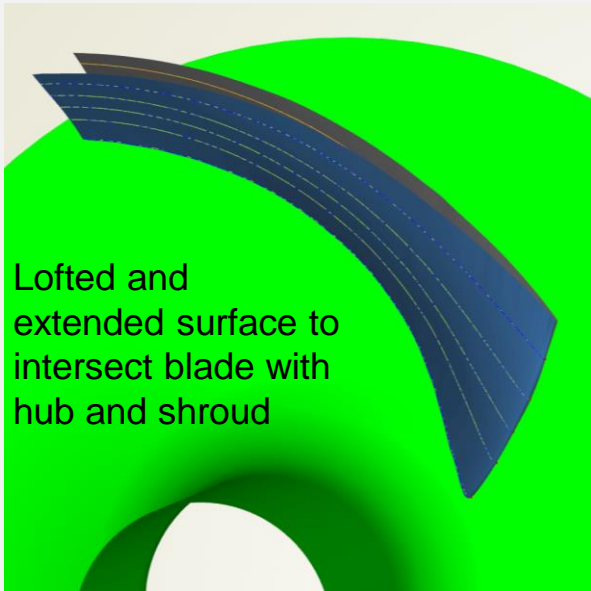


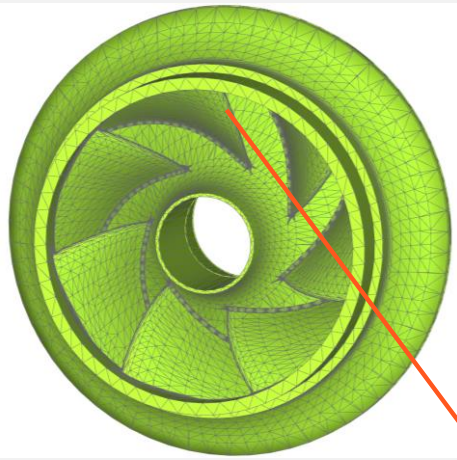
Generation of profile curves **Procedure**

After generation of meridional
curves stream intersection
with STL is possible

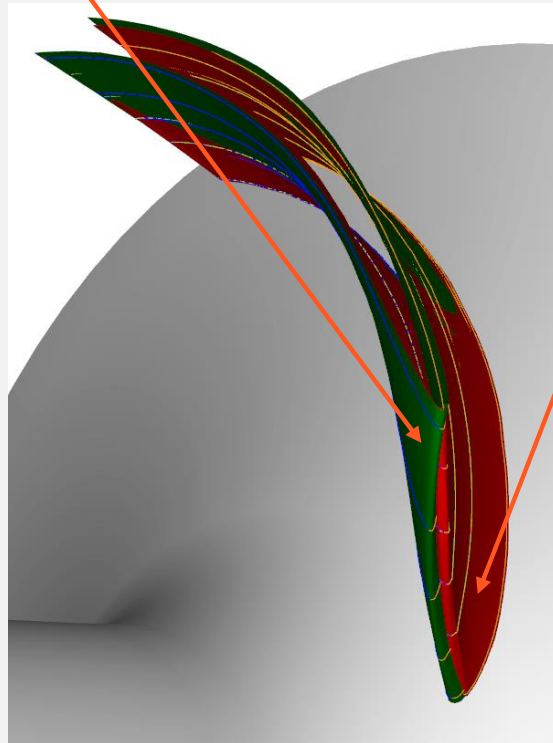
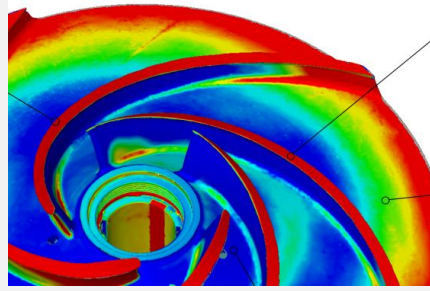
- Define required amount of
stream intersections
- Set leading and trailing
edge for separated control
of pressure and suction
side
- Recreate blade shape

Lofted and
extended surface to
intersect blade with
hub and shroud





Example colour map comparison



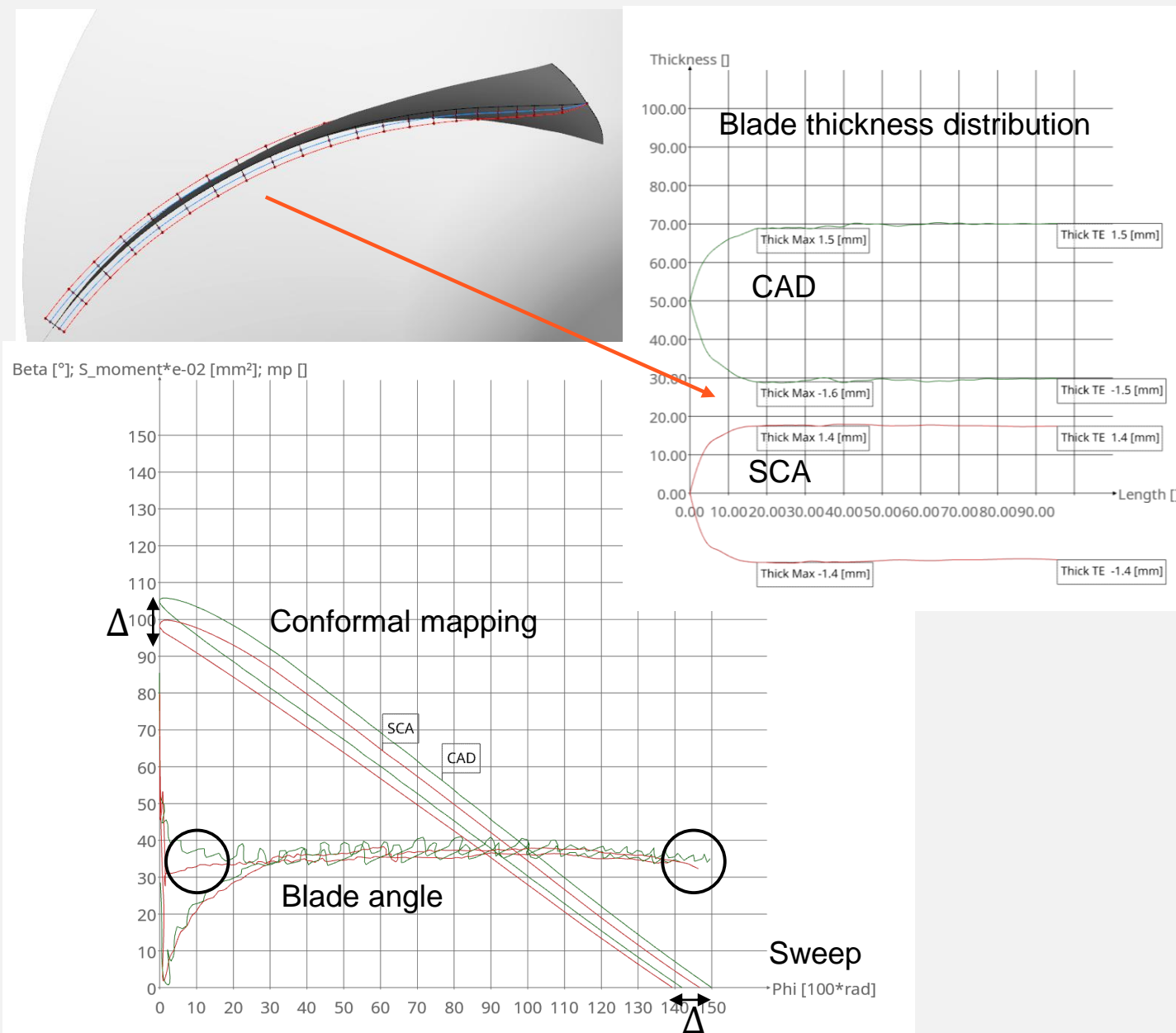
Review colour map comparison **Analysing scanned pump data**

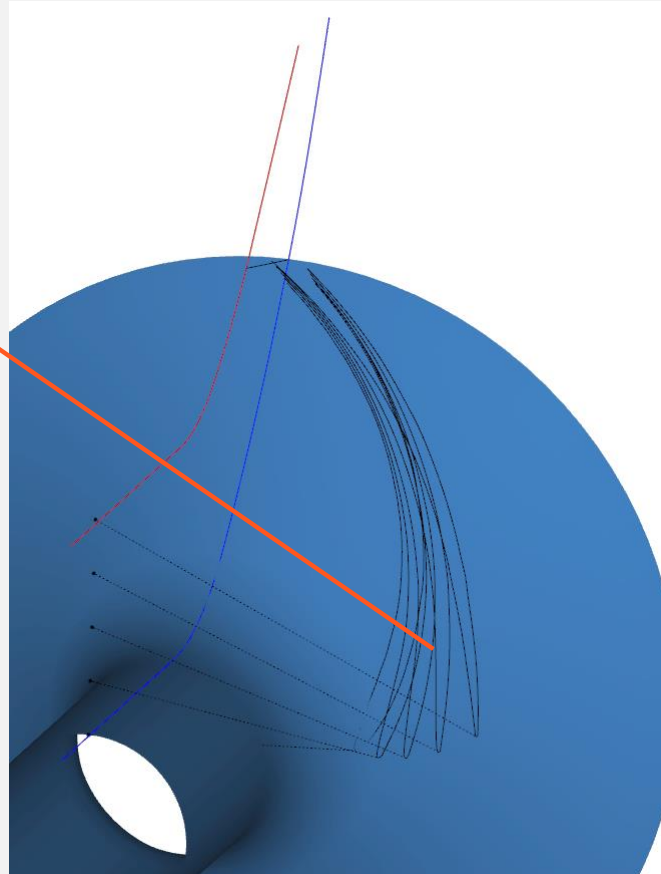
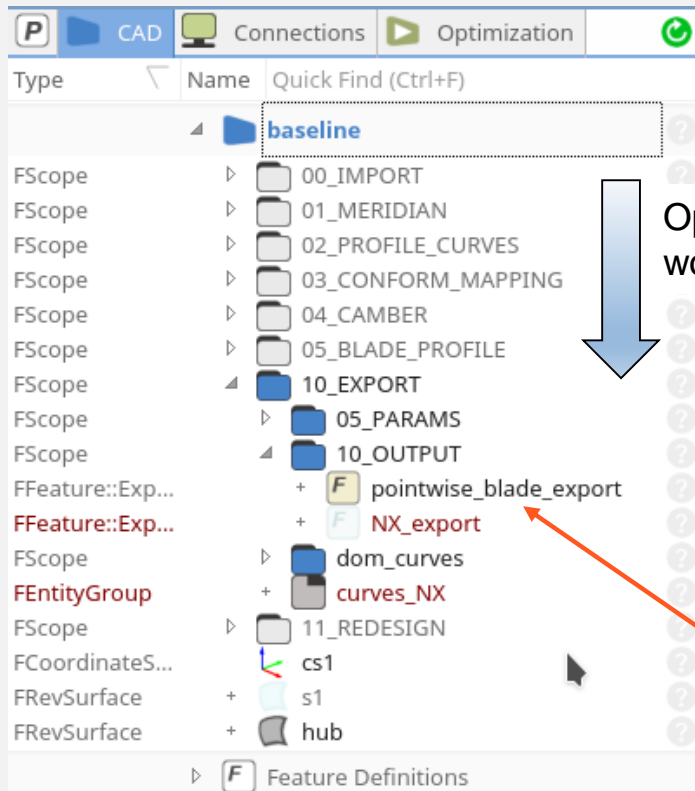
- Signification of fast colour map comparison regarding hydraulic design information is limited
- Blade reconstruction in CAESES as starting point for a deeper quantitative analysis

Deep geometrical analysis Analysing scanned pump data

Application of self-programmed custom features at ~50% spanwise position

- Reconstruction of camber line and analysing of blade thickness distribution
- Analysing blade angle distribution and conformal mapping





Analysing hydraulic performance data

Work flow integration

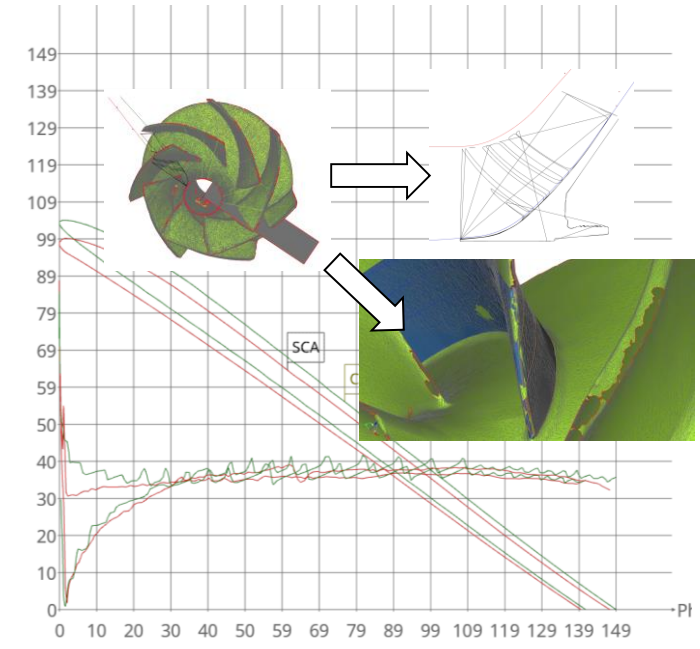
- For quantification of scanned pump performance no additional work is necessary
- Existing export features of optimization work flow can be used
- Export of pump geometrical data in all required turbomachinery data formats

No redesign is necessary!

Nominal-Actual comparison of optical measured pump impellers within CAESES!

- CAESES internal functionality gives the possibility for a fast hydraulic design analysis of non parametric STL blade geometries in an automated workflow
- Procedure can be integrated very easily in existing optimization workflow
- Non automated work is reduced to:
 - STL file positioning
 - If necessary, definition of the meridian curves
 - Setup intersection curve spanwise positions
 - Definition of blade leading and trailing edge
- Restored hydraulic geometrical and performance data can be used as basis for an ongoing optimization process

Conclusion



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