Case Studies about Combination of CAESES and ANSYS CFX for Pumps

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（日本电业社机械制作所）

Introduction of DMW Corporation

Domestic Deployment

MISHIMA PLANT
Shizuoka Pref.

HEAD OFFICE Tokyo

and 14 Regional Offices in Japan

Mt. Fuji

Manufacturing and sale of

- **Pumps**
- **Fans, Blowers, Turbo-compressors**
- **Valves**
- **Environment Equipment**
- **Electric Control / Monitoring System**
- **Others**

International Network

Subsidiaries:

DMW India Pvt. Ltd., Mumbai

Offices:

- Abu Dhabi
- Amsterdam
- Dalian, China
- Houston, U.S.A.
- Singapore

Maintenance Facilities (Local Partners):

- FEC: Mumbai, India
- WESCO: Abu Dhabi, U.A.E.
- WAMCO: Damman, Saudi Arabia
- APSCO: Iran

Case Study about Mixed Flow Pump Impeller

Introduction

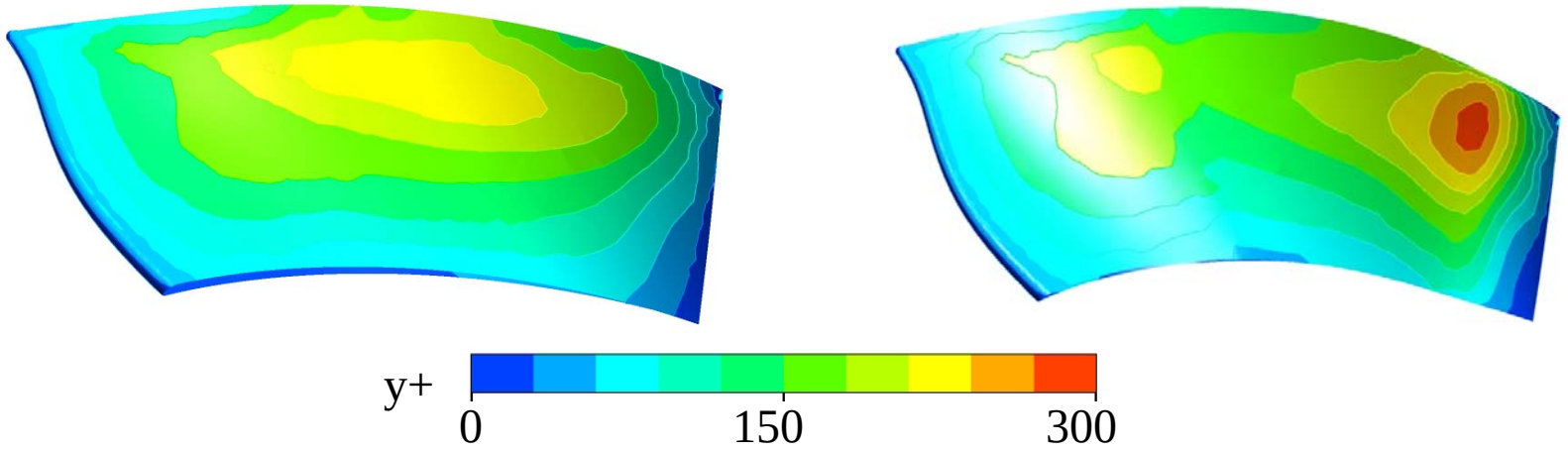
In DMW, ANSYS Blade Modeler has been used for CFD modeling because ANSYS CFX has been mainly used as a CFD software.

However, it is difficult to optimize a fluid machinery using the model made by ANSYS Blade Modeler.

We considered to make a CFD model of a mixed flow pump impeller using CAESES.

Mesh Quality by Mesh Morphing

The design optimization technique is often used at the pump development.



Before morphing

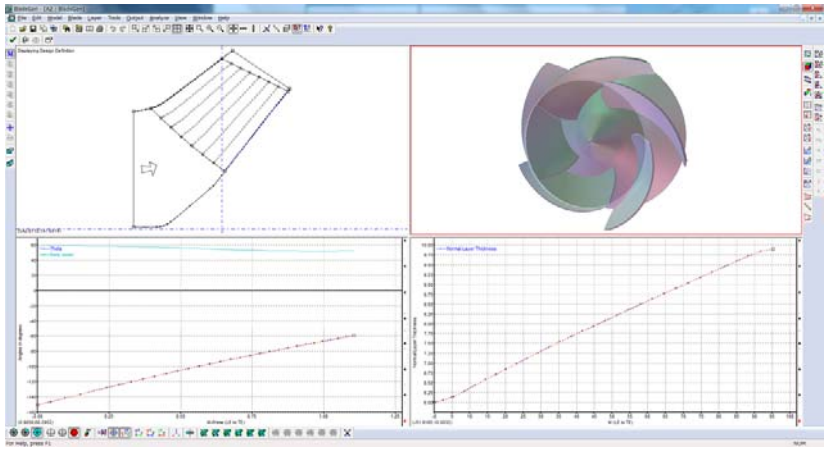
After morphing

y+ on Surface of impeller blade（Meshed by CFX-Mesh）

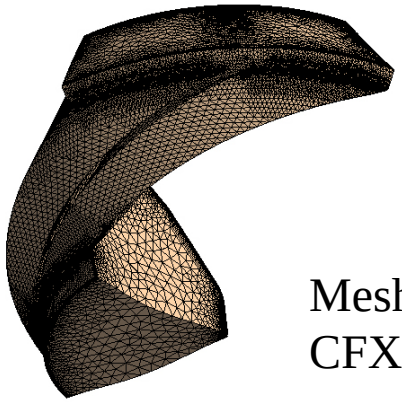
The value of y+ is drastically changed by the mesh morphing.

Conventional Approach

Coordinate data → Modeling → Meshing → Morphing → CFD



Modeled by CFX Blade Modeler



Meshed by CFX-Mesh

When CFD is conducted, a hexa-mesh model is better than a tetra-mesh model in order to keep analysis quality.

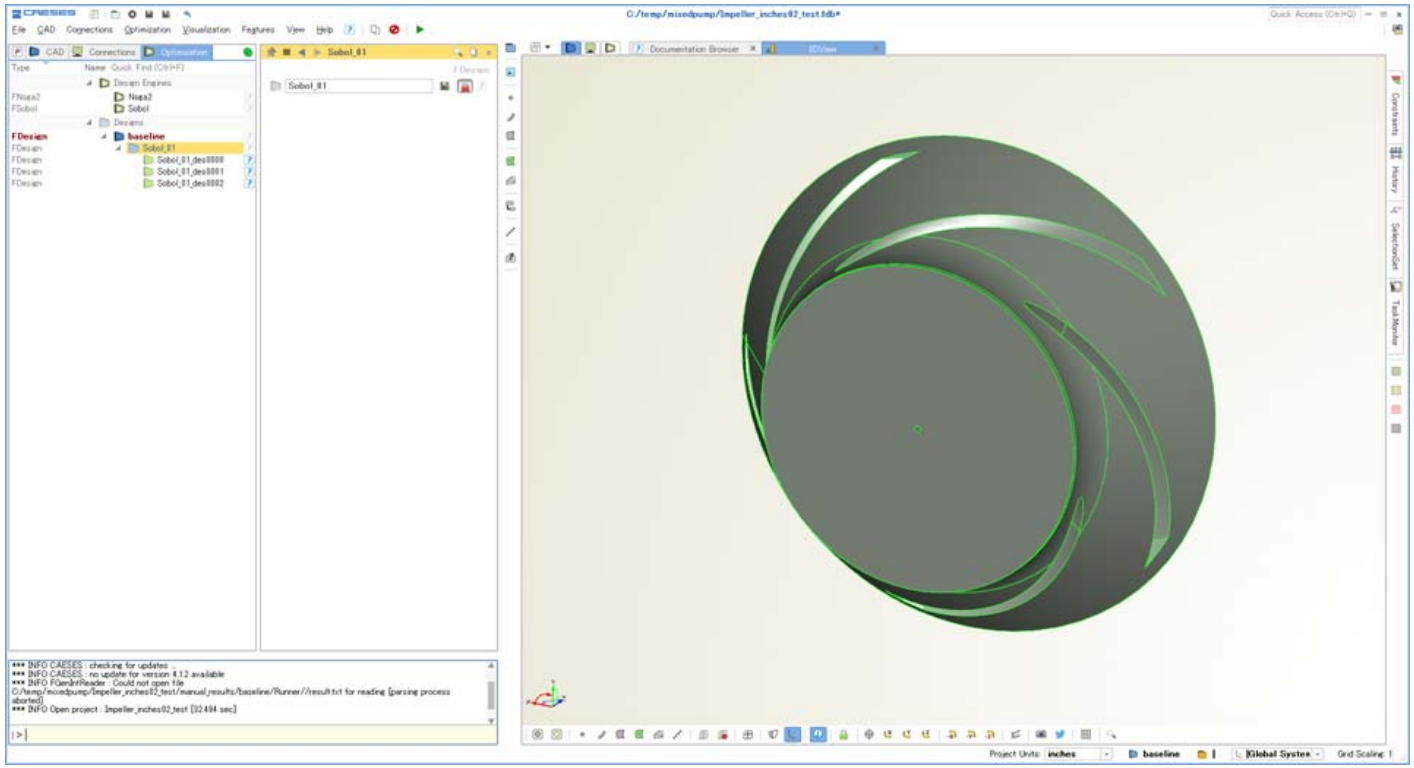
Conflict!

When morphing is conducted, a tetra-mesh model is better than a hexa-mesh model in order to keep mesh quality.

Improved Approach

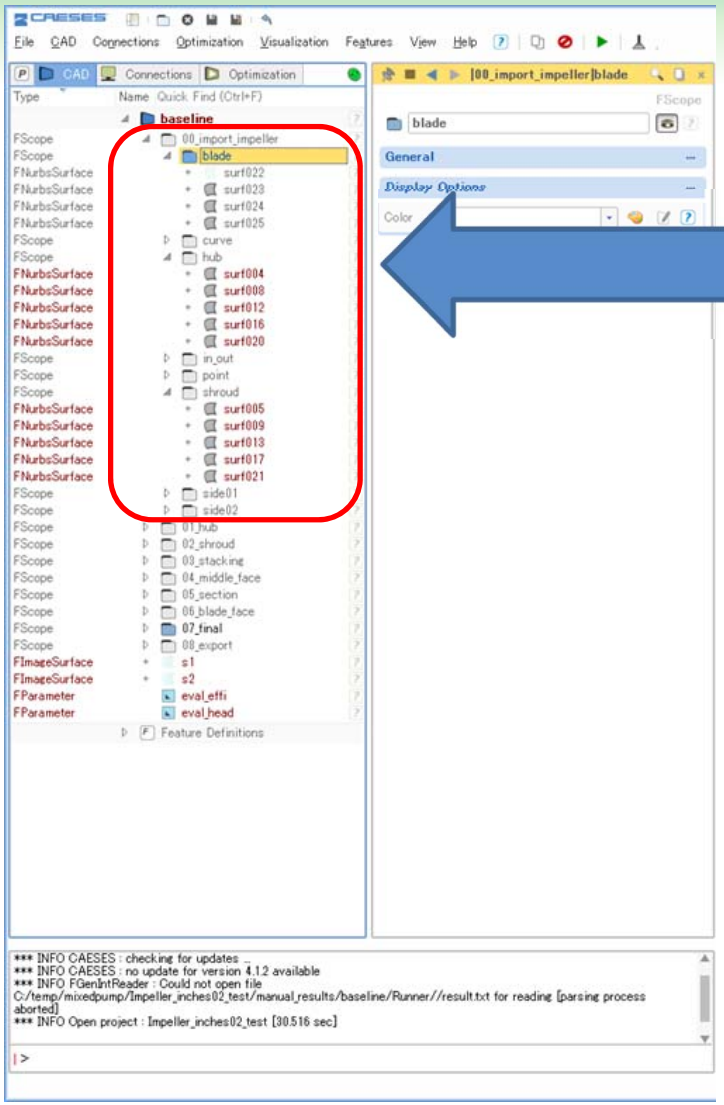
Coordinate data → Modeling → Morphing → Meshing → CFD

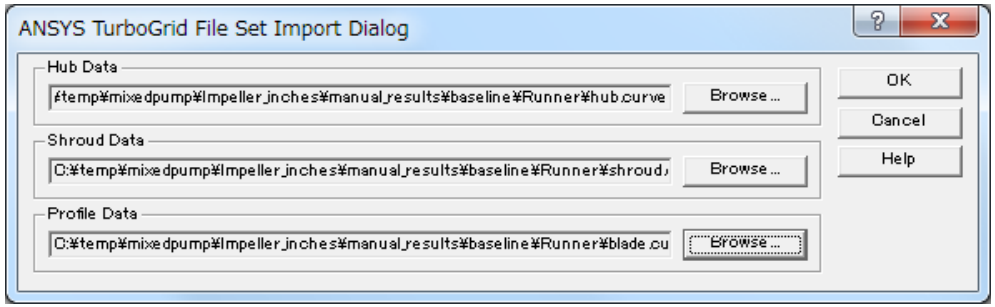
Shape morphing will be better than mesh morphing.



Fluid path modeled by CAESES

Import Coordinate Data



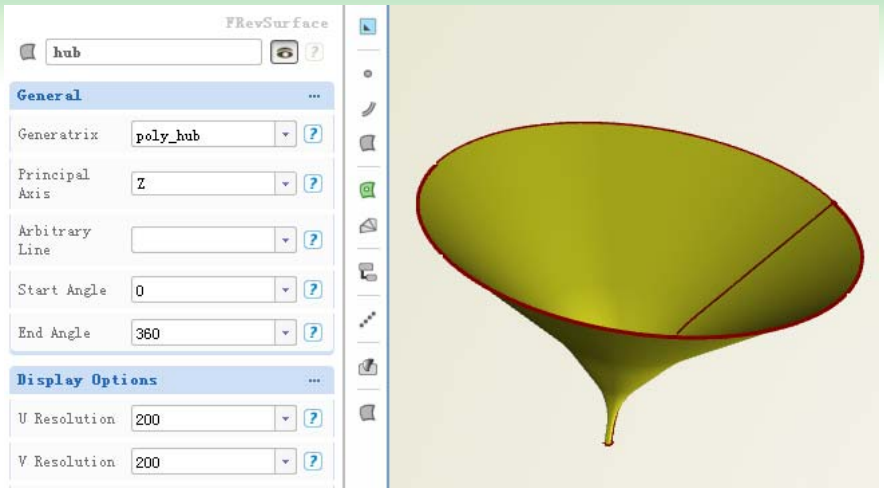


Import Dialog of ANSYS Blade Modeler

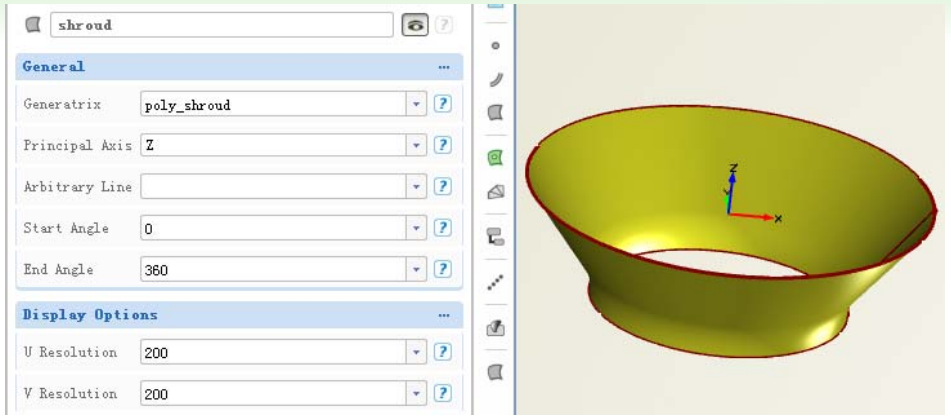
Coordinate data files for a blade, a hub, a shroud used by ANSYS Blade Modeler don't need to be changed for CAESES.

We can make efficient use of our technological asset.

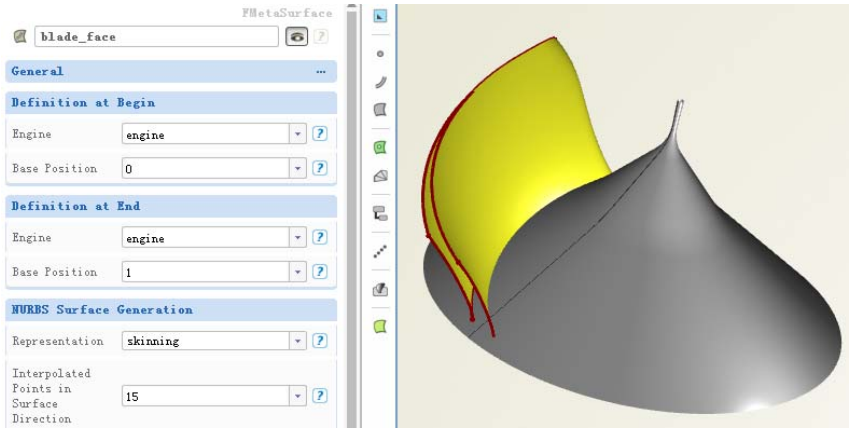
Modeling



Hub

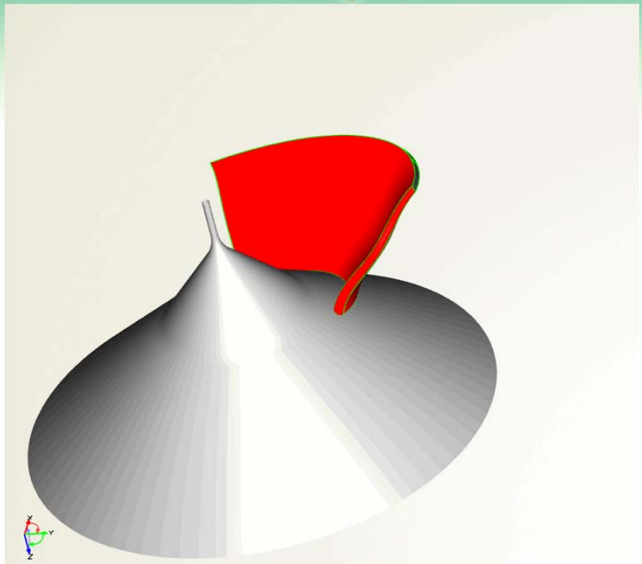


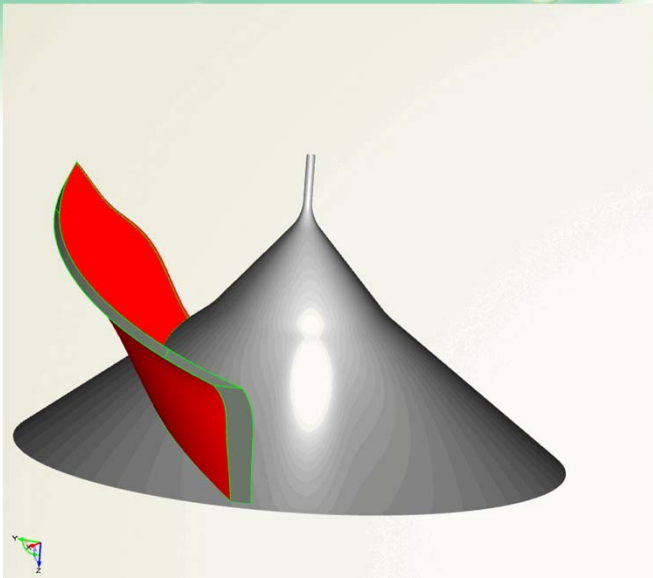
Shroud

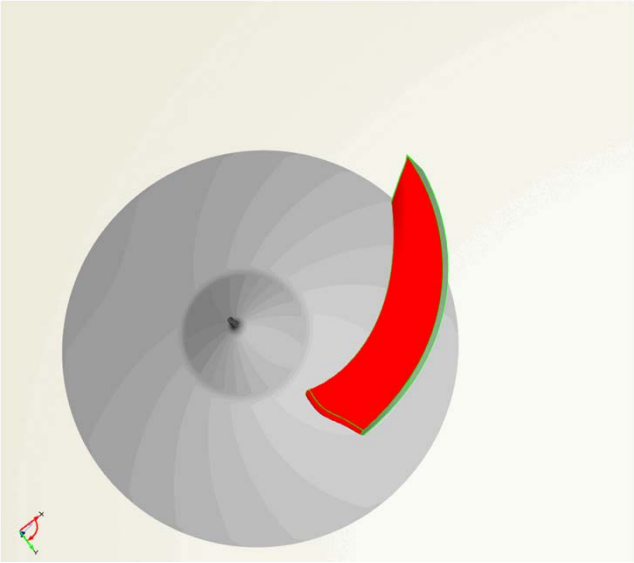


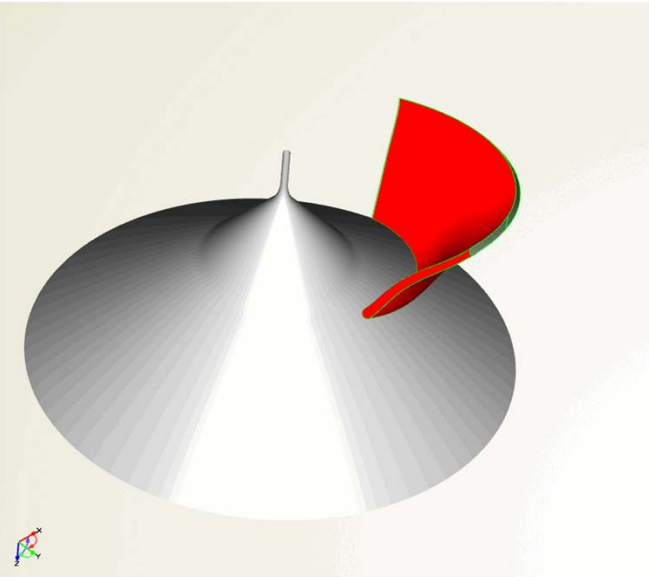
Blade

Shape Morphing

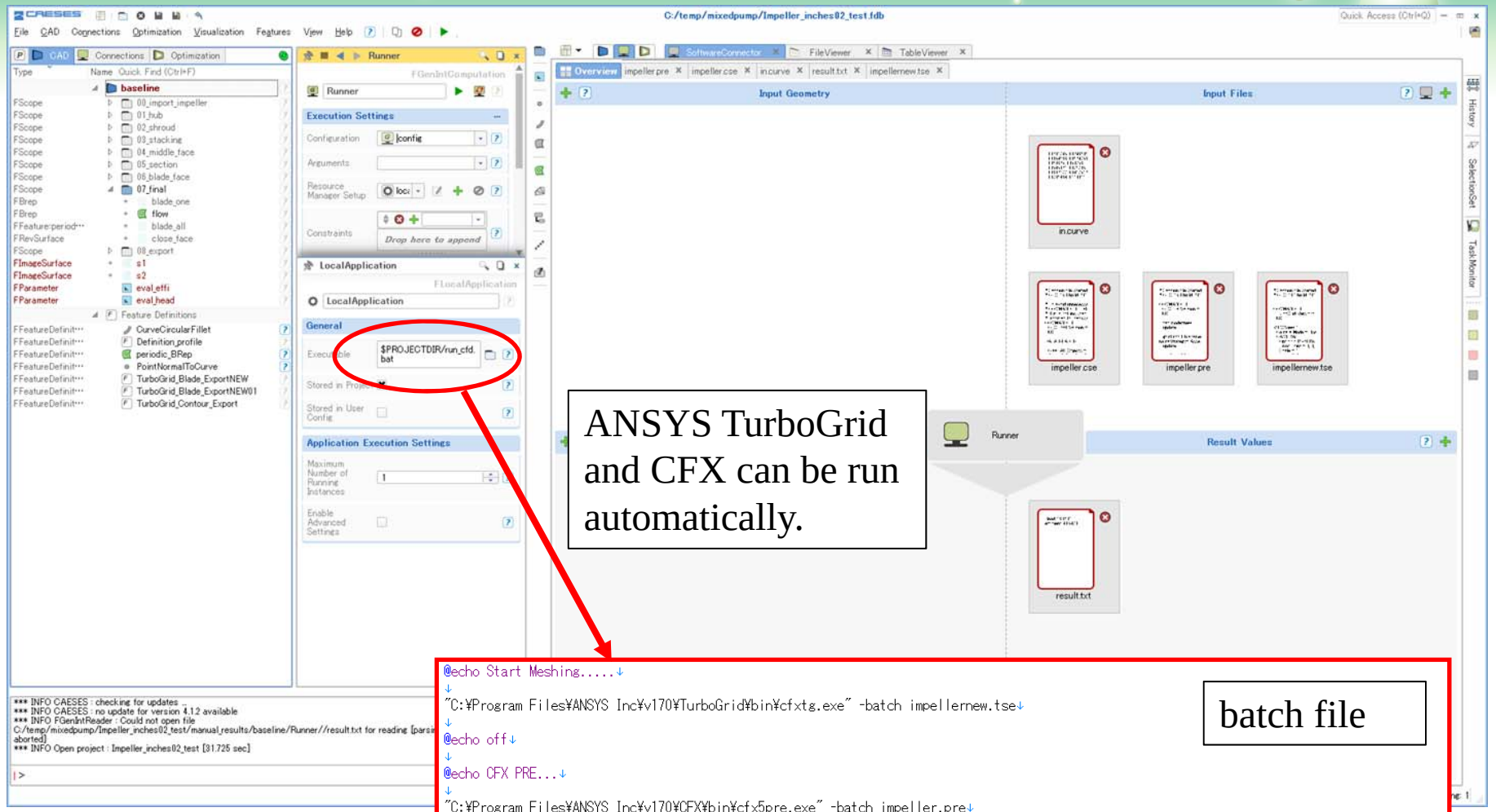




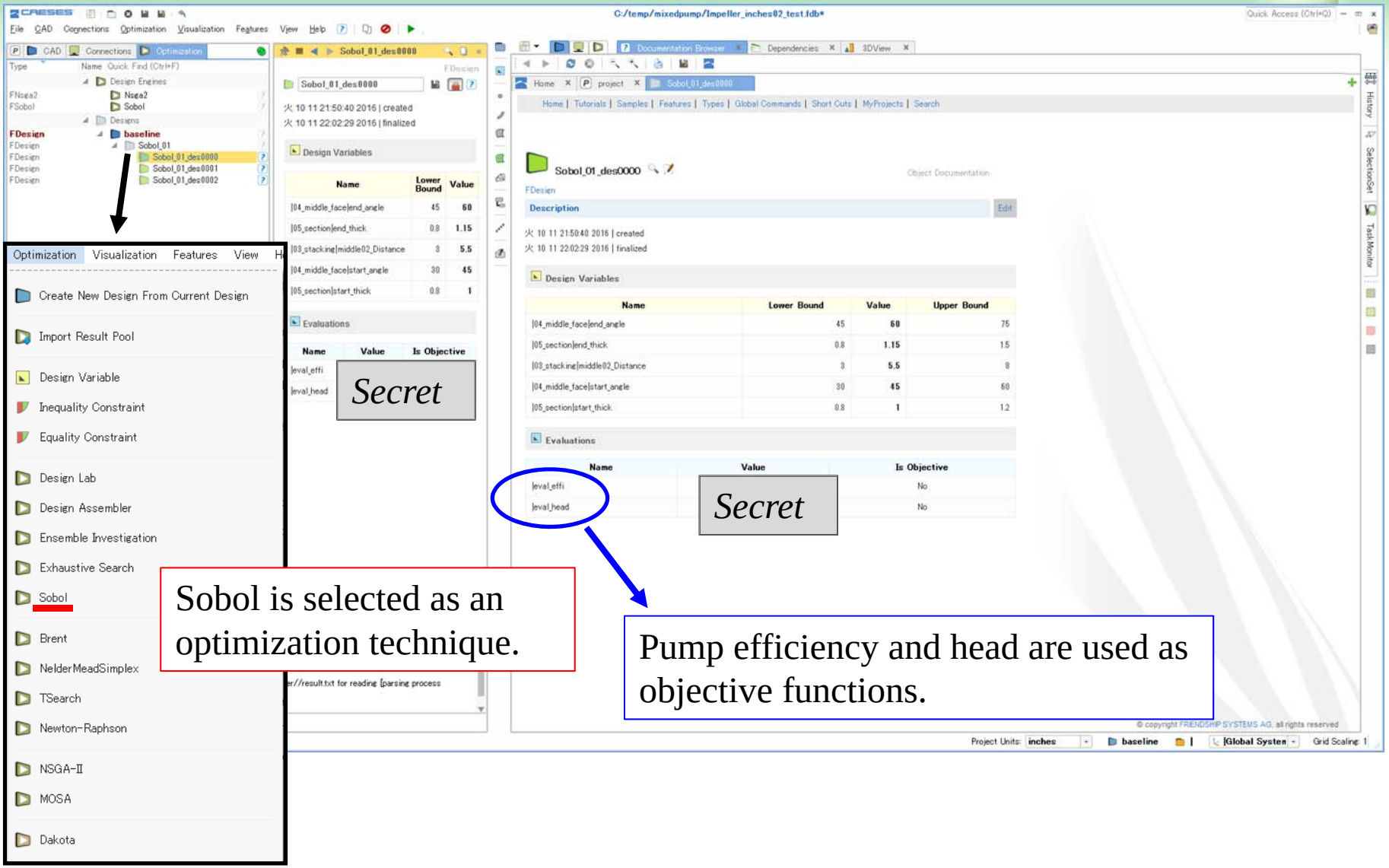




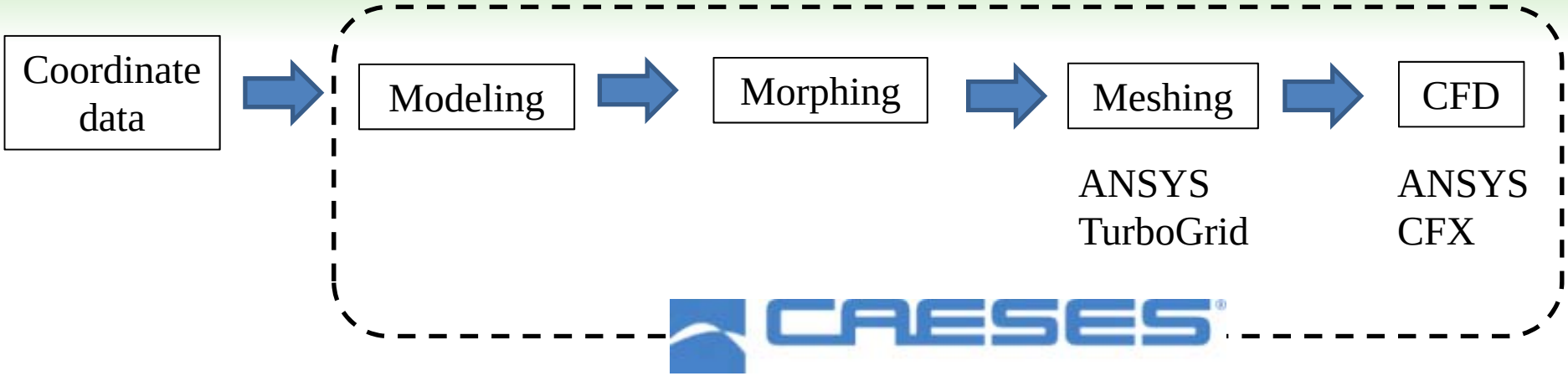
Meshing and CFD



Optimization



Conclusions



These phases can be controlled by CAESES.

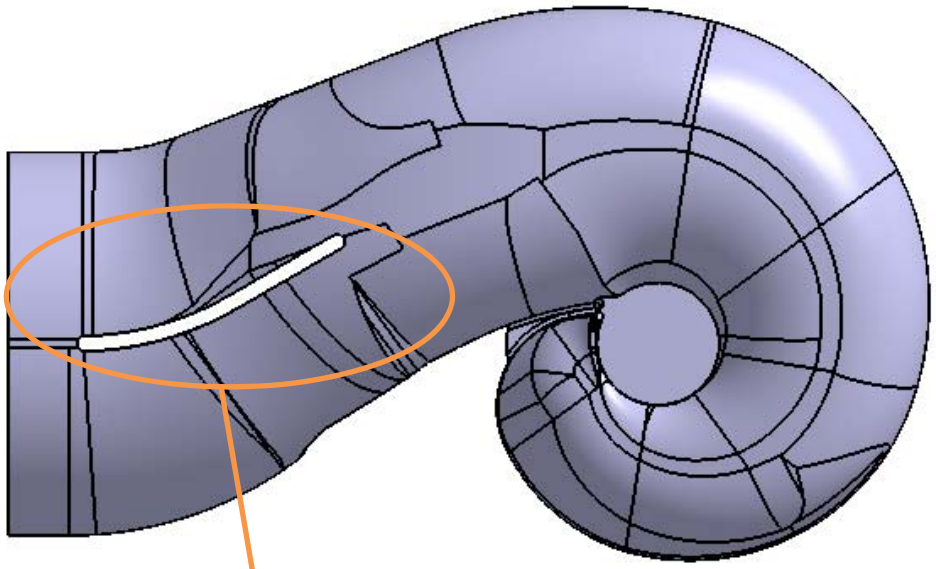
It will be able to be improved operational efficiency.

Future Work

Optimization for a merged model of a rotor and a stator of a mixed flow pump will be conducted.

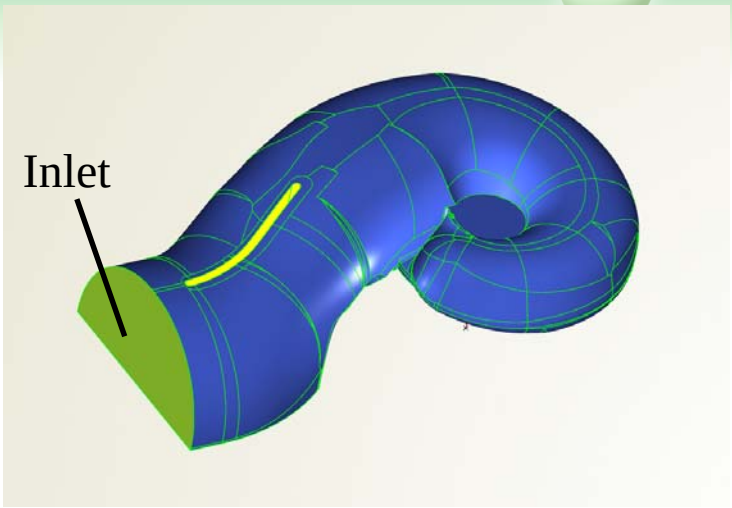
Case Study about Suction Part of Double Suction Pump

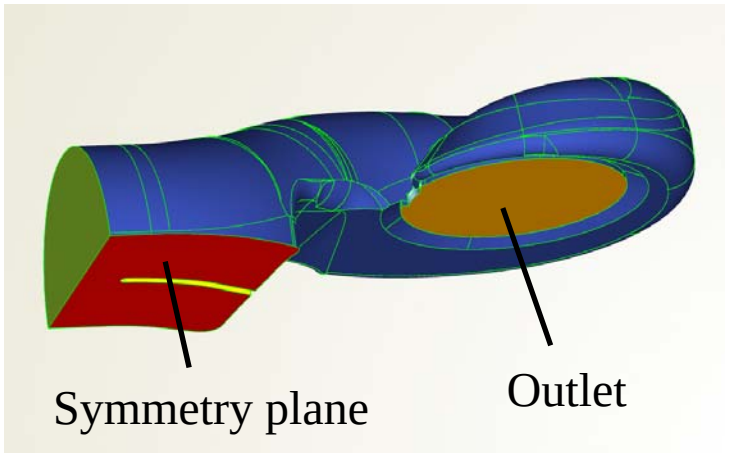
Suction Part of Double Suction Pump



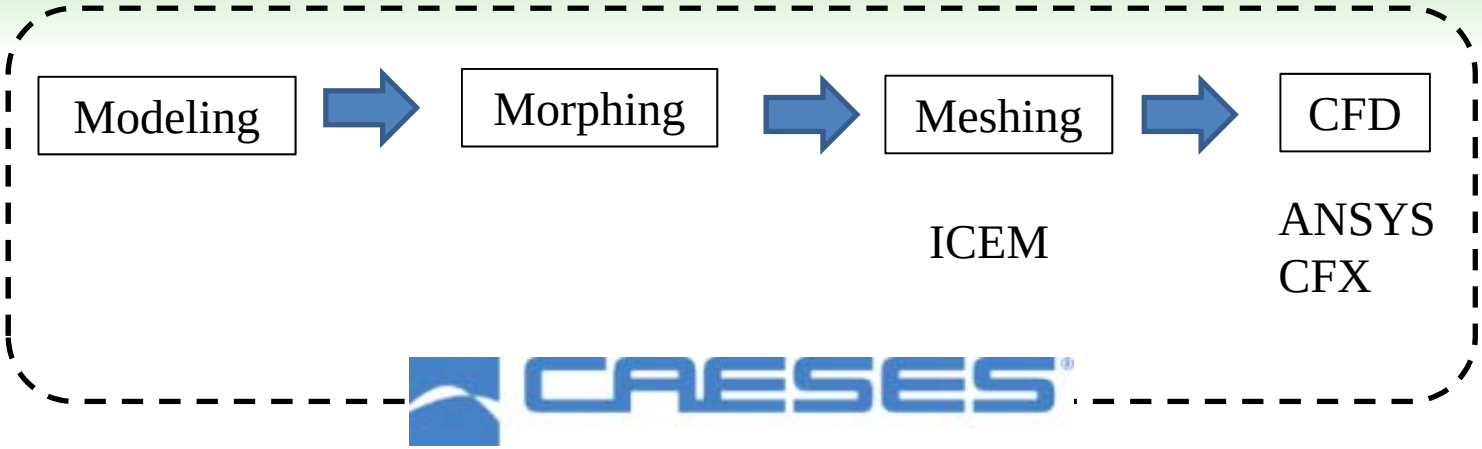
Fluid path modeled by CATIA

The optimization technique is used in order to find the shape of the guide vane having the lowest pressure drop.





Approach



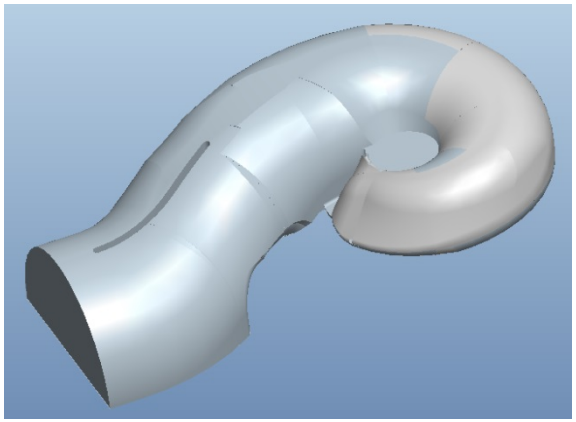
Each phase is controlled by CAESES.

Challenge

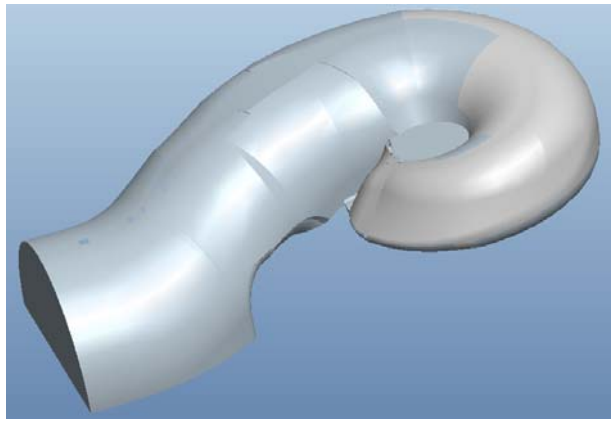
- ✓ It is reused the CATIA model as much as possible.
- ✓ ICEM is automatically controlled by CAESES.

Modeling

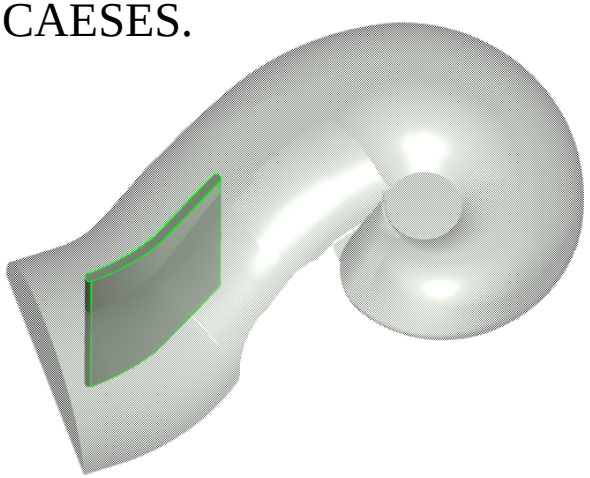
1. The CATIA model is read as a solid model.



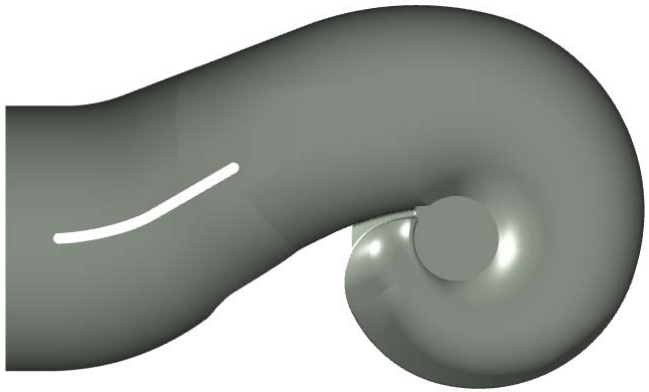
2. The guide vane is removed.



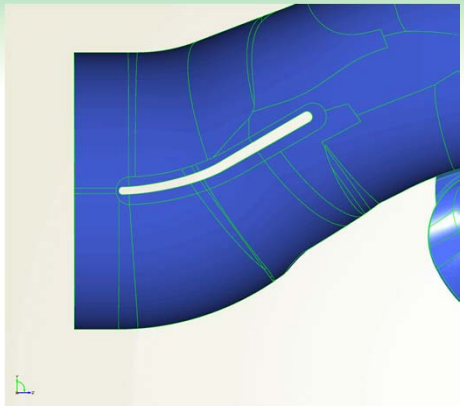
3. The guide vane is remodeled by CAESES.



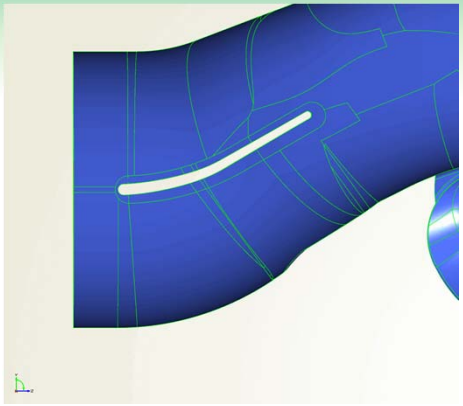
4. The guide vane is subtracted from the solid model.



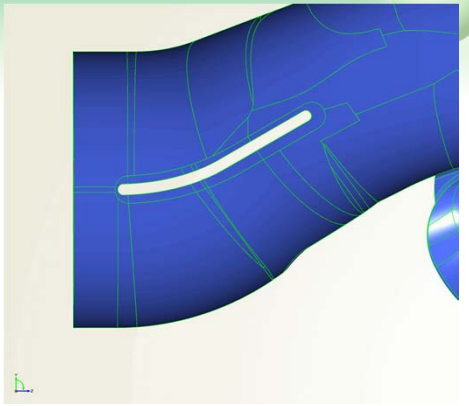
Morphing



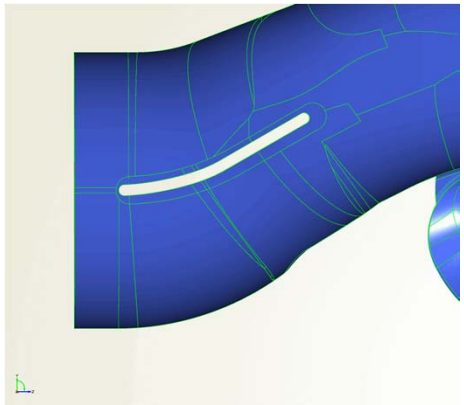
Thickness around leading edge



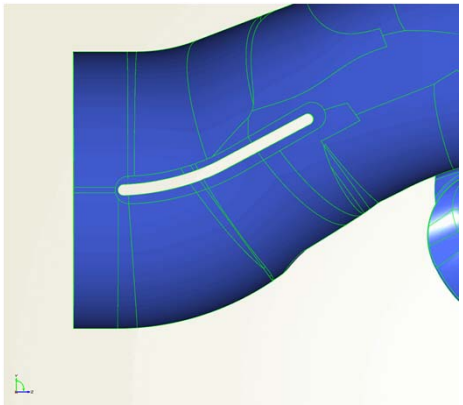
Thickness around trailing edge



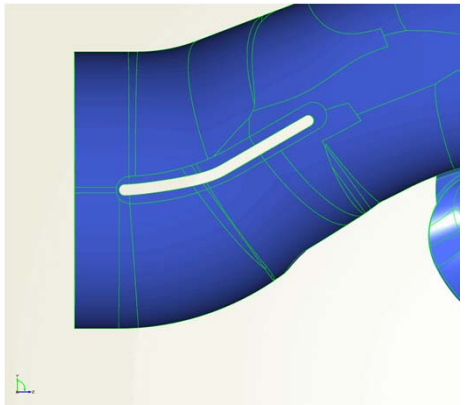
Geometry definition parameter 1



Length of guide vane



Exit angle of guide vane

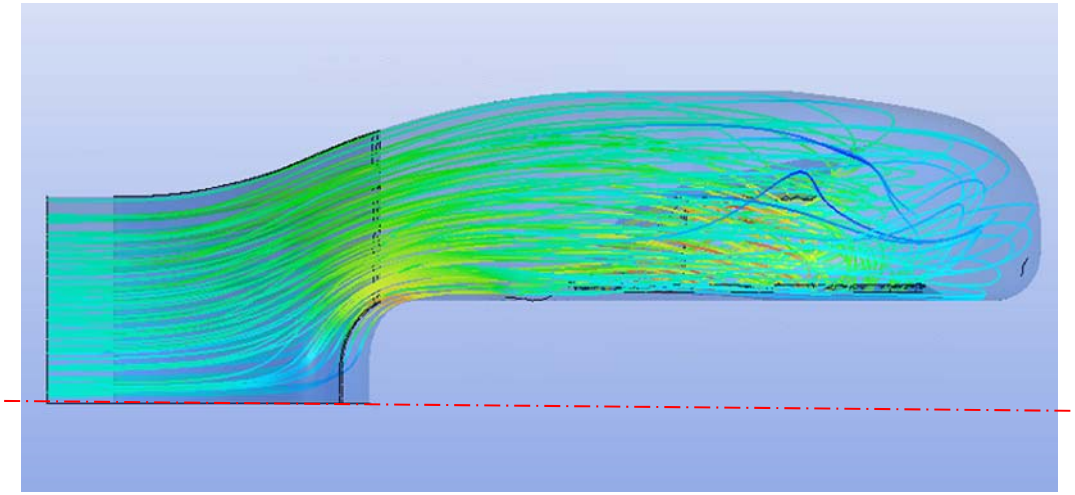


Geometry definition parameter 2

Meshing and CFX

```
@echo Start Meshing.....
↓
call "<entry>ANSYS_DIR</entry>¥icemcfd¥win64_amd¥bin¥icemcfd.bat" -batch -script ICEM.rpl
↓
@echo CFX PRE...
↓
"<entry>ANSYS_DIR</entry>¥CFX¥bin¥cfx5pre.exe" -batch DF.pre
↓
@echo CFX SOLVE...
"<entry>ANSYS_DIR</entry>¥CFX¥bin¥cfx5solve.exe" -def "DF.def" -start-method "MPI Local Parallel" -part 4 -double  -fullname DF_001
↓
@echo CFX POST...
"<entry>ANSYS_DIR</entry>¥CFX¥bin¥cfx5post.exe" -batch DF.cse
```

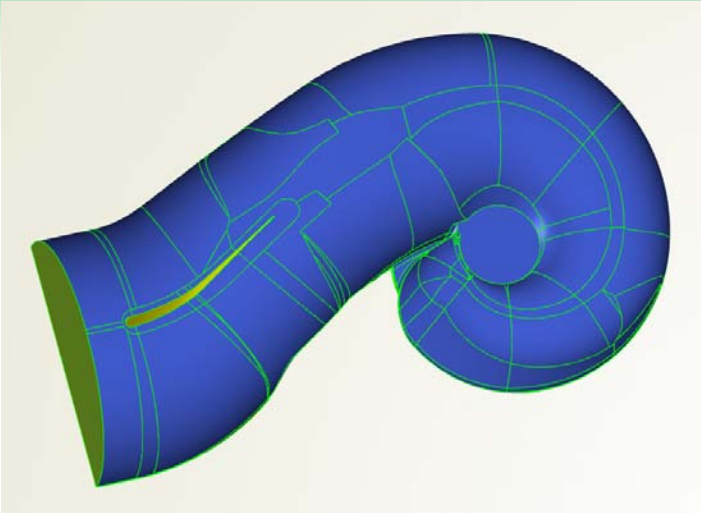
ICEM is automatically run by a batch file.



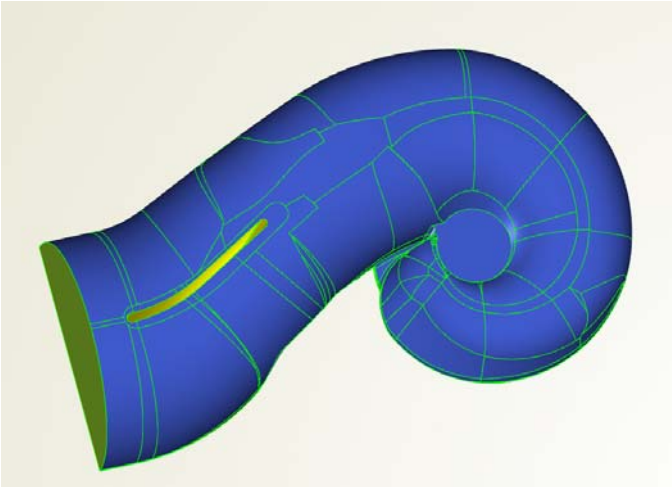
Symmetry plane

By considering the symmetry of the suction part of the double suction pump, the symmetry condition is applied to the CFD model.

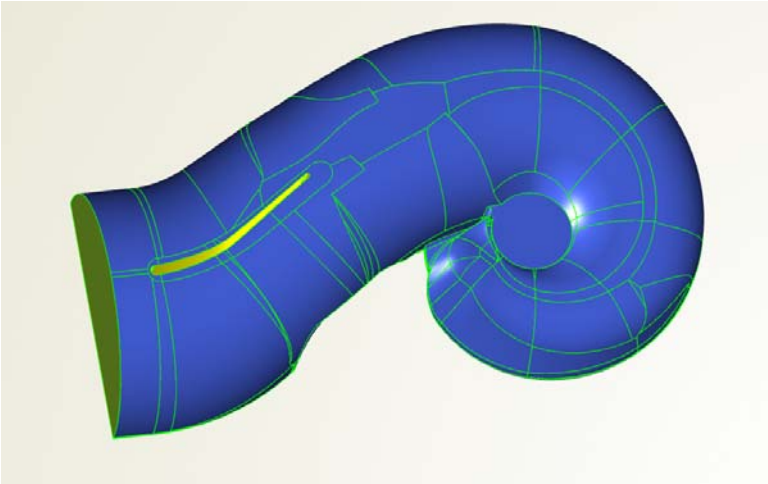
Optimization



Minimum pressure drop model

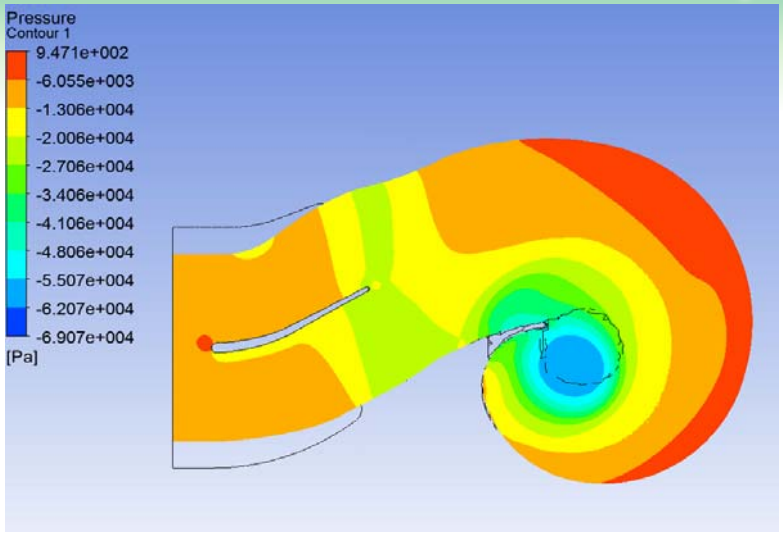


Original model

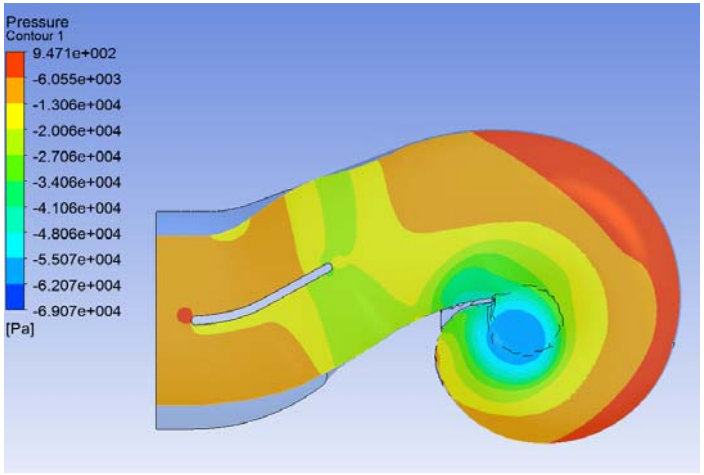


Thicker trailing edge model

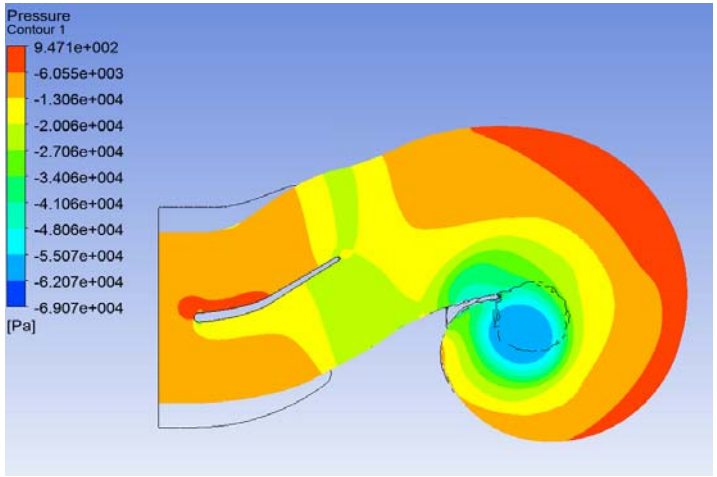
Pressure Distribution



Minimum pressure drop model

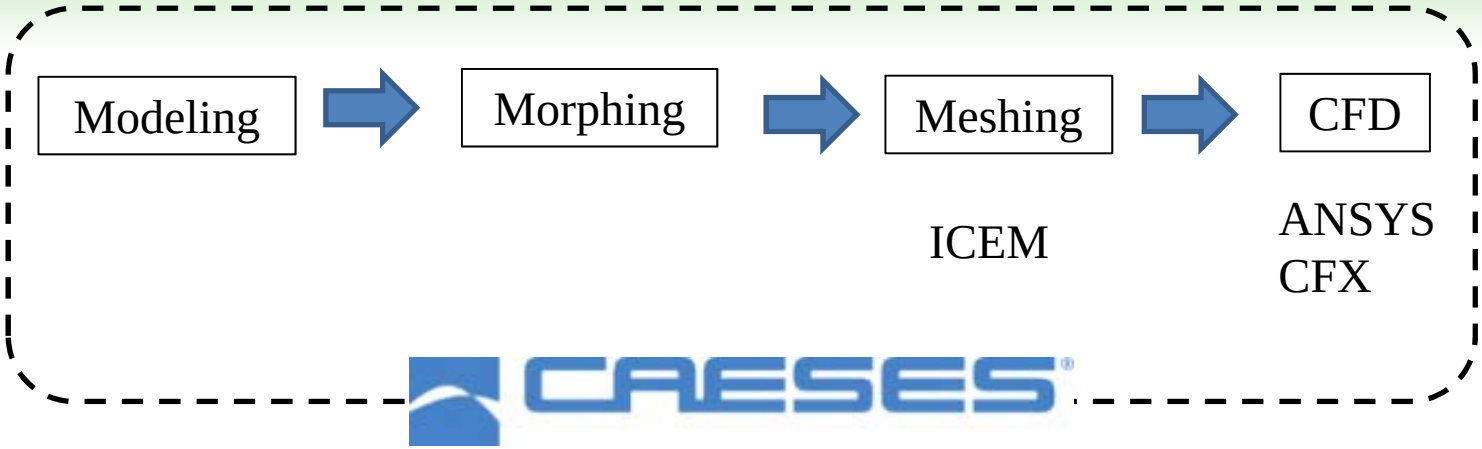


Original model



Thicker trailing edge model

Conclusions



Each phase is possible to be controlled by CAESES. ICEM and ANSYS CFX are automatically run.

The optimized geometry of the guide vane in the suction part of the double suction pump is found.

Future Work

Optimization for a whole double suction pump model will be conducted.