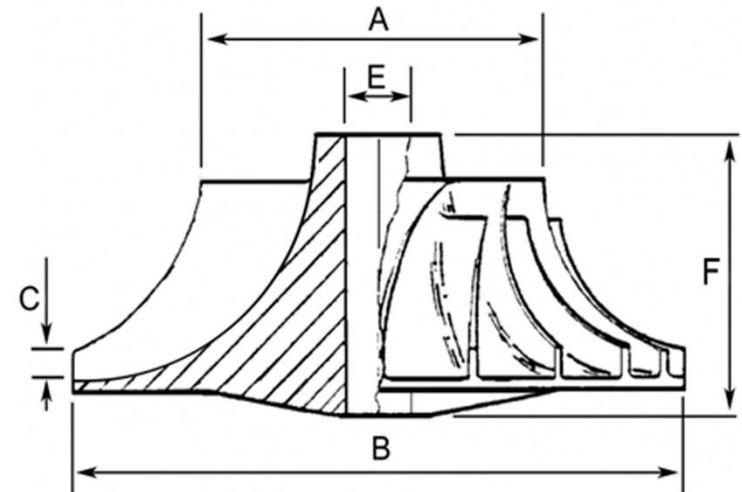
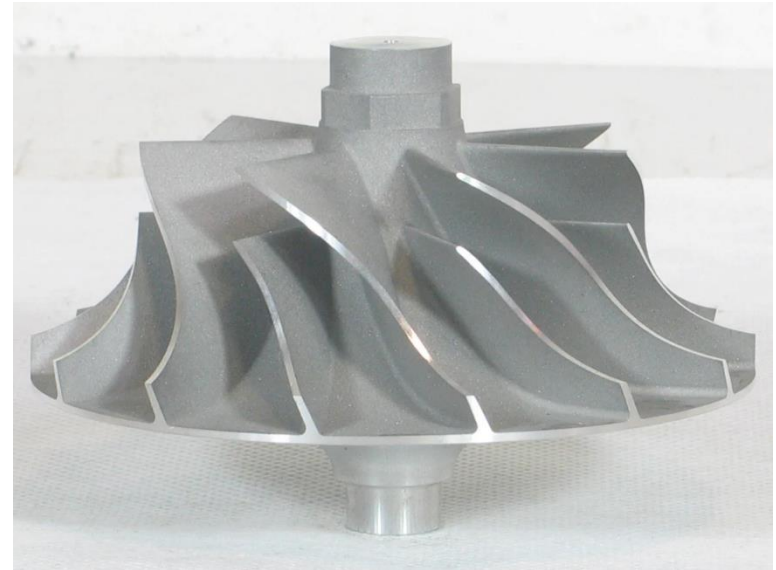




Reverse Engineering

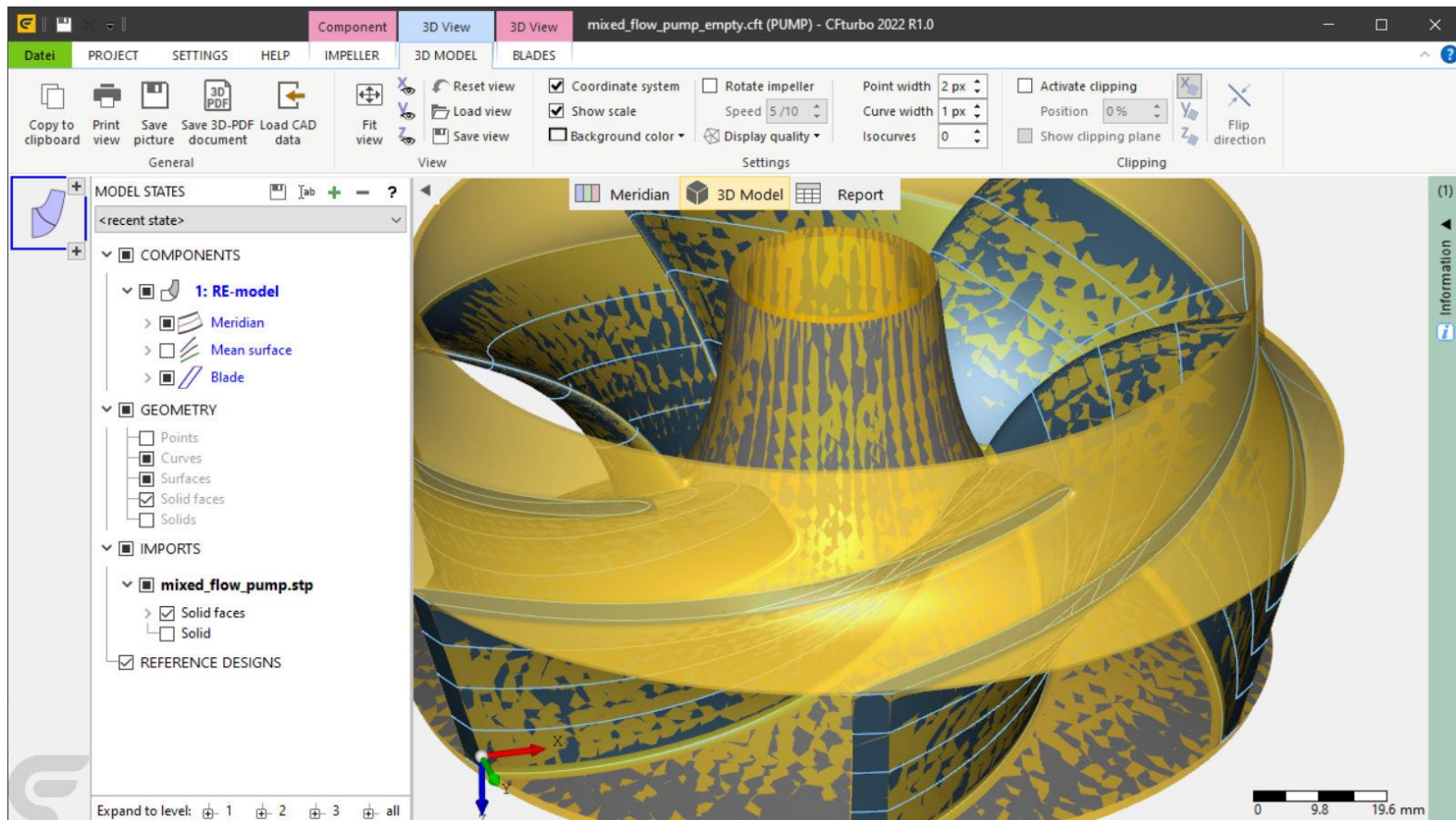
What is Reverse Engineering?

- Many turbomachinery companies have collected a large number of legacy designs for which 3D CAD data are available
- Those CAD models are often non-parametrized or parametrized with limited flexibility for redesign
- Turbomachinery designs should be accessible for convenient and fast geometry modifications to improve performance and efficiency
- The conversion into a turbomachinery specific parametric modeling is required



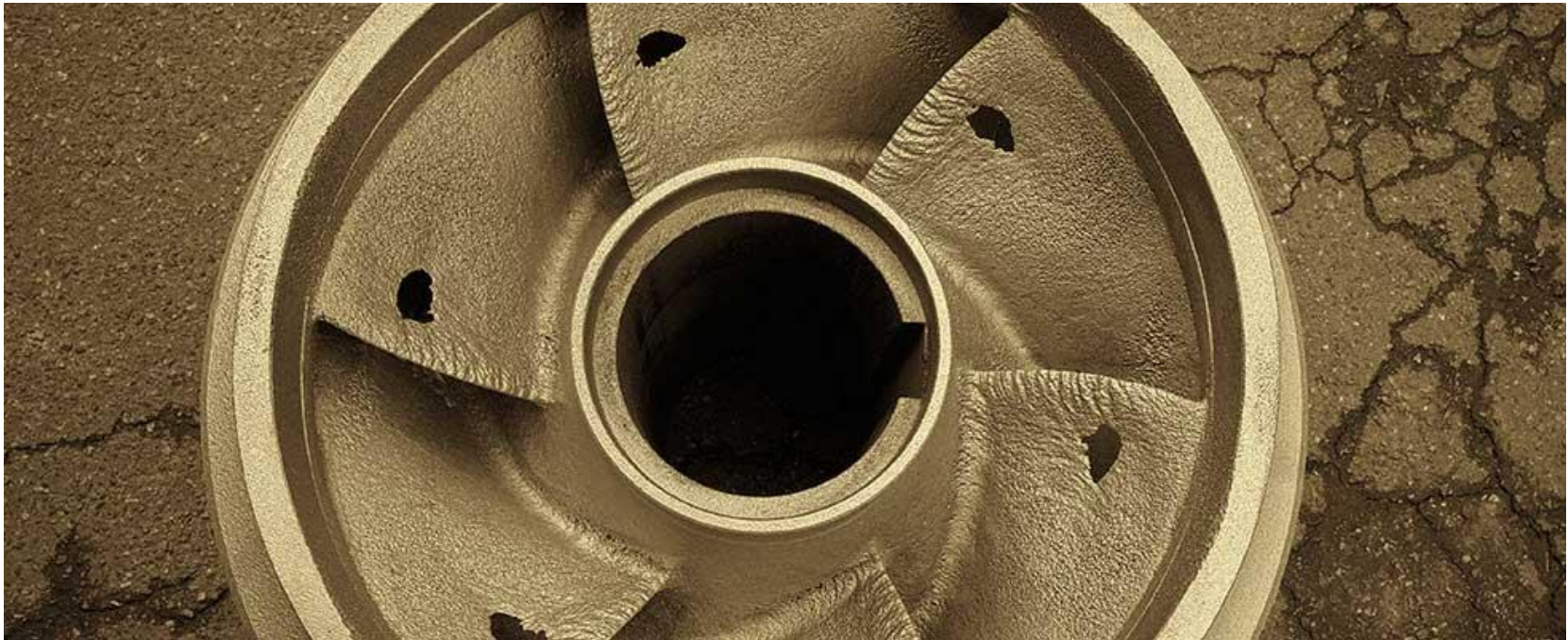
What is Reverse Engineering?

- CFturbo's new reverse engineering tool converts any bladed turbomachinery CAD model into a **fully parametric** CFturbo file for further design exploration in a very short time



Why do Reverse Engineering?

- If legacy designs are available but no parametric CAD drawing, CFturbo modeling helps to rebuild 3D-CAD files of Turbomachinery components
- CFturbo reverse engineering will be effective for comparing data and geometry models with other parts on the market
- In the after-market business, reverse engineered models are key for re-design and production of turbomachinery parts and components



How does Reverse Engineering work?

Step1. Import of the 3D CAD model

Any number of files in STEP, IGES, Parasolid or BREP format can be selected.

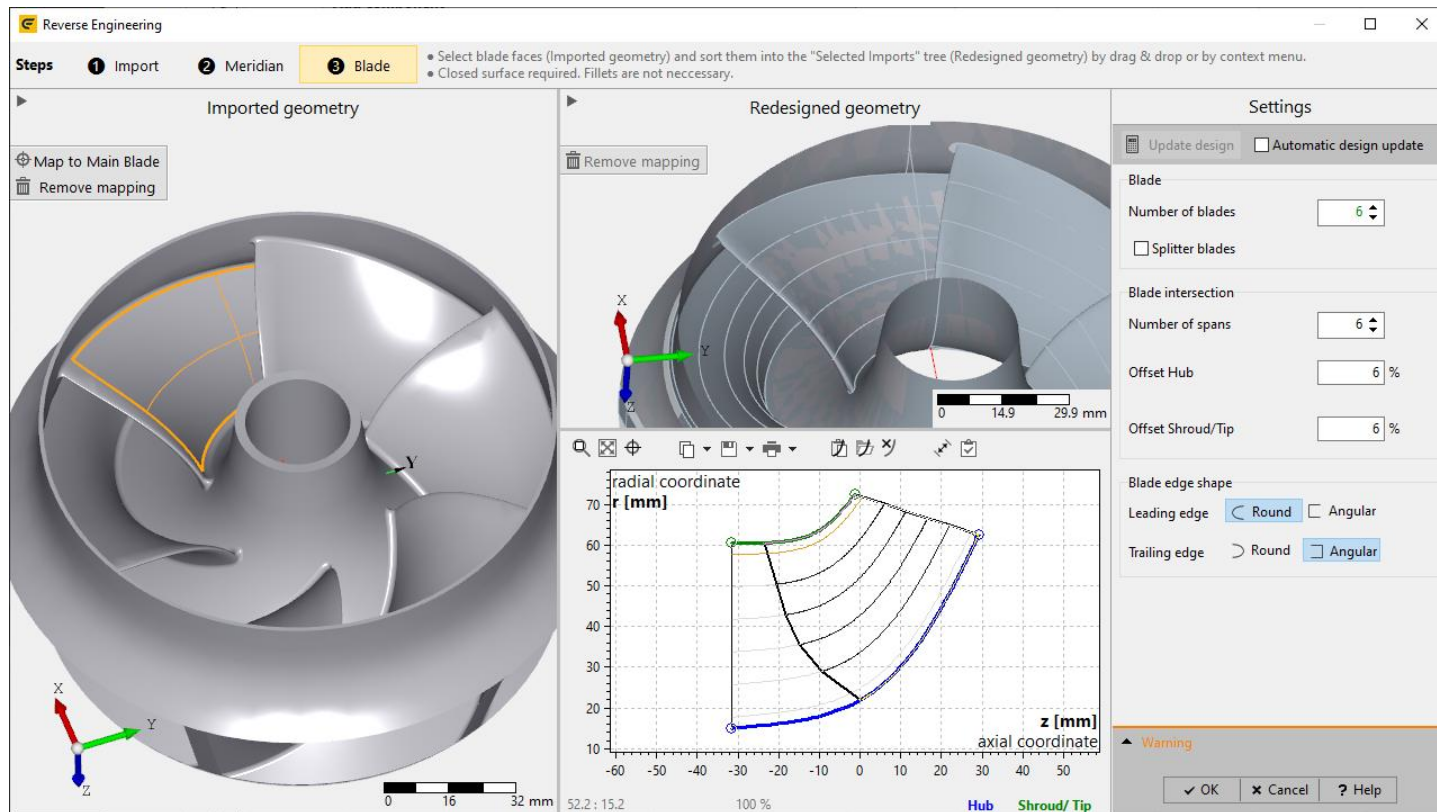
Reverse engineering is currently possible for radial, mixed-flow and axial impellers, as well as vaned stators of pumps, blowers, fans, compressors, hydro turbines and gas turbines.



How does Reverse Engineering work?

Step 2. Detect the meridional contour and blades

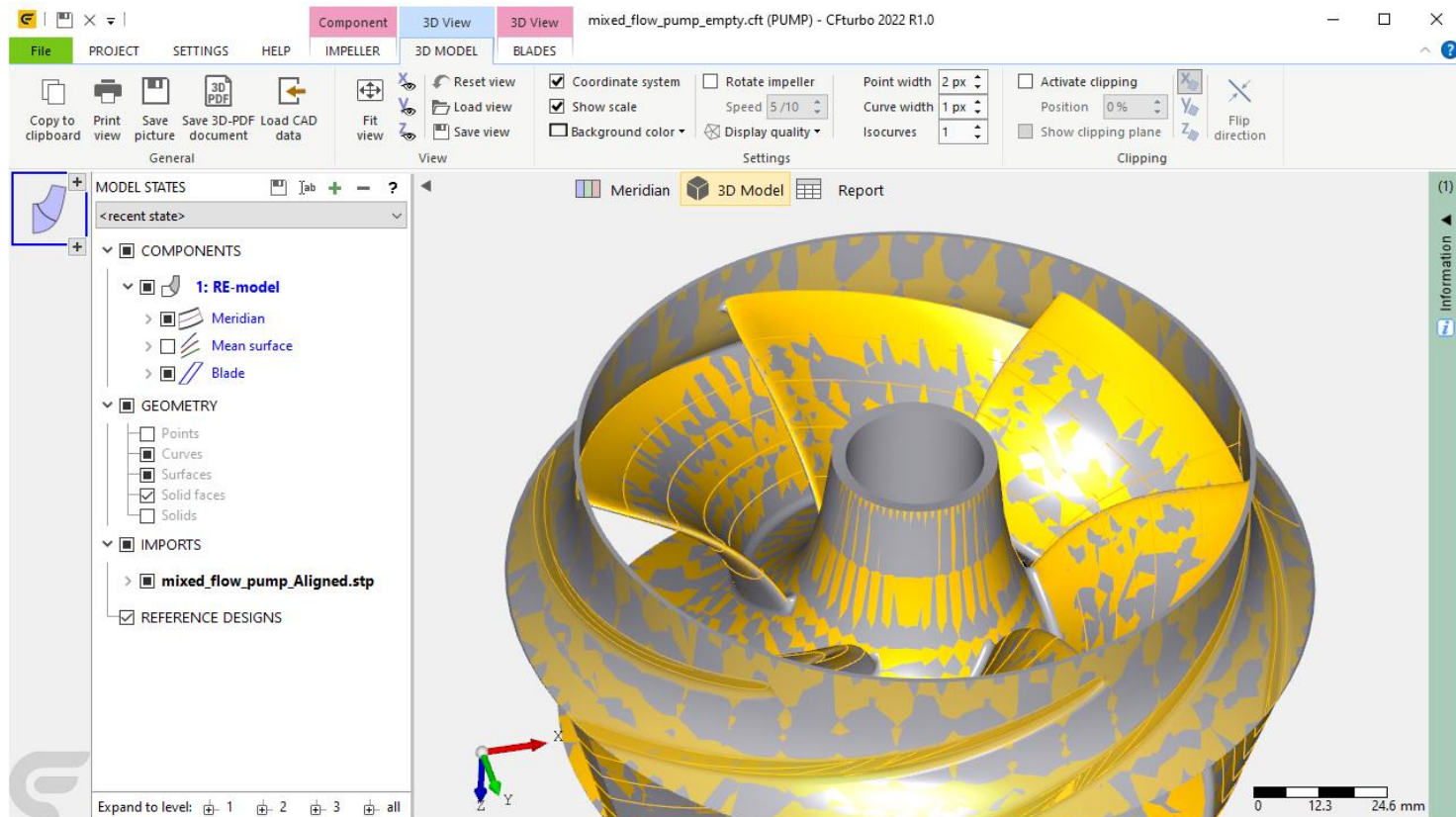
By selecting the corresponding surfaces in the original 3D model, the meridional contours, and the surfaces of the main blades can be defined, if required also those of the splitter blade.



How does Reverse Engineering work?

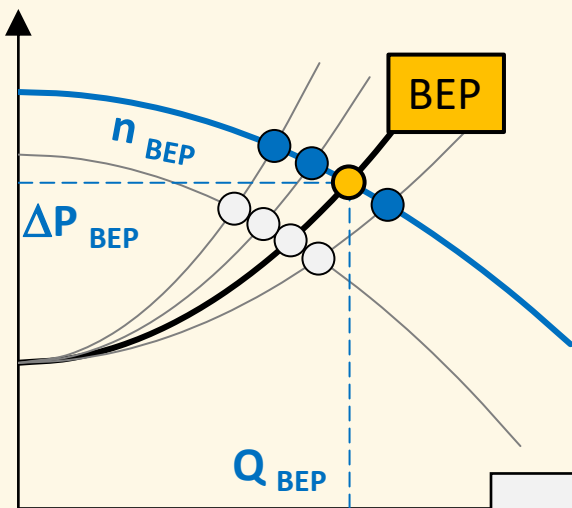
Step.3 Continue work in CFturbo design process

Subsequently, all geometry parameters are available in CFturbo, for manual variations or optimizations, allowing the full potential for product improvements to be unlocked.





Adjust, modify, re-design, export ... all fully parametric



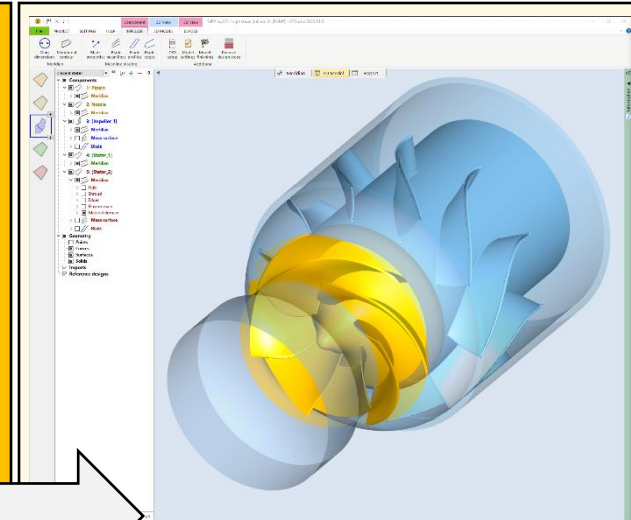
Define operating point Best Efficiency Point (BEP)

Volume flow rate, head or total pressure difference, rotational speed, fluid properties, inlet conditions

Fundamental equations
Bernoulli-, Euler equation,
Mass-, Momentum-, Energy
conservation, ...

CFturbo

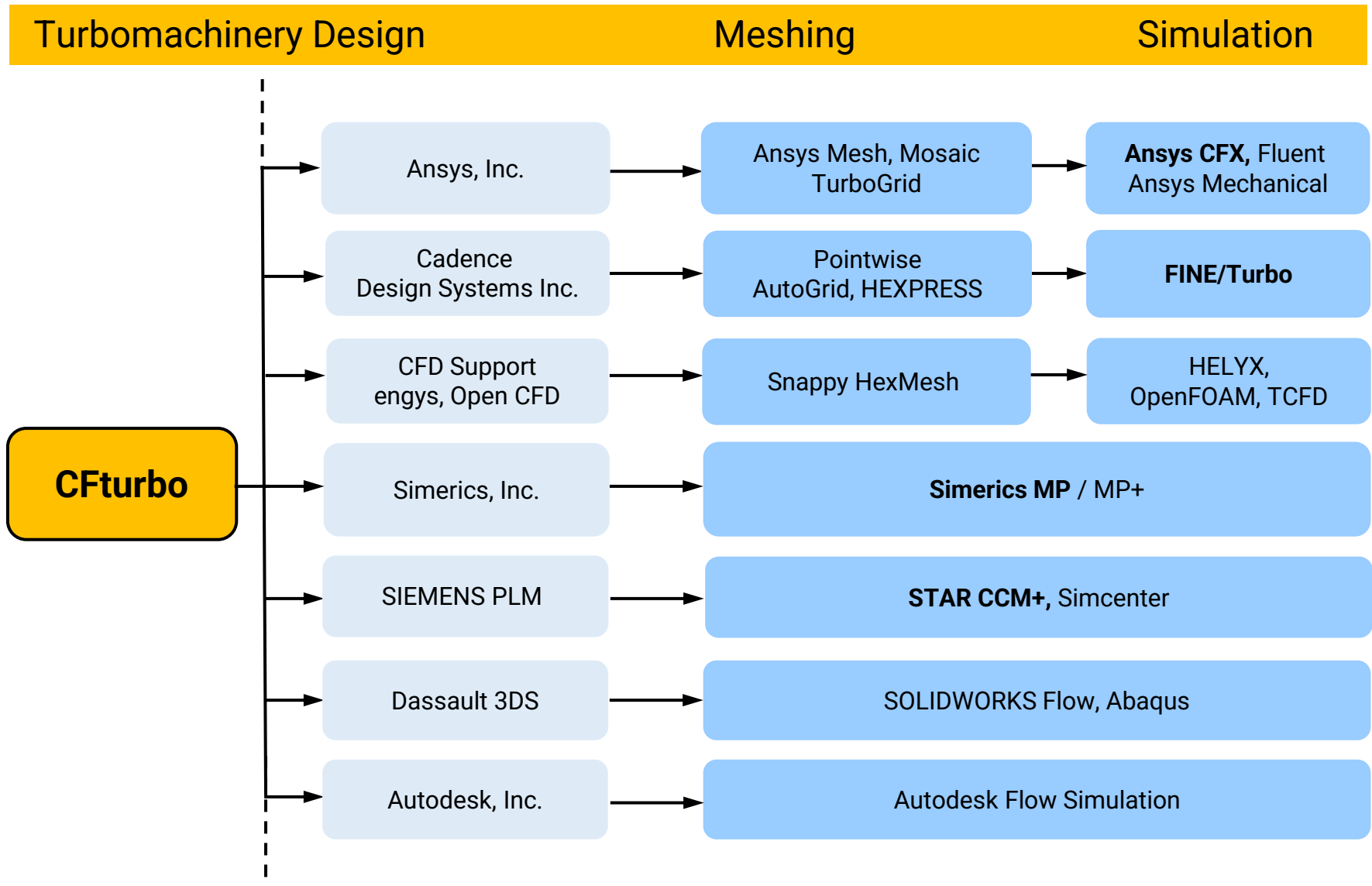
Empirical correlations
Using publicly available
knowledge, or own
proprietary data



Get 3D-CAD-model
Fluid and solid
domains

CAD / CFD / FEM -
export formats
define batch-mode

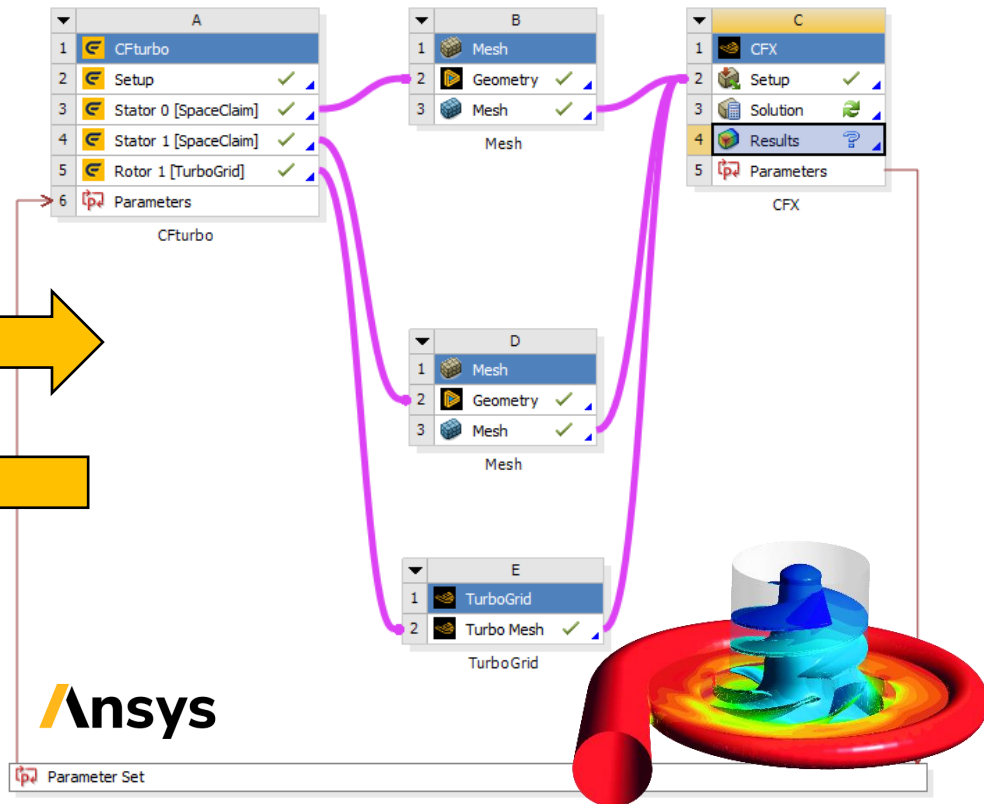
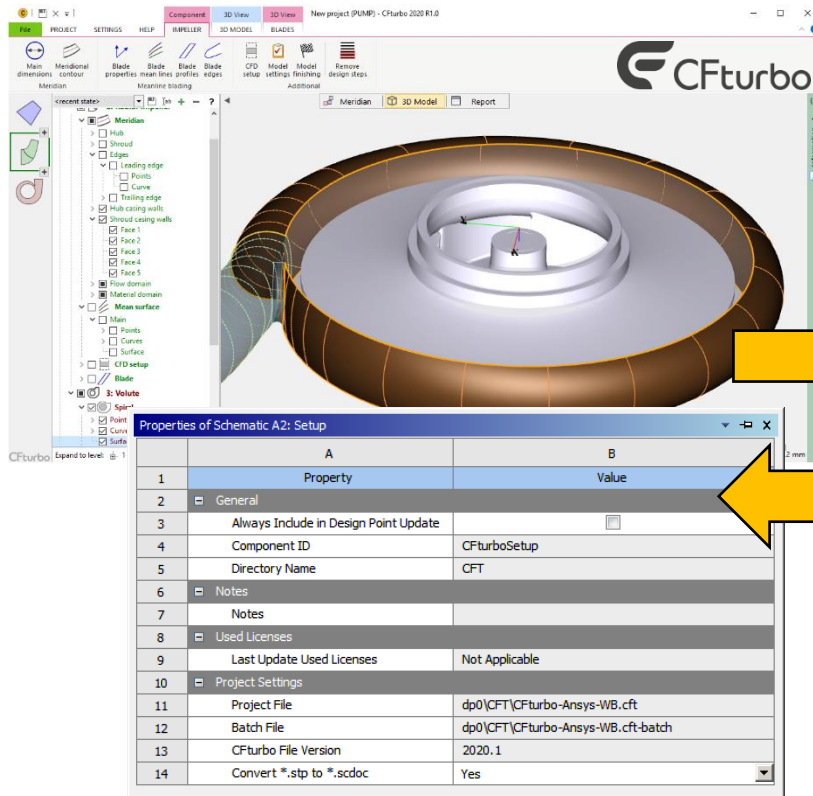
Option: CFturbo Interfaces to 3D-CFD/FEA



Option: CFturbo for Design Exploration and Optimization

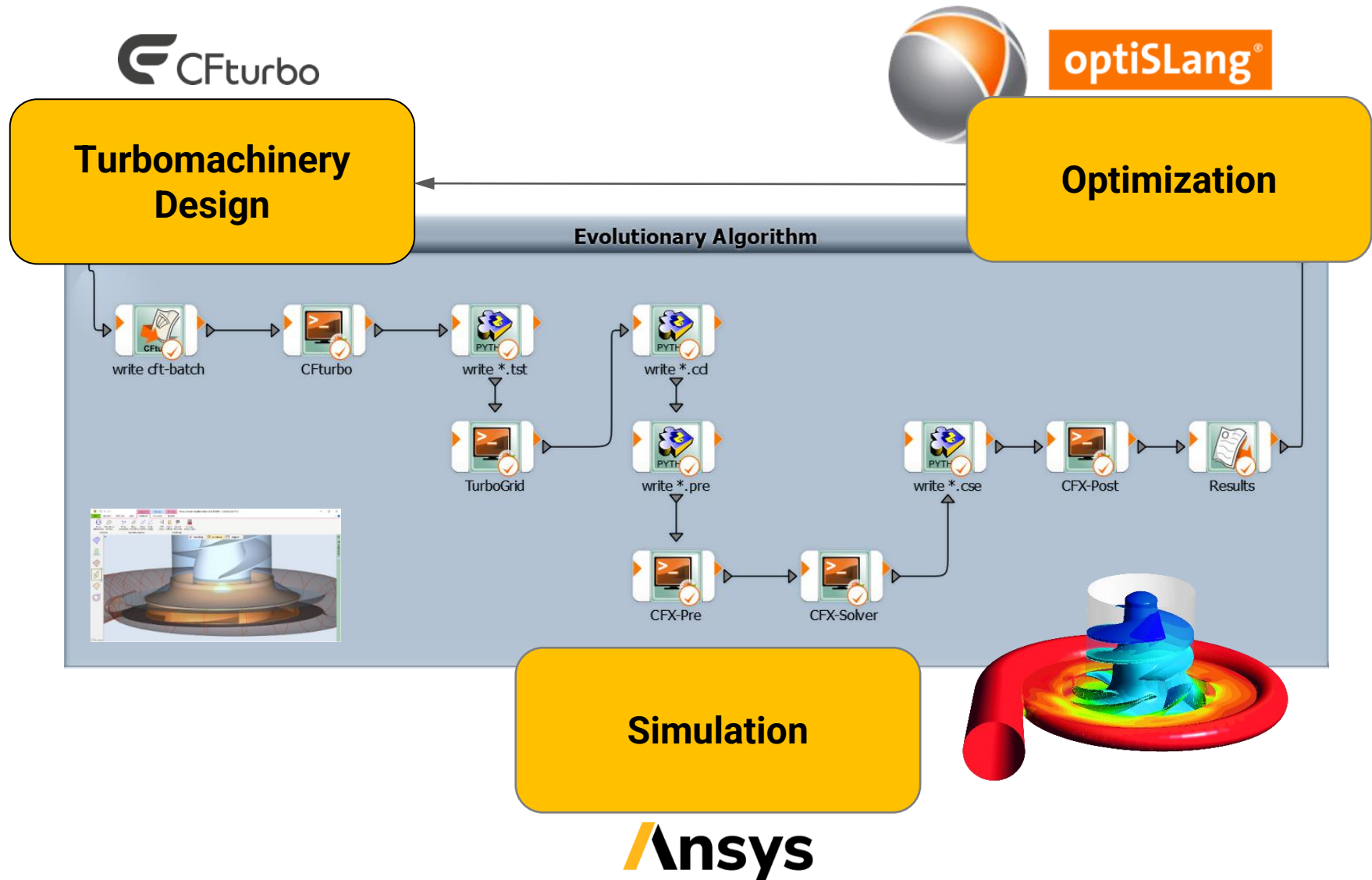


Bi-directional Integration, example Ansys Workbench



CFturbo can be combined with other CFD, FEA, optimization code

Optimization Workflow: CFturbo - Ansys CFX - optiSLang

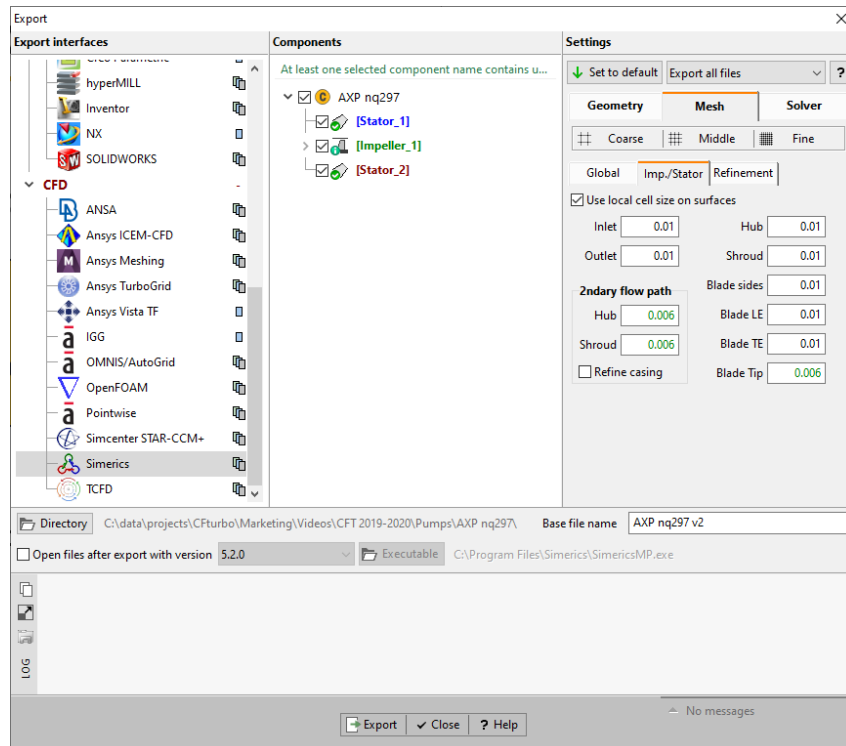




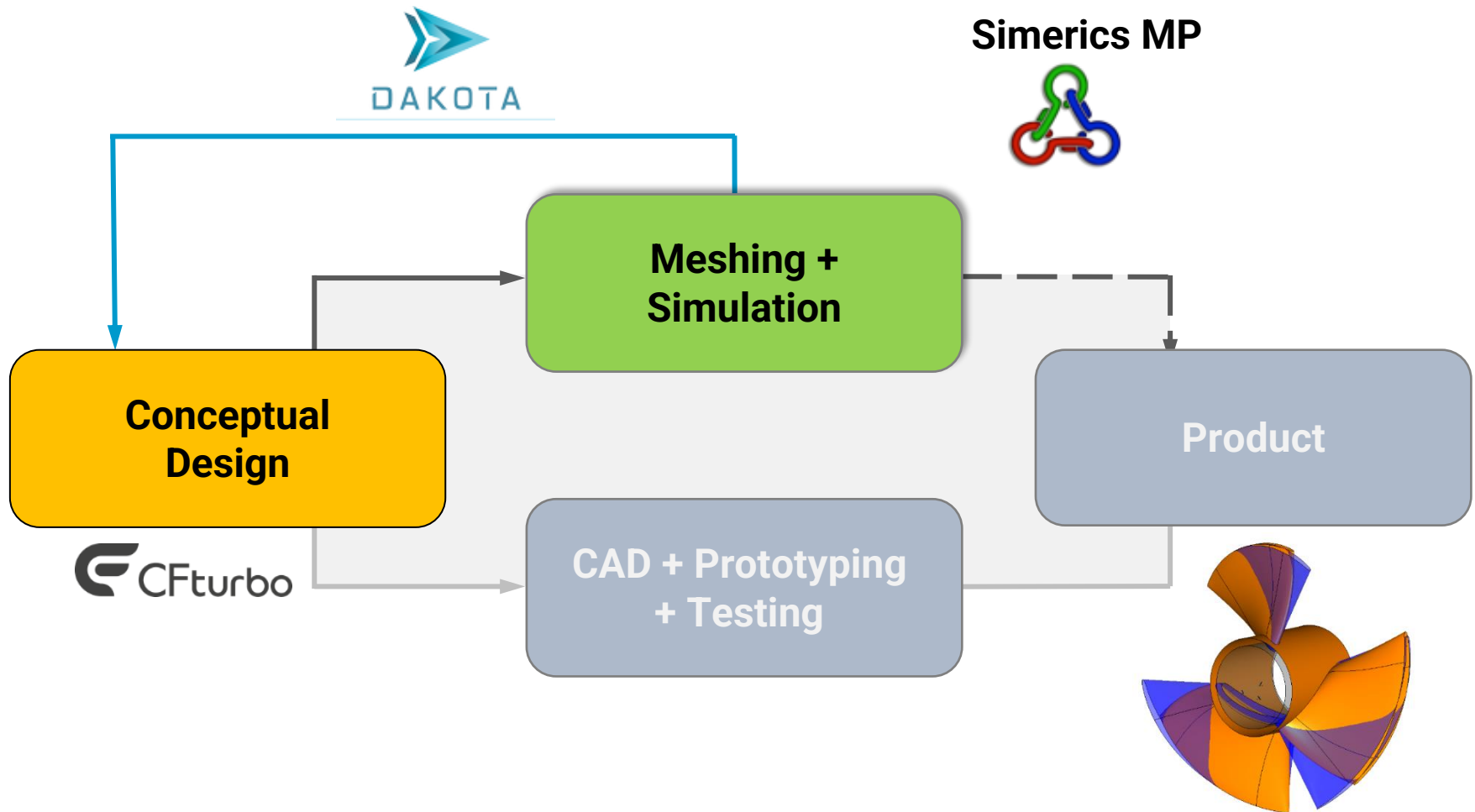
**Conceptual
Design**

SMP

**Meshing +
Simulation**



- Define mesh parameters and solver settings in CFturbo export window
- Immediate start of simulation for the CFturbo design point
- Python scripts for batch runs are available to get performance curves



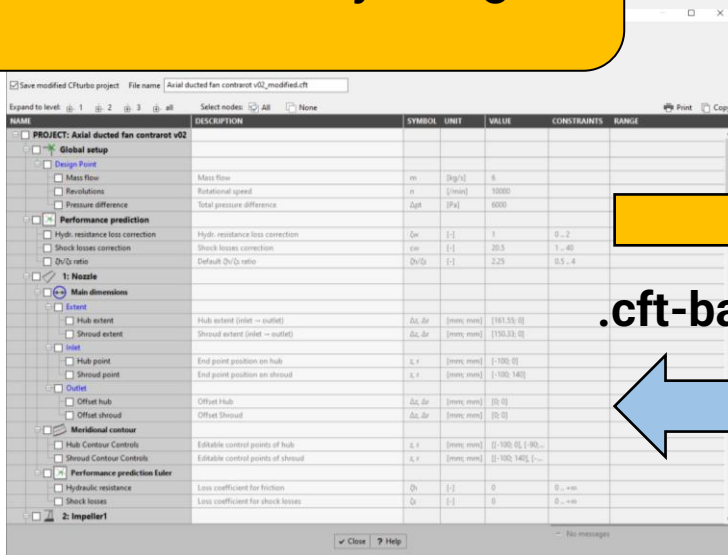


SIEMENS

StarCCM+
Design Manager

**Conceptual
Turbomachinery Design**

**Meshing + Simulation,
Design Exploration**

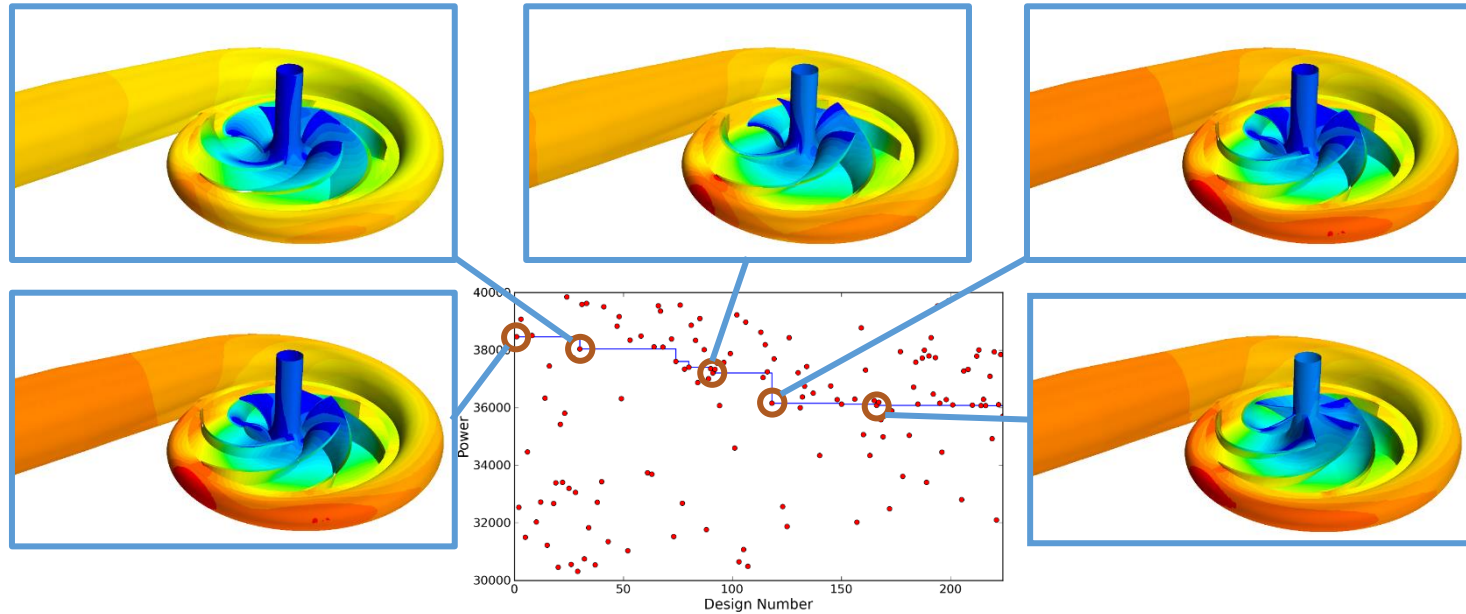


NAME	DESCRIPTION	SYMBOL	UNIT	VALUE	CONSTRAINTS	RANGE
PROJECT: Axial ducted fan contrarot v02						
Global setup						
Design Point						
Mass flow	Mass flow	m	[kg/s]	8		
Rotational speed	Rotational speed	n	[1/min]	10000		
Pressure difference	Total pressure difference	Δpt	[Pa]	6000		
Performance prediction						
Hyd. resistance loss correction	Hyd. resistance loss correction	Δp	[-]	1	9..2	
Shock losses correction	Shock losses correction	csw	[-]	20.5	1..40	
On/Off ratio	Default On/Off ratio	On/Off	[-]	2.25	0.5..4	
1: Nozzle						
Main dimensions						
Extent						
Hub extent	Hub extent (inlet → outlet)	Δx, Δr	[mm; mm]	[181.55; 0]		
Shroud extent	Shroud extent (inlet → outlet)	Δx, Δr	[mm; mm]	[150.33; 0]		
Point						
Hub point	End point position on hub	x, r	[mm; mm]	[100; 0]		
Shroud point	End point position on shroud	x, r	[mm; mm]	[100; 140]		
Outlet						
Offset hub	Offset hub	Δx, Δr	[mm; mm]	[0; 0]		
Offset shroud	Offset shroud	Δx, Δr	[mm; mm]	[0; 0]		
Meridional contour						
Hub Contour Controls	Editable control points of hub	x, r	[mm; mm]	[100; 0], [90; 0]		
Shroud Contour Controls	Editable control points of shroud	x, r	[mm; mm]	[100; 140], [100; 0]		
Performance prediction Euler						
Hydraulic resistance	Loss coefficient for friction	Δh	[-]	0	0..∞	
Shock losses	Loss coefficient for shock losses	Δs	[-]	0	0..∞	
2: Impeller1						

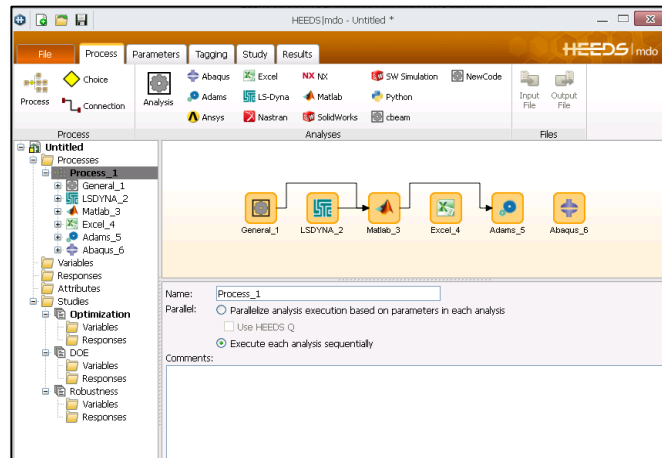
.cft-batch files (.xml)

Under Development
Release target Q2.2023

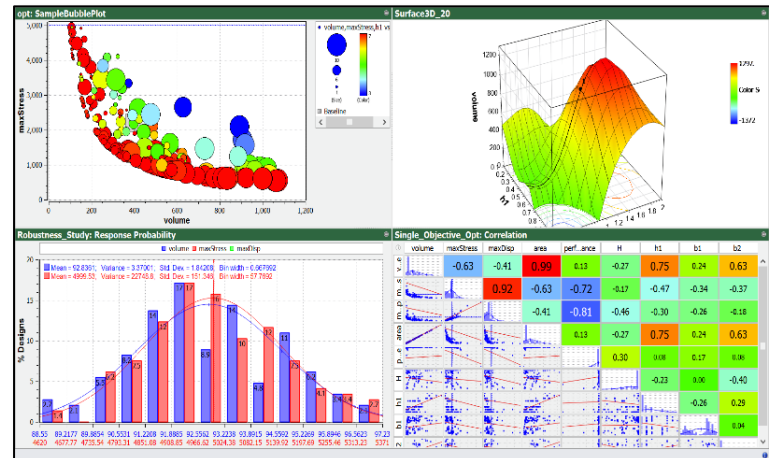
Optimization Workflow: CFTurbo - StarCCM - HEEDS



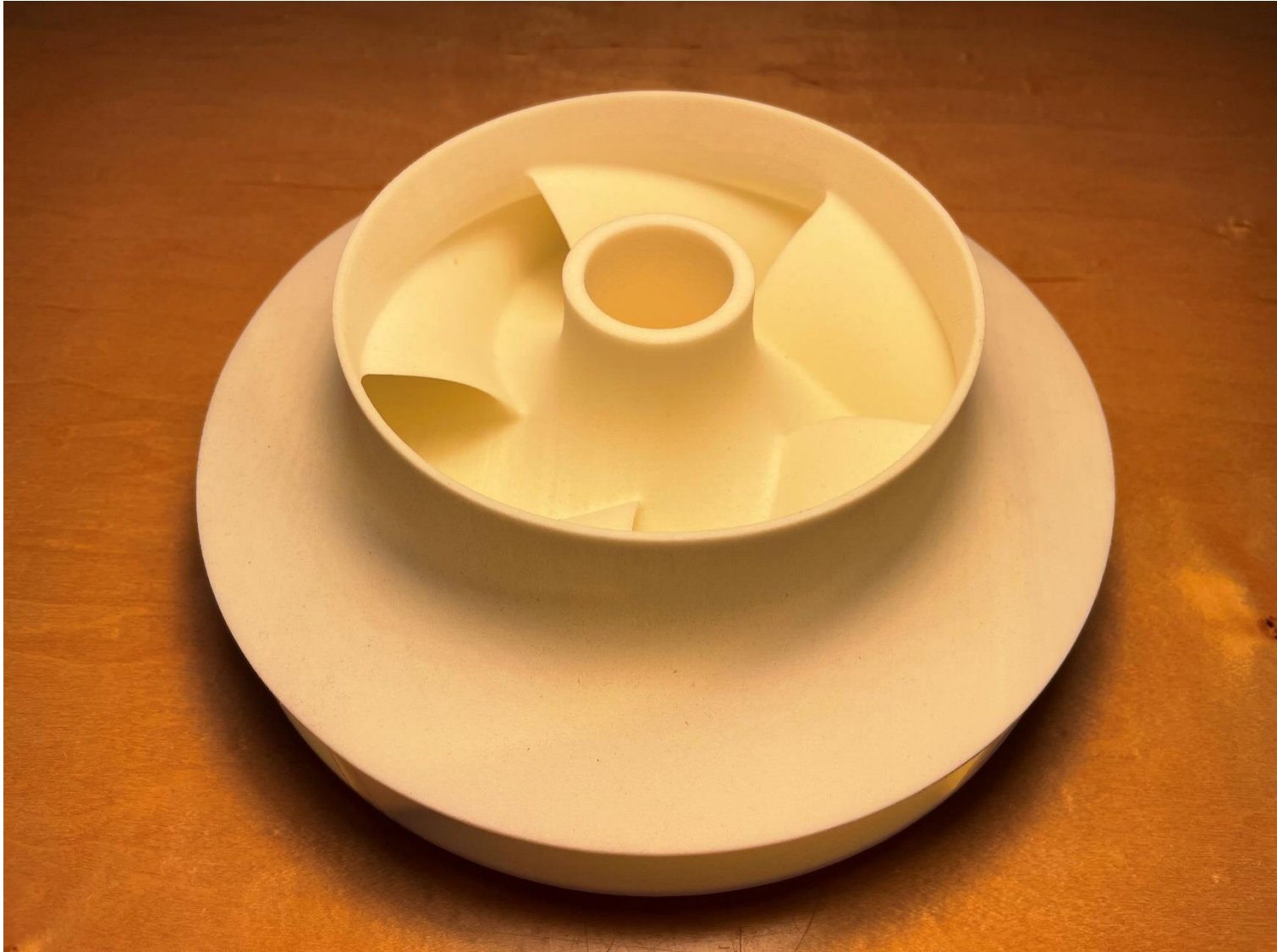
Process Automation

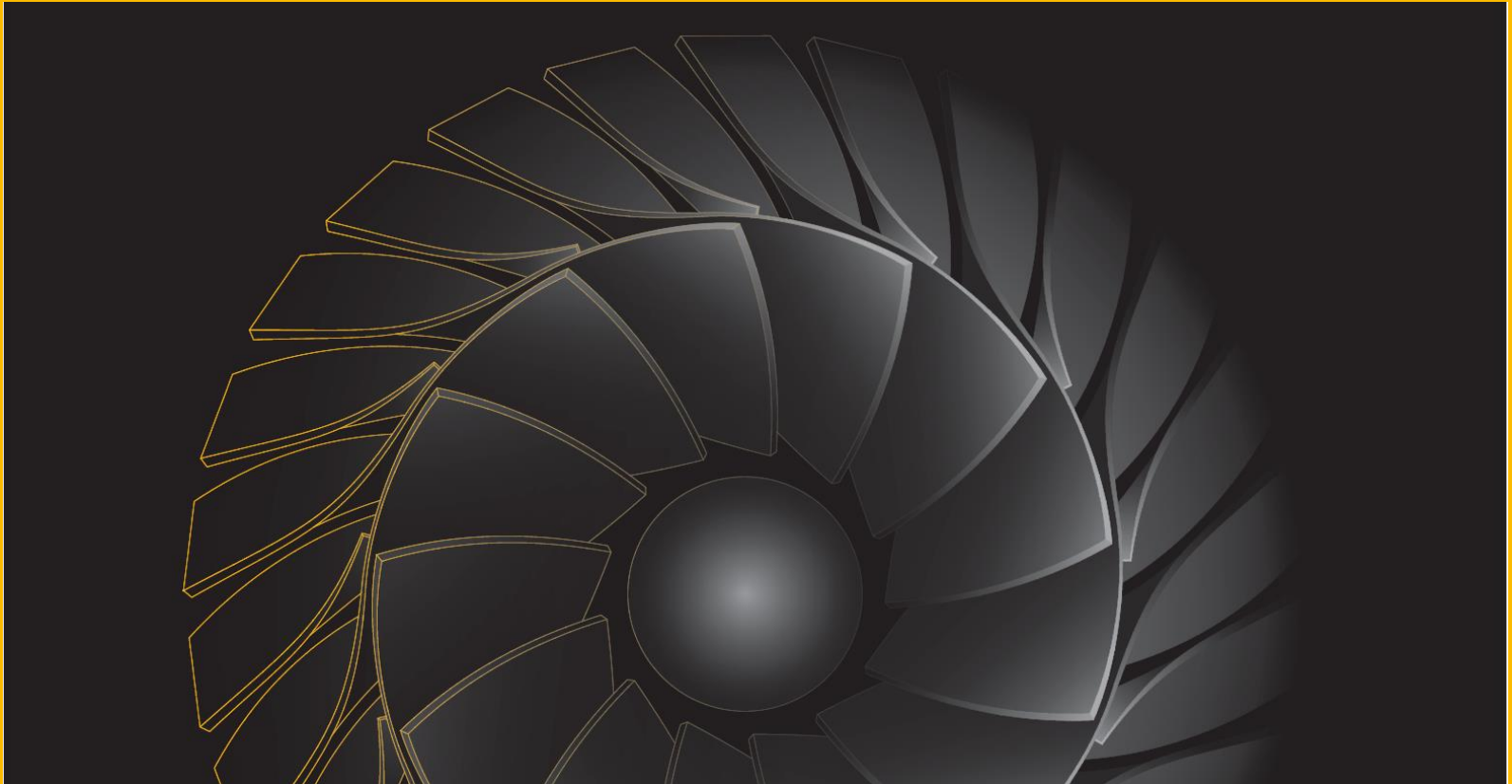


Design Exploration



Option: direct export of 3D printed models





For more information and to register for a free trial visit
cfturbo.com