CAESES & optiSLang

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optiSLang

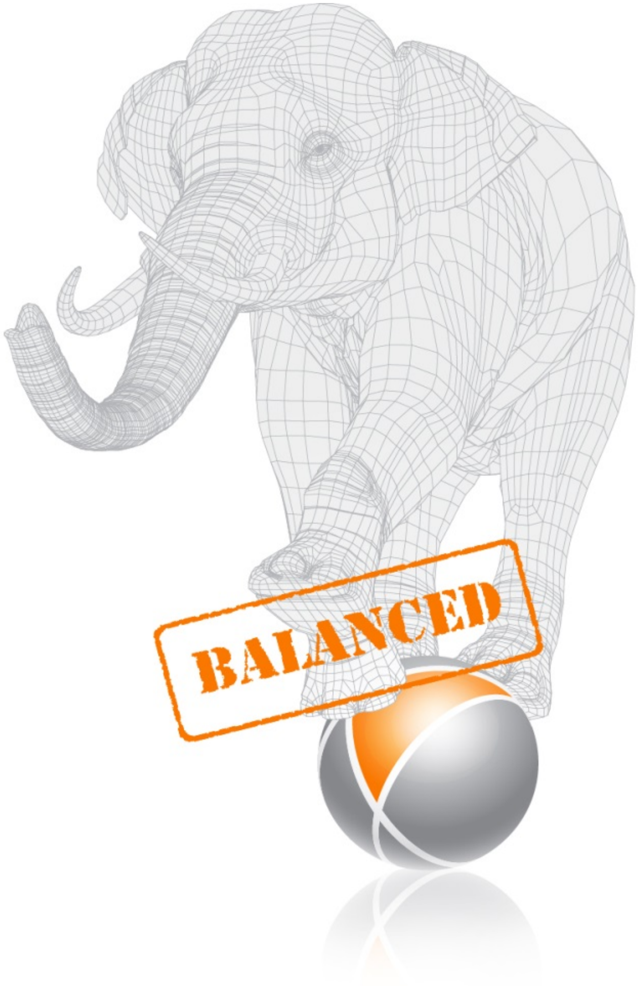
is a general purpose tool for variation analysis

Variation analysis (CAx)

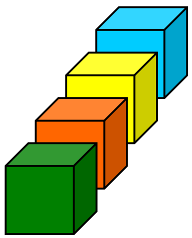
- (automatic) evaluation of *CAx processes*

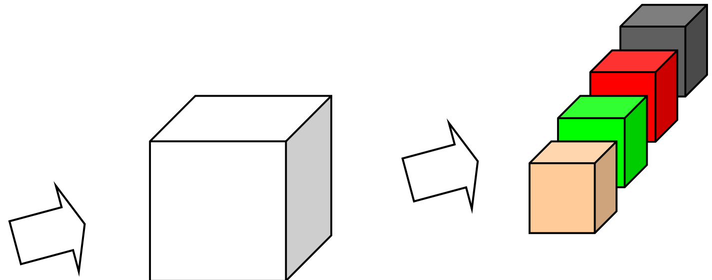
- without parametric
  - repeat persevative tasks
  - standardized
  - automatized
  - ➔ QA for Simulation processes
  - ➔ Democratization of Simulation

- with parametric
  - Parametric Study (DOE)
  - Optimization
  - Tolerance Analysis
  - Design for Six Sigma
  - ➔ Better product in less time



Variation analysis (CAx)

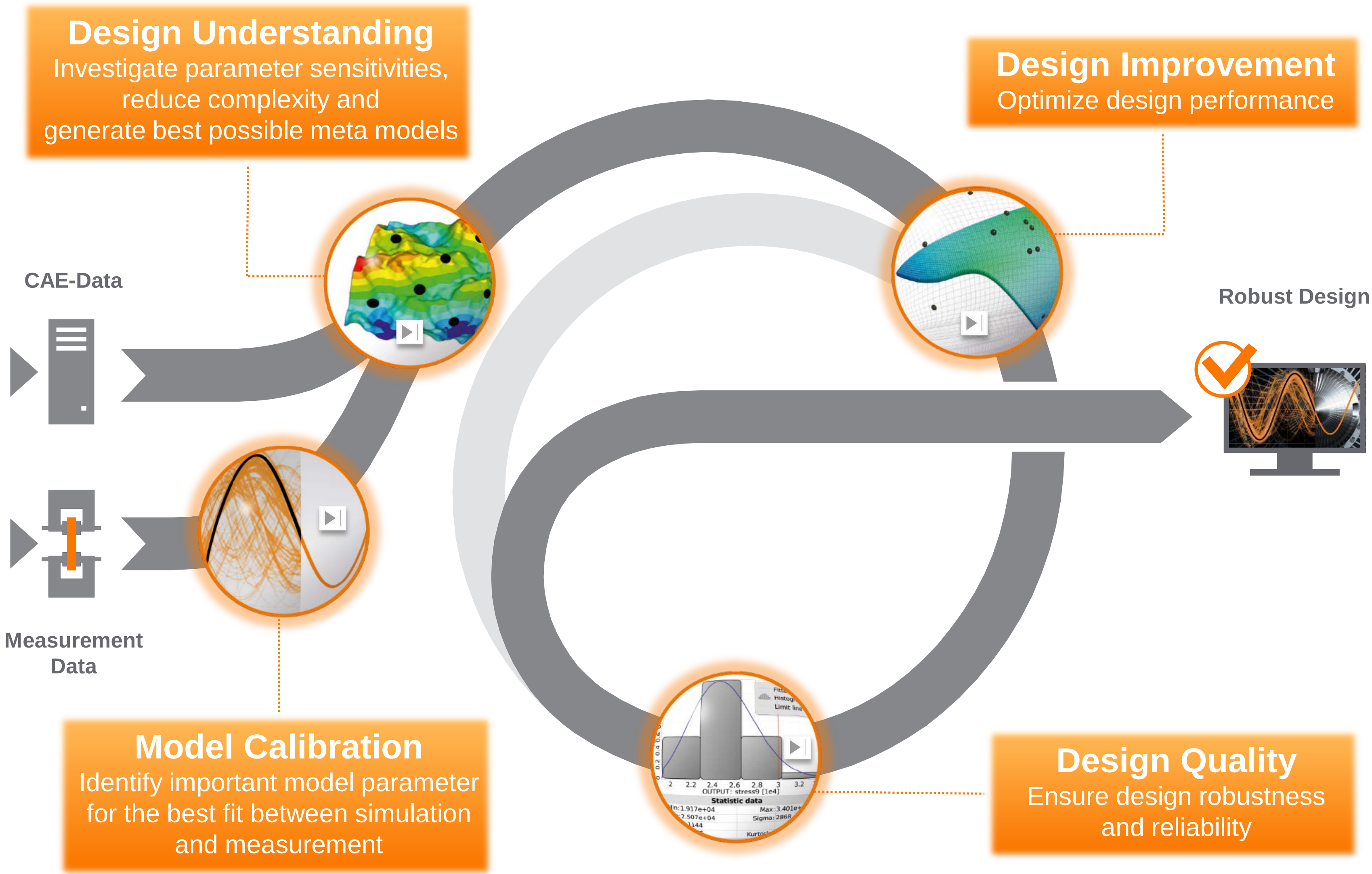




The CAx process
Generates the results according to the inputs

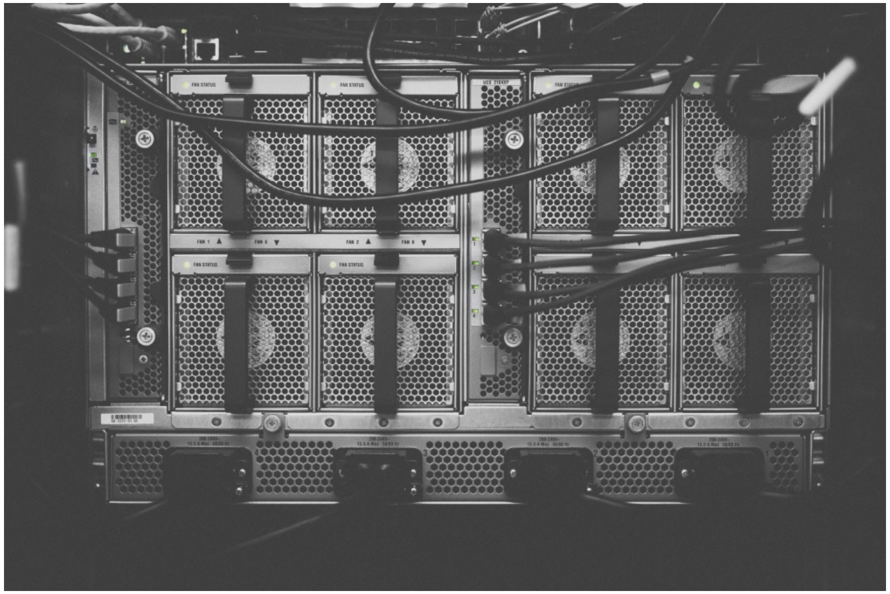
Response variables
Outputs from the system

Variables
Entities that define the CAx model


Design Understanding
Investigate parameter sensitivities, reduce complexity and generate best possible meta models
Design Improvement
Optimize design performance
CAE-Data
Robust Design
Measurement Data
Model Calibration
Identify important model parameter for the best fit between simulation and measurement
Design Quality
Ensure design robustness and reliability

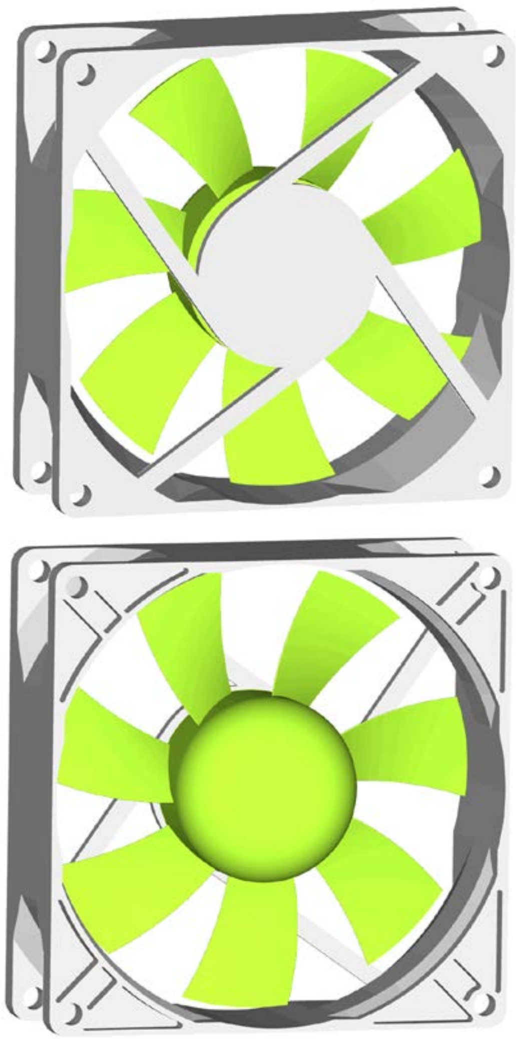
optiSLang fan model

optiSLang fan model



a **computer cooling fan** is a type of axial fan, attached to a computer case used for active cooling. Depending on the location of the fan, it may serve to draw cooler air into the case from the outside, expel warm air from inside, or move relatively colder air across a heat sink.

optiSLang fan model



The main objective is to increase the fan efficiency which is the ratio between the power transferred to airflow and the power used by the fan.

- power transferred to airflow *(W, Nm/s)*

  $P_{airflow} = \Delta P * Q$

  where,

  ΔP = total pressure difference (Pa)

  Q = air volume delivered by the fan (m^3/s)

- power used by the fan *(W, Nm/s)*

  $P_{fan} = T * \omega$

  where,

  T = Torque of the fan wrt rotational axis (N*m)

  ω = rotational speed (rad/s)

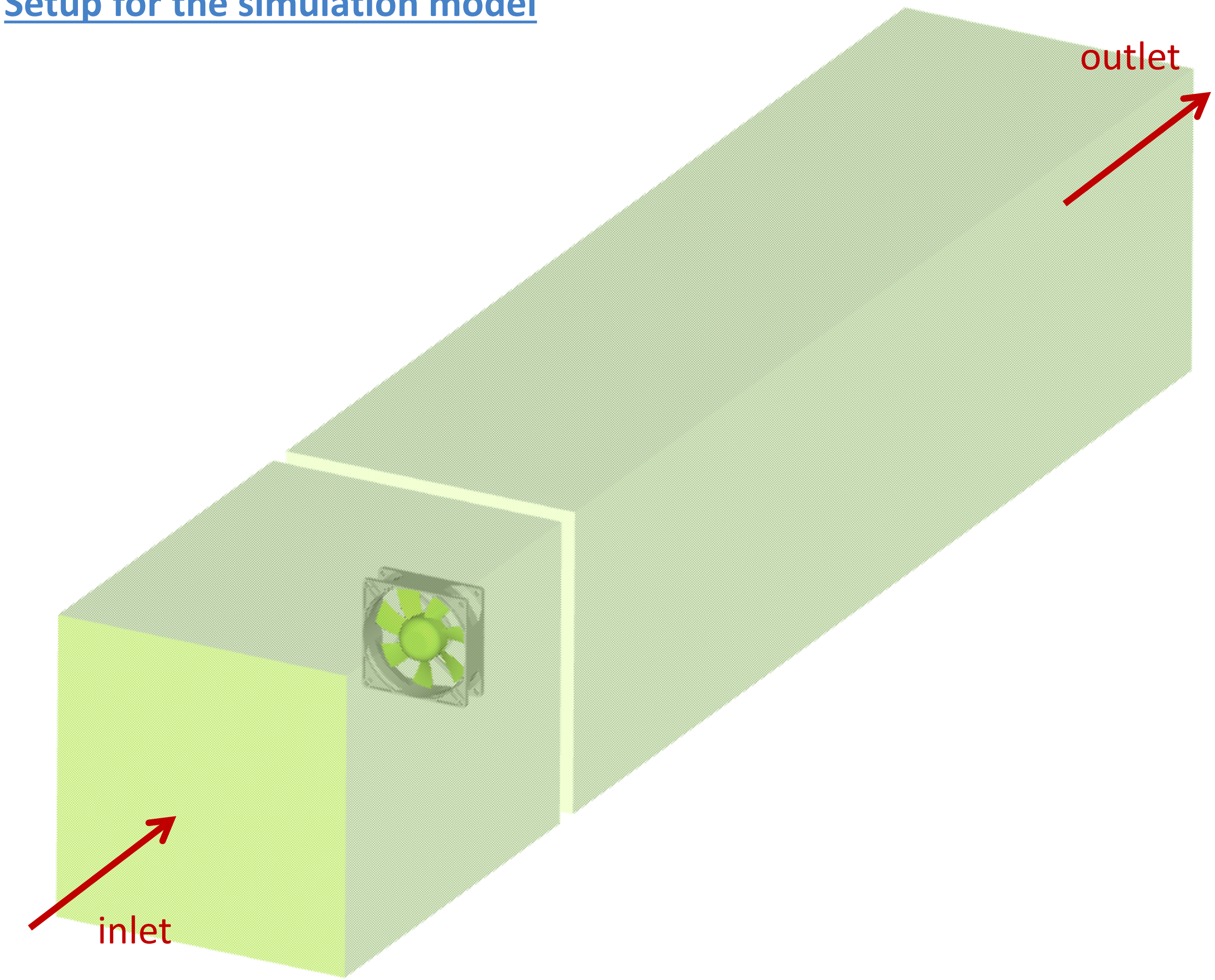
fan efficiency

finally,

$\mu_f = P_{airflow} / P_{fan}$

optiSLang fan model

Setup for the simulation model



Boundary Conditions

- **inlet**

mass flow rate = 0.04 kg/s

- **outlet**

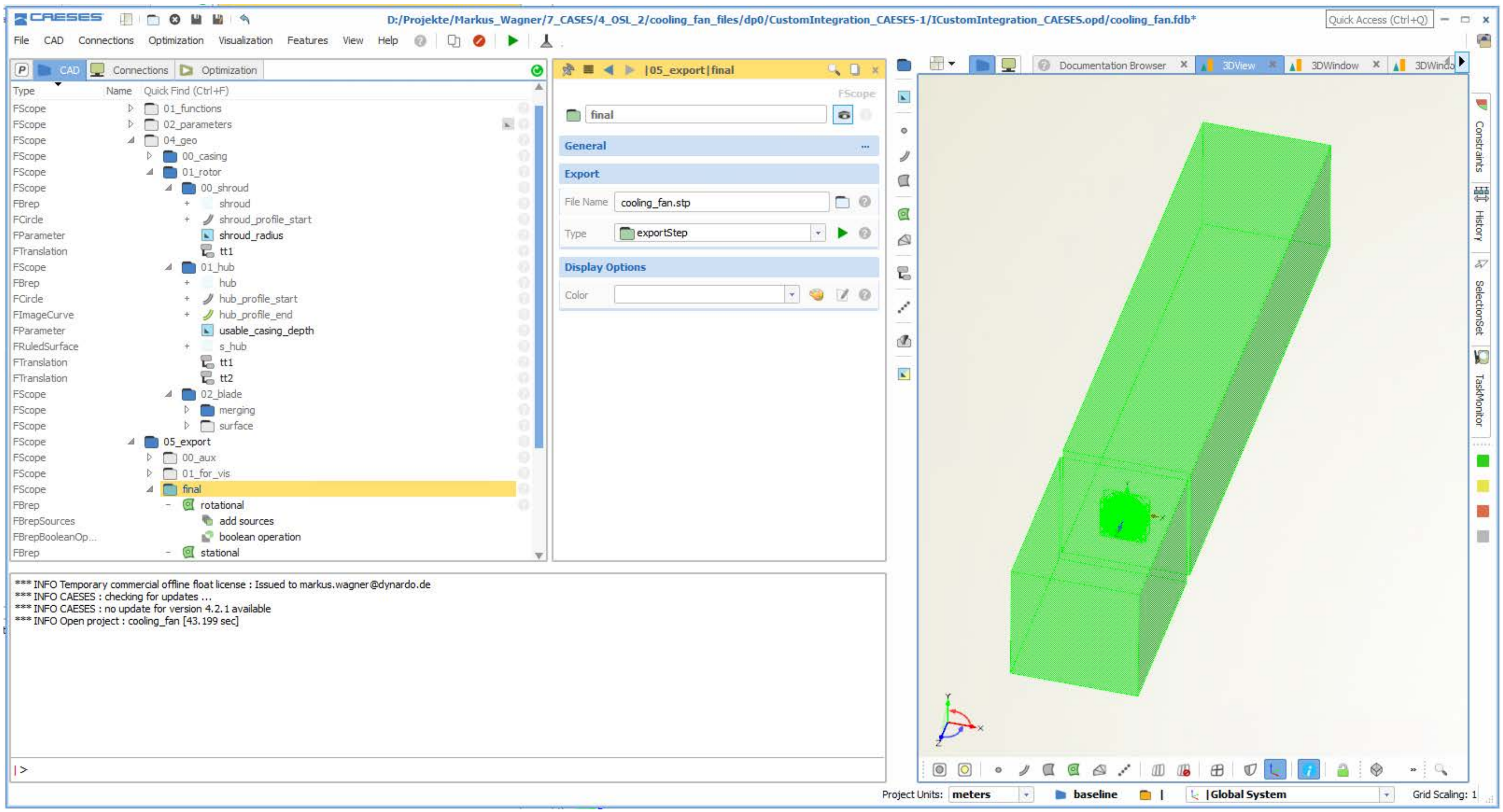
Average static pressure= 0 Pa

- **rotor**

ω = 2400 rpm

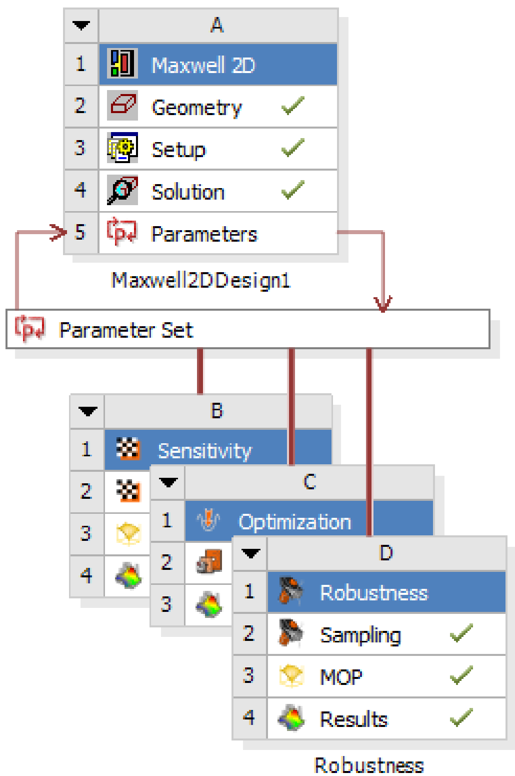
optiSLang fan model

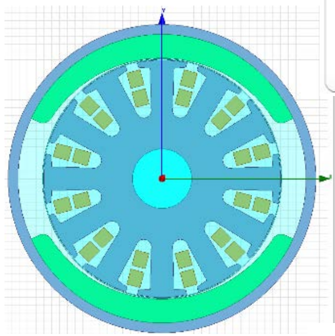
Setup for the simulation model



ANSYS optiSLang – Integration Methods

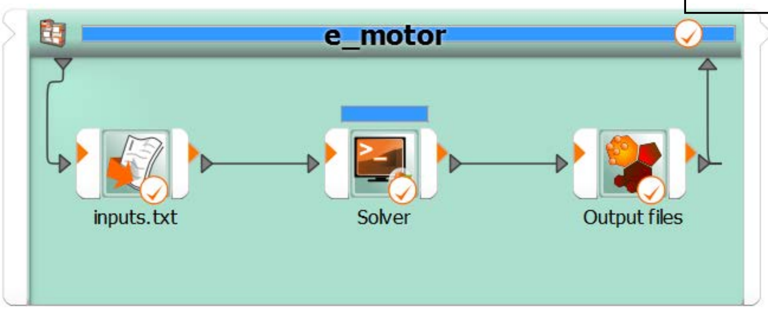
ANSYS Workbench plugin



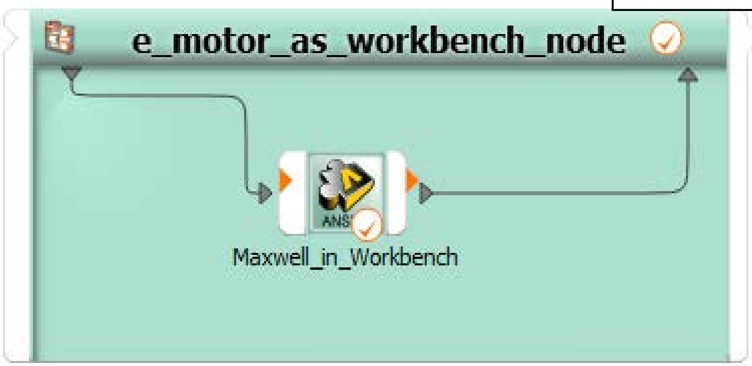


optiSLang

Direct

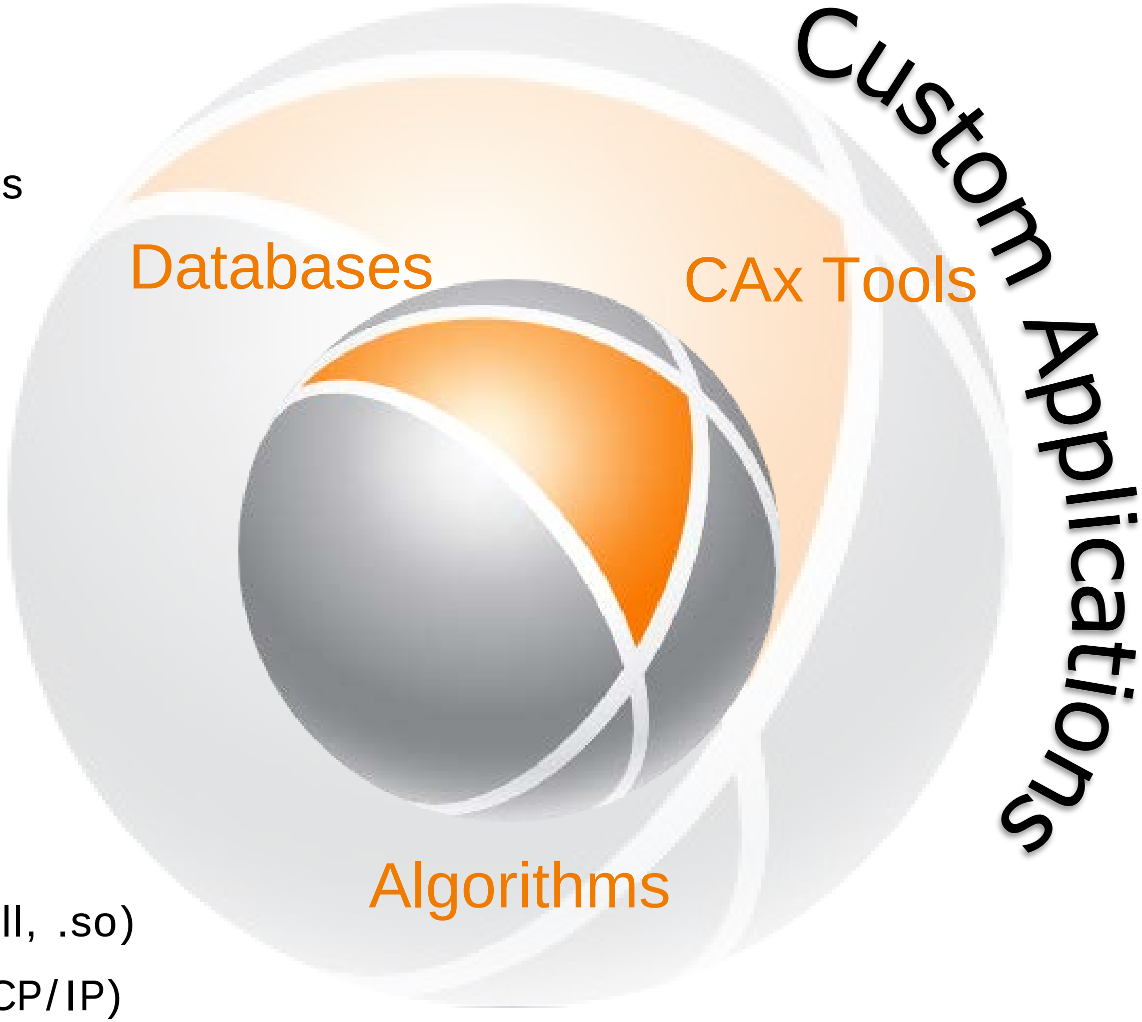


WB node



Openness – open and programmable architecture

- Plugins
  - CAx Toolintegrations
  - Algorithms
  - (PLM-) Databases
- Interfaces
  - Batch
  - Scriptable (.py)
  - Shared libraries (.dll, .so)
  - Remote control (TCP/IP)

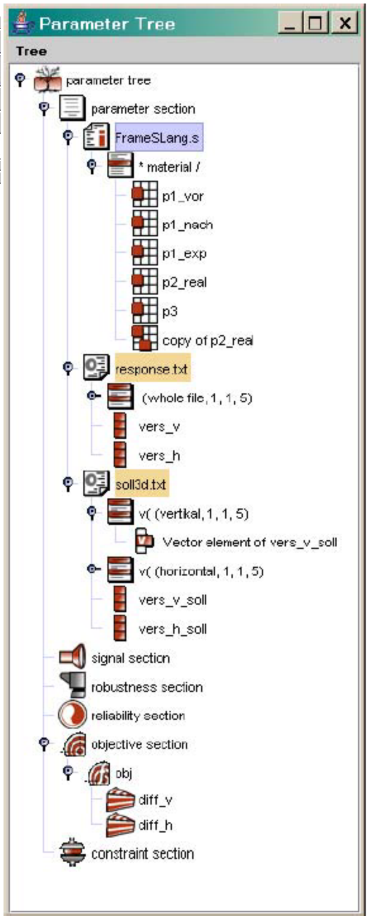


CAESES & optiSLang: 201x

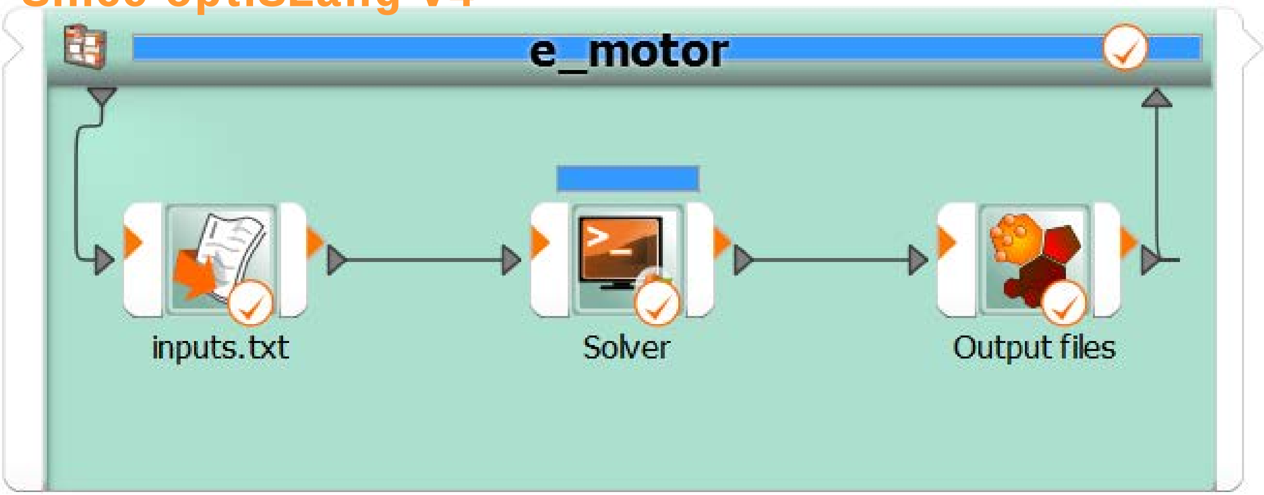
Customer uses both tools together since 2010/11

- Textinterface
- Parametrize input file
- Run FFW/CAESES in batch

optiSLang v2 / v3



Since optiSLang v4



CAESES & optiSLang now

- Custom Integration (Plugin)
- 2016 Available @Dynardo-support
- Since Feb. 2017 built-in

CAESES

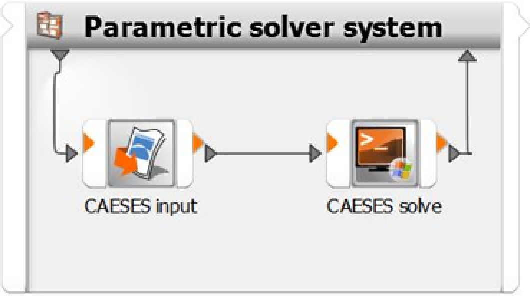
X	Built-in
X	Customized
X	Wizard supported

CAESES input node

- Define parameter
- Autoparse Designtable
- Read and write *txt* files

Solver call

- Batch / Bash
- Single solver or script call
- Timeout and N parallel



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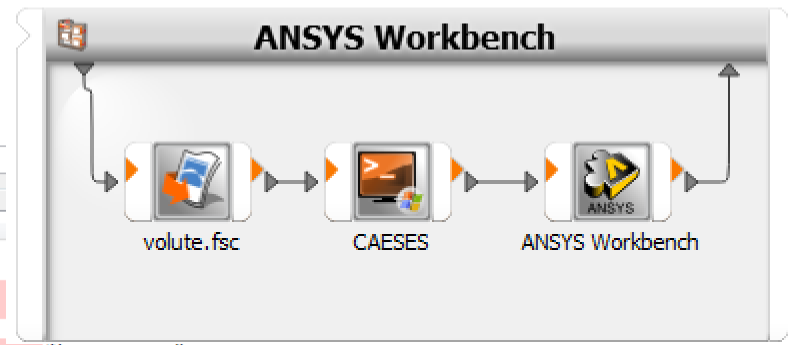
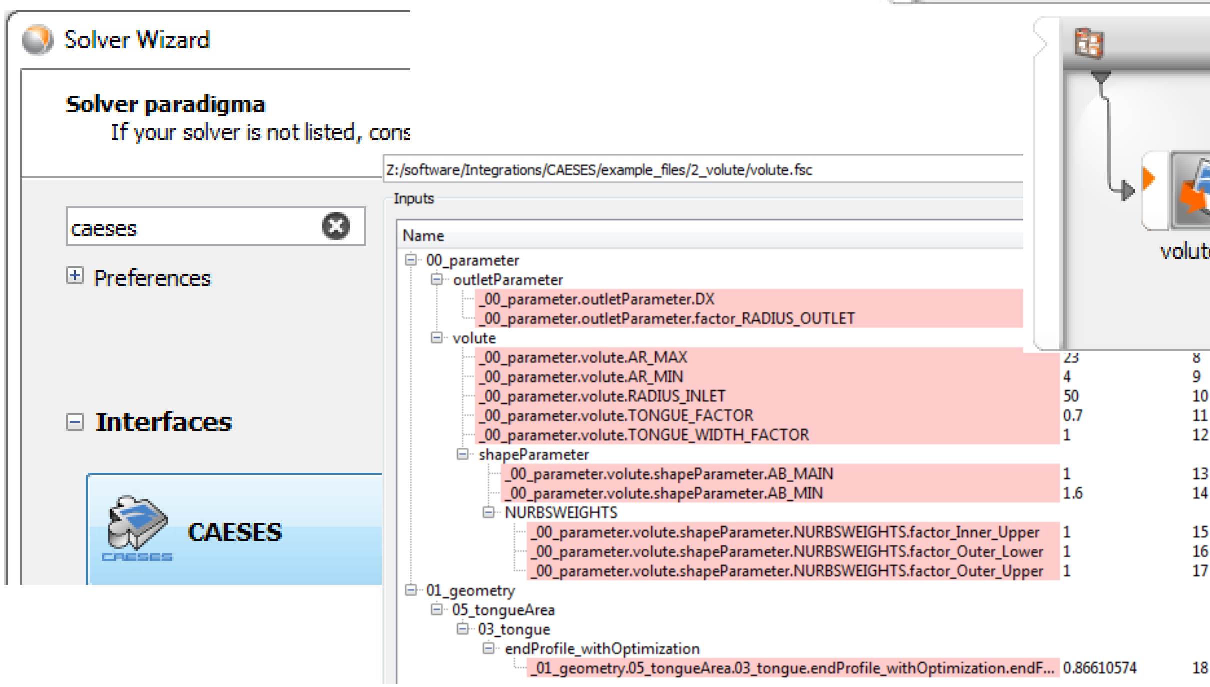
CAESES & optiSLang now

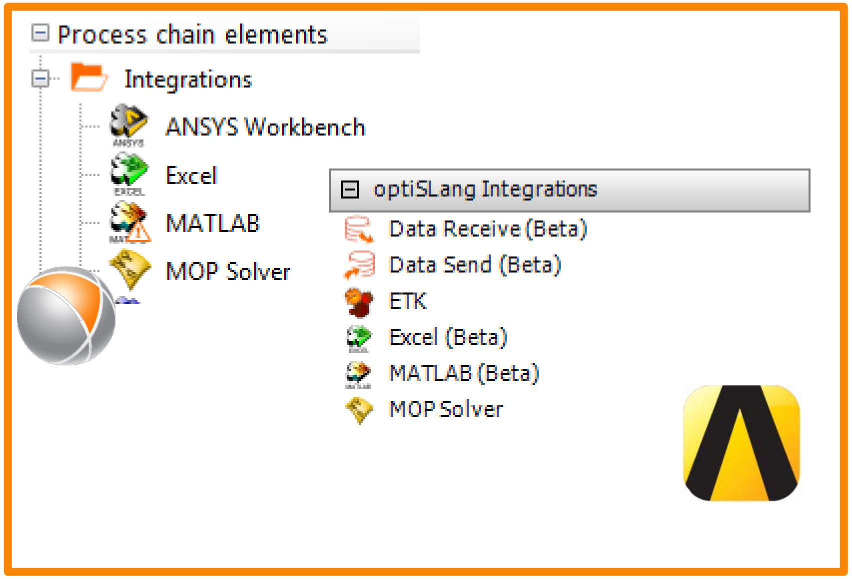
- Parametrize&Update Geometry
- Connect to Mesher/Solver
- Solve
- Return Results

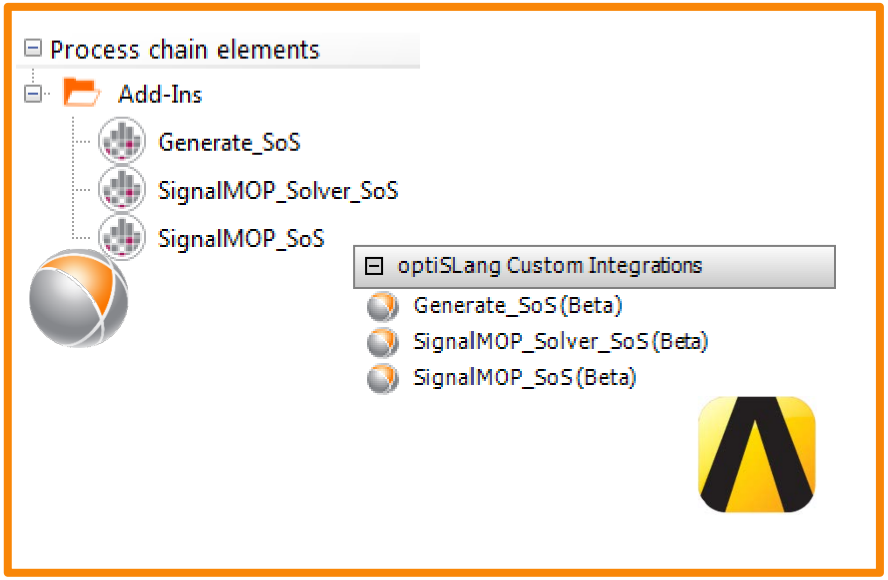




Two new categories inside ANSYS Workbench

- Use optiSLang integrations directly in ANSYS Workbench



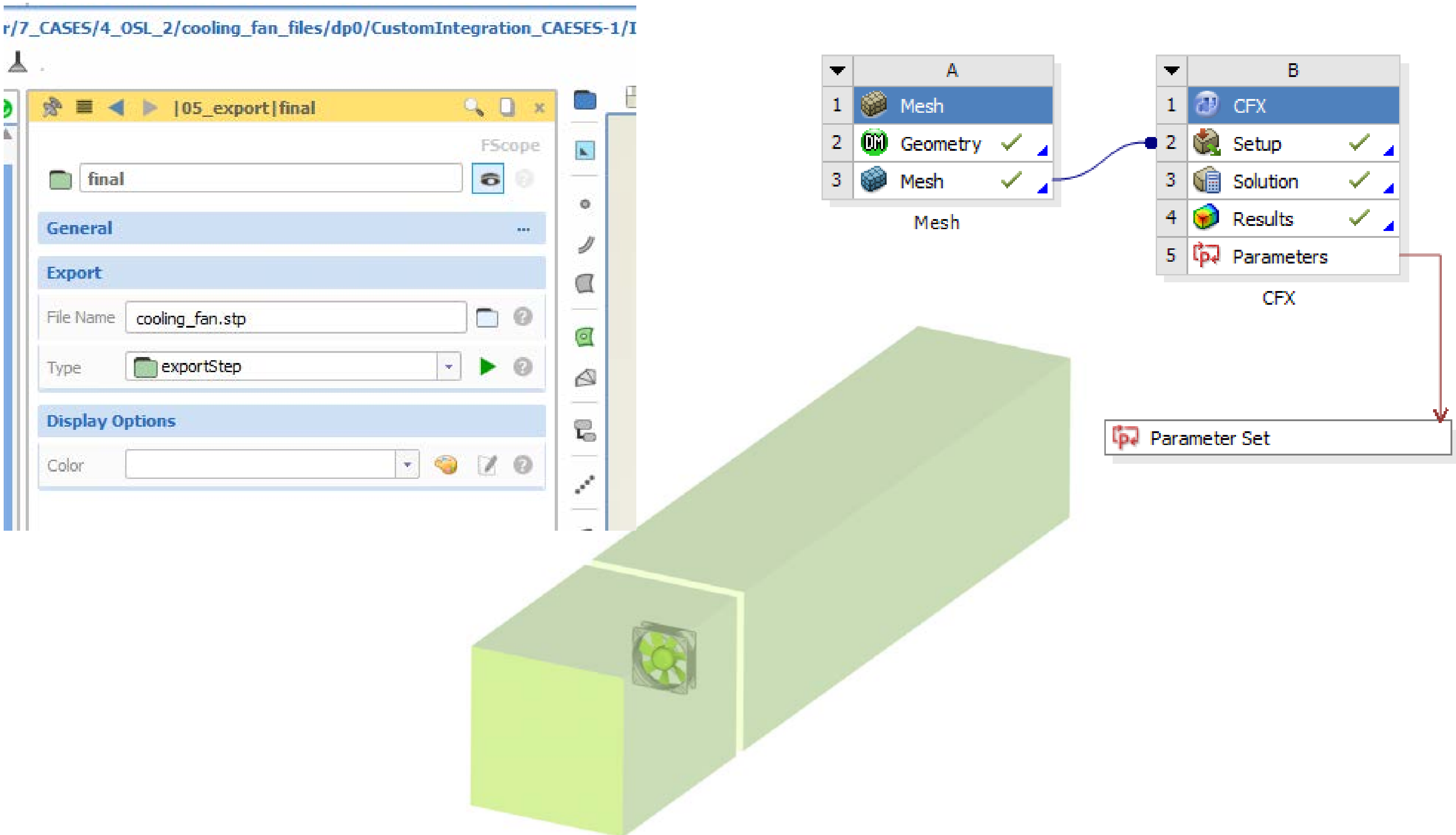


→ Same Look&Feel in optiSLang and Workbench

→ User can stay in Workbench

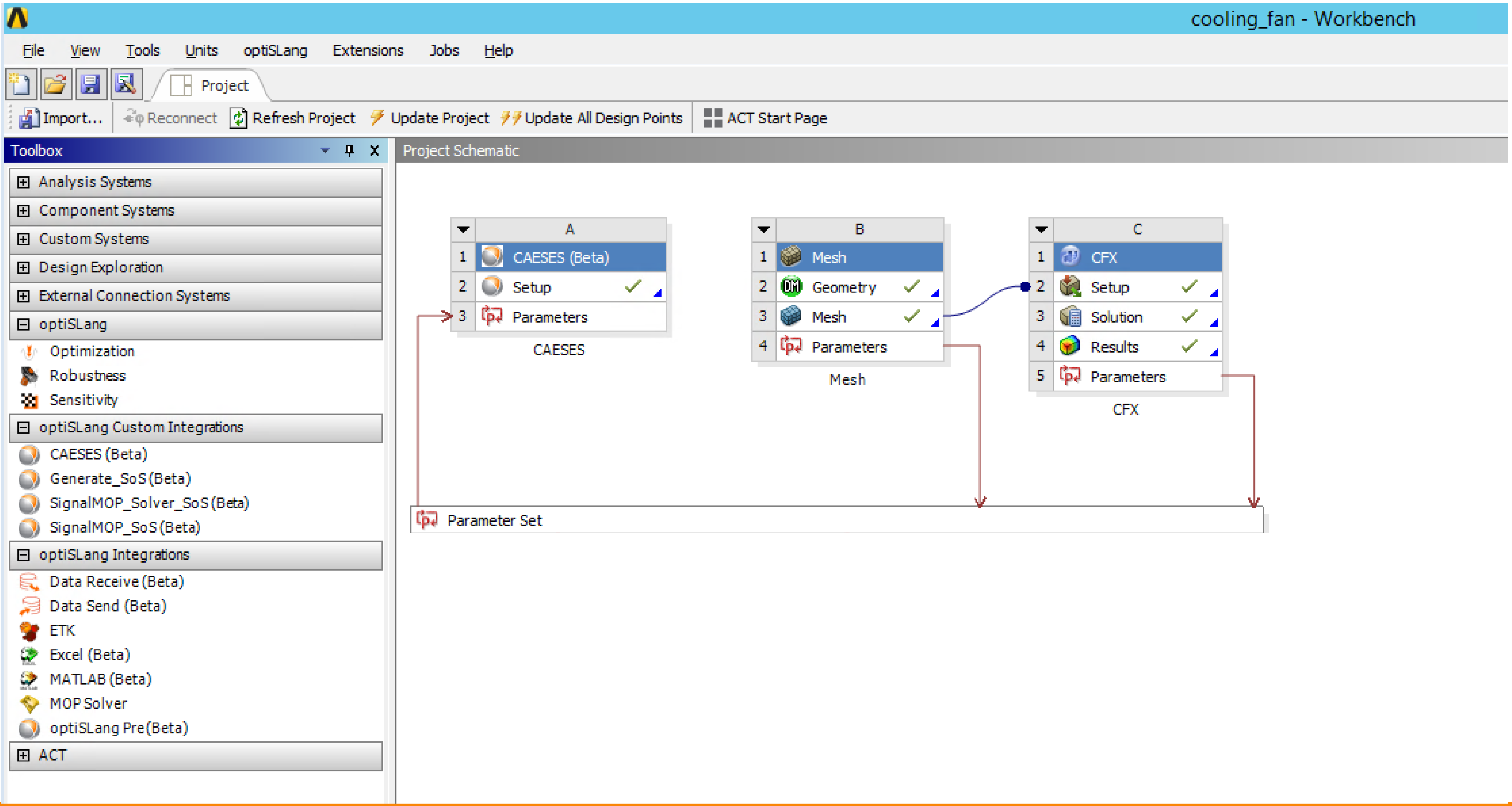
→ More flexibility in Workflow management

Back to task


r/7_CASES/4_OSL_2/cooling_fan_files/dp0/CustomIntegration_CAESES-1/I
|05_export|final
FScope
final
General
Export
File Name
cooling_fan.stp
Type
exportStep
Display Options
Color
A
1 Mesh
2 Geometry
3 Mesh
Mesh
B
1 CFX
2 Setup
3 Solution
4 Results
5 Parameters
CFX
Parameter Set

CAESES Workbench plugin

- Parametrize&Update Geometry
- Connect to Mesher/Solver
- Solve



CAESES Workbench plugin

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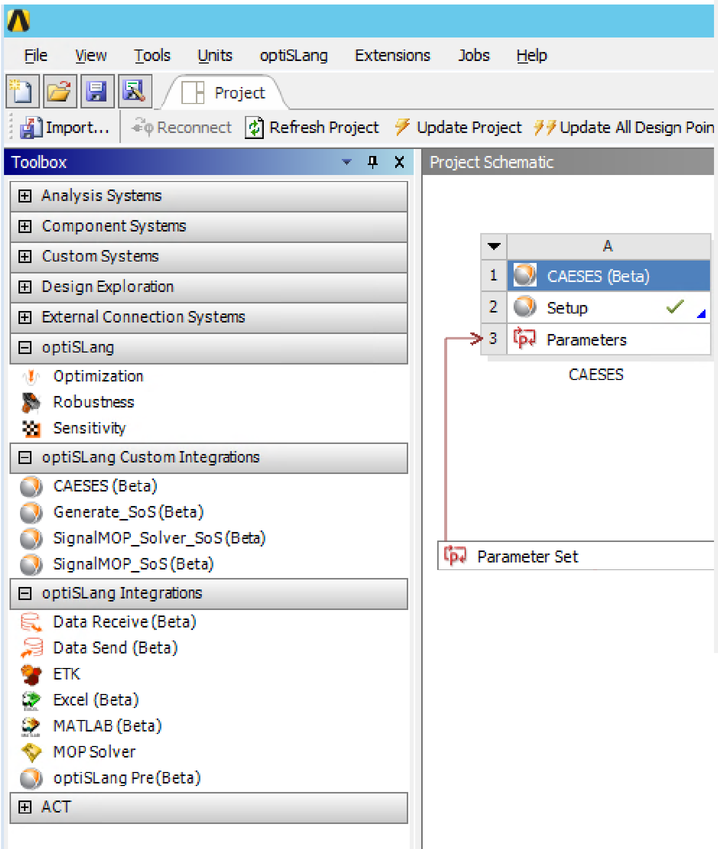
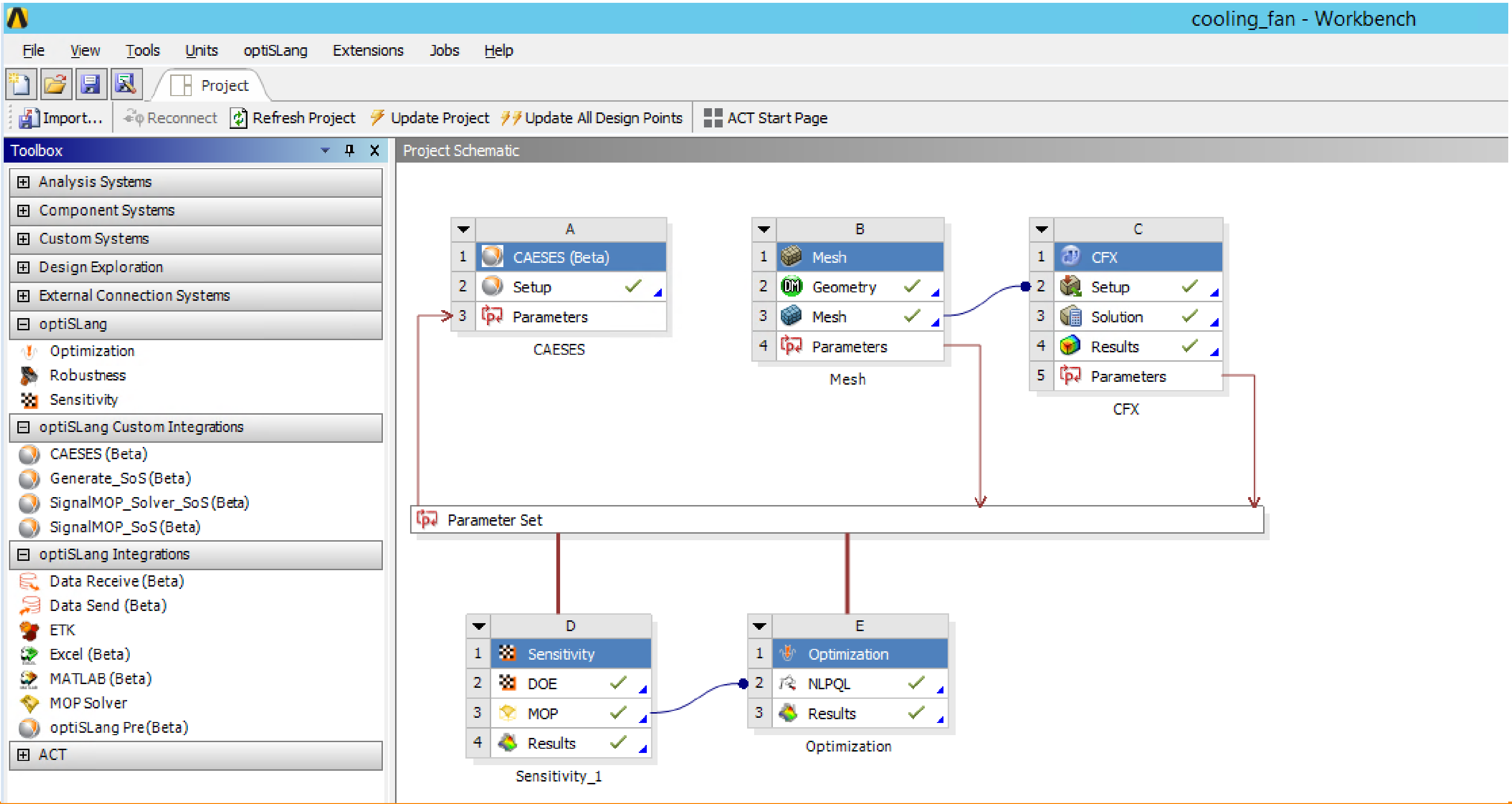


Outline of All Parameters

	A	B	C	D
1	ID	Parameter Name	Value	Unit
2	Input Parameters			
3	CAESES (A1)			
4	P18	_02_parameters_01_rotor_00_hub_R_hub	0,4	
5	P19	_02_parameters_01_rotor_01_blade_CAMBER_ANGLE_AT_HUB	0	
6	P20	_02_parameters_01_rotor_01_blade_CAMBER_ANGLE_AT_SHROUD	0	
7	P21	_02_parameters_01_rotor_01_blade_CHORD_AT_HUB	0,4	
8	P22	_02_parameters_01_rotor_01_blade_CHORD_AT_TIP	0,7	
9	P23	_02_parameters_01_rotor_01_blade_PITCH_AT_HUB	0,4	
10	P24	_02_parameters_01_rotor_01_blade_PITCH_AT_TIP	0,1	
*	New input parameter	New name	New expression	
12	Output Parameters			
13	CFX (C1)			
14	P2	Total Pressure Difference	140,2	Pa
15	P3	Density Inlet	1,185	kg m^-3
16	P4	Efficiency	0,88989	
17	P5	Mass Flow Rate Inlet	0,04	kg s^-1
18	P6	Torque	0,0043019	J
19	P7	Current Time Step	500	
20	P8	Sequence Step	500	
21	Mesh (B1)			
22	P17	Geometry Volume	8,4758E+07	mm^3
*	New output parameter		New expression	
24	Charts			

CAESES Workbench plugin

- Parametrize&Update Geometry
- Connect to Mesher/Solver
- Solve



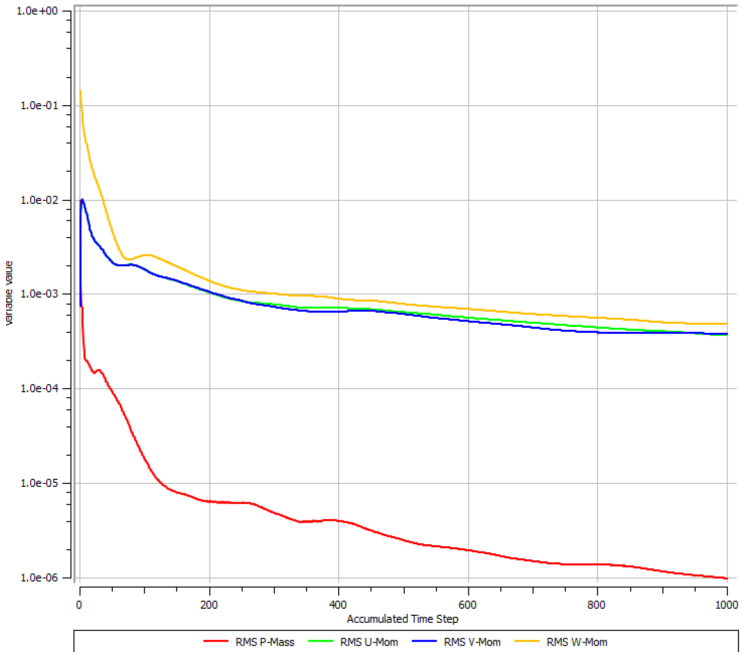
1st Sensitivity study: CAESES Workbench plugin

- Bad Coefficient of Prognosis

→ Immediately saw in Postprocessing: solution not converged for all designs

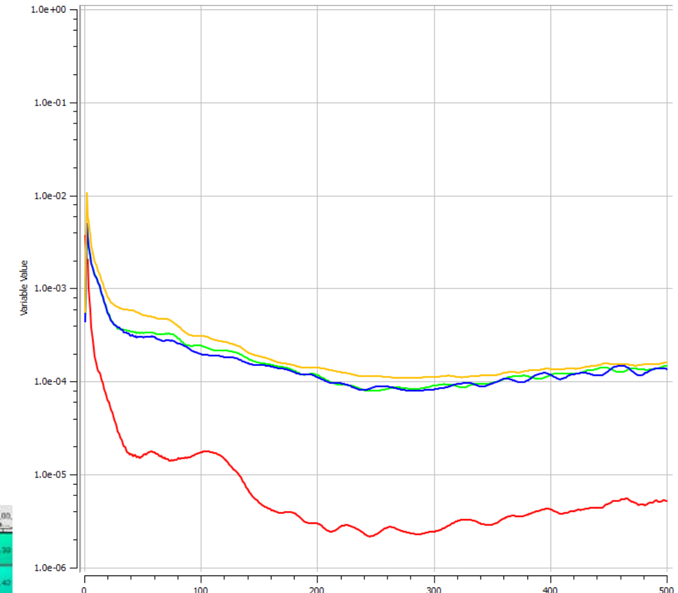
➔ Quick fix in model

➔ Restart



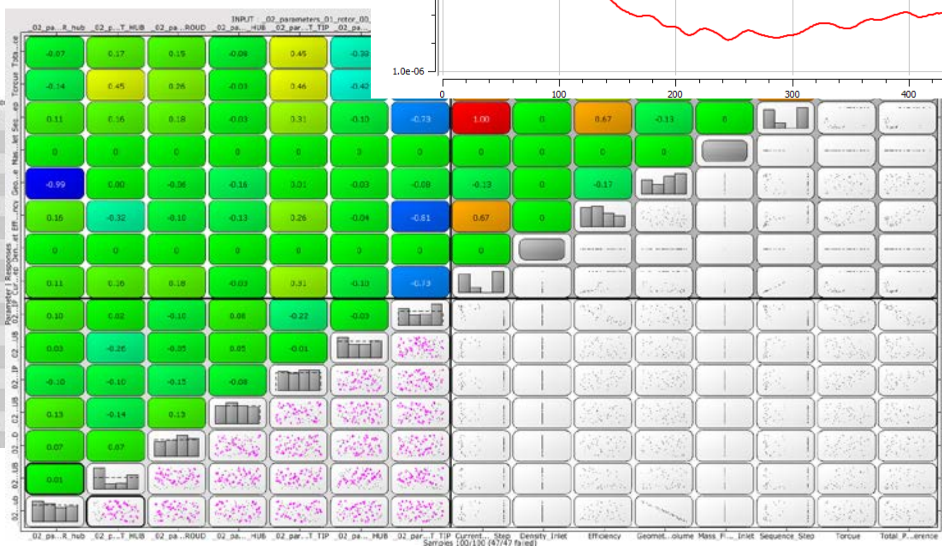
Sensitivity study: CAESES Workbench plugin

- DOE with 100 Designs
- 53 Succeeded
- 47 Failed due to several reasons
  - e.g. to strong changes in geometry



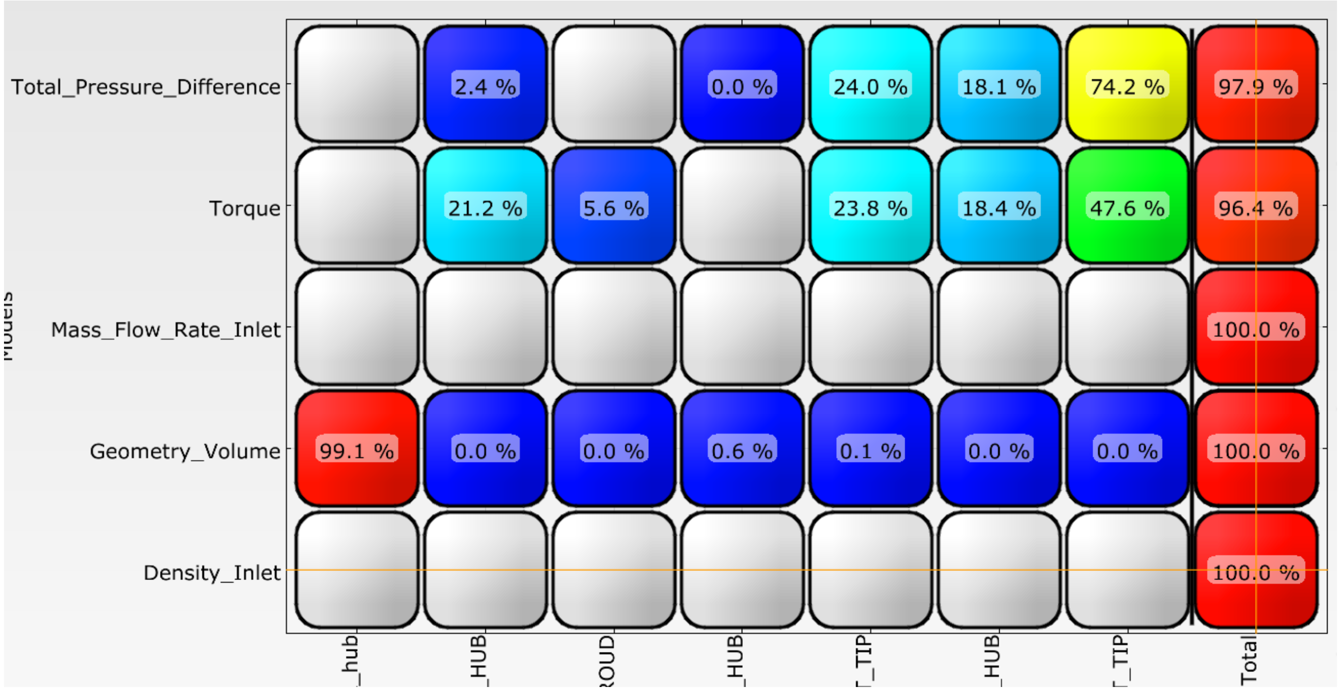
	Total	Active
All	100	100
Succeeded	53	53
Incomplete	0	0
Failed	47	47
Feasible	100	100
Selected	0	

	Id	Feasible	Duplicates	Status	Style	:ters_01_rotor_00_	:or_01_blade_CAN	:_01_blade_CAMB	1_rotor_01_blade_	)1_roto
1	0.1	true		Succeeded		0.3515	12.075	5.95	0.30525	0.862
2	0.2	true		Succeeded		0.3555	12.825	6.75	0.33675	0.734
3	0.3	true		Succeeded		0.3045	2.175	4.15	0.35475	0.806
4	0.4	true		Not succeeded		0.3865	8.025	0.35	0.43425	0.654
5	0.5	true		Not succeeded		0.3415	5.775	9.45	0.31125	0.846
6	0.6	true		Succeeded		0.3925	1.125	2.75	0.43575	0.694
7	0.7	true		Not succeeded		0.3935	10.275	2.55	0.42825	0.882
8	0.8	true		Succeeded		0.3165	9.525	6.45	0.34425	0.618
9	0.9	true		Succeeded		0.3495	11.625	3.25	0.35175	0.638
10	0.10	true		Succeeded		0.3215	6.525	5.55	0.38775	0.762
11	0.11	true		Succeeded		0.3005	12.225	8.55	0.31275	0.794
12	0.12	true		Not succeeded		0.3655	4.575	3.85	0.38325	0.61
13	0.13	true		Not succeeded		0.3835	11.325	0.45	0.30825	0.714
14	0.14	true		Not succeeded		0.3725	12.675	5.85	0.39825	0.81
15	0.15	true		Not succeeded		0.3485	7.875	0.75	0.43875	0.898
16	0.16	true		Succeeded		0.3315	6.375	2.45	0.30975	0.738



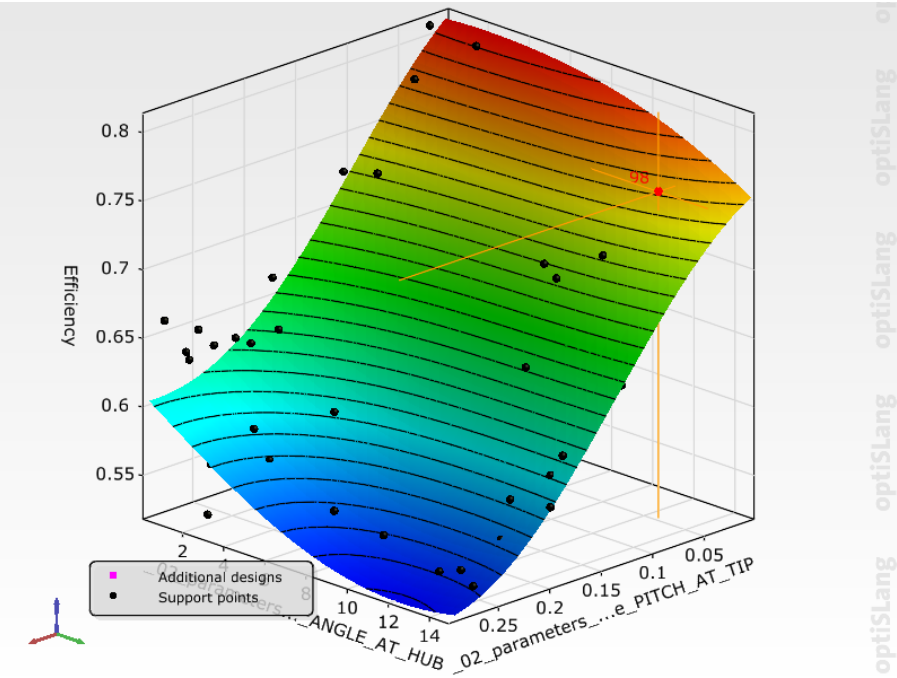
Metamodel: CAESES Workbench plugin

- Very good Coefficient of Prognosis
- Use Metamodel (surrogate) for optimization



Optimization: CAESES Workbench plugin

- Optimization on Metamodel
- Efficiency: 65% → 89%



- power transferred to airflow *(W, Nm/s)*

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  where,

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- power used by the fan *(W, Nm/s)*

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fan efficiency

finally,

$\mu_f = P_{airflow} / P_{fan}$

- Example was work of <1week (engineer time) – need to be finalized
- Outlook: Provide example as webinar and tutorial

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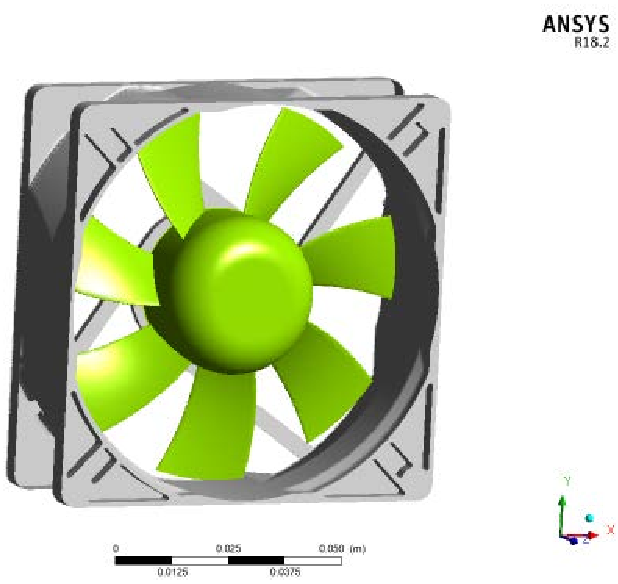

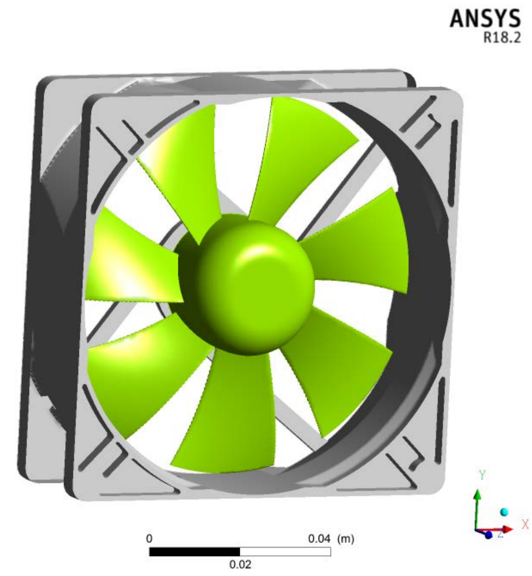

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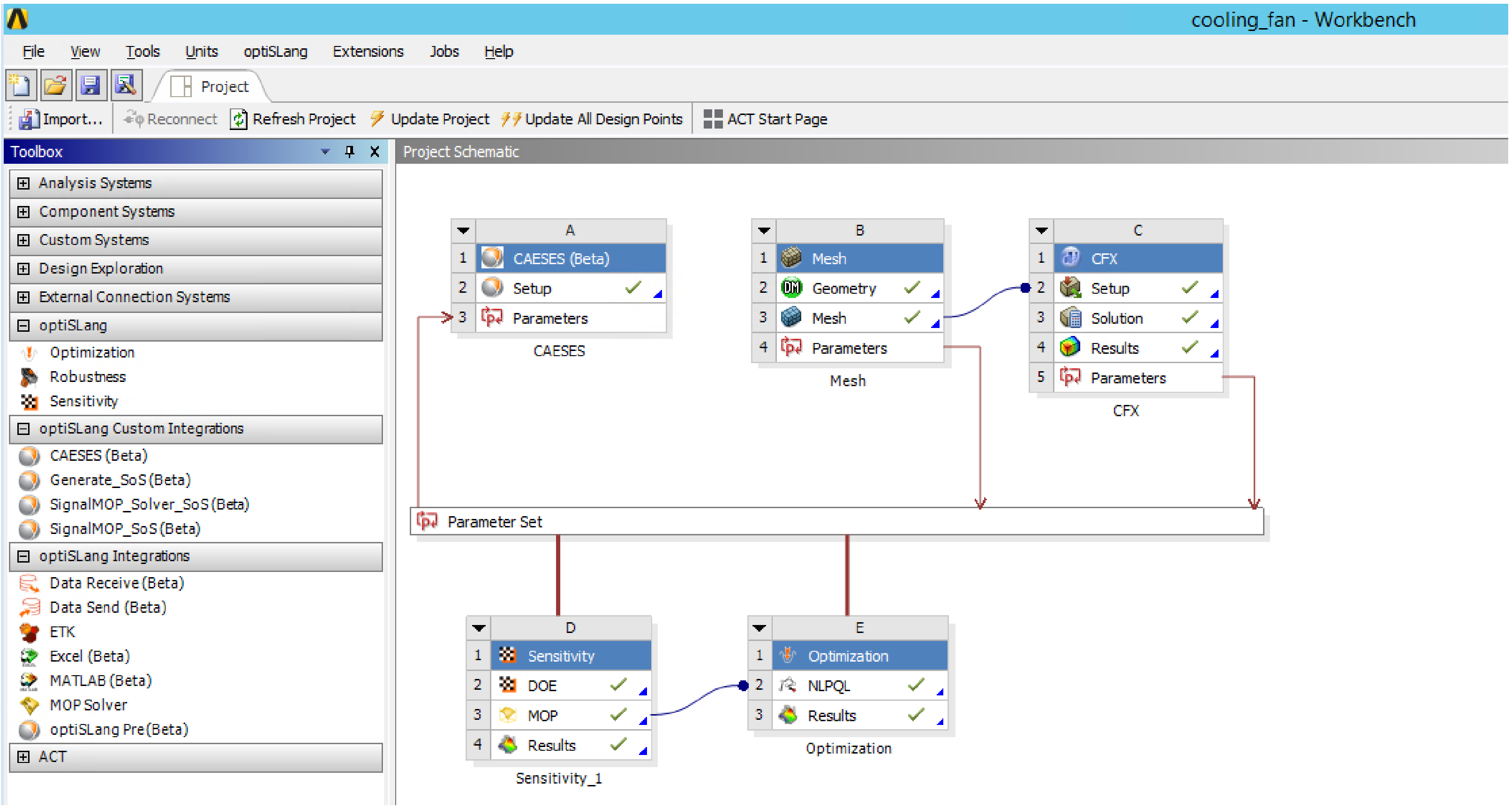
CAESES Workbench plugin



You like to try it?

Contact us: **support@dynardo.de**

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