FloEFD v17 What‘s New

Mechanical Analysis

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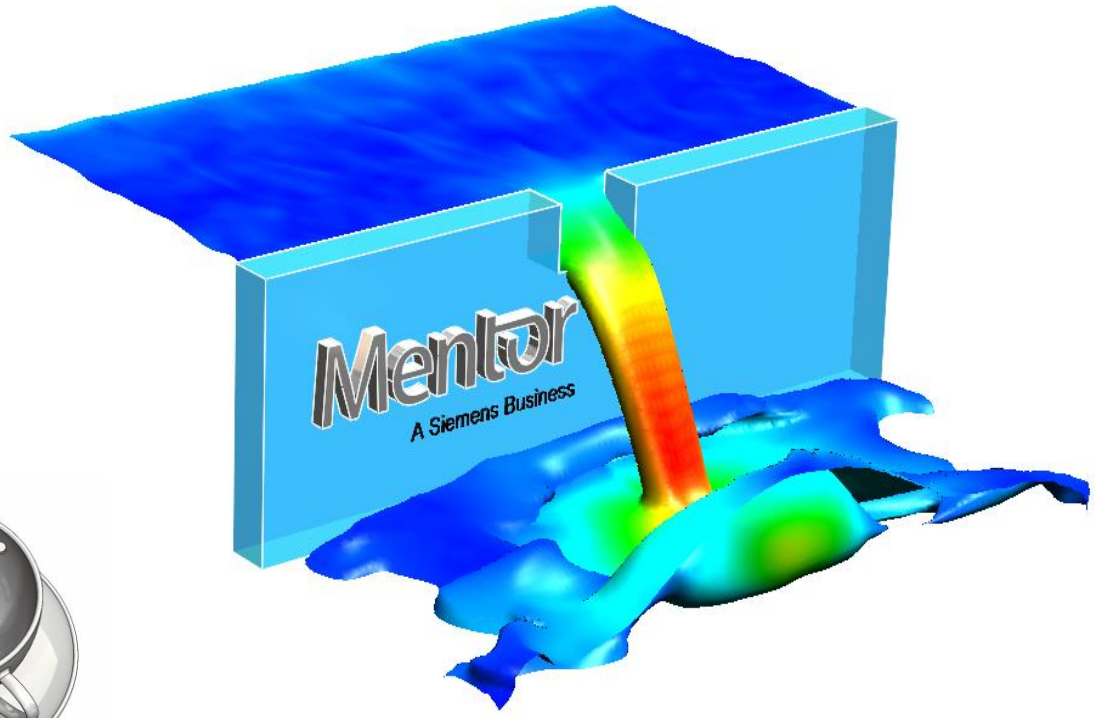
GENERAL

Free Surface

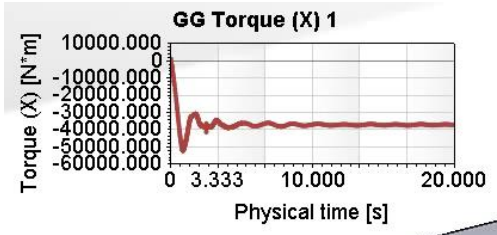
Robust and general enough method (Volume-Of-Fluid) to simulate a moving interface between immiscible fluids with densities ratio up to 10^4.

- Two fluid mixture
- Gas – Liquid, Liquid – Liquid
- Gas – Non-Newtonian (ADVANCED module)
- Incompressible solver only (valid for Mach < 0.3)
- Many drops, bubbles or complex topology of free surface lead to large mesh for accurate representation of the surface
- Surface tension is not modelled
- No Boundary Layer model on free surface
- No condensation, evaporation, cavitation
- No rotation

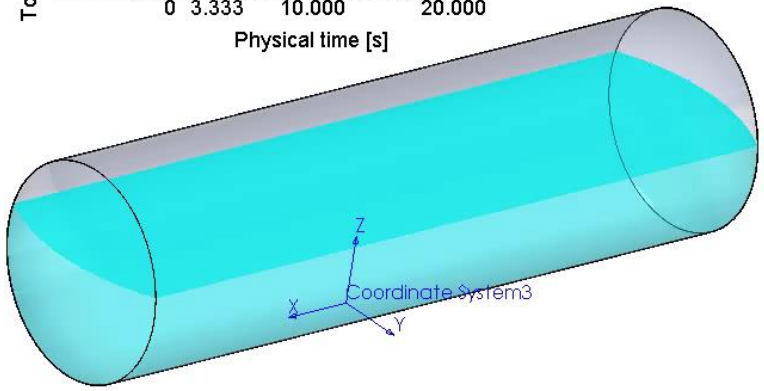


Free Surface - Applications

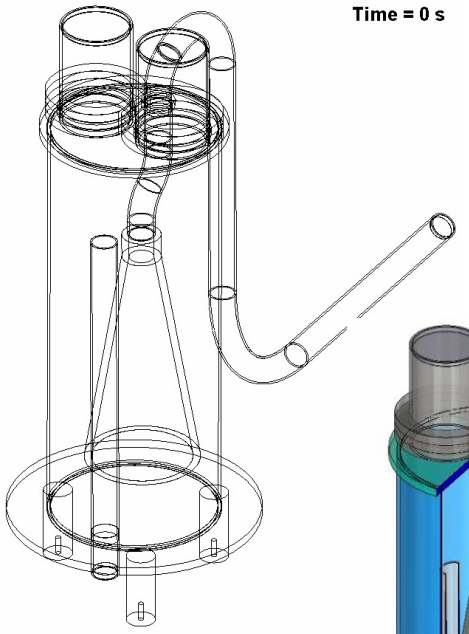
Sloshing

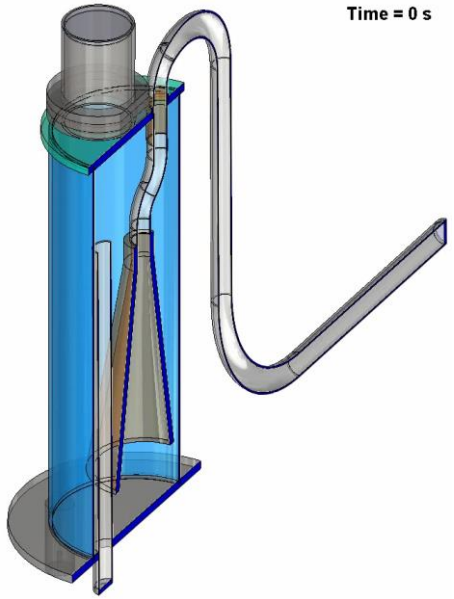


Time = 0 s

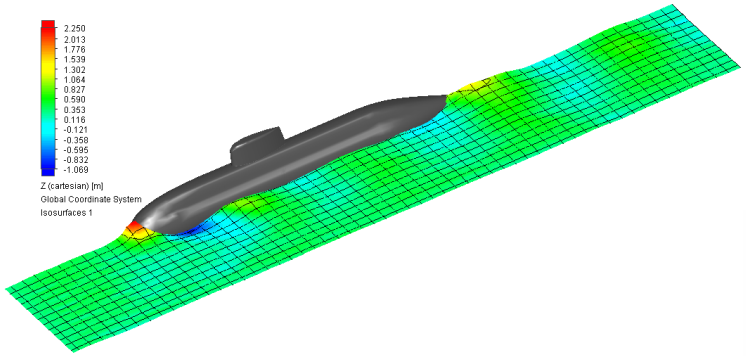


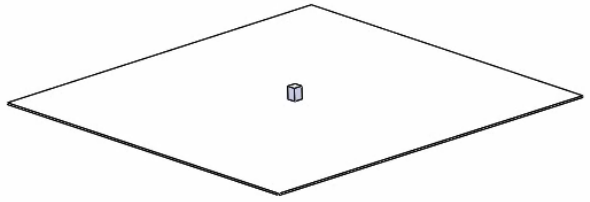
Filling/Evacuation





Jet/Open water

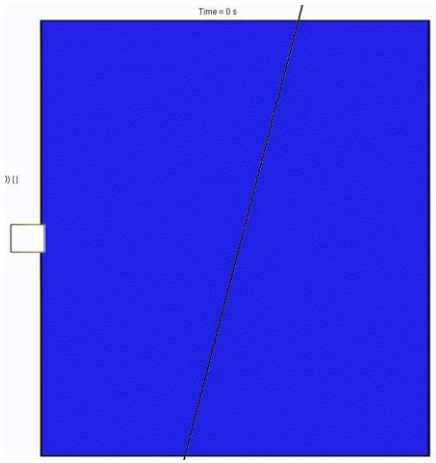


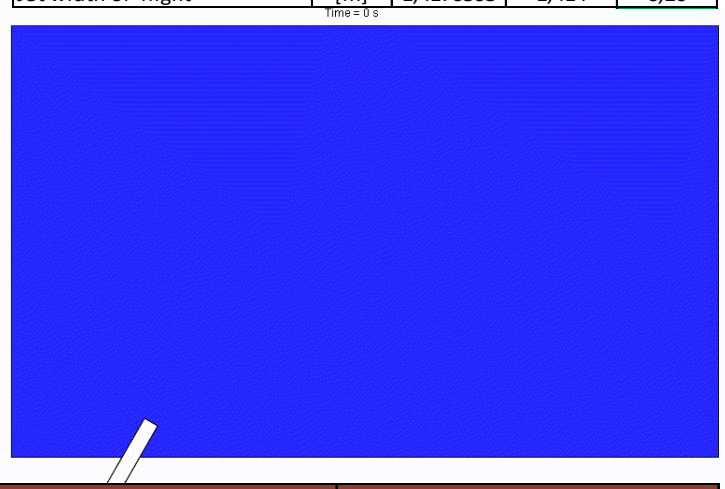


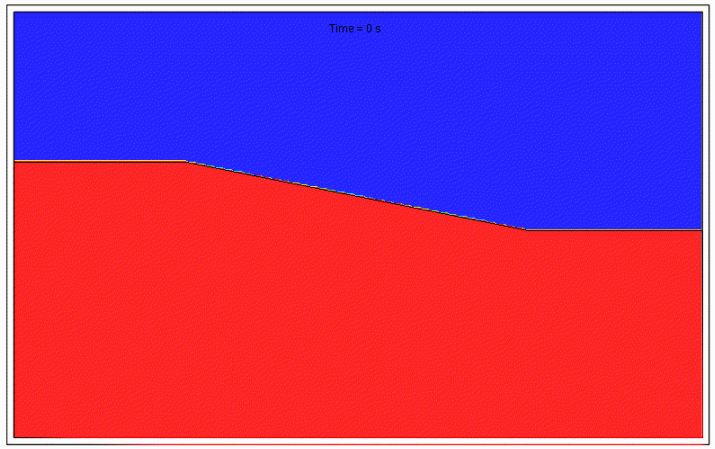
Free Surface - Validations

		V=3 m/s			V=4 m/s		
Goal Name	Unit	Value	Reference	Error,%	Value	Reference	Error,%
Fountain Height (VOF)	[m]	0,477	0,459	3,95	0,834	0,815	2,32
Fountain Height (Velocity)	[m]	0,478	0,459	4,20	0,835	0,815	2,44

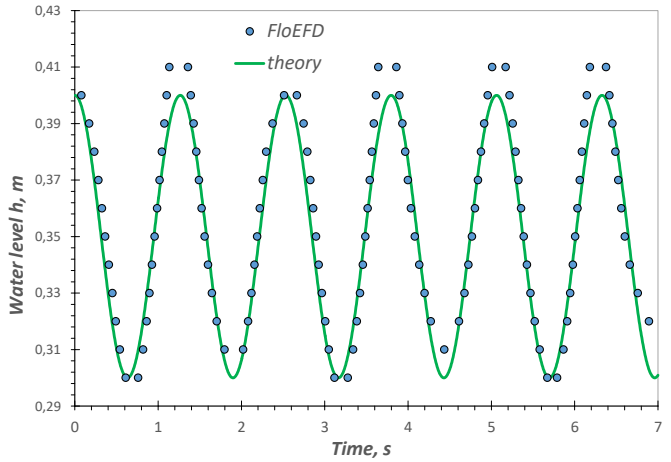
		V=4m/s		
Goal Name	Unit	Value	Reference	Error, %
Jet lift height	[m]	0,6303249	0,612	2,95
Jet width of flight	[m]	1,4176308	1,414	0,26



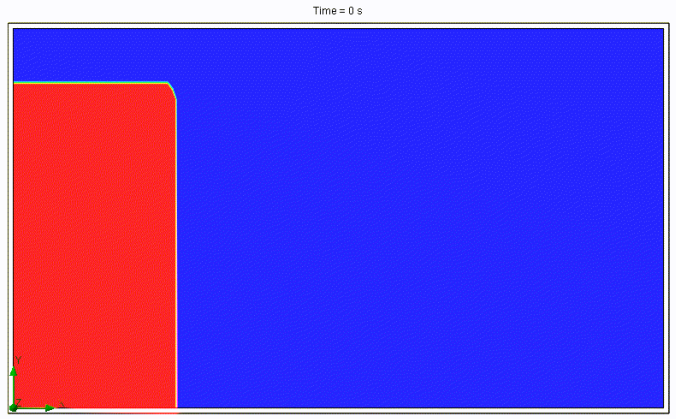


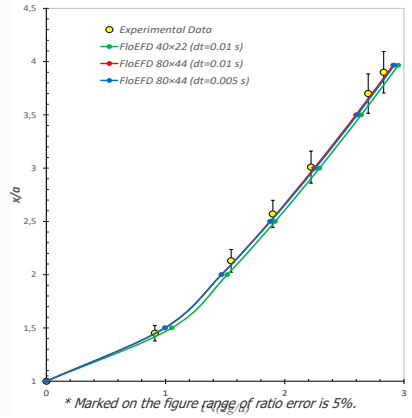


		45 degree			60 degree			75 degree		
Goal Name	Unit	Value	Reference	Error,%	Value	Reference	Error,%	Value	Reference	Error,%
SG Normal Force 1	[N]	7,068	7,072	0,05	8,672	8,661	0,13	9,688	9,659	0,29
SG Normal Force (X) 1	[N]	4,989	5,001	0,25	7,502	7,501	0,02	9,360	9,330	0,32
SG Normal Force (Y) 1	[N]	-5,007	-5,000	0,15	-4,349	-4,330	0,45	-2,498	-2,500	0,08
SG Force 1	[N]	7,068	7,072	0,05	8,672	8,661	0,13	9,688	9,659	0,29
SG Force (X) 1	[N]	4,989	5,001	0,25	7,502	7,501	0,02	9,360	9,330	0,32
SG Force (Y) 1	[N]	-5,007	-5,000	0,15	-4,349	-4,330	0,45	-2,498	-2,500	0,08
SG Torque (Z) 1	[N*m]	0,357	0,354	0,88	0,252	0,250	1,00	0,133	0,129	2,71
V top jet (Vtj)	[m/s]	1,00212	1,00000	0,21	1,00315	1,00000	0,31	0,99600	1,00000	0,40
V bottom jet (Vbj)	[m/s]	0,96735	1,00000	3,27	0,97739	1,00000	2,26	0,98165	1,00000	1,83
B top jet (Btj)	[m]	0,08528	0,08535	0,07	0,07471	0,07500	0,29	0,06274	0,06294	0,20
B bottom jet (Bbj)	[m]	0,01433	0,01465	0,32	0,02403	0,02500	0,97	0,03841	0,03706	1,35

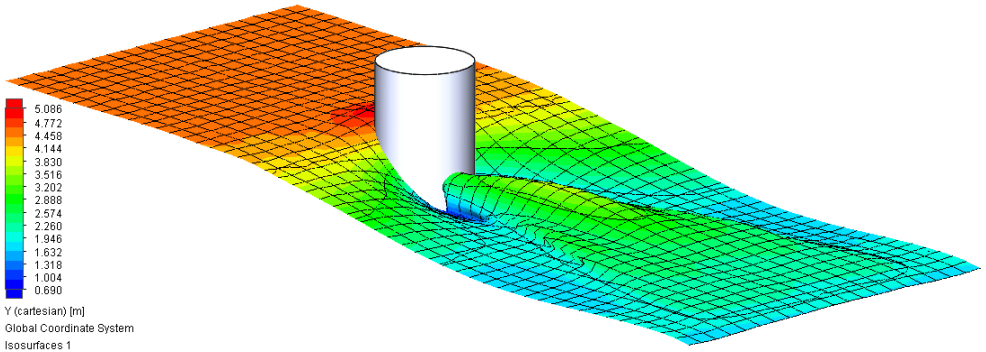


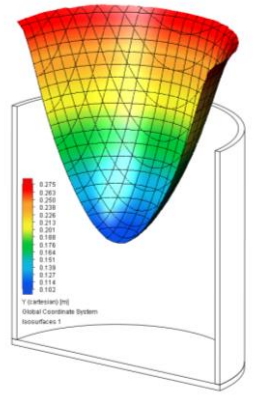
Free Surface - Validations

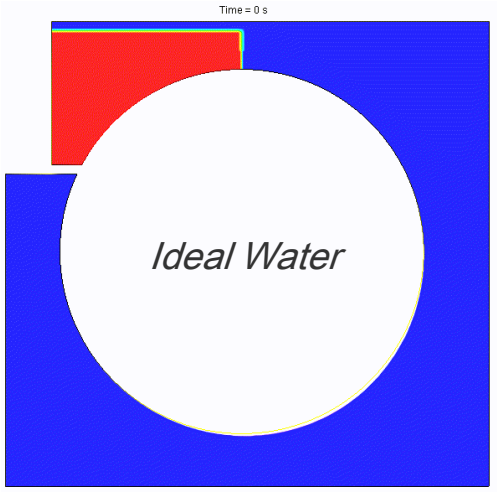


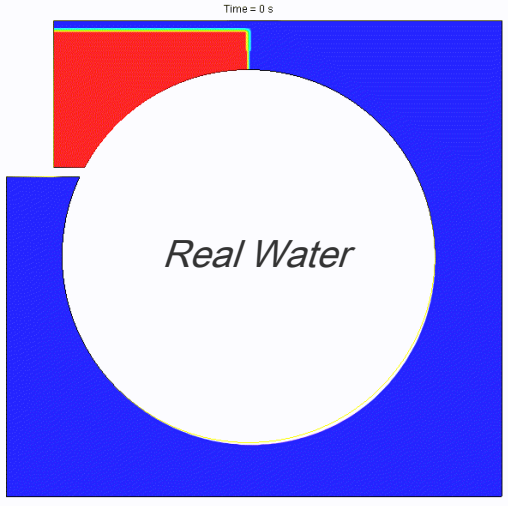


* Marked on the figure range of ratio error is 5%.



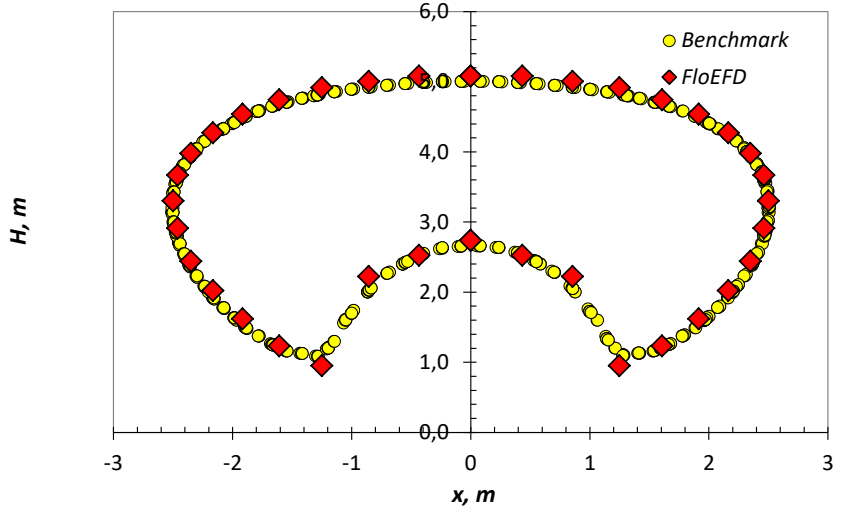


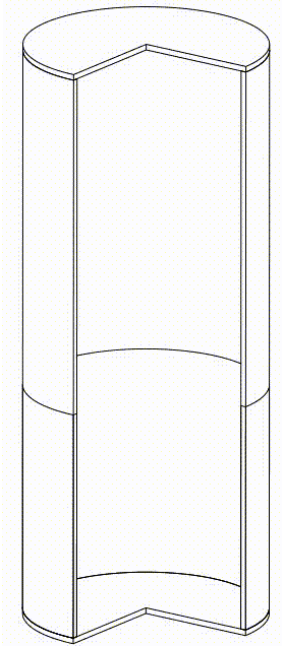




Coanda effect

Water level around *the cylinder*



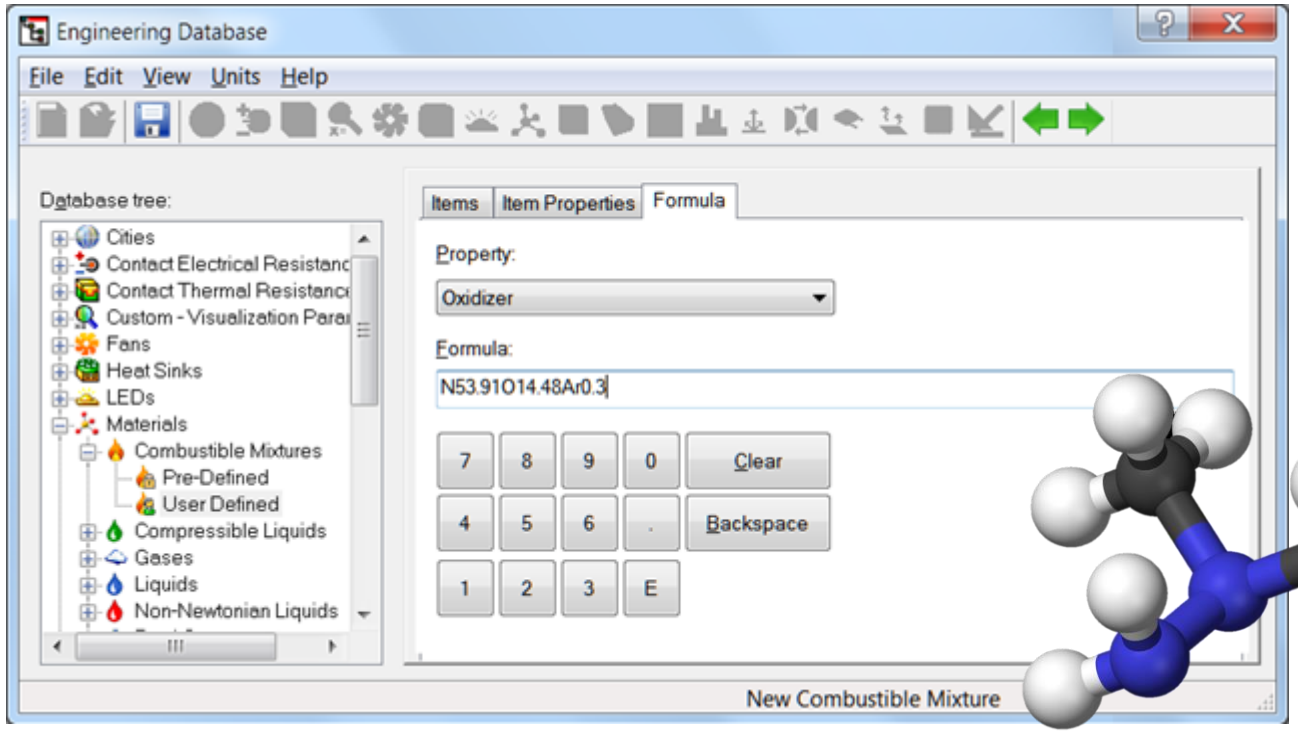


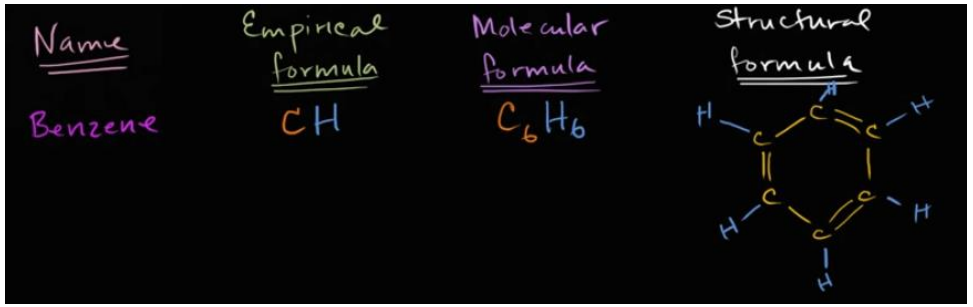
Molecular formula

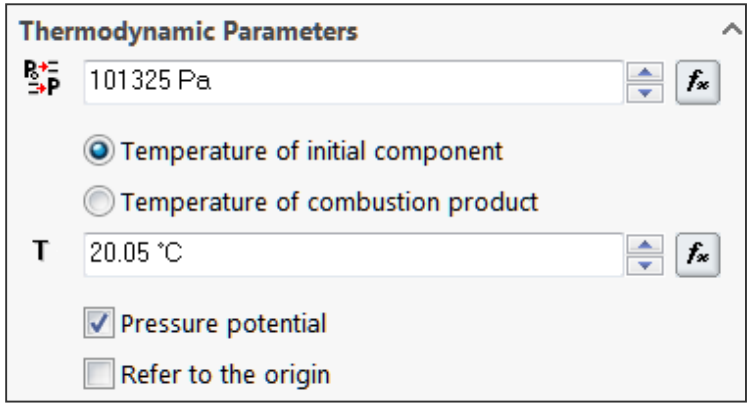
Combustion

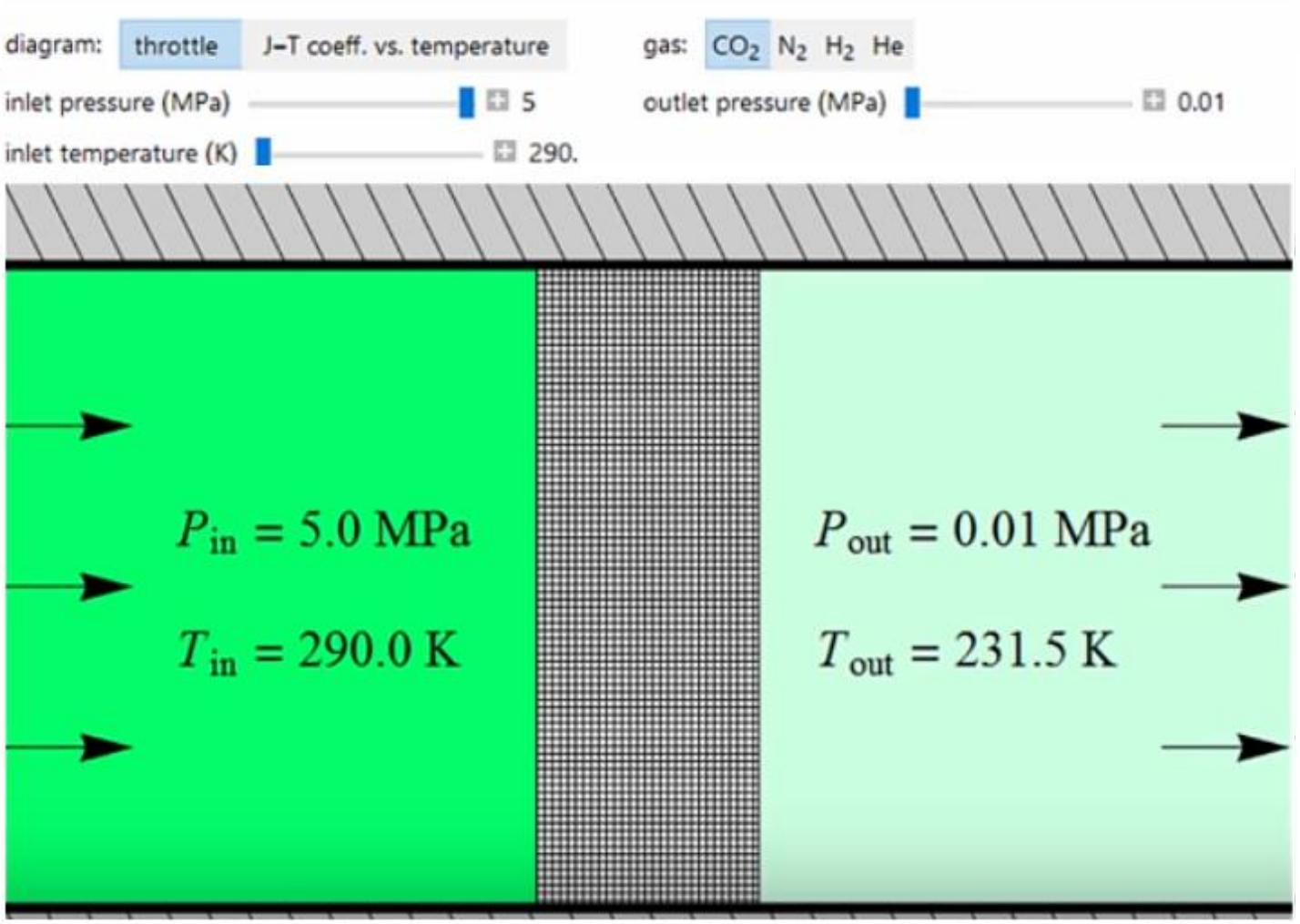
Possibility to set Fuel or Oxidizer as a molecular formula (such as C2H8N2).

You can choose to set input Temperature as Temperature of initial components or Temperature of combustion products.





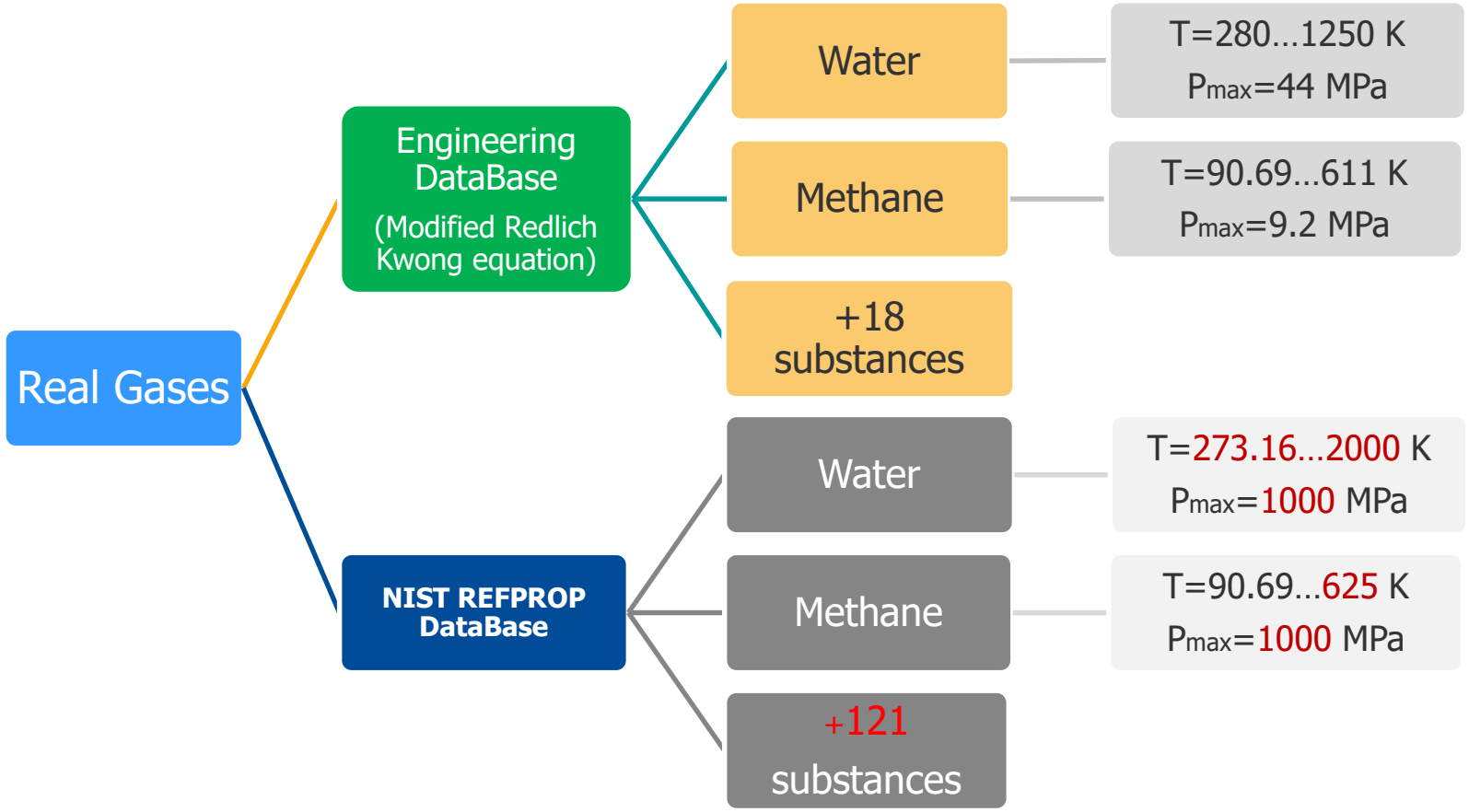




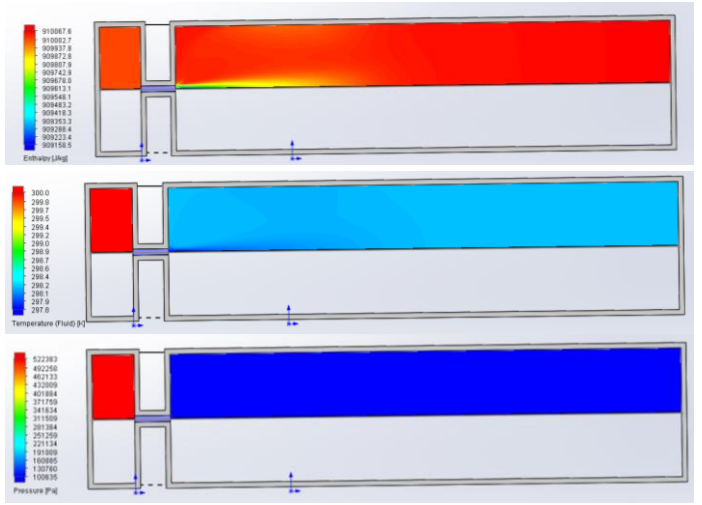
The throttling process is commonly exploited in thermal machines such as generators, air conditioners, heat pumps, and liquefiers.

Extended Real Gas Properties

NIST Database with extended properties of Real Gases is included (available for Advanced license).



Joule–Thomson effect describes the temperature change of a *real* gas when it is forced through a porous plug while kept insulated so that no heat is exchanged with the environment.



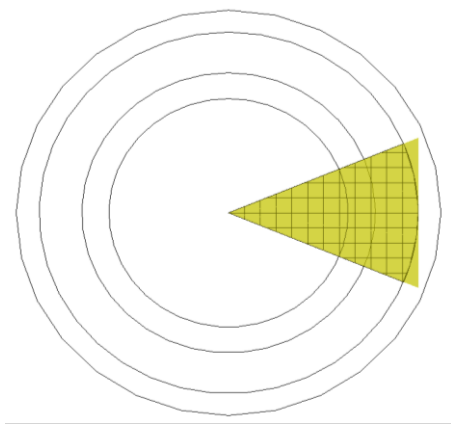
Relative error in Joule-Thomson Coefficient calculation:

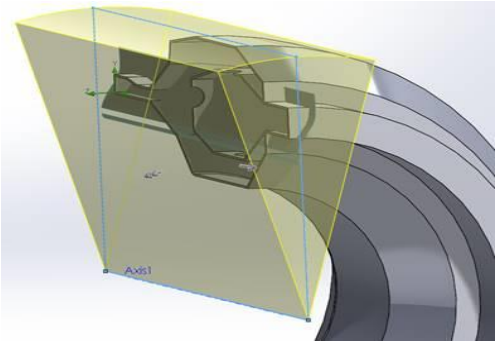
	EDB	NIST REFPROP
Water	2,49%	1%
Methane	18,11%	1.21%

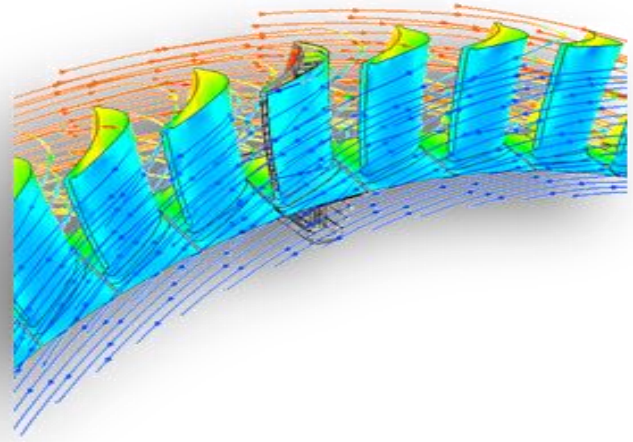
Sector Periodicity

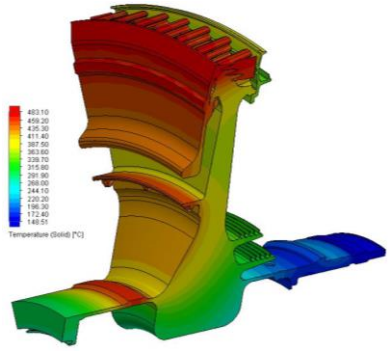
Sector periodicity allows to decrease mesh size in case of sector periodic tasks (nozzle guide vanes for example). Periodic boundary can be plane.

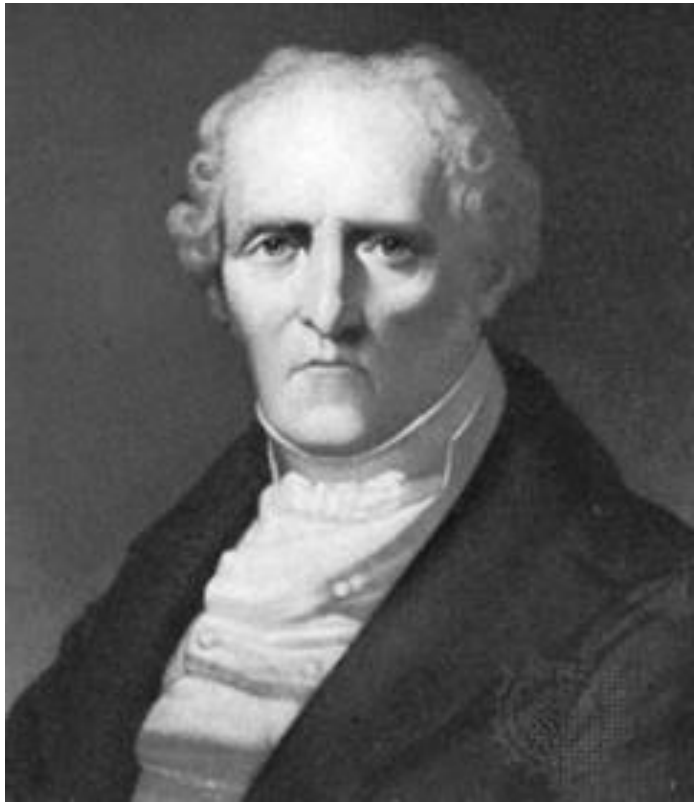
- Single periodic domain only
- Not supported:
  - Porous Media
  - High Mach Number
  - Radiation
  - Rotating is local region (Averaging)
  - Cavitation
  - Fluid Film, Sorption.



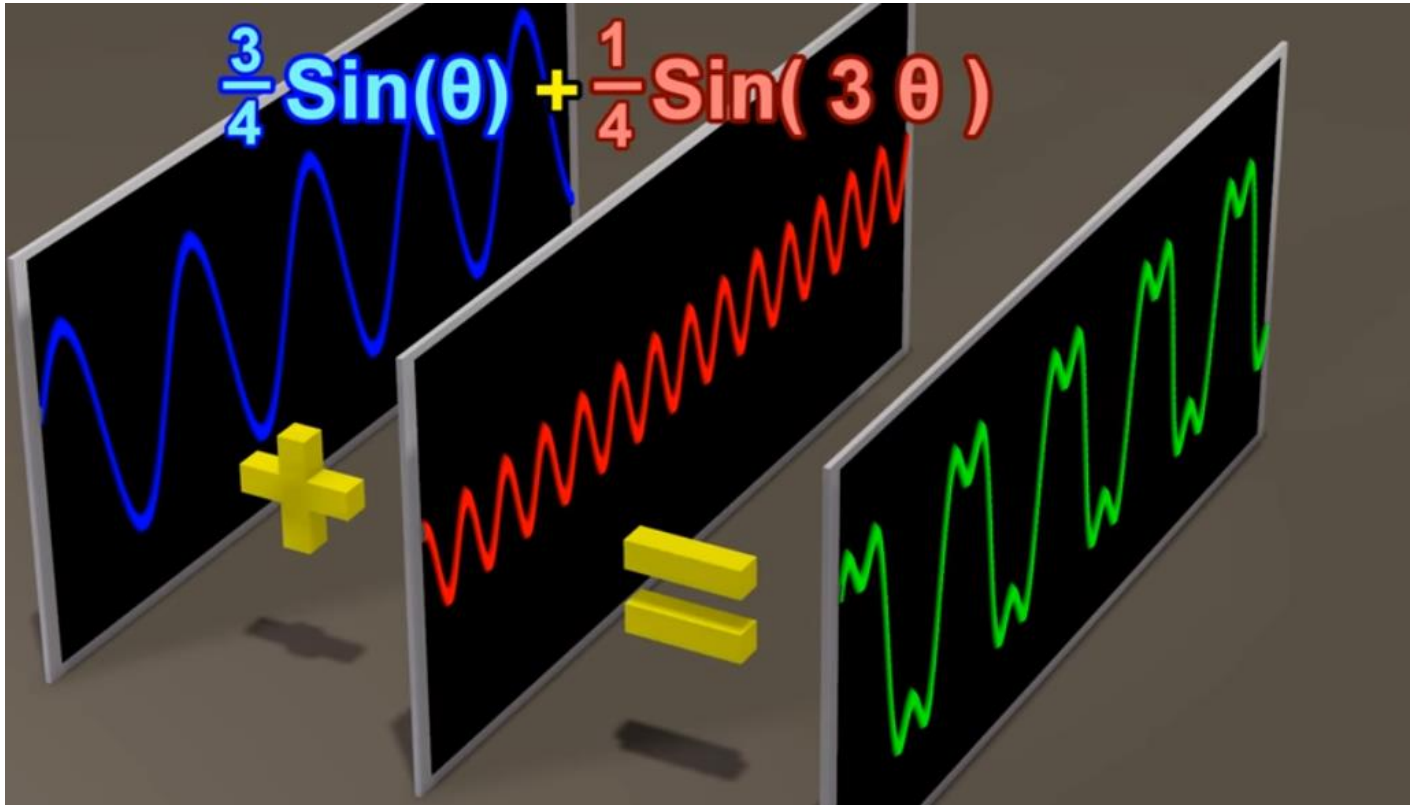






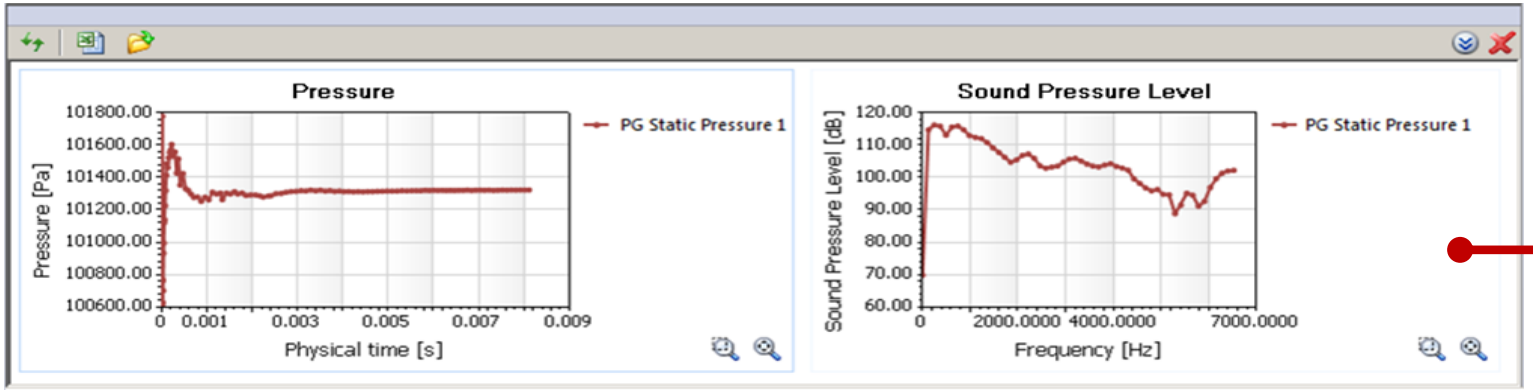


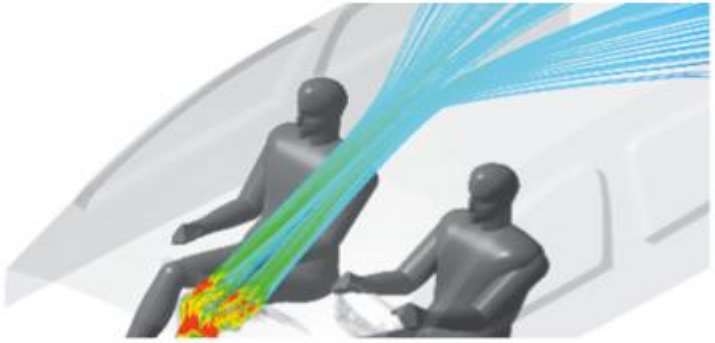
Fast Fourier Transform

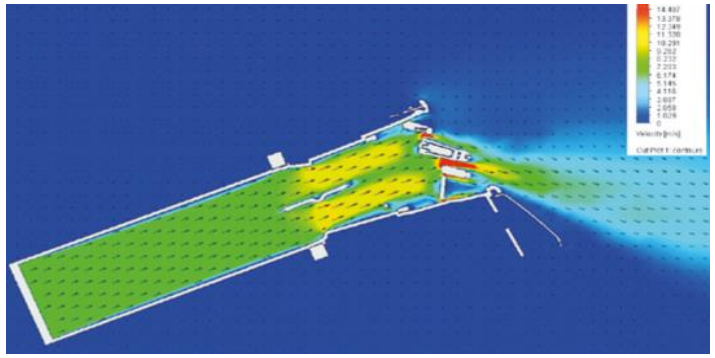


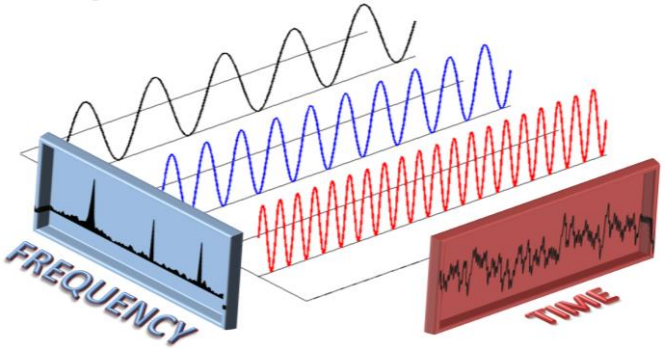
Noise Estimation: Fast Fourier Transform

Fast Fourier Transform allows to convert a time signal to the complex frequency domain.
A parameter oscillation (e.g. Pressure) can be represented as Sound Pressure Level [dB]-Frequency plot.









LIGHTING
RADIATION
WATER FILM

FloEFD TeraLED Interface

Import non-linear LED characteristics from TeraLED as a raw table instead of coefficients of linearity (sensitivities).

Property:

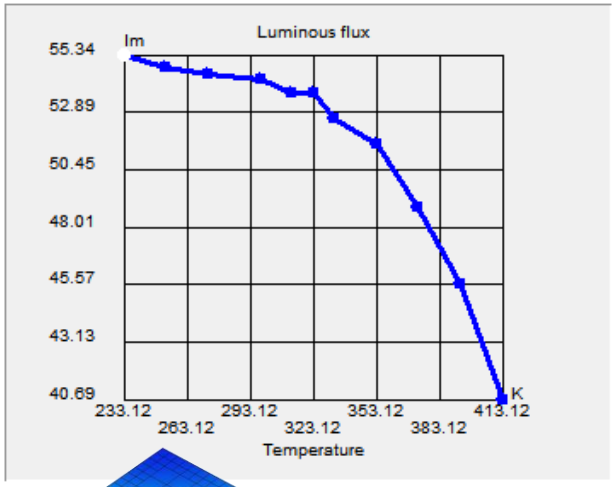
Luminous flux

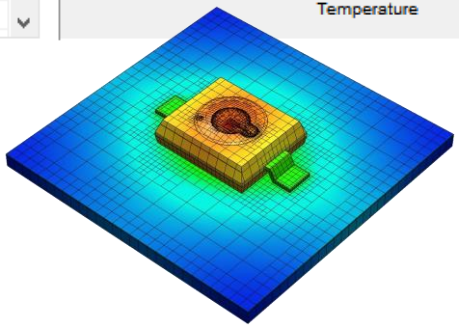
Current
0.15 A
0.42 A
0.7 A
0.8 A

Current: 0.15 A

Temperature	Luminous flux
233.12 K	55.335 lm
253.12 K	54.7925 lm
273.12 K	54.52125 lm
298.12 K	54.25 lm
313.12 K	53.7075 lm
323.12 K	53.7075 lm
333.12 K	52.6225 lm

Import from T3Ster TeraLED...

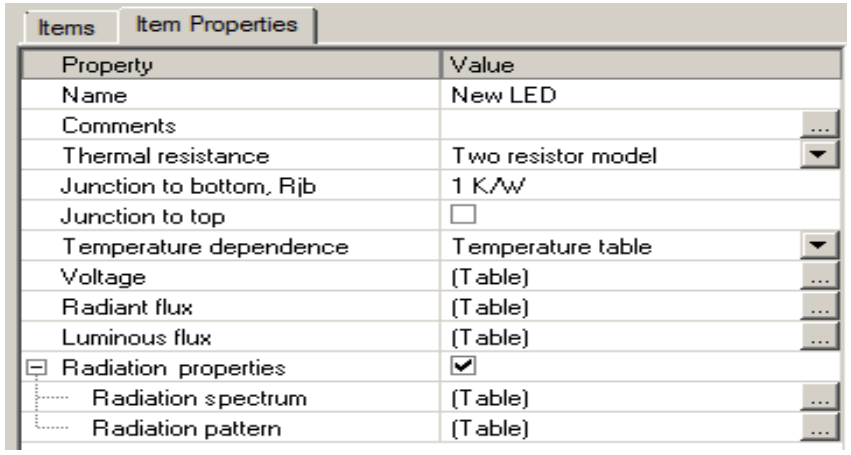


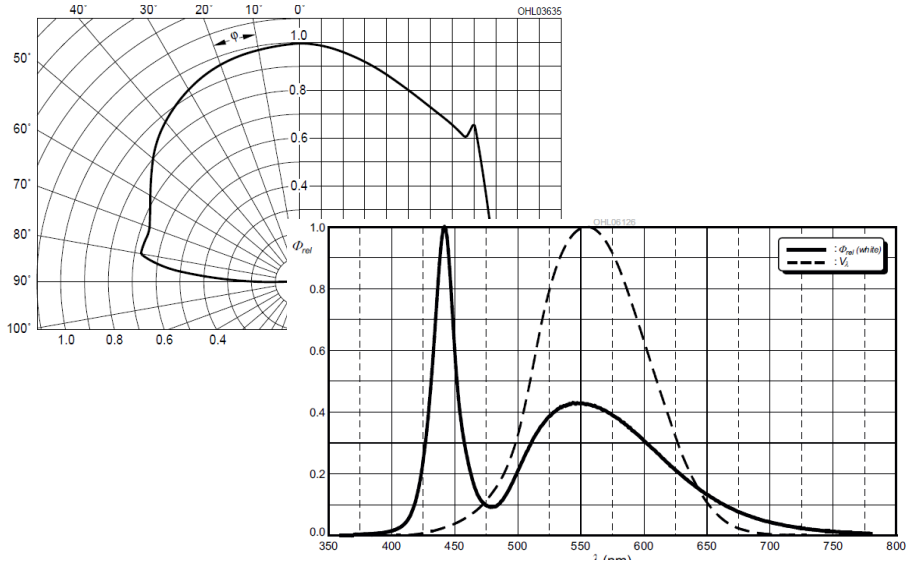


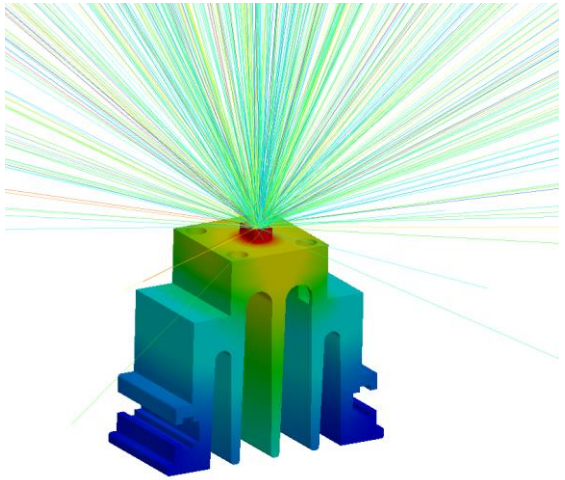
Radiation Pattern and Spectrum for LED

Radiation pattern (power dependency on angle) **and spectrum** are added to the definition of **LED Thermal-Optical** compact model.

Adding radiation pattern and spectrum automatically **enables radiation source** on LED's top surface.

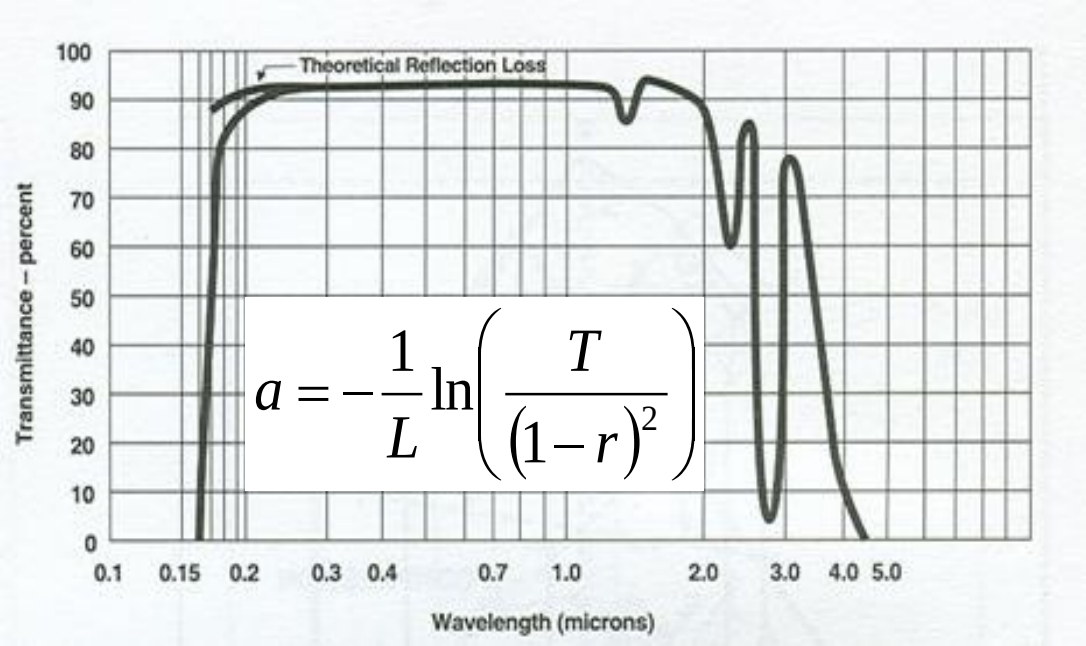






Transmission Curve

Possibility to add **transmission curve** instead of absorption curve as a radiation characteristic for semi-transparent solid materials.



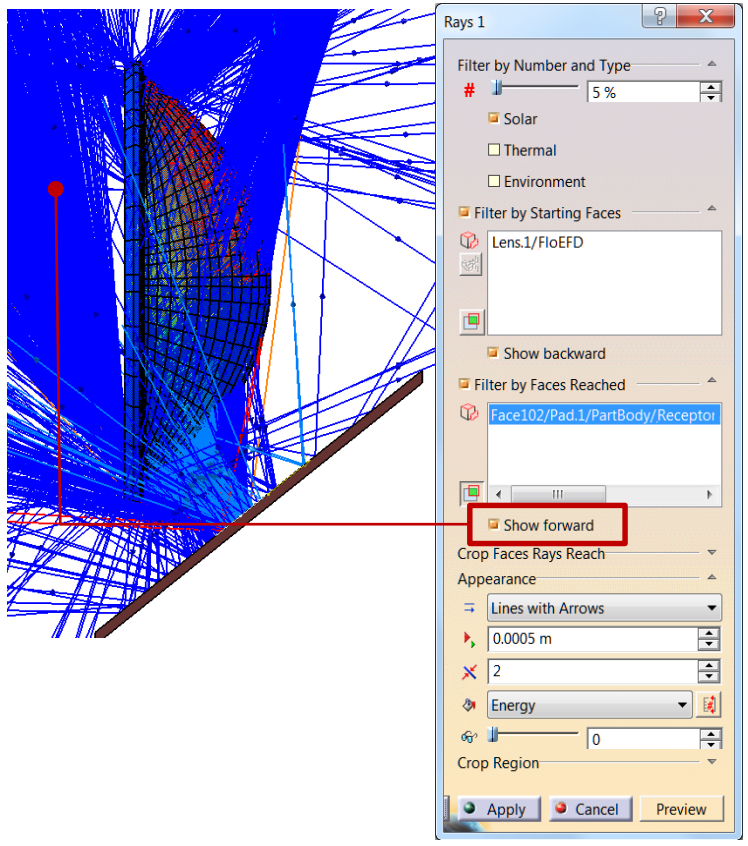
Transmission curve

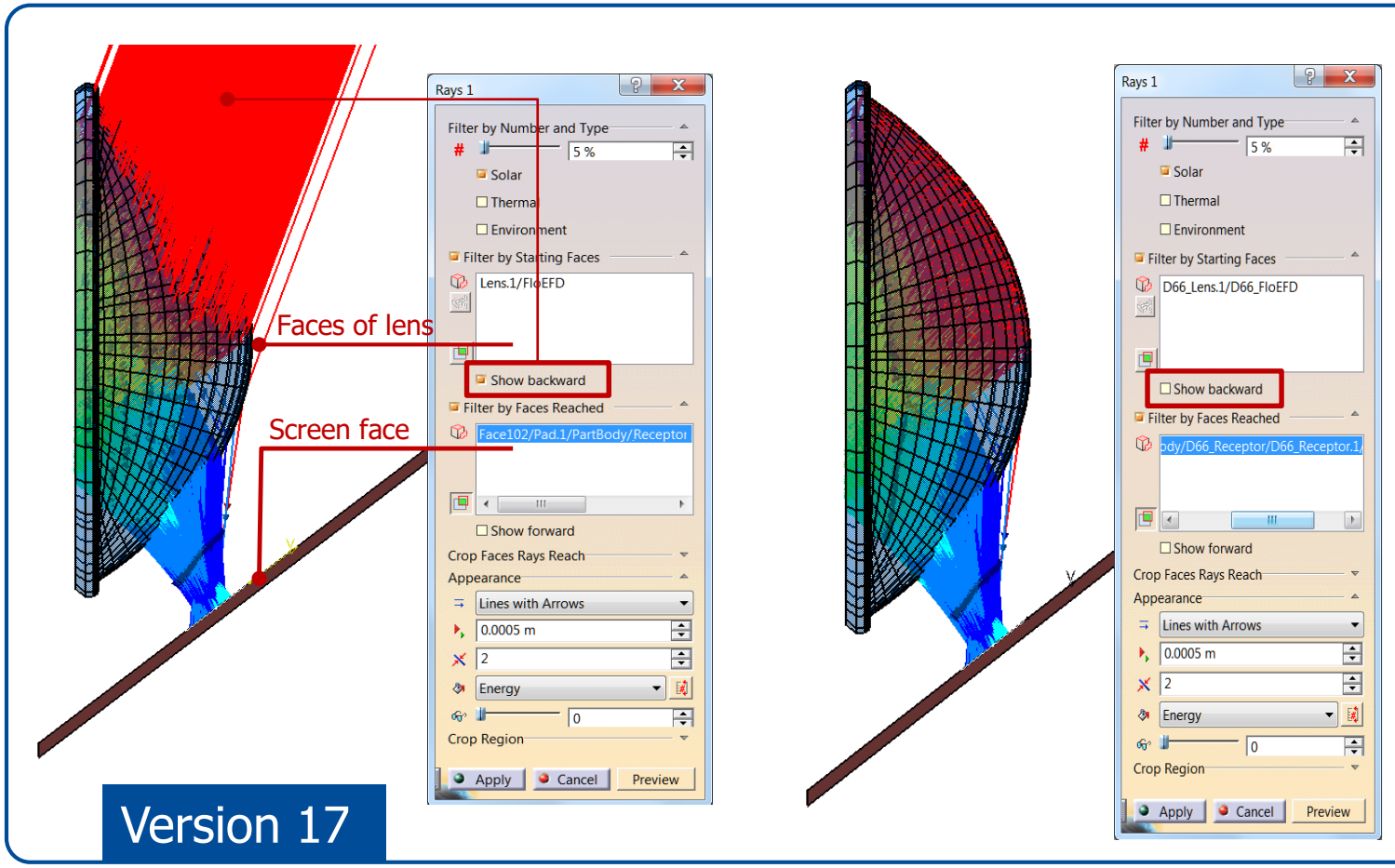
Radiation properties	☑
Set absorption properties as	Absorption coefficient
Absorption coefficient	(Table)
Refractive index	(Table)

Radiation properties	☑
Set absorption properties as	Transmission
Transmission	(Table)
Reference thickness	1 mm
Absorption coefficient cut-off	1 1/mm
Refractive index	(Table)

Improved Ray Visualization

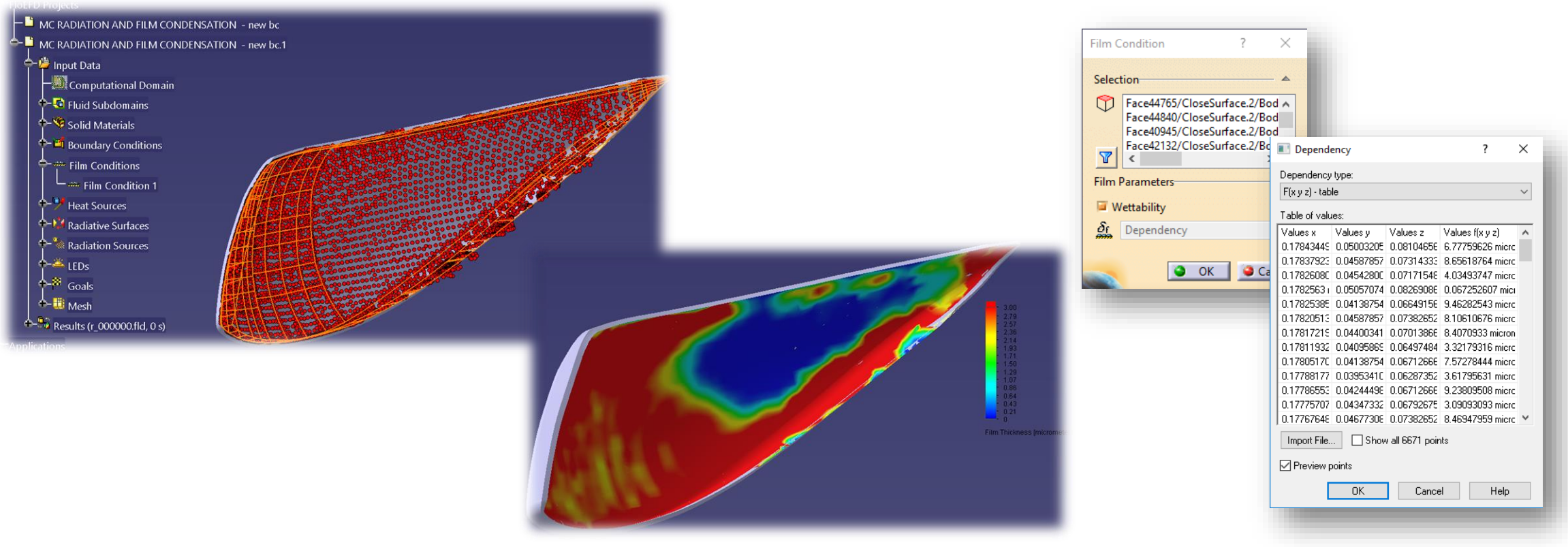
You can now display rays between two selected surfaces, including those which go through a selected semi-transparent surface.





Film Thickness Import

Film thickness mapping - Import film thickness as a table of points. Used for transferring results of film condensation to other simulation.

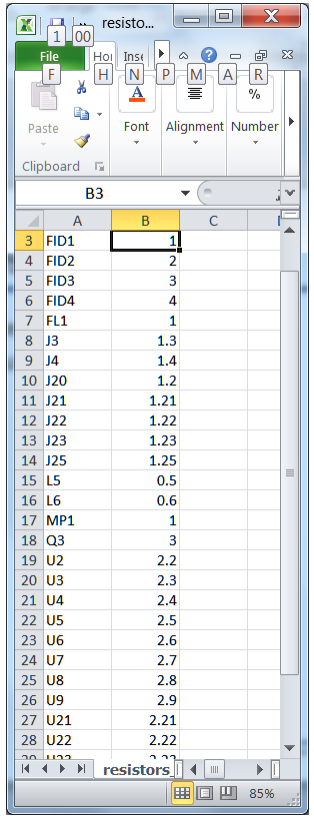


PCB MODELING ELECTRONICS

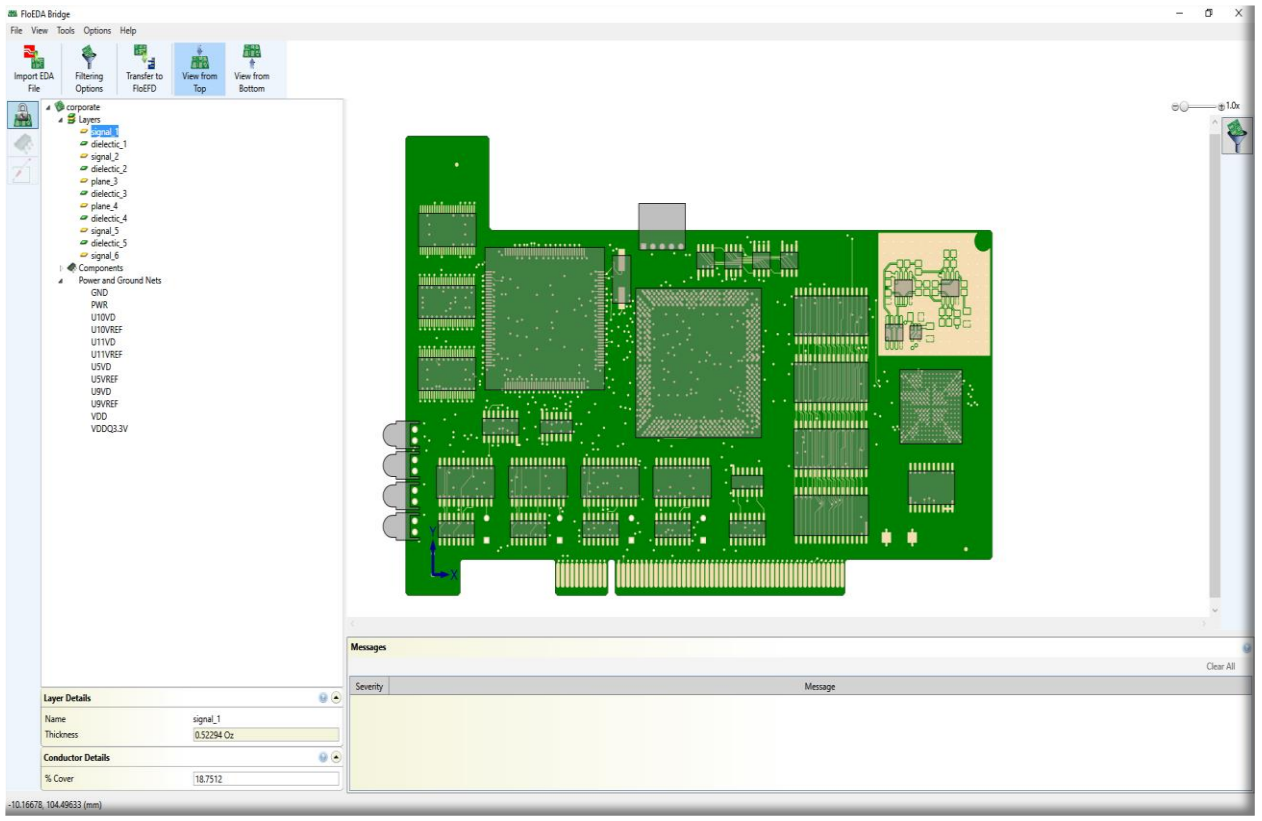
EDA Bridge: Import Power List

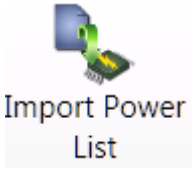
Create CSV file with power map: [ComponentName;Power].

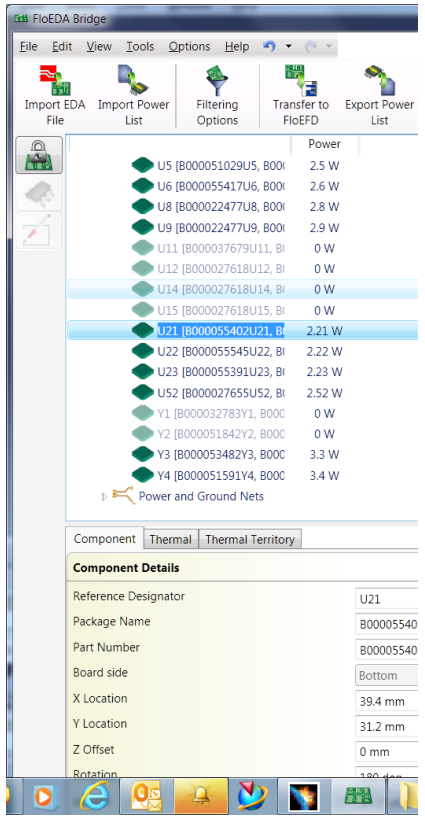
Import it into EDA bridge (or you can change power manually).



	A	B
3	FID1	1
4	FID2	2
5	FID3	3
6	FID4	4
7	FL1	1
8	J3	1.3
9	J4	1.4
10	J20	1.2
11	J21	1.21
12	J22	1.22
13	J23	1.23
14	J25	1.25
15	L5	0.5
16	L6	0.6
17	MP1	1
18	Q3	3
19	U2	2.2
20	U3	2.3
21	U4	2.4
22	U5	2.5
23	U6	2.6
24	U7	2.7
25	U8	2.8
26	U9	2.9
27	U21	2.21
28	U22	2.22





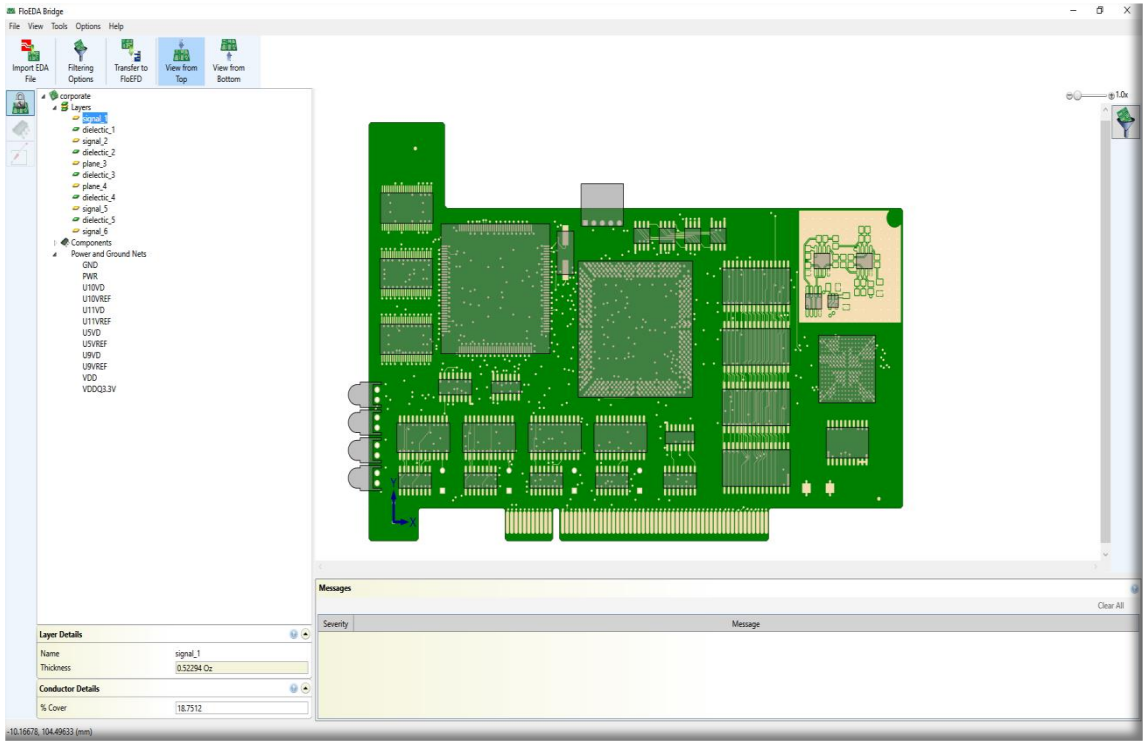


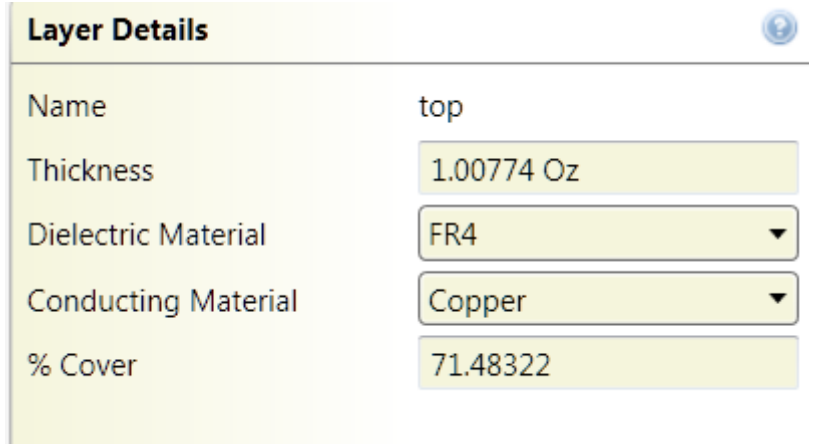
EDA Bridge: Material Properties for Layers

Copper content is calculated for layers.

Material for dielectric can be: FR4, FR4(24% Fibre) or Polyamide.

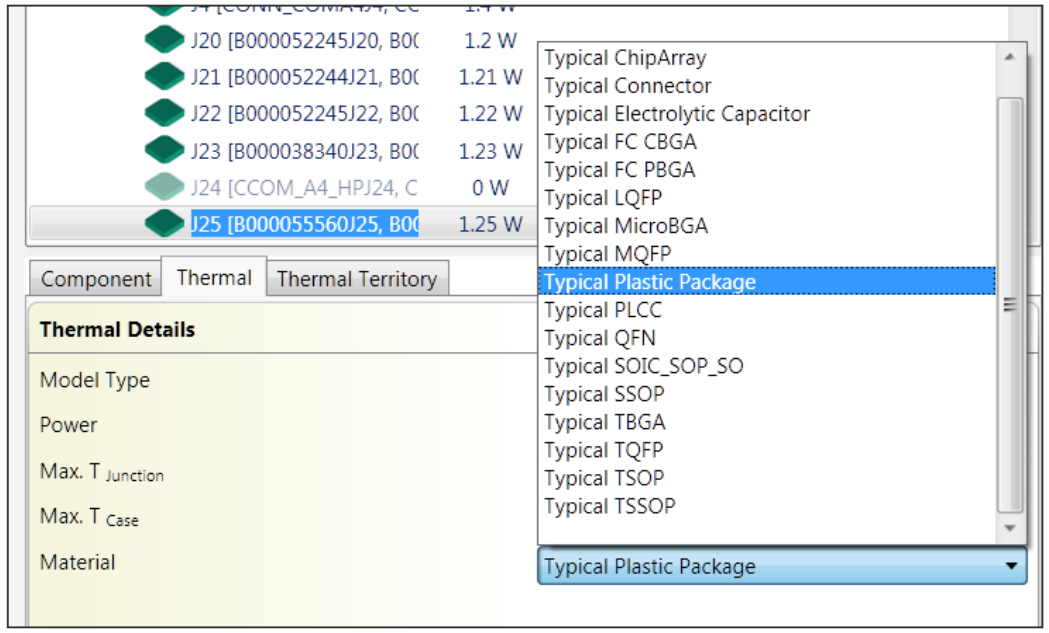
Material for conductor can be: Copper or Copper Tungsten.

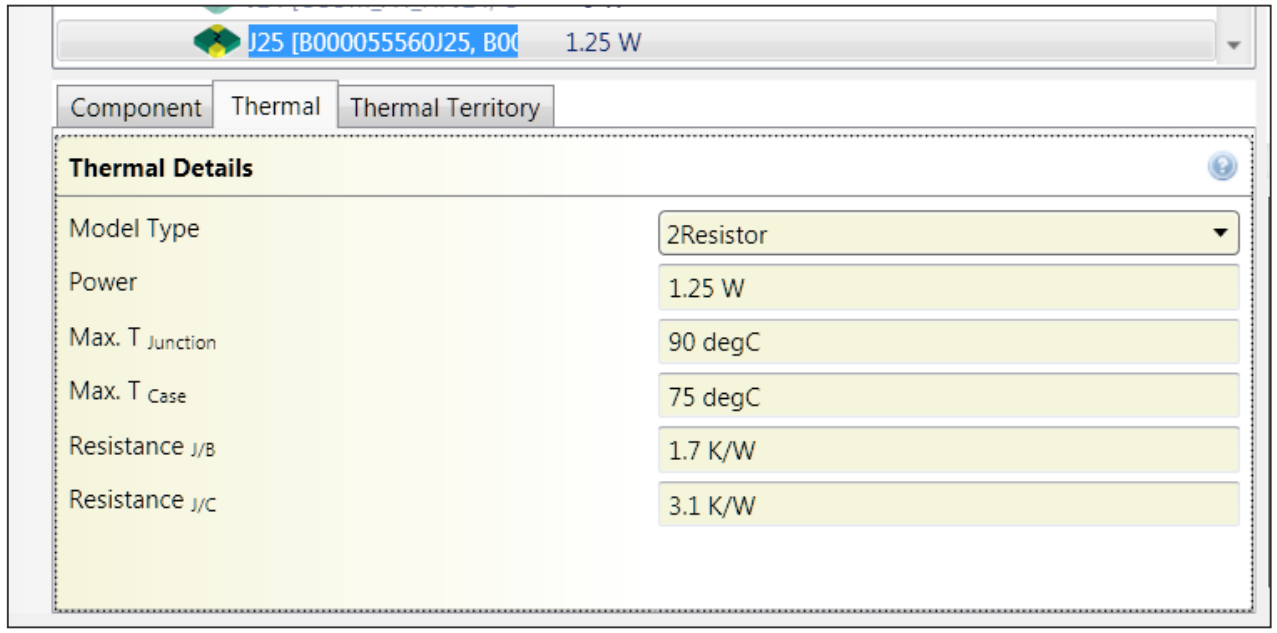




EDA Bridge: Material Properties for Components

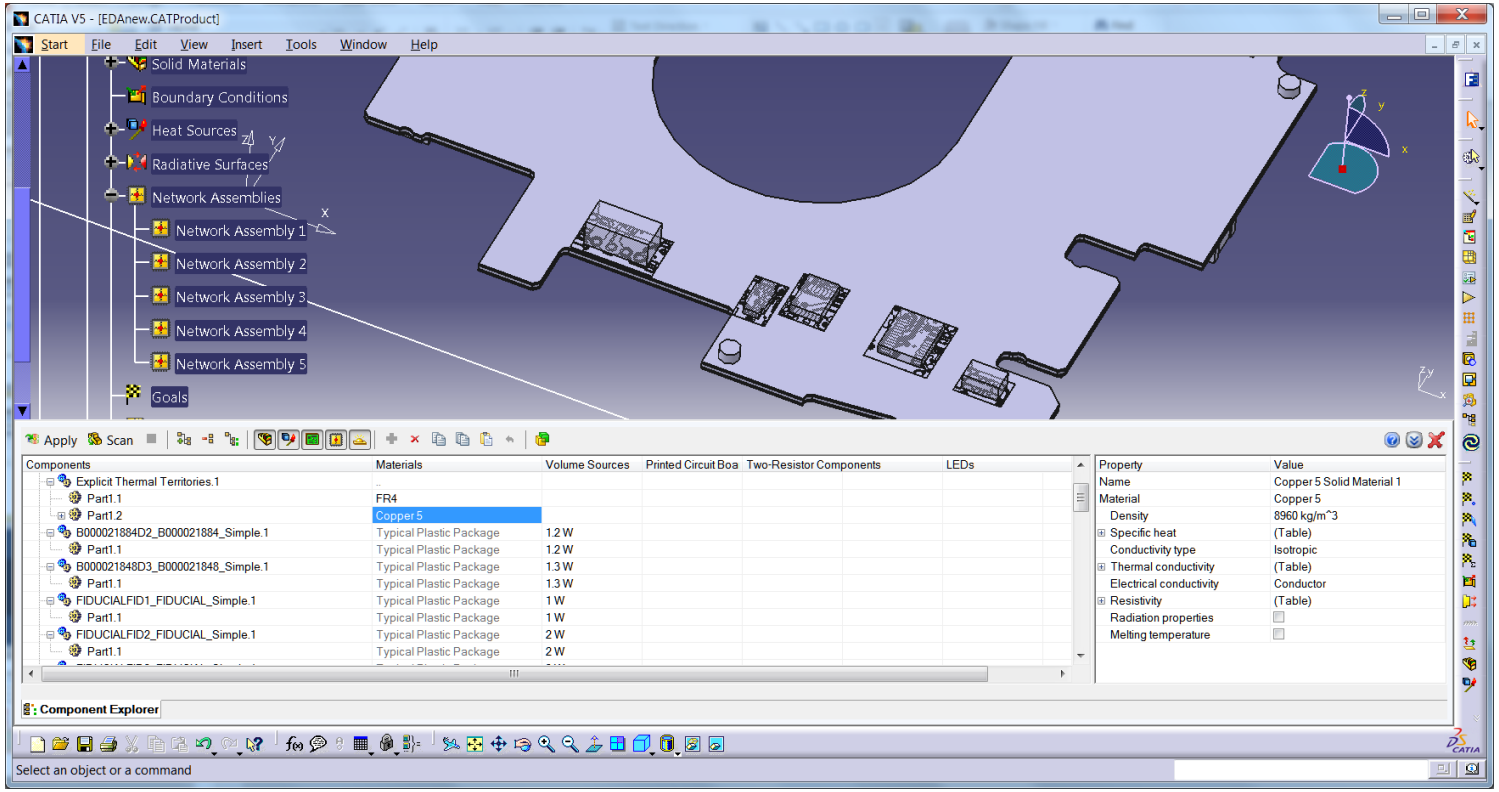
Component can be defined as a solid material or 2Resistor.





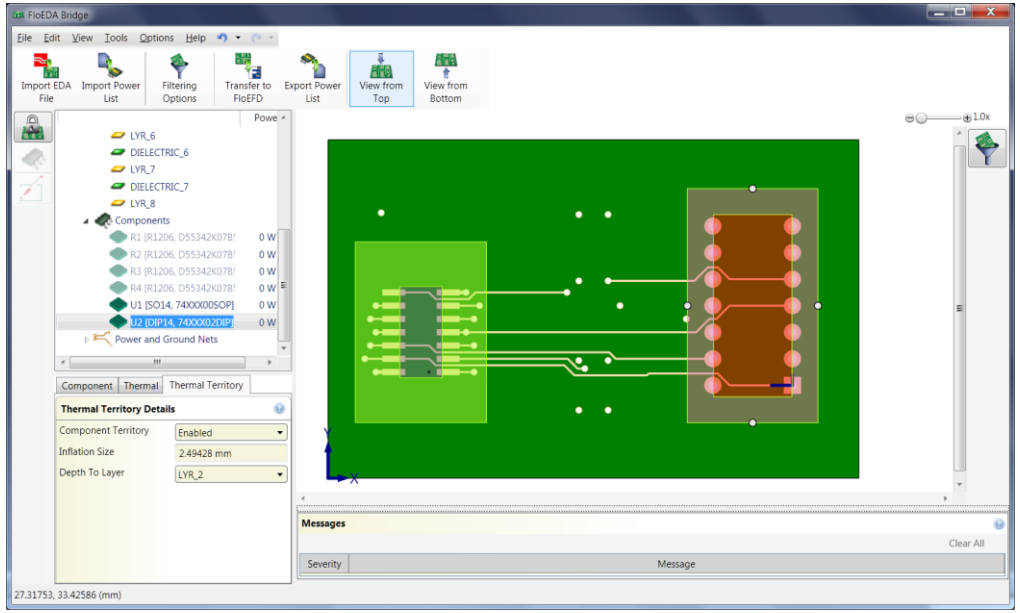
EDA Bridge: Material Properties for Components

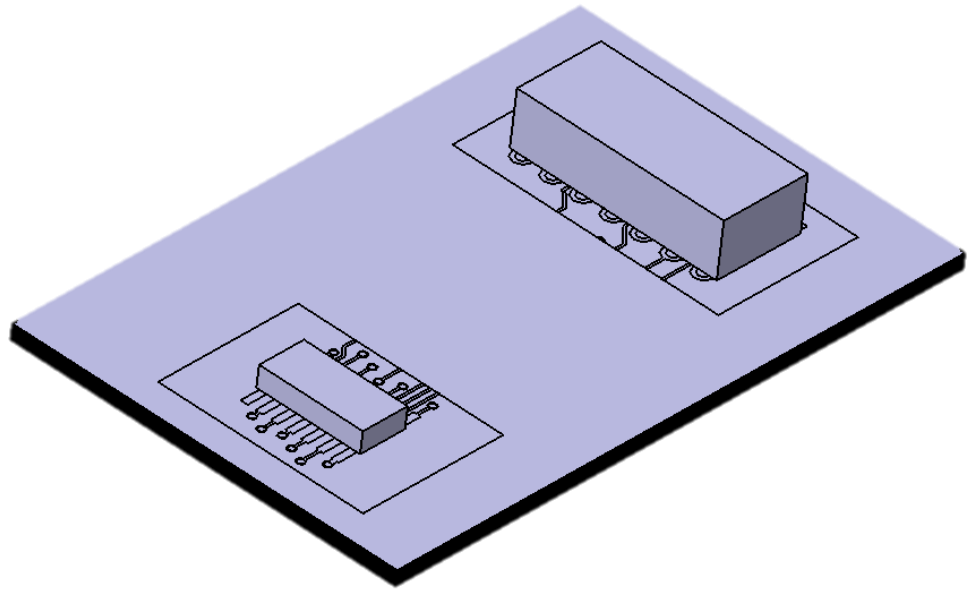
After importing the corresponding **Material** and **Boundary Conditions** (Heat Sources, Network Assembly, Radiative Surfaces) are **automatically** created.



EDA Bridge: Thermal Territory

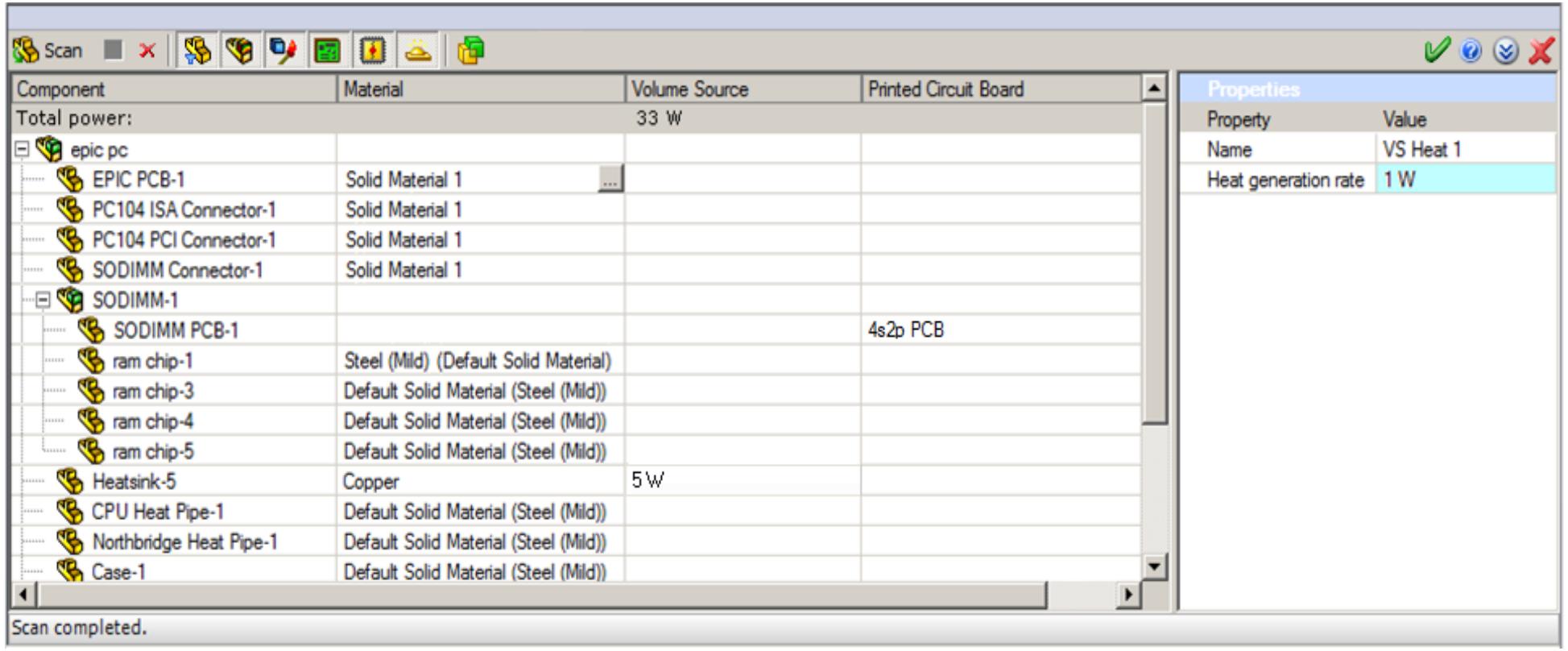
Thermal Territory is ability to explicitly model only a selected area under a component.





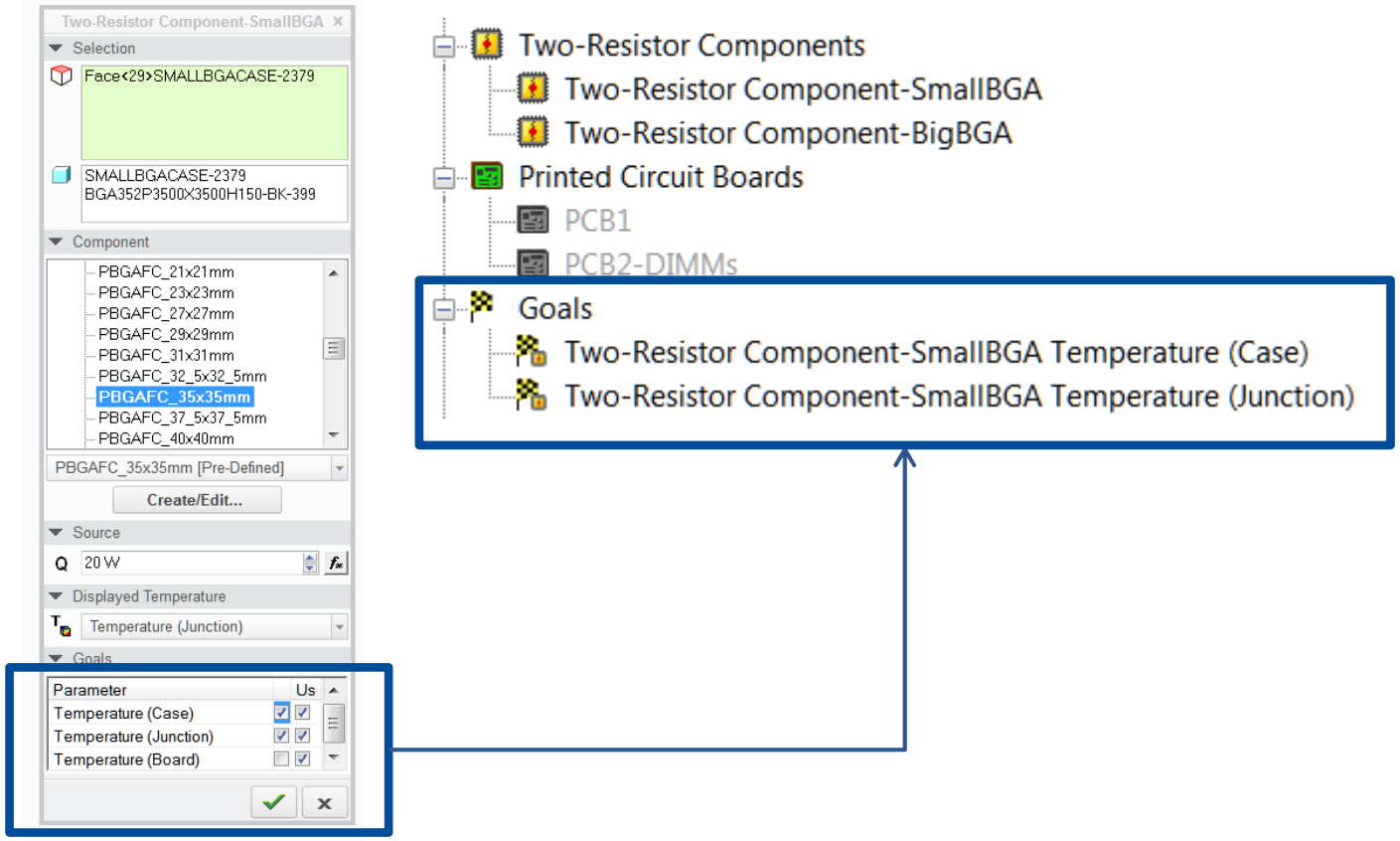
Edit from Component Explorer

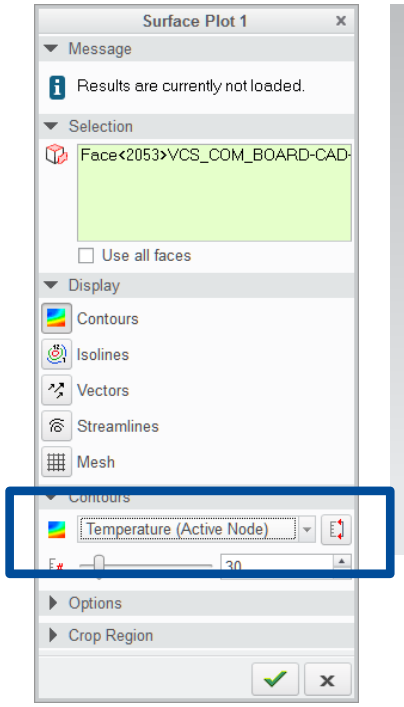
- Create/edit sources, 2R, LED, PCB and materials from the table.
- Display total power applied.

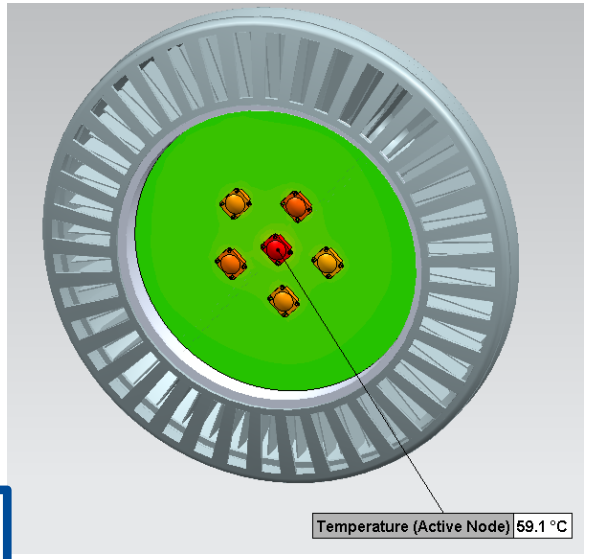


Feature Goals for LED, 2R, Network Assembly. Display Junction T.

- Create Goals for the nodes of compact models (LED, 2R, NA) in definition dialog.
- Select a node (Junction, Bottom, or Top) to display as **Temperature (Active Node)**.



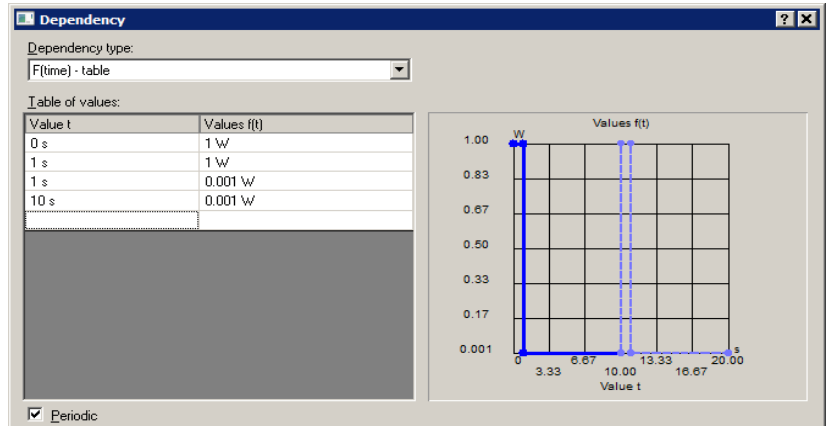


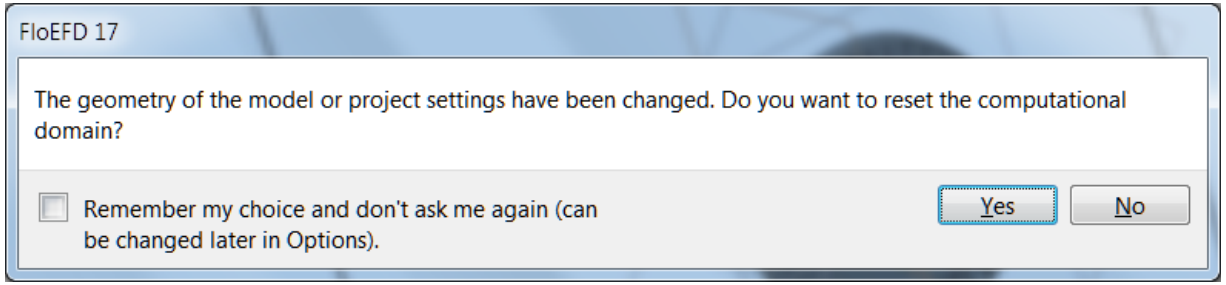


USABILITY

Usability: Preprocessing

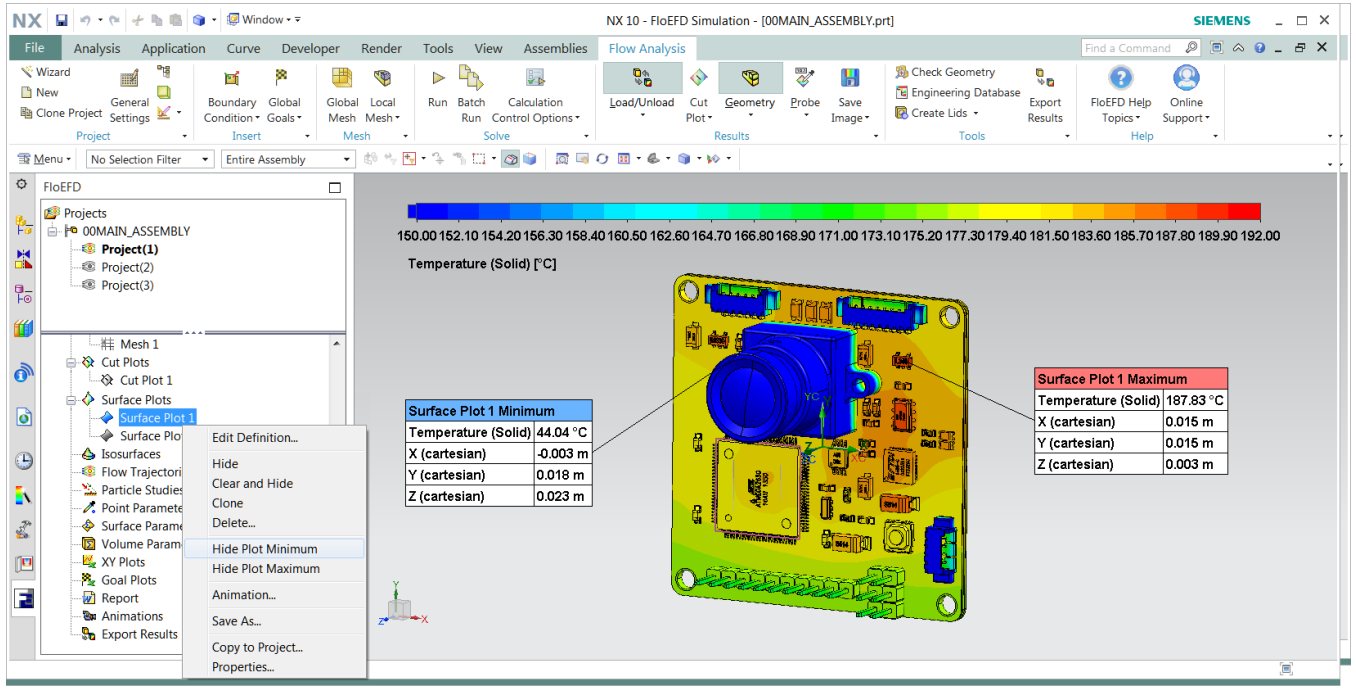
- “Don’t ask me again” for reset mesh and reset computational domain
- Full Template: all data is now saved in template
- Rebuild Error don’t block boundary condition creating
- Toggle to set periodic (cycling) time dependence
- Display used cores in Monitor and logs incl. for Linux
- BC name is displayed in the caption of dialog
- TEC driving current as a function of Goal
- Display linked condition in the main project tree
- Dynamic Viscosity is added into point goal
- Inlet Mass Flux

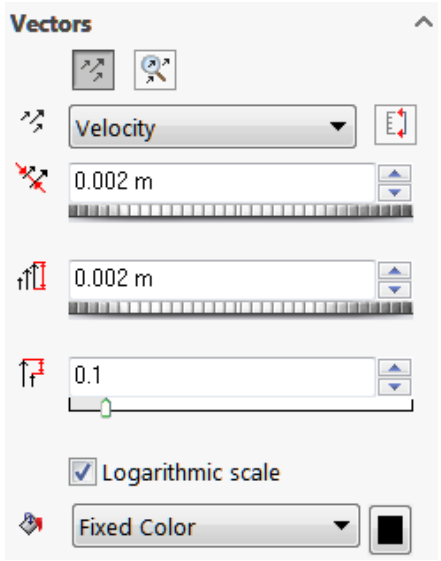


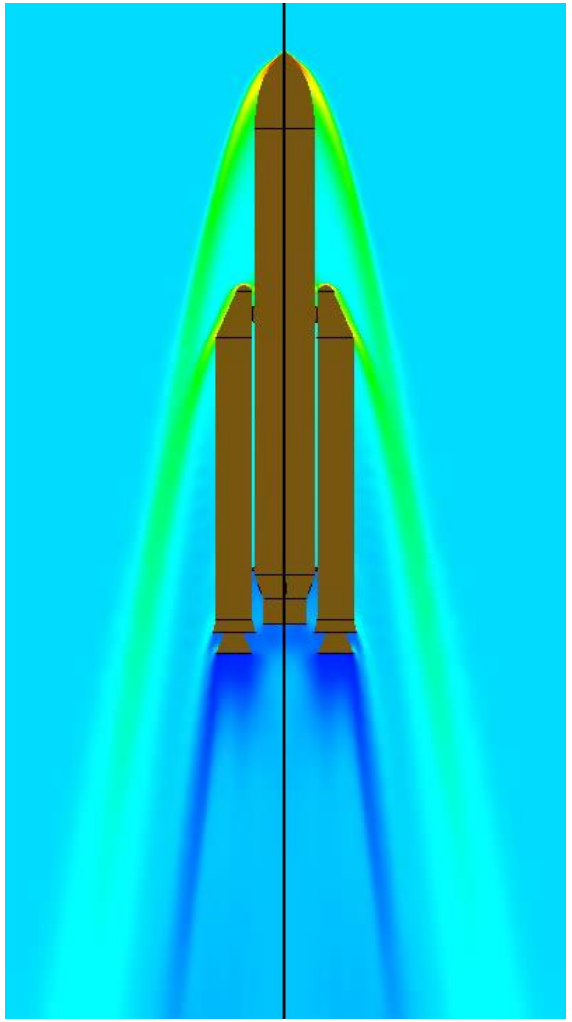


Usability: Postprocessing

- Logarithmic scale for contours and vectors
- Horizontal legend
- Min Max callouts on plot optionally with coordinates

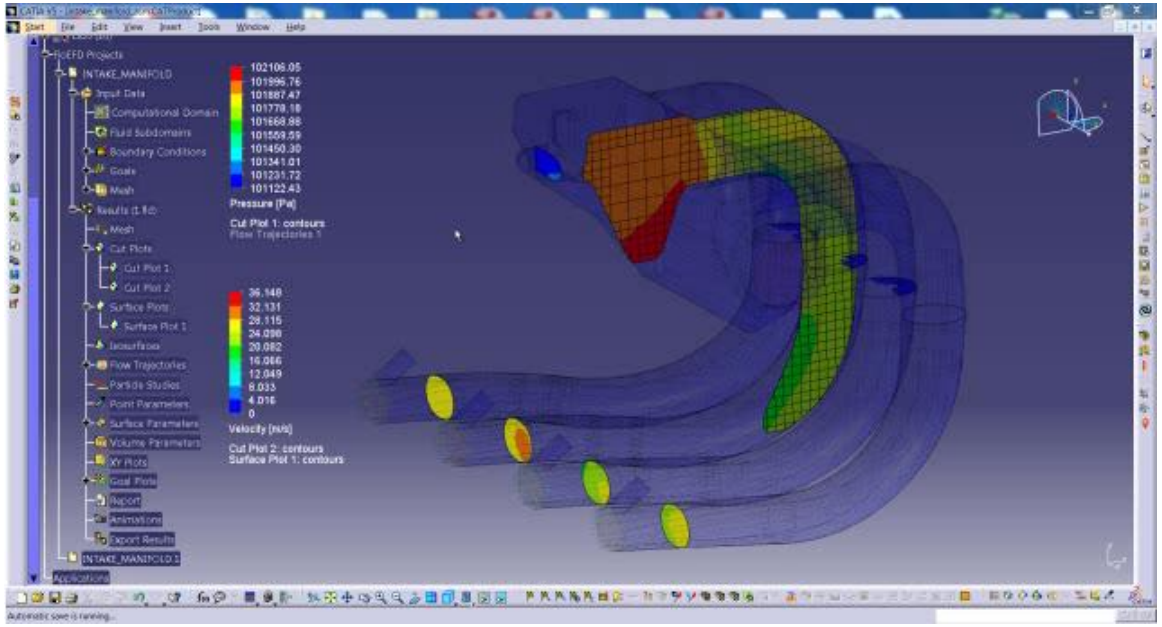


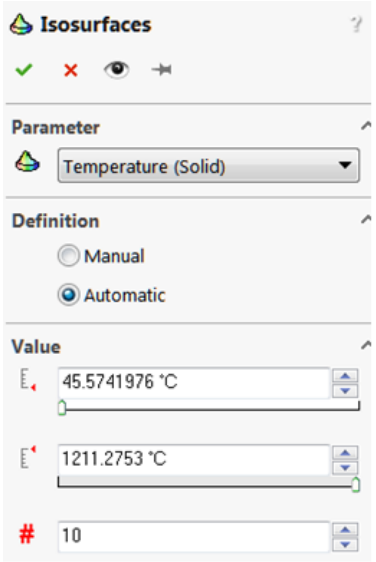


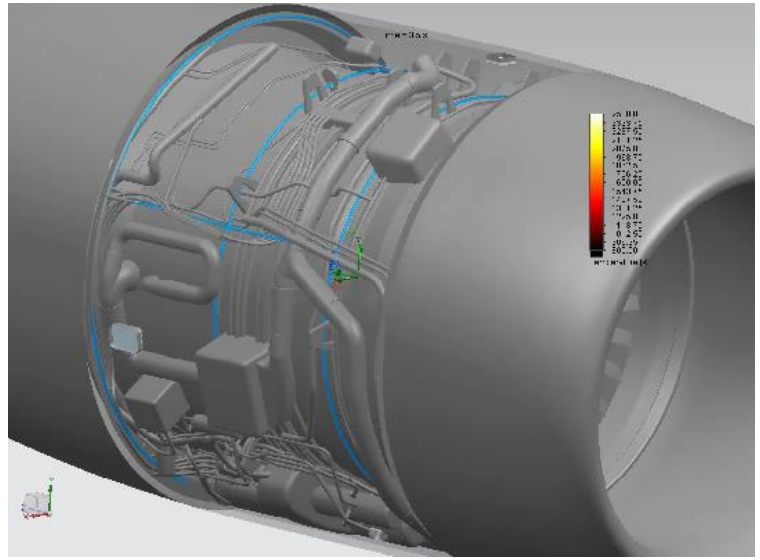


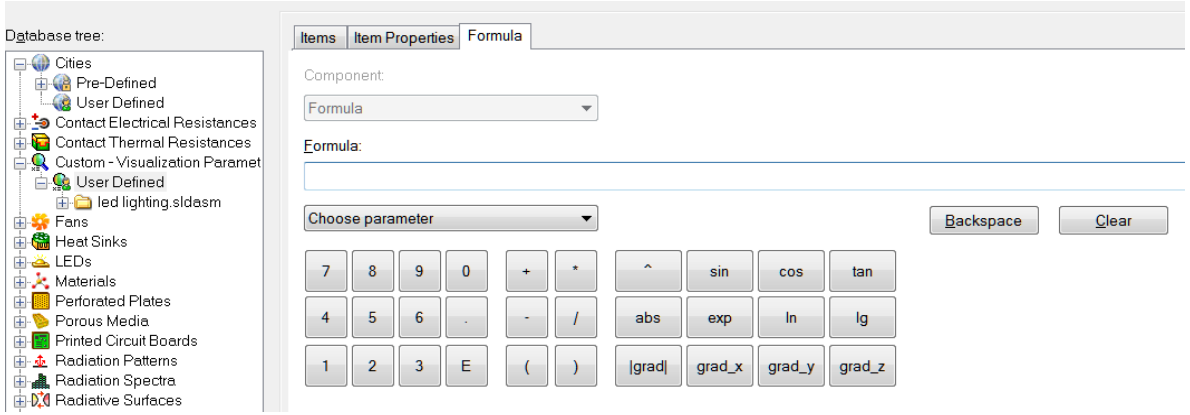
Usability: Postprocessing

- Isosurface: number of values in a range
- Cut plots: Orient the plot parallel to the screen
- Parameters: Specific and Absolute Humidity
- Parameters: Custom Gradient parameter



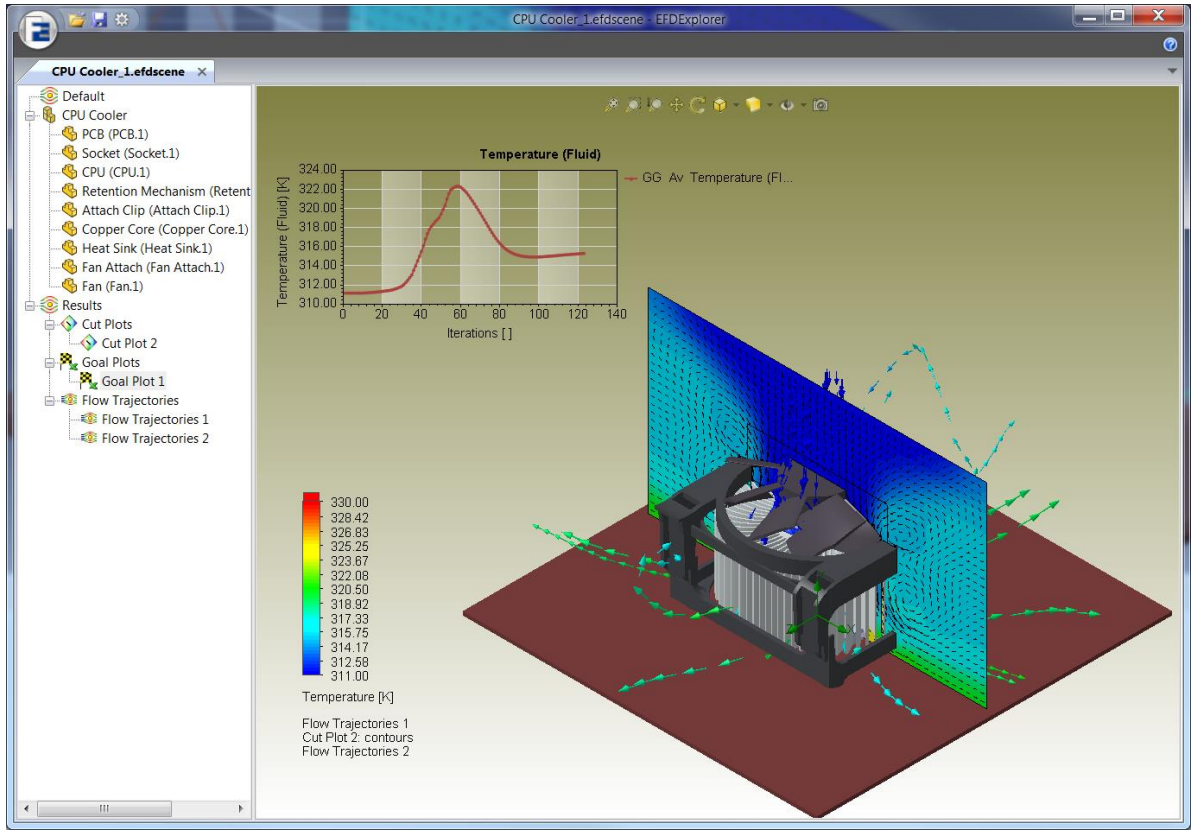


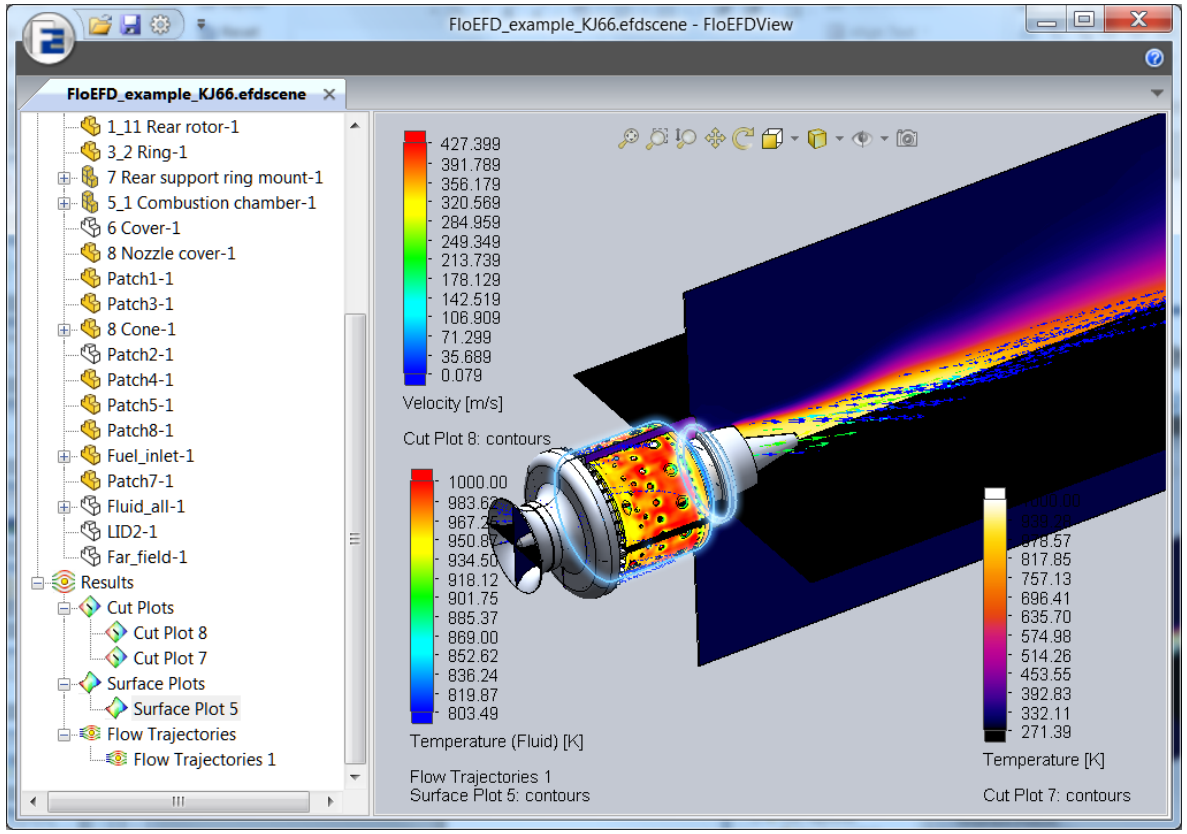




FloEFDView

Standalone FREE viewer to explore FloEFD results optionally including original CAD geometry.

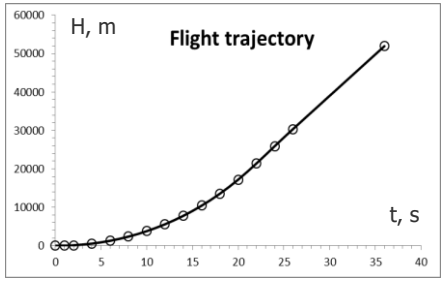


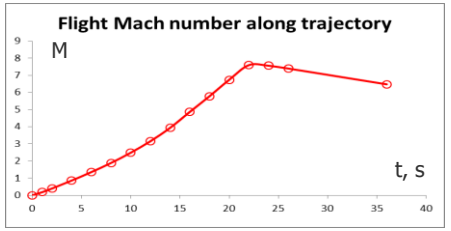


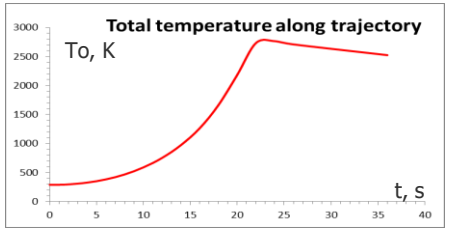
PERFORMANCE

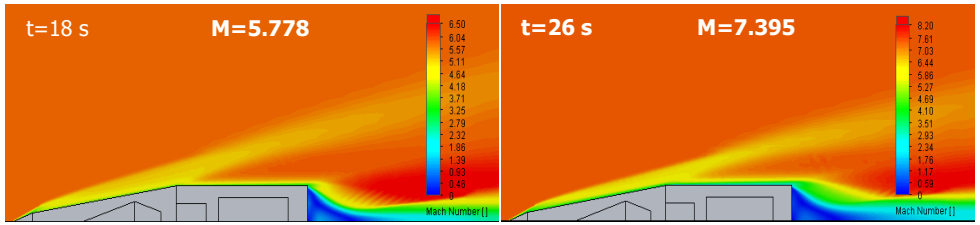
Transferred HTC

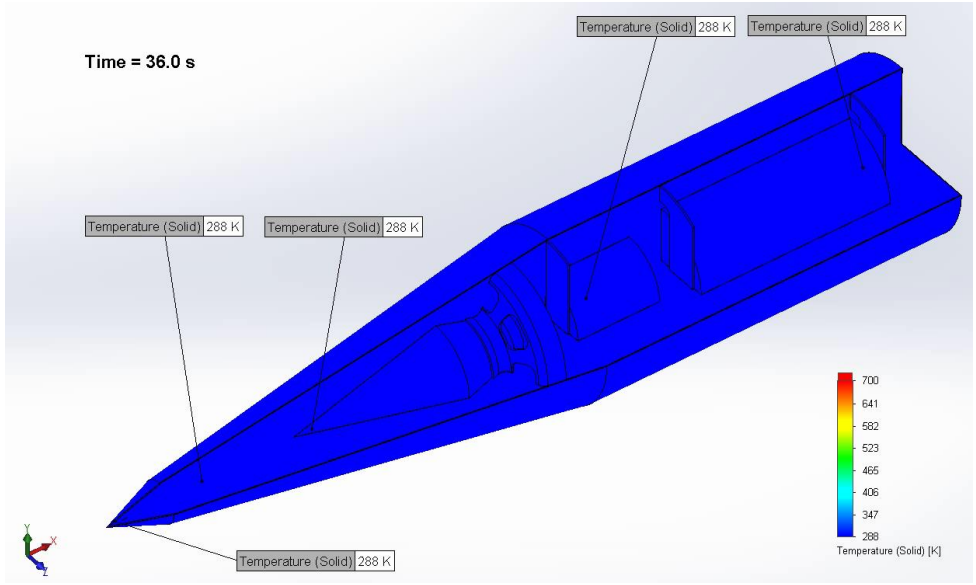
Heat Transfer Coefficient can be transferred from other results (fld) file, or set of files (in case of transient simulation).

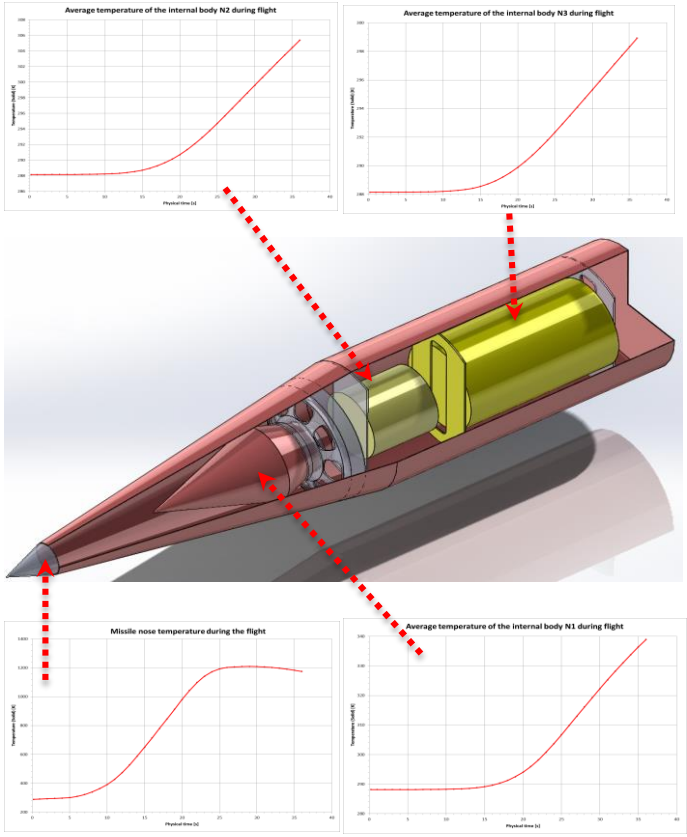


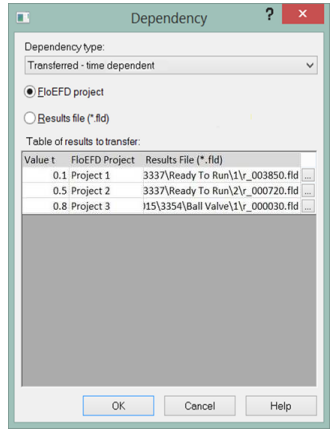






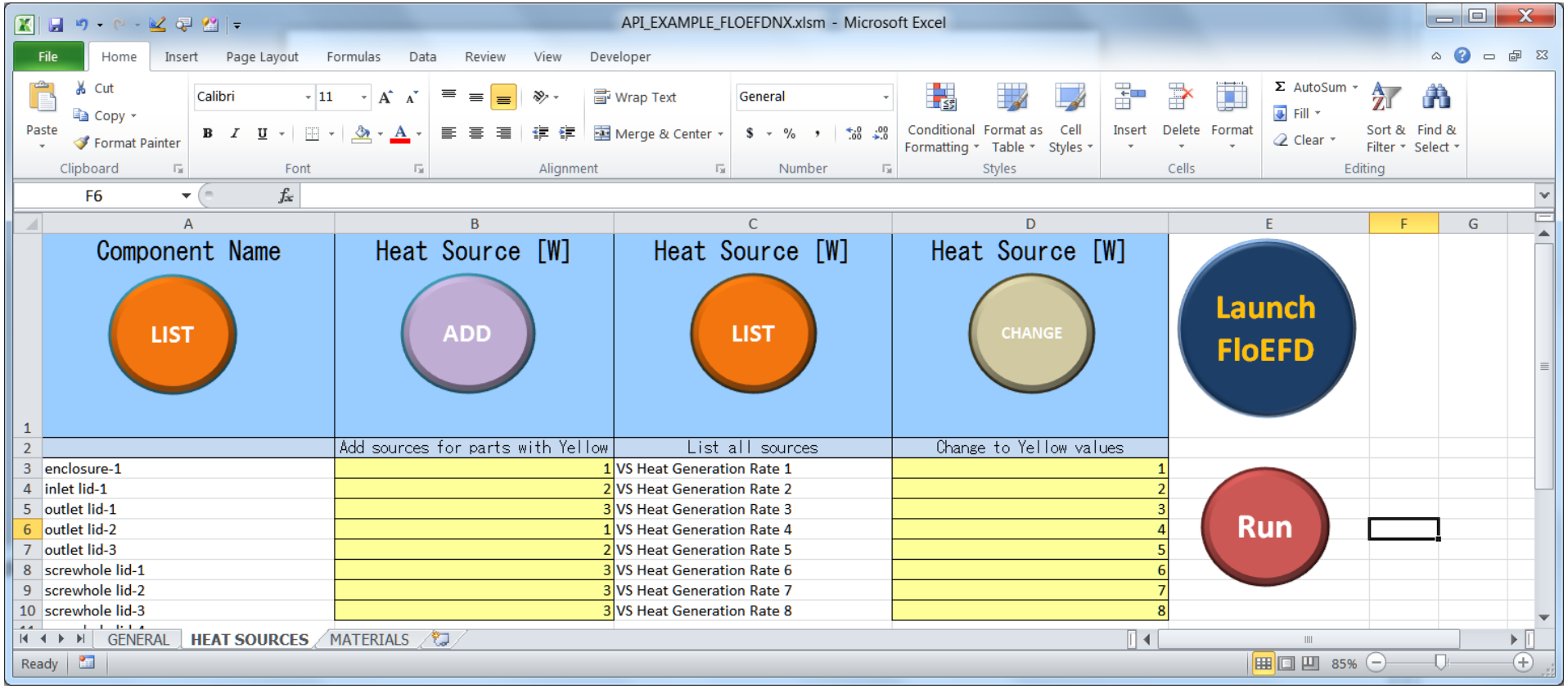






API: Now You Can Create Conditions

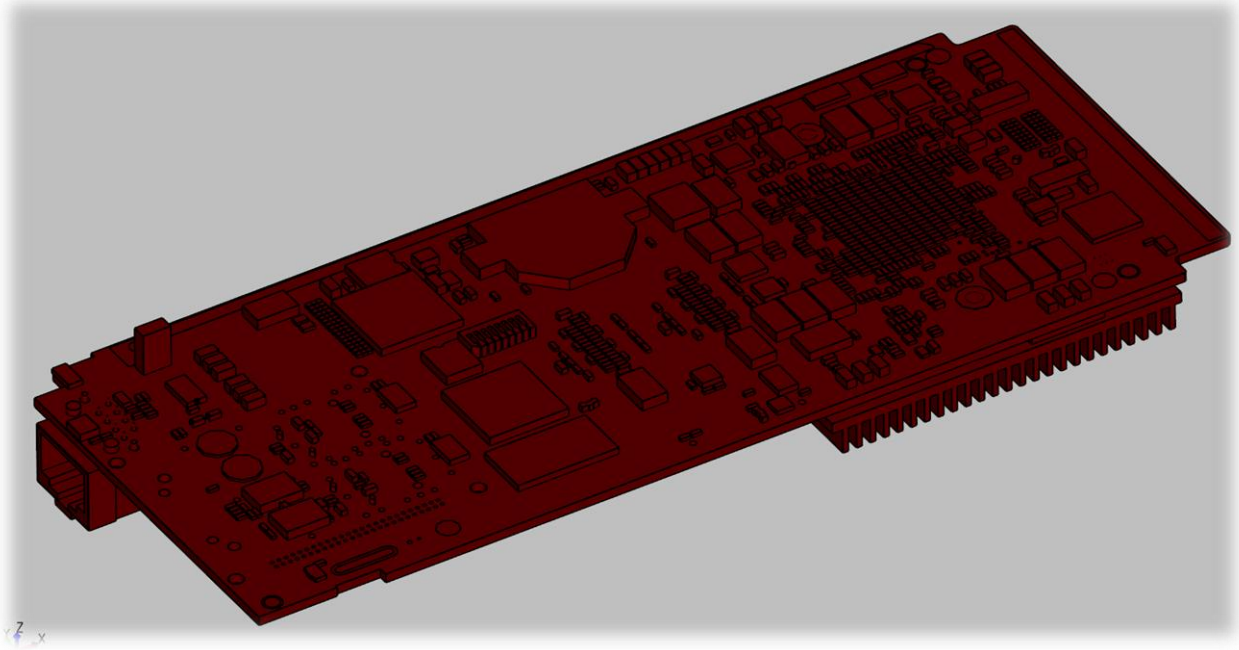
Possibility to add heat sources and solid material to a component by name or pre-selection (also available for face conditions like mass flow rate, electrical current), delete condition using API (VBA, VBS, C++).



Improved Geometry Handling with Own Boolean

Own Boolean Kernel is designed to automatically heal geometry and significantly speedup CAD geometry extraction.

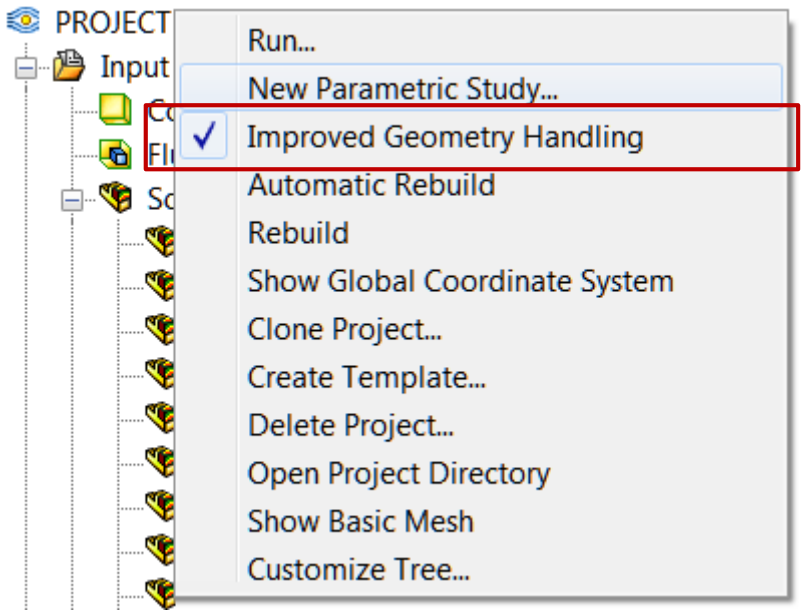
- The current procedure is based on CAD Boolean operations which are slow and not parallelized (use 1 core).
- The new Geometry Handling procedure assumes creating solid and fluid bodies using topology information by means of FloEFD internal mathematical kernel = FloEFD Boolean operations.
- As a result the preparation process can be shared among many cores.
- The new algorithm will coexist with the current version for a few years.

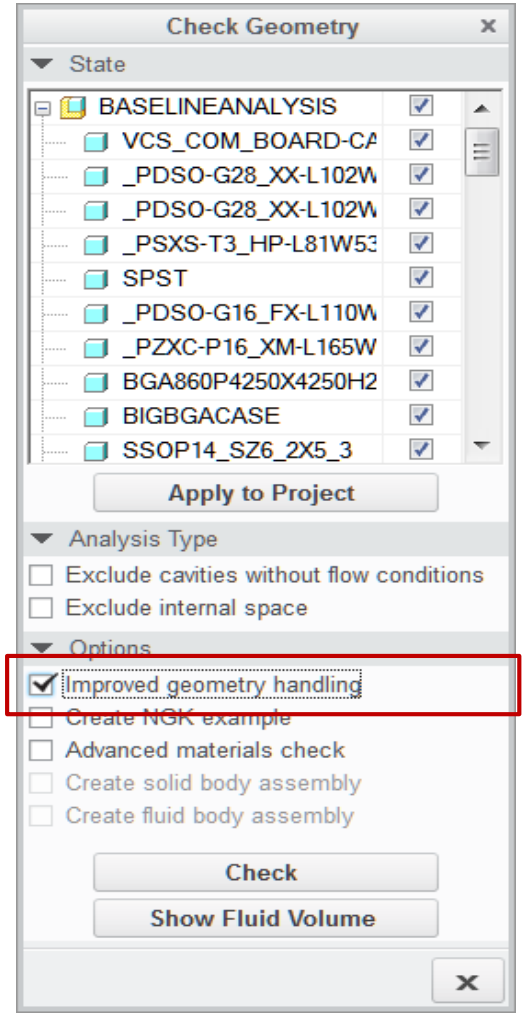


Improved Geometry Handling

Activated for the project as **Improved Geometry Handling.**

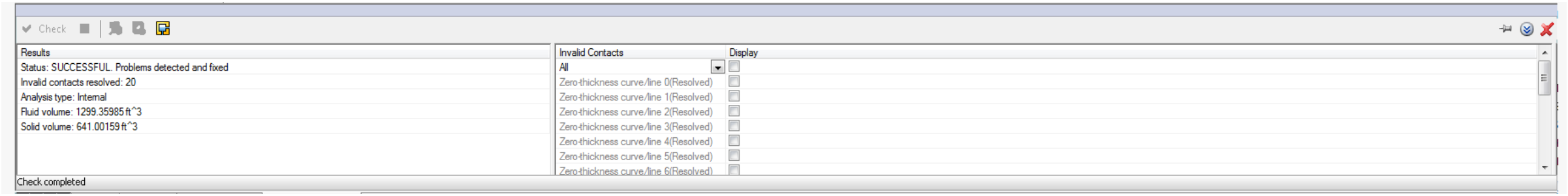
Can be activated in **Check Geometry** for diagnostic.



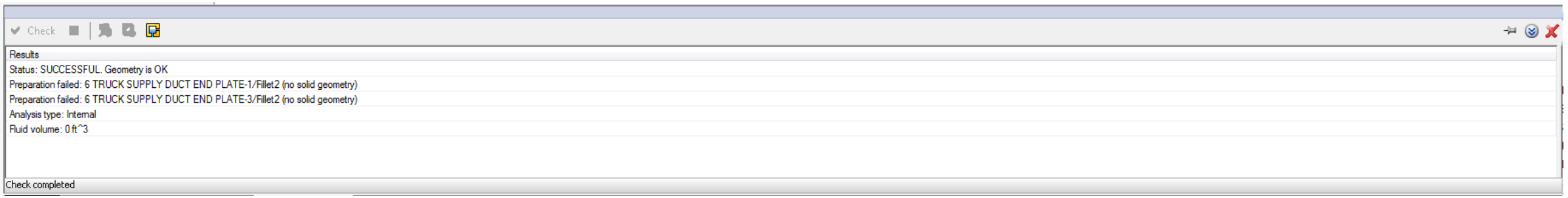


Better Diagnostic and auto Healing, Speed up

- CAD Boolean: Successful geometry check but stopped at preparing



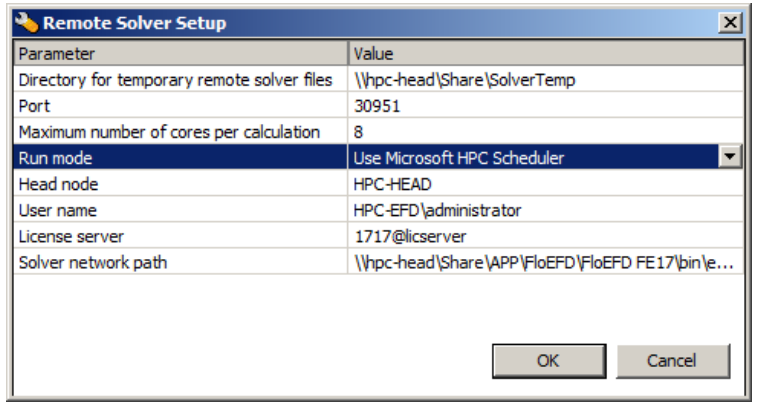
- FloEFD Boolean: Detected problem geometry

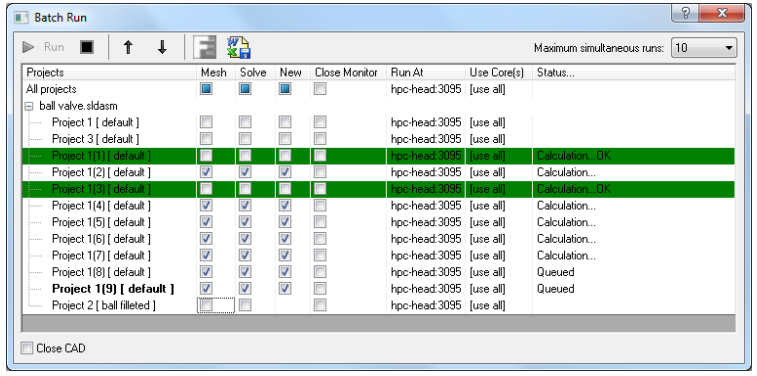


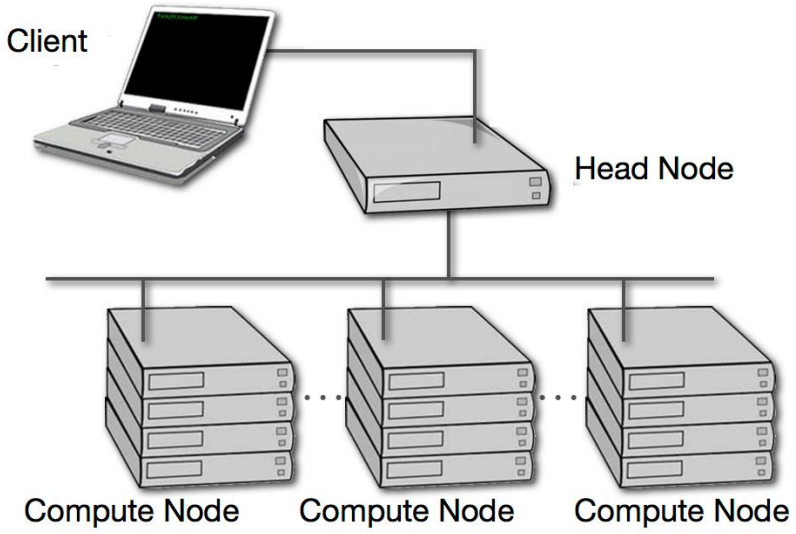
- **Customer example: 7 hours (FloEFD Boolean) compared to 72+ hours (CAD Boolean)**

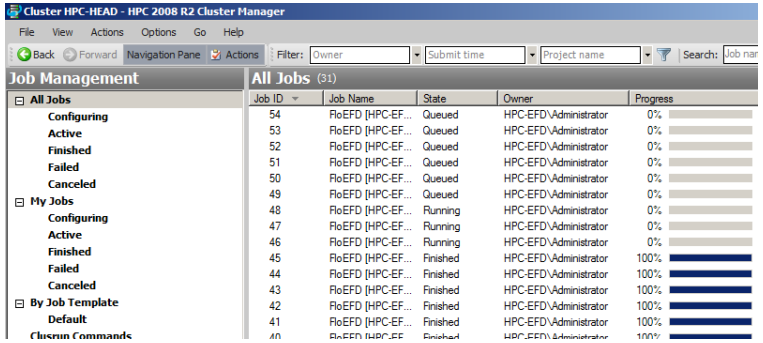
Microsoft HPC Job Scheduler

- The new **Use Microsoft Windows Job Scheduler** mode to manage calculations on the server.
- HPC Scheduler automatically distributes tasks to computer nodes of the HPC.



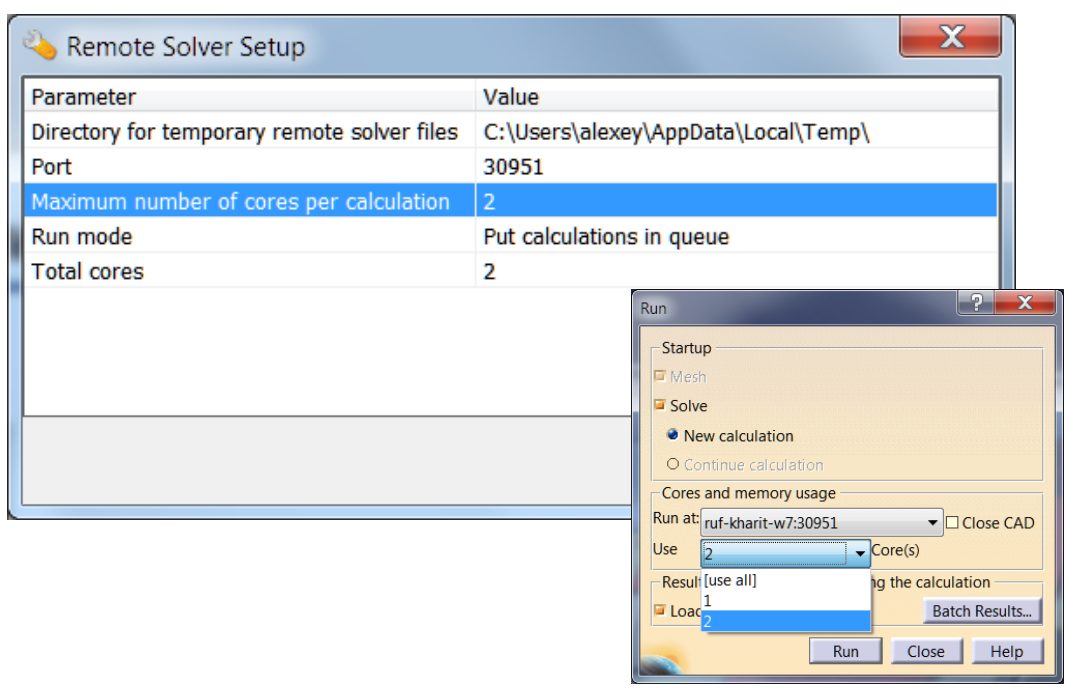


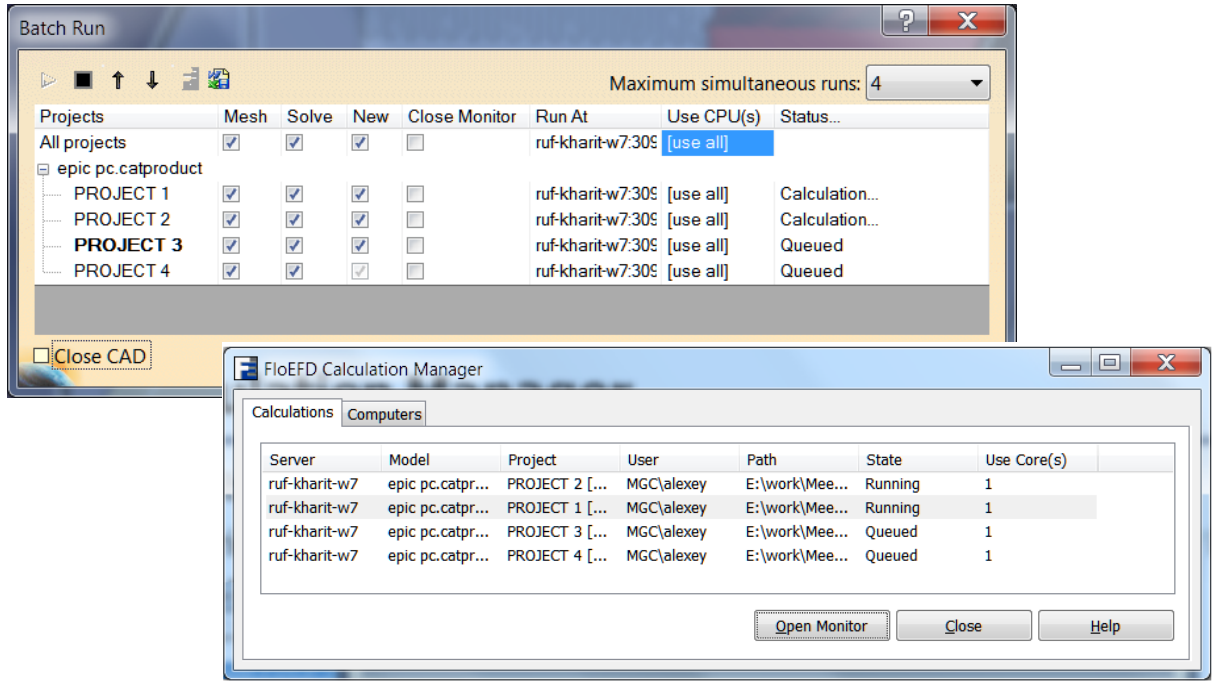




Remote Solver Queueing

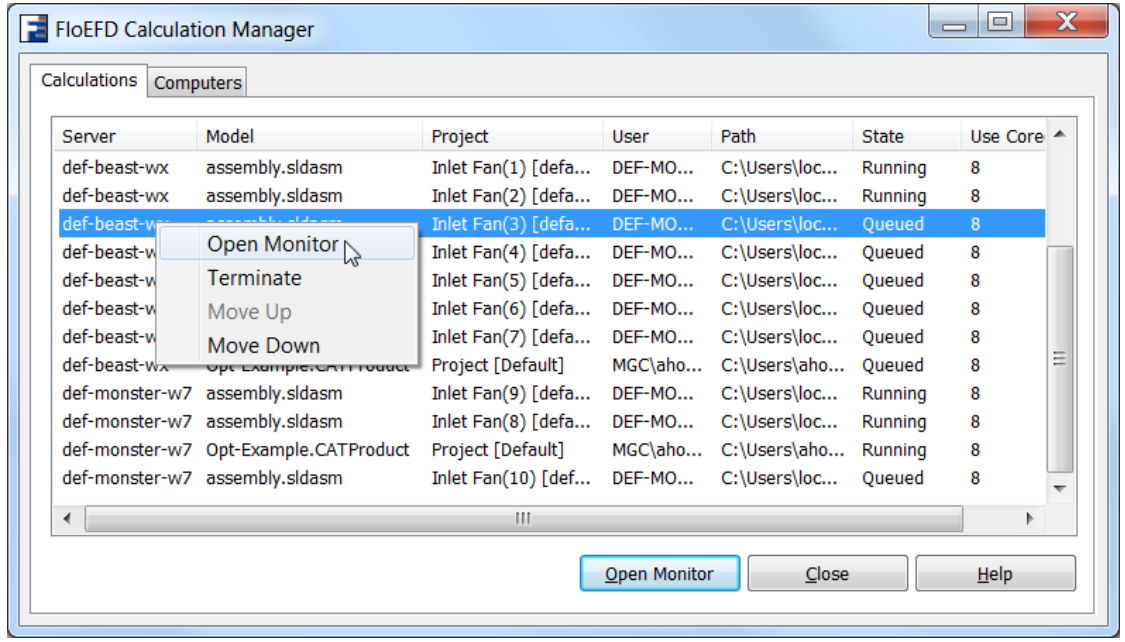
- Possibility to define a queue of calculations on FloEFD server.
- Restrict maximum number of server's cores used per a calculation. Restrict total number of server's cores to be used by FloEFD. Additional analysis tasks will be put into a queue for later calculation.

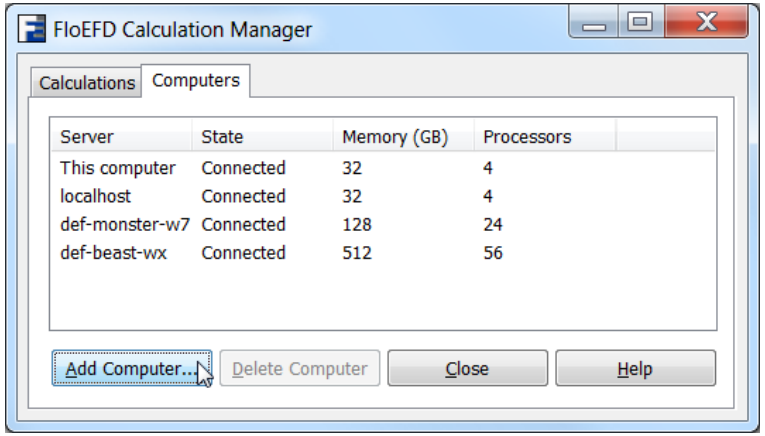




Calculation Manager

- The Calculation Manager was enhanced to view and control solving and queued FloEFD projects on any configured Remote Solver.
- Normal users can only terminate their tasks. A FloEFD Administrator (a user added to the global domain group “FloEFDAdministrators”) can Open the Solver Monitor, Terminate any project or Adjust the position of queued projects.

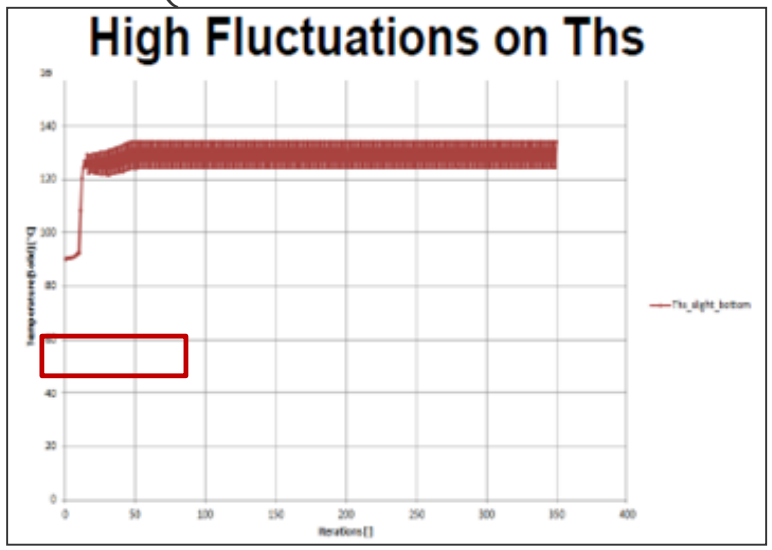


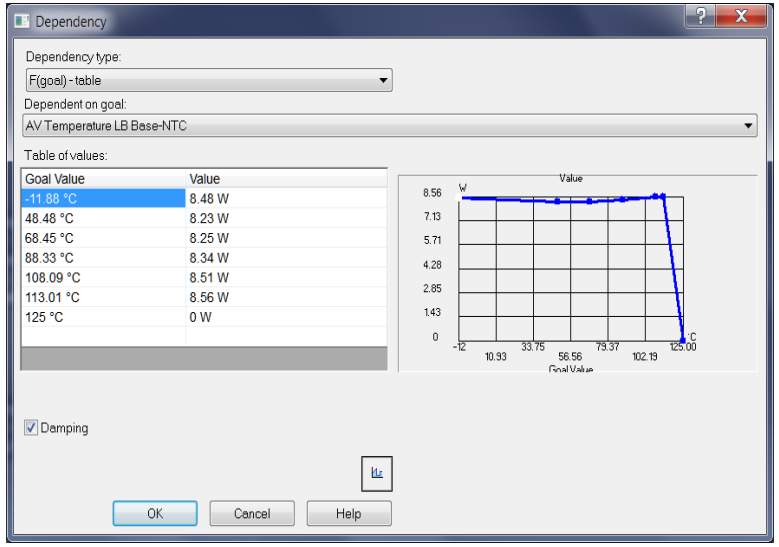


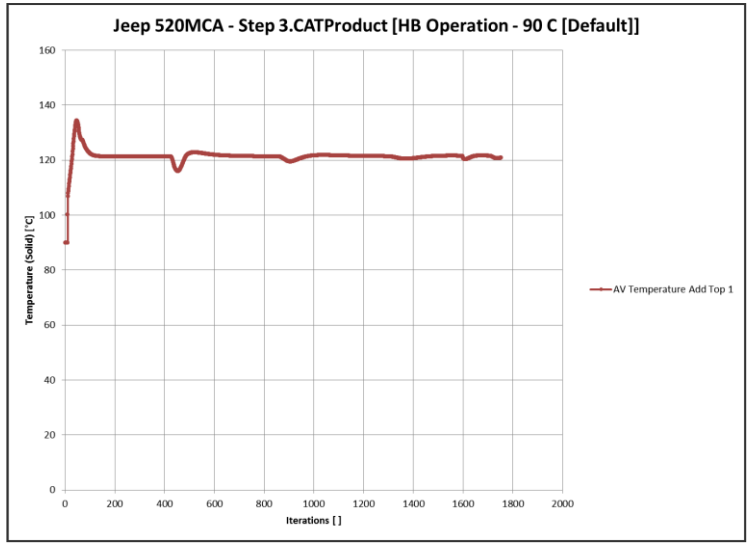
Damping for goal dependency in steady-state

- Damping factor for goal dependent parameters to avoid oscillations or relaxation of an extreme change of dependent parameters in steady-state.
- Damping: the actual value of the goal is replaced by the value averaged on the ¼ of analysis interval (4 * Ta = Analysis itnterval specified for Goal convergence, by default Ta = 0.125 Travel).

$$f_i = \begin{cases} f_0 \dfrac{T - t_i}{T} + \bar{f}_{i-1} \dfrac{t_i}{T} & , \quad for\ t_i < T_a \\ \bar{f} & , \quad for\ t_i \geq T_a \end{cases}$$

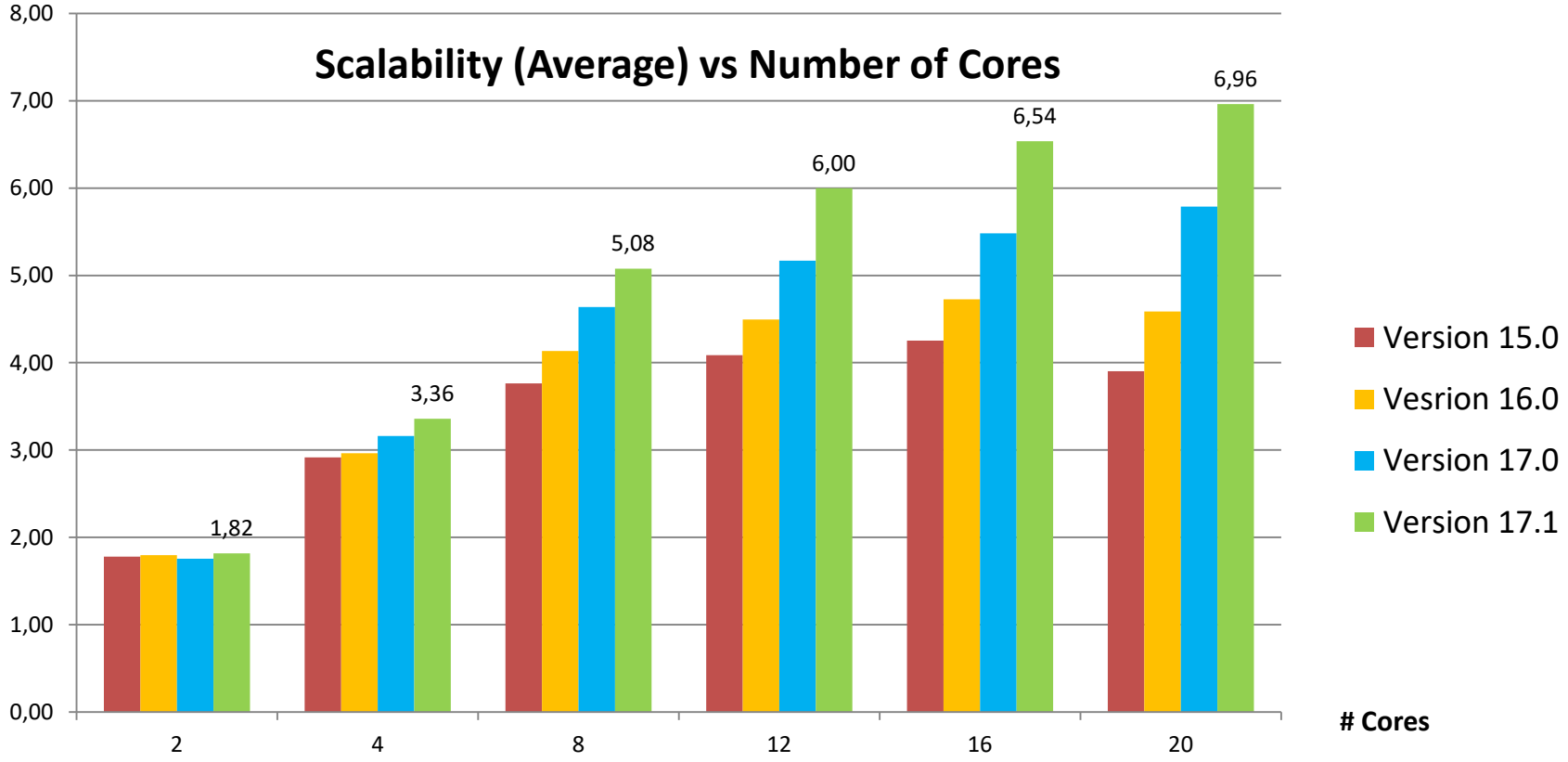


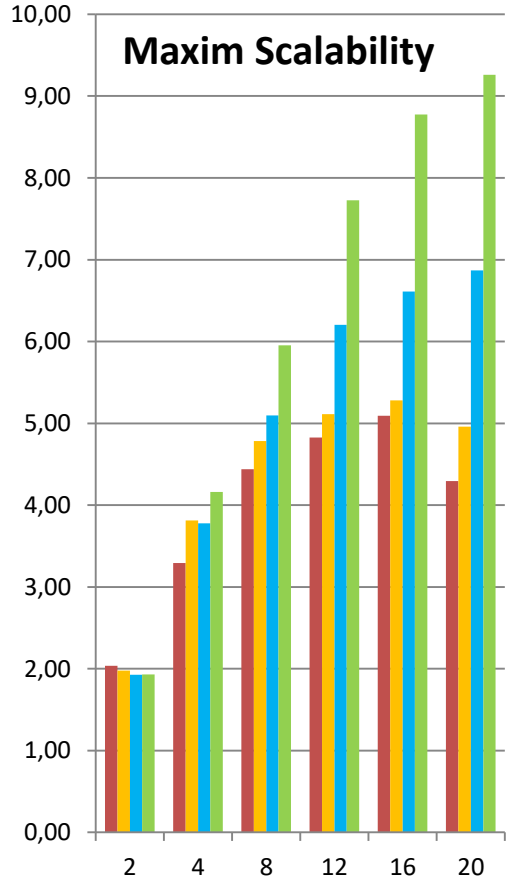




Scalability (shared memory)

Scalability is the ratio of calculation time to the time obtained with only one core.
The chart shows average and maximum scalability obtained from a number of cases.





Scalability = Average scalability for a number of cases representing FloEFD capabilities (excl. High Mach Number flow)
1 core calculation uses Intel Turbo BOOST technology which can automatically run the processor core faster than the noted frequency.

$$\sqrt{292.41} = 17.1$$

FLOEFD 17.1

FloEFD 17.1

- Membrane
- Improved solver scalability
- GIF Animation: select transparent color
- Mirror Results for Sector Periodicity
- FloEFDView: Support Section View
- Support 4K monitors
- Isosurface in Transient Explorer (cool for Free Surface)
- Free surface parameter for plots
- Uniformity Index Goal
- Creo 4.0 support
- Siemens NX12 support
- …