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Simcenter FLOEFD™ What's New in v18.0

Alexey Kharitonovich

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Thermal Management

Flux Plot

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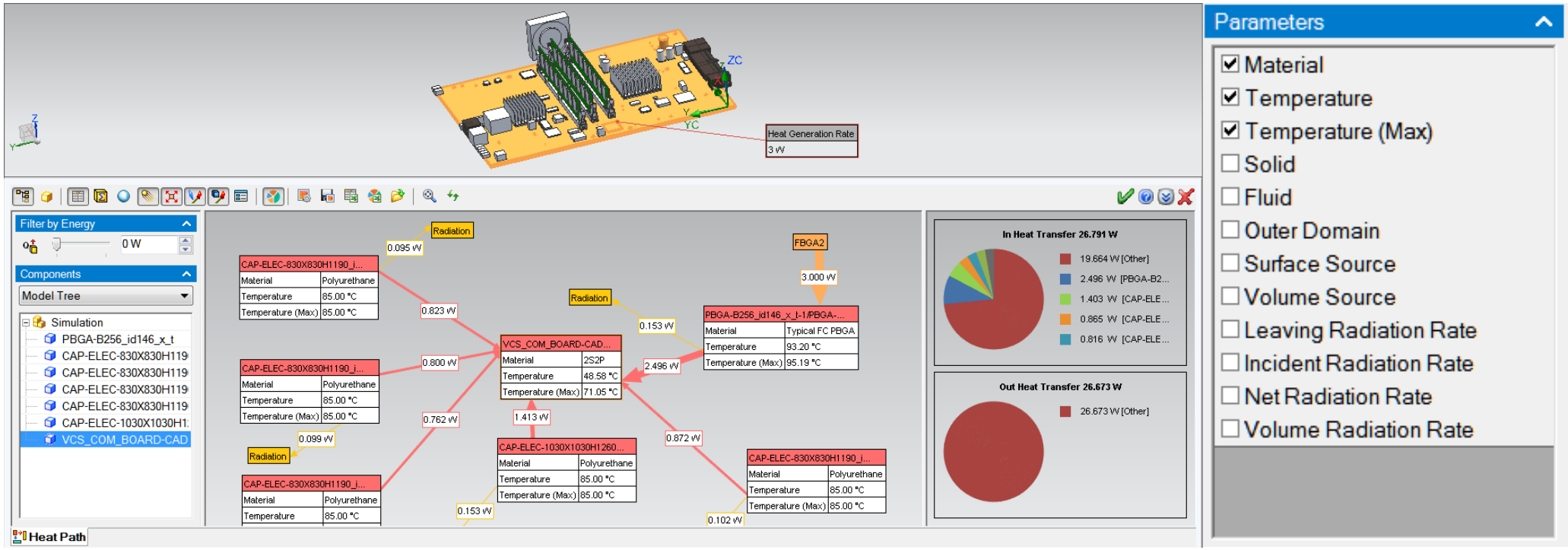
You can display how much heat goes from one component to another (by conduction) as a graph. You can also display the heat transfer to fluid (convection) and via radiation. Components can be grouped so the heat is calculated as total heat for all components grouped. The Pie chart for incoming and outgoing heat helps to understand the balance of heat.



File | Analysis | Application | Curve | Developer | Render | Tools | View | Assemblies | Flow Analysis

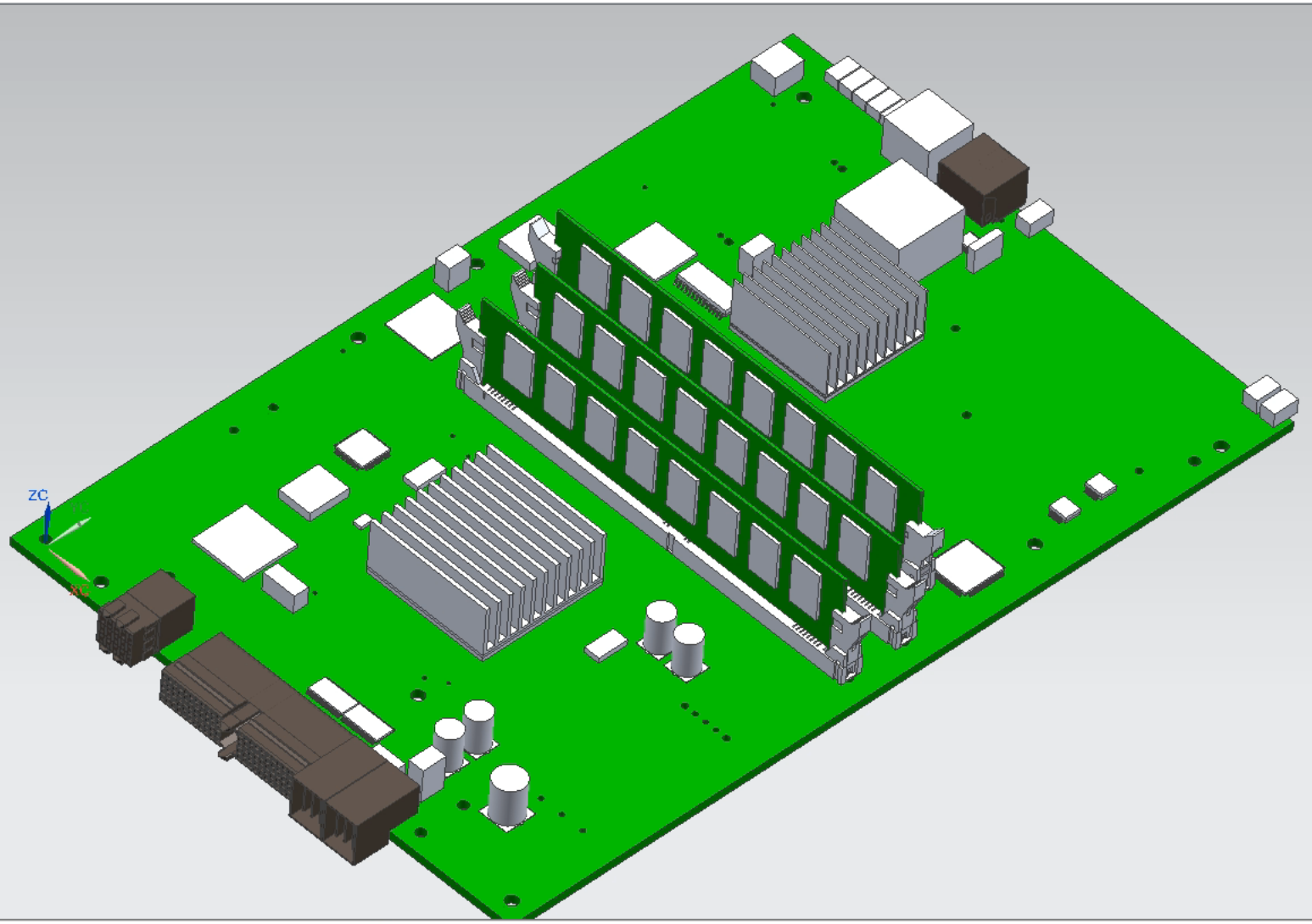
Find a Command

Window | More (Operation) | Zoom | 0.7690 (Zoom) | Show and Hide | Immediate Hide | Hide | Show | 1 | Move to Layer | Layer Settings | Edit Section | Clip Section | See-Thru All | More (Visibility) | Style | Preferences | Edit Object Display | Export PNG (Visualization)

Menu | No Selection Filter | Entire Assembly

FloEFD

- Projects
  - pcb-assy_asm_x_t
  - Simulation
    - **Simulation**
      - DIMMs Max Temperature (Solid)
      - SmallBGA Junction Max Temperature
      - BigBGA Junction Max Temperature
    - Mesh
      - Global Mesh
      - Local Initial Mesh DIMM + Heat Sink
  - Results (1.fld)
    - Mesh
    - Cut Plots
    - Surface Plots
    - Isosurfaces
    - Flow Trajectories
    - Particle Studies
    - Point Parameters
    - Surface Parameters
    - Volume Parameters
    - XY Plots
    - Goal Plots
    - Flux Plots
      - Flux Plot 1
    - Report
    - Animations



total 1

Smart PCB (Requires “EDA Bridge” module*)

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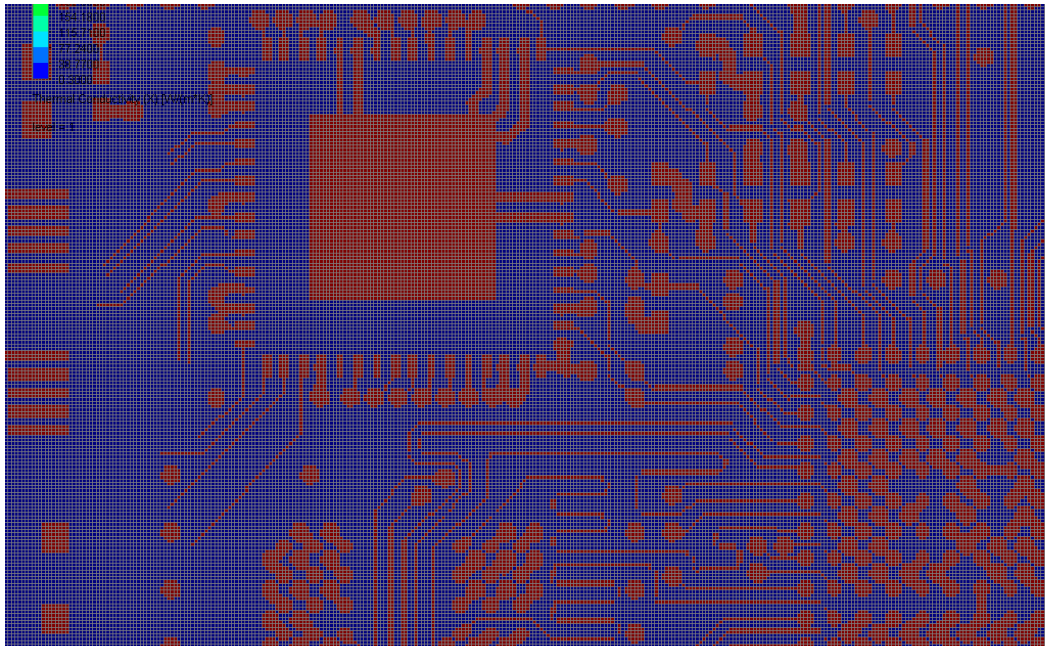
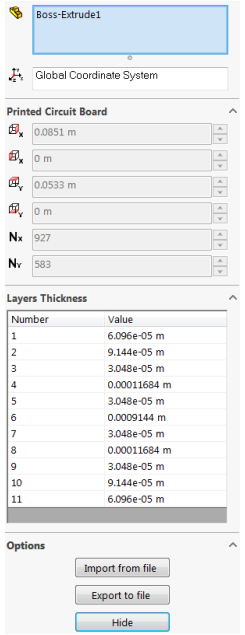
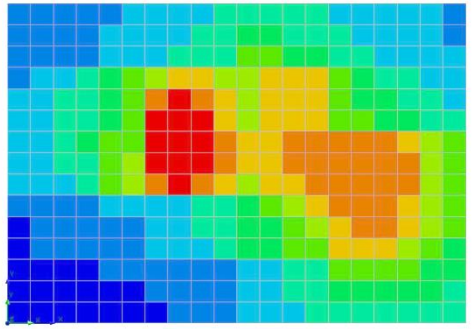
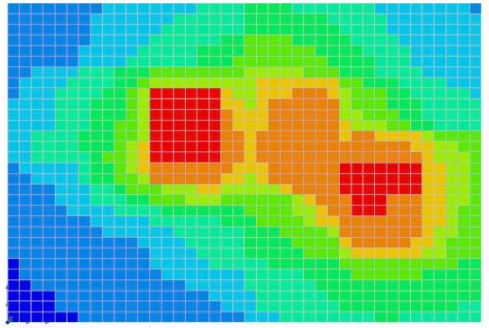
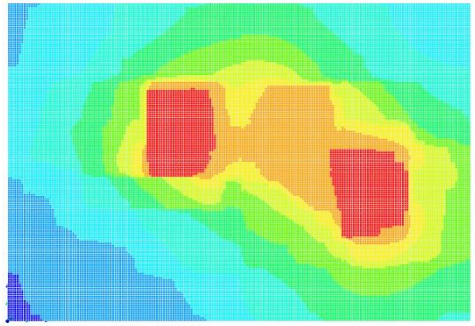
A new Smart PCB feature represents a PCB as a Network Assembly with a large number of nodes. The network assembly is constructed from original ODB++, Xpedition or other formats supported by EDA bridge using the layer images providing precise conductivity and capacity map of the PCB’s internal structure. The Smart PCB also allows importing effective conductivity map as a *.csv or *.trmexport file.











* See list of PNs at the last slide

EDA Bridge (Requires “EDA Bridge” module)

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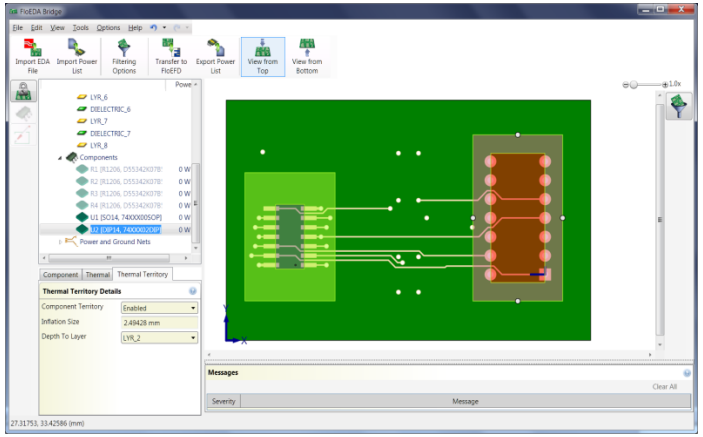
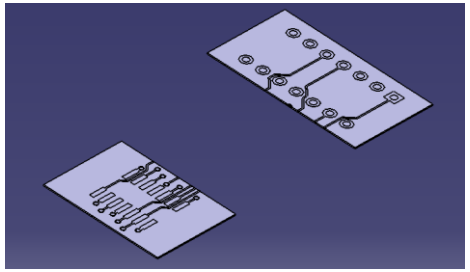
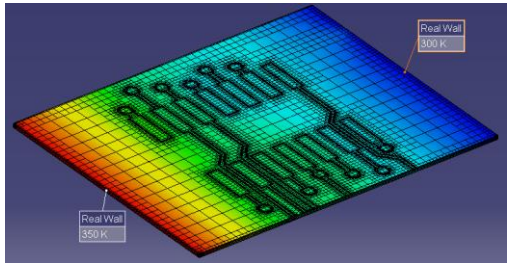
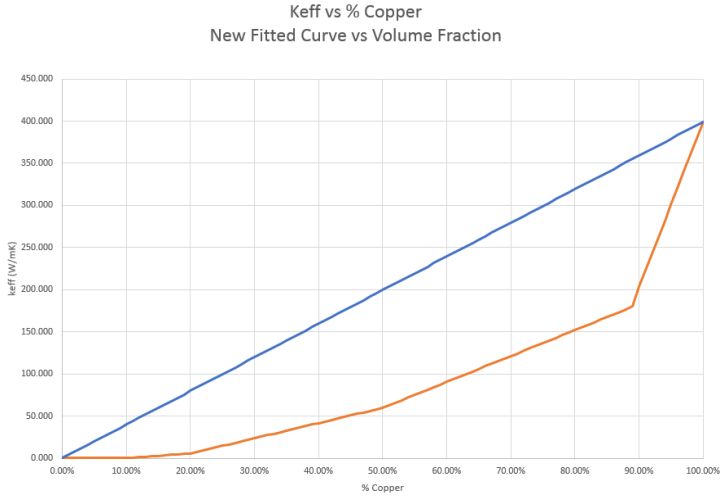
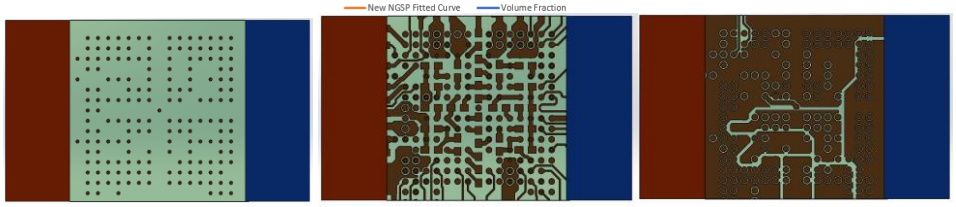
- Added IPC2581 (Rev B) and IDX (Prostep) formats to the import list.
- A new method to calculate Effective Thermal conductivity based on empirical data.
- Components can now be changed to and from Simple, 2R and Filtered











AutoCalibration (Requires T3STER Auto Calibration)

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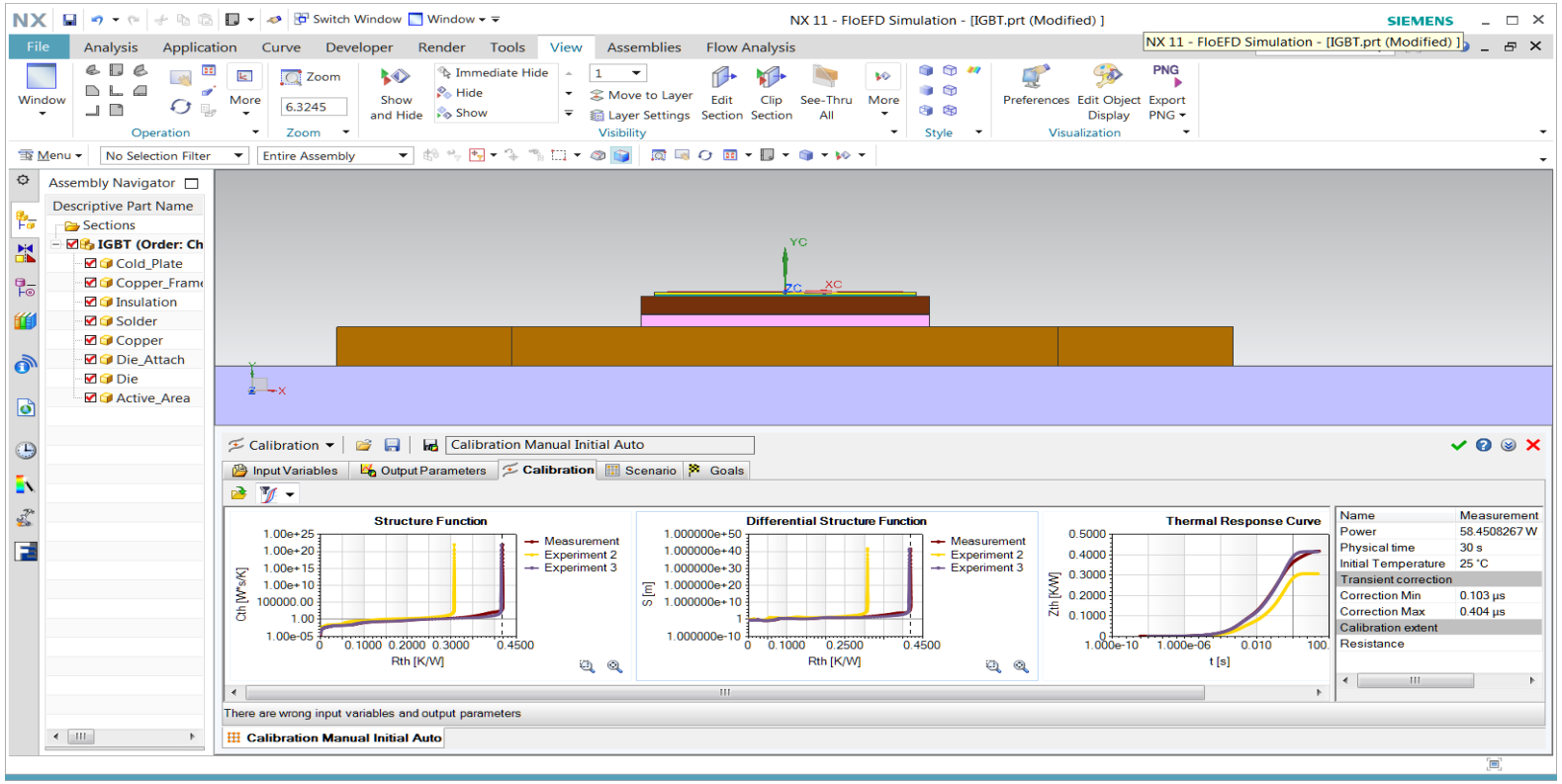
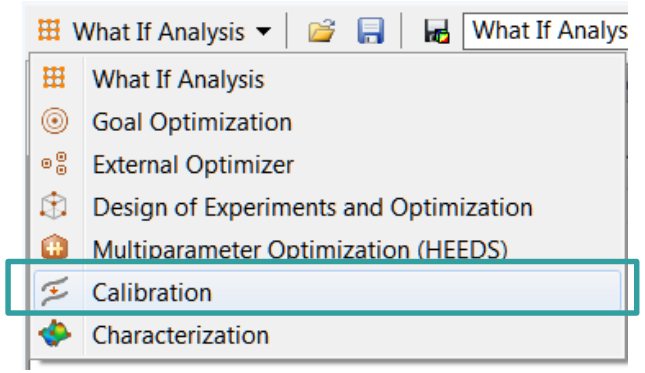
- Simcenter T3STER™ obtains transient thermal response of a package.
- The AutoCalibration uses Parametric Study to get package properties fitting the measured response.

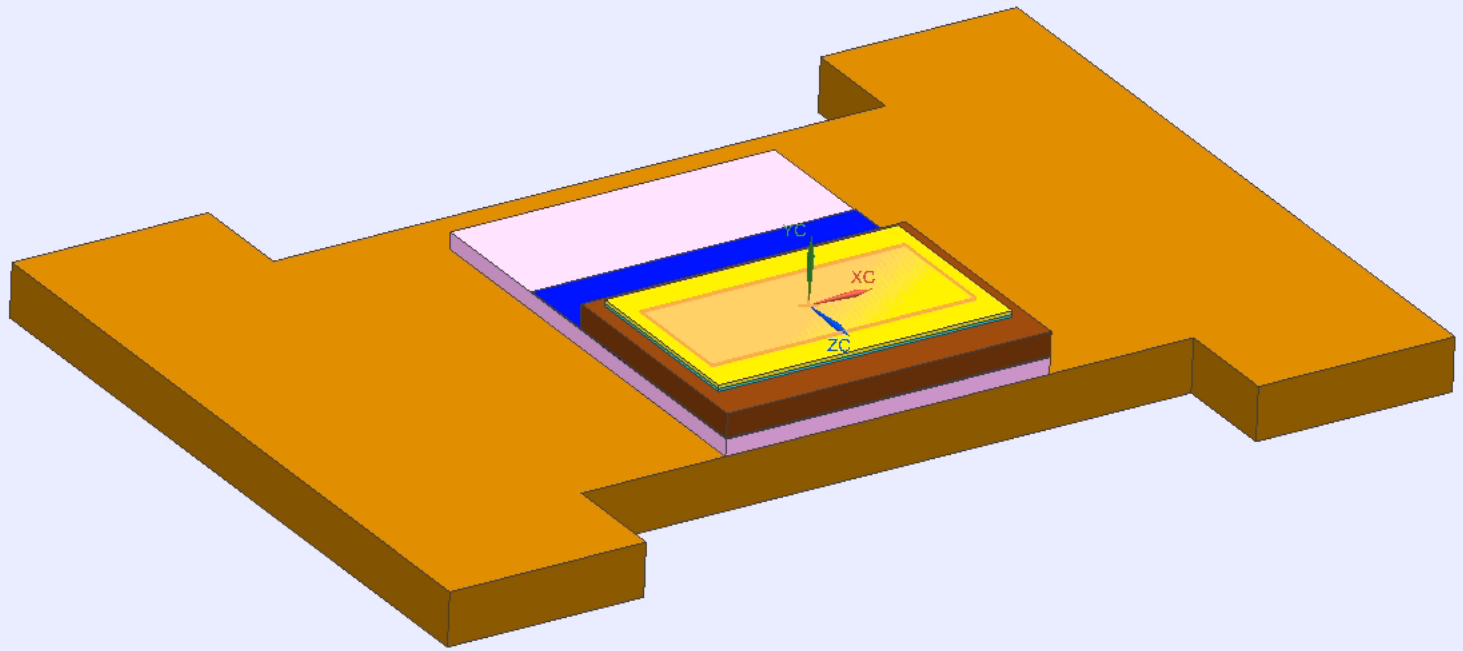




Assembly Navigator

Descriptive Part Name

- Sections
- IGBT (Order: Chronological)
  - Cold_Plate
  - Copper_Frame
  - Insulation
  - Solder
  - Copper
  - Die_Attach
  - Die
  - Active_Area



COLD_PLATE

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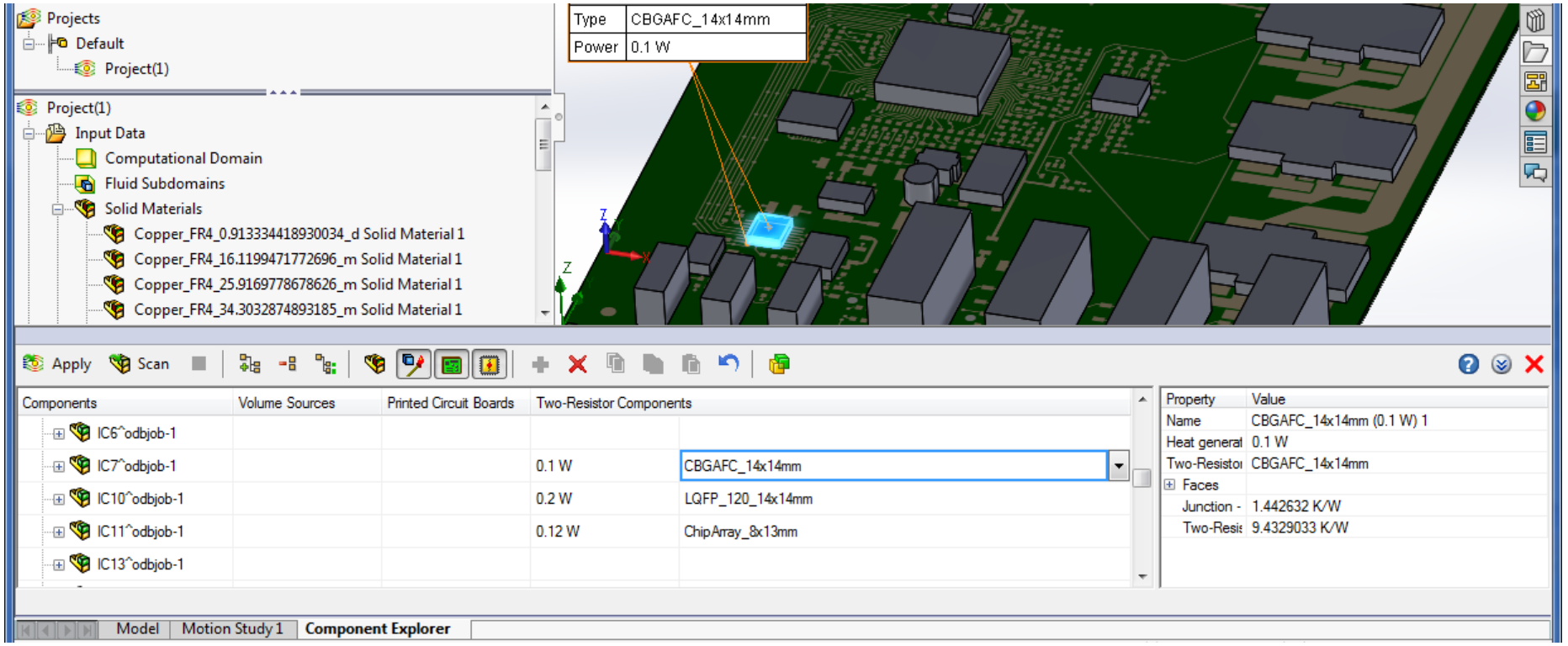
Component Explorer: Edit 2R, LED

- You can now edit a Two-resistor, LED, materials directly from the Component Explorer table.



Fan Operating Point

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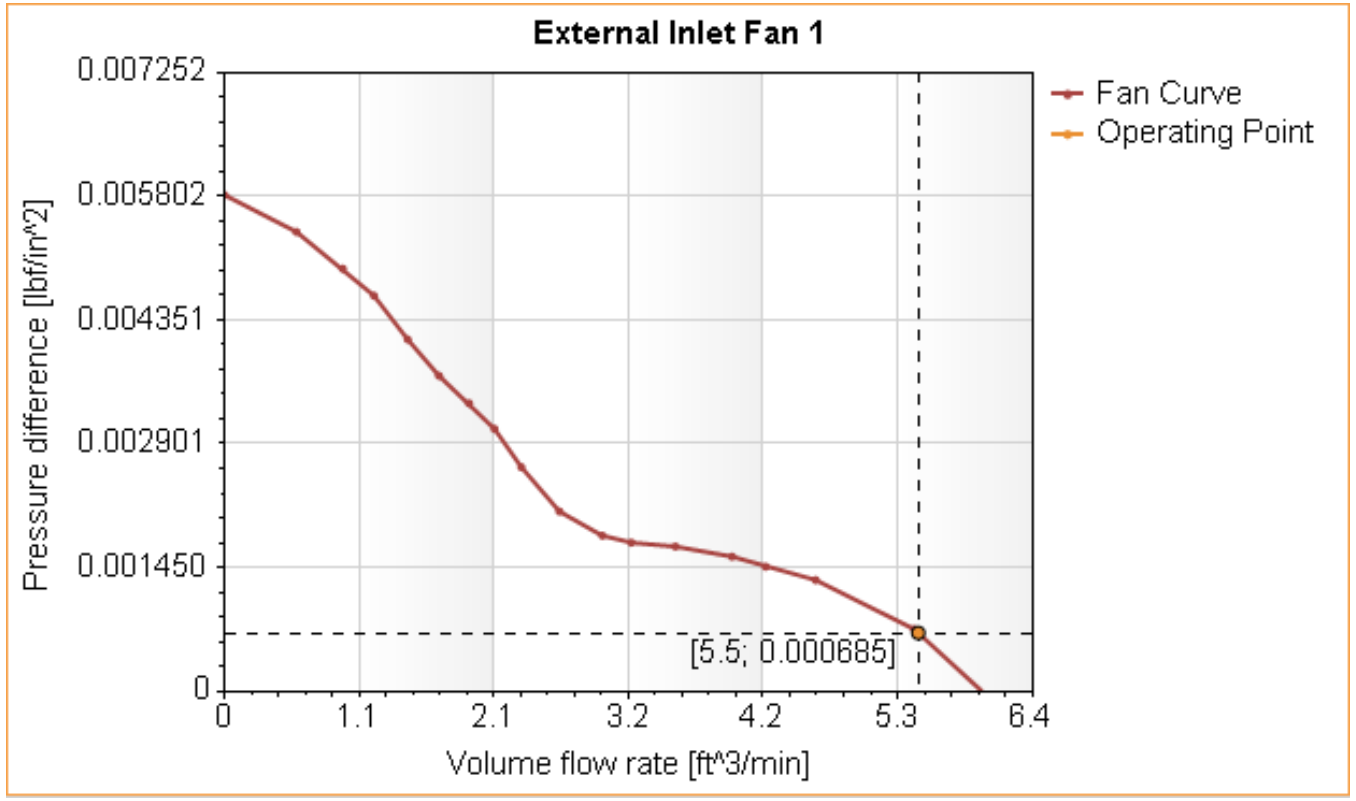
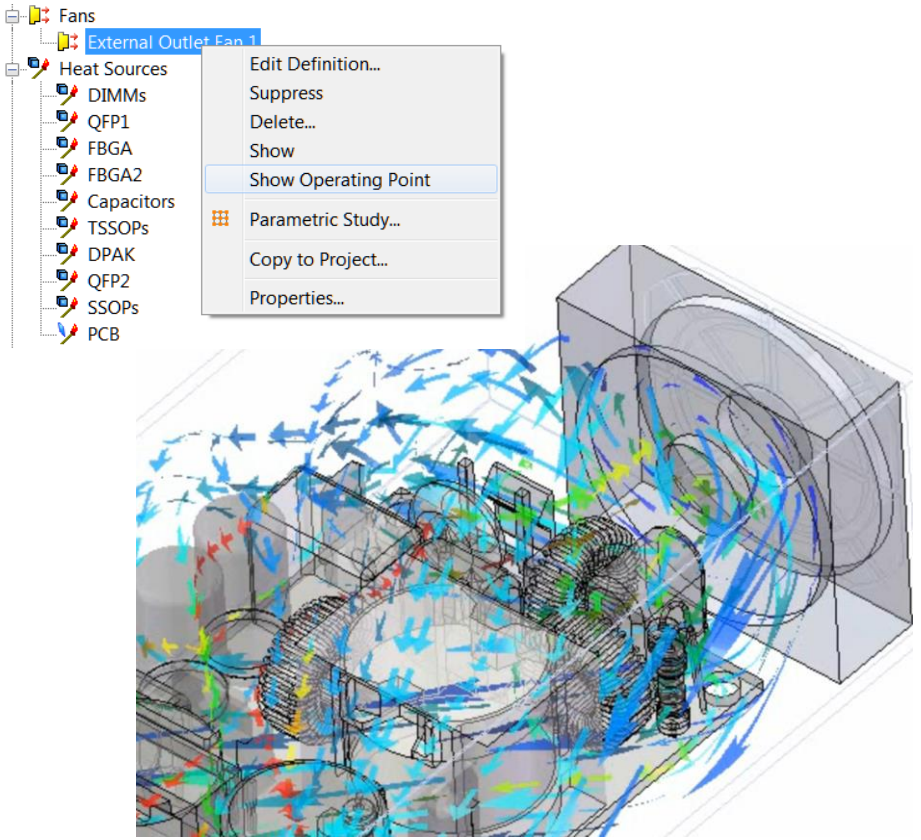
- You can display the fan operating point on the fan curve in the graphics area. Right-click a fan condition and select “Show Operating Point”.

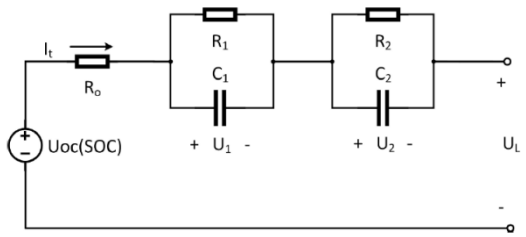


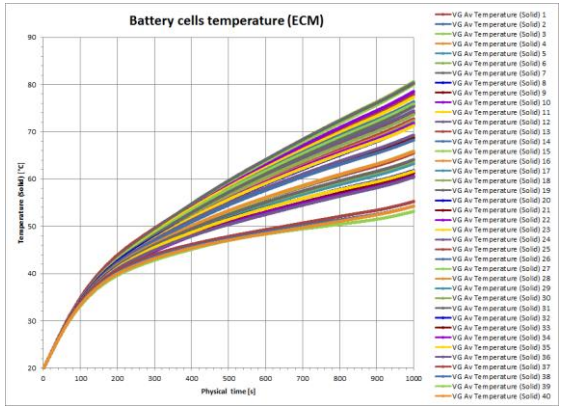


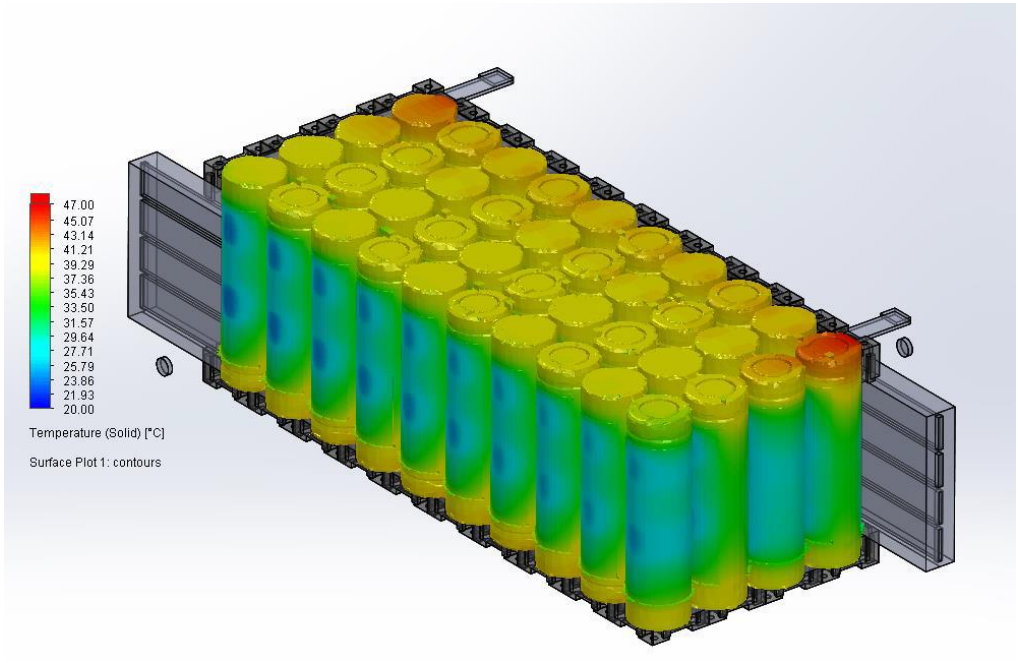
Battery Model (Requires new Power Electrification module)

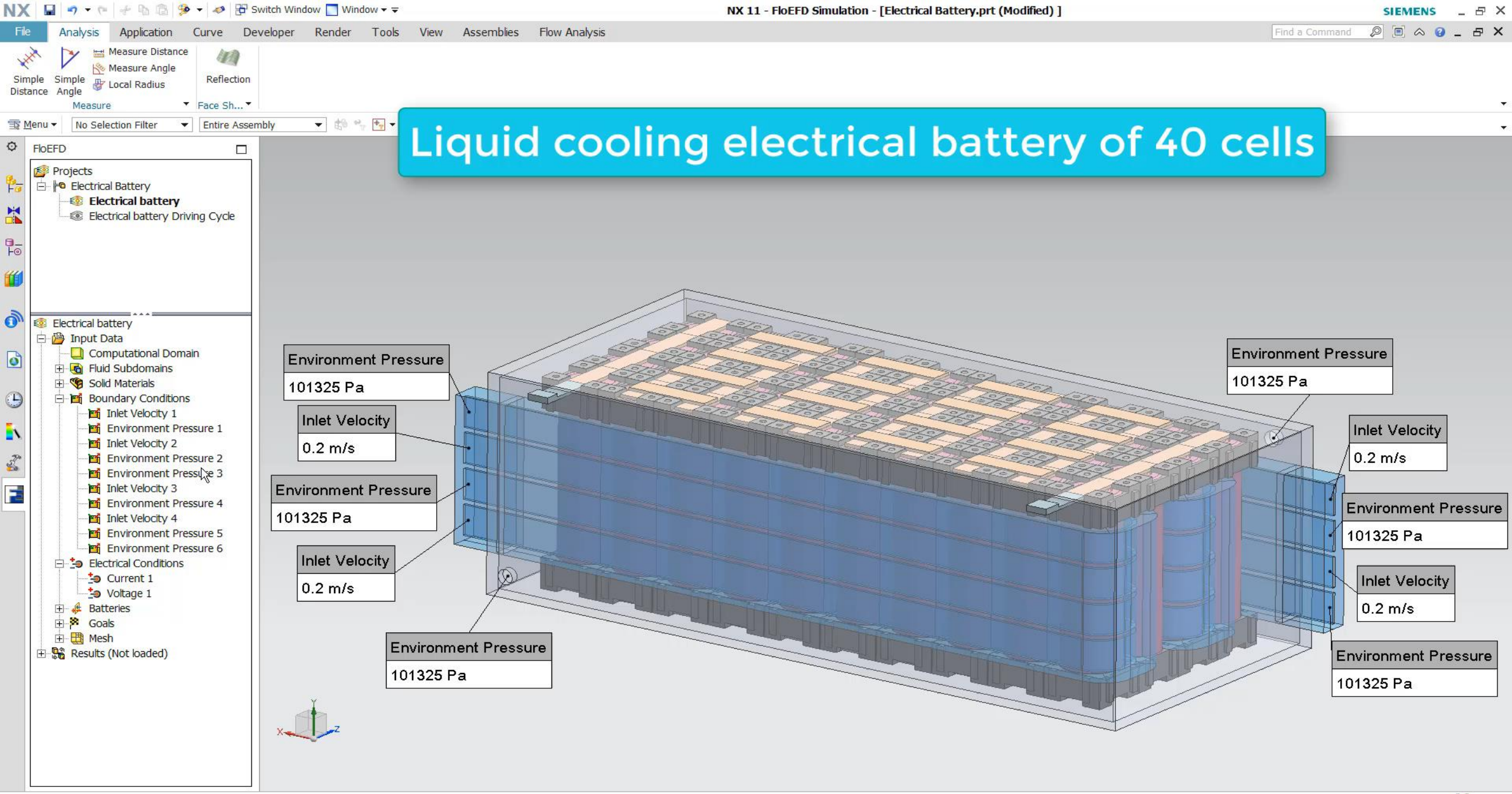
The new Battery compact model calculates the heat dissipation rate based on the electrical or electrical-chemical characteristics of the battery cell. The obtained heat dissipation rate is applied to the cell. The state of charge, voltage, current and the temperature distribution are predicted. Two models are supported:

- The Equivalent Circuit model represents a cell as a second-order resistor-capacitor (2RC) equivalent circuit model. The model inputs are OCV (open circuit voltage), resistance and capacitance values as functions of SOC and temperature.
- The Electrochemical-thermal coupled model simulates thermal and electrochemical behaviors of the battery cell. Requires chemical properties of electrolyte.








NX 11 - FloEFD Simulation - [Electrical Battery.prt (Modified)]
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File
Analysis
Application
Curve
Developer
Render
Tools
View
Assemblies
Flow Analysis
Find a Command
Simple Distance
Simple Angle
Measure Distance
Measure Angle
Local Radius
Measure
Reflection
Face Sh...
Menu
No Selection Filter
Entire Assembly
Liquid cooling electrical battery of 40 cells
FloEFD
Projects
Electrical Battery
Electrical battery
Electrical battery Driving Cycle
Electrical battery
Input Data
Computational Domain
Fluid Subdomains
Solid Materials
Boundary Conditions
Inlet Velocity 1
Environment Pressure 1
Inlet Velocity 2
Environment Pressure 2
Environment Pressure 3
Inlet Velocity 3
Environment Pressure 4
Inlet Velocity 4
Environment Pressure 5
Environment Pressure 6
Electrical Conditions
Current 1
Voltage 1
Batteries
Goals
Mesh
Results (Not loaded)
Environment Pressure
101325 Pa
Inlet Velocity
0.2 m/s
Environment Pressure
101325 Pa
Inlet Velocity
0.2 m/s
Environment Pressure
101325 Pa
Environment Pressure
101325 Pa
Inlet Velocity
0.2 m/s
Environment Pressure
101325 Pa
Inlet Velocity
0.2 m/s
Environment Pressure
101325 Pa

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Radiation and Lighting

Coating

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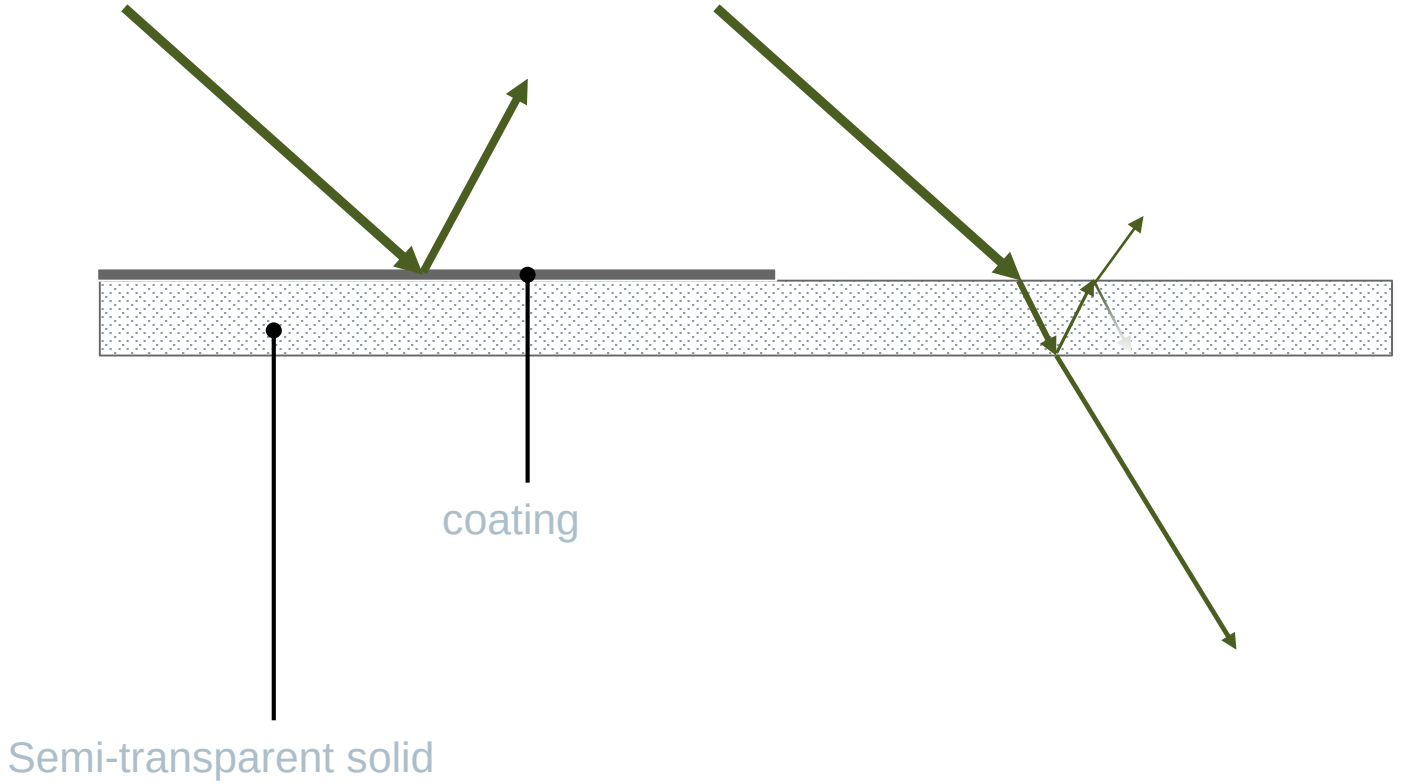
- A non-transparent radiative surface can be applied at semi-transparent bodies.



Radiant Flux Measured on Semi-Transparent Bodies

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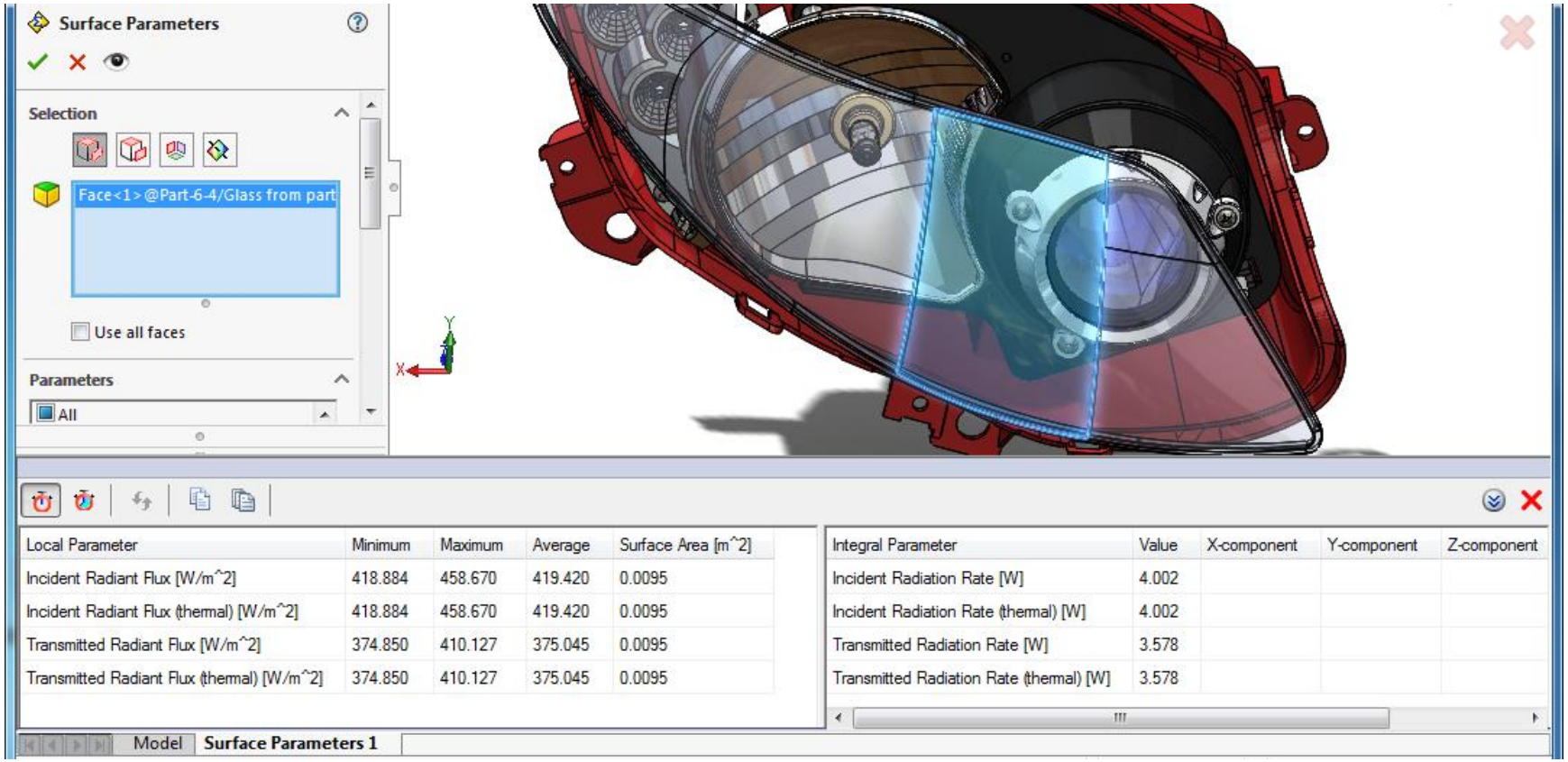
- Evaluation of incoming and transmitted radiation flux on surfaces of semi-transparent bodies.



Radiative Surface: Wall to Wall

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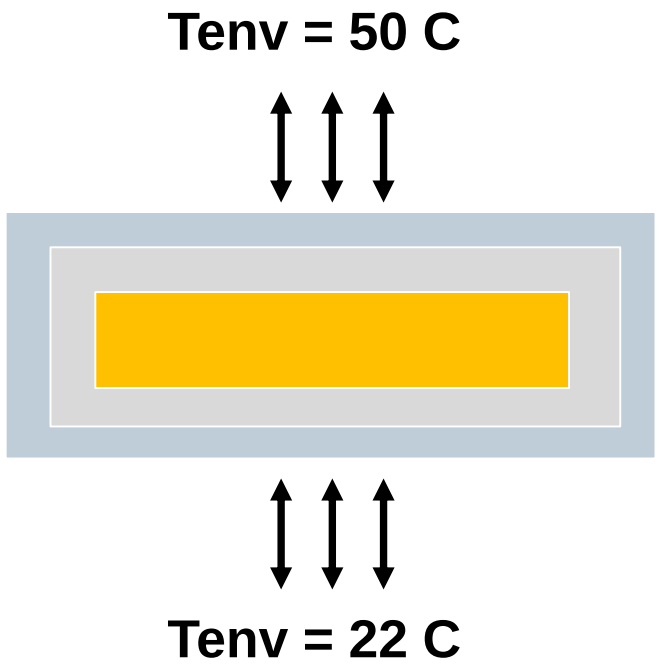
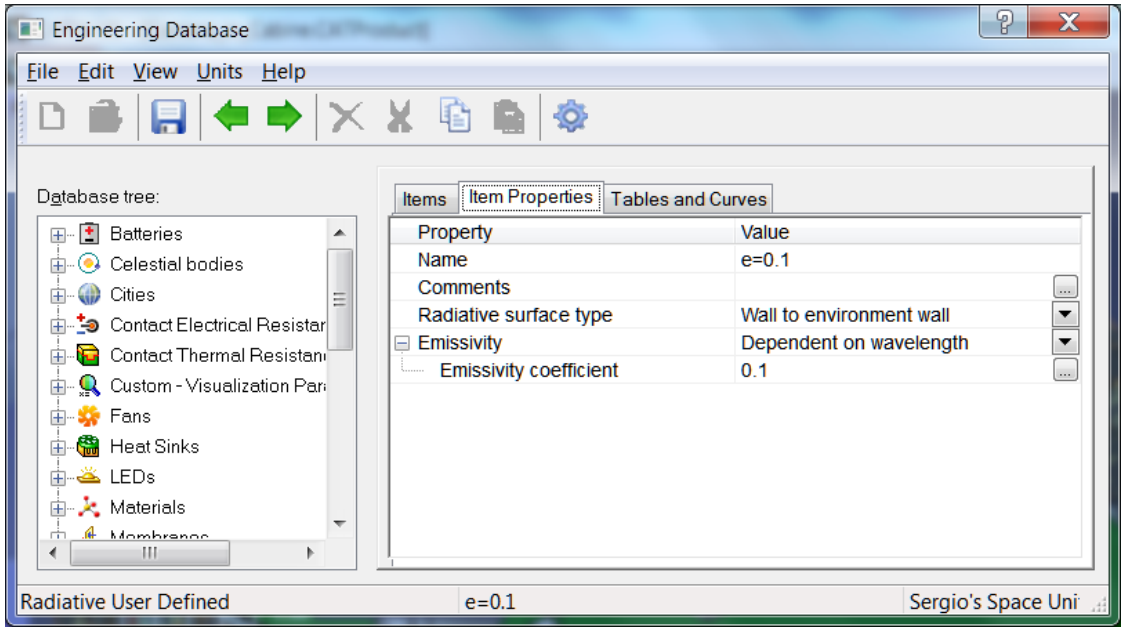
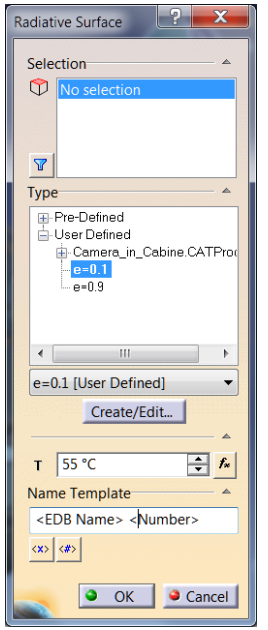
Setting Radiation Temperature other than the global Environment Temperature for a specific wall.

- A new “Wall to environment wall” type of radiative surface allows setting for a particular surface a radiation environment temperature other than the global one defined in the General Settings. This type of condition can be used in case different sides of the model undergo radiation with different environment temperatures (available for DTRM radiation model).







Display Solar Radiation Direction for Transient Analysis

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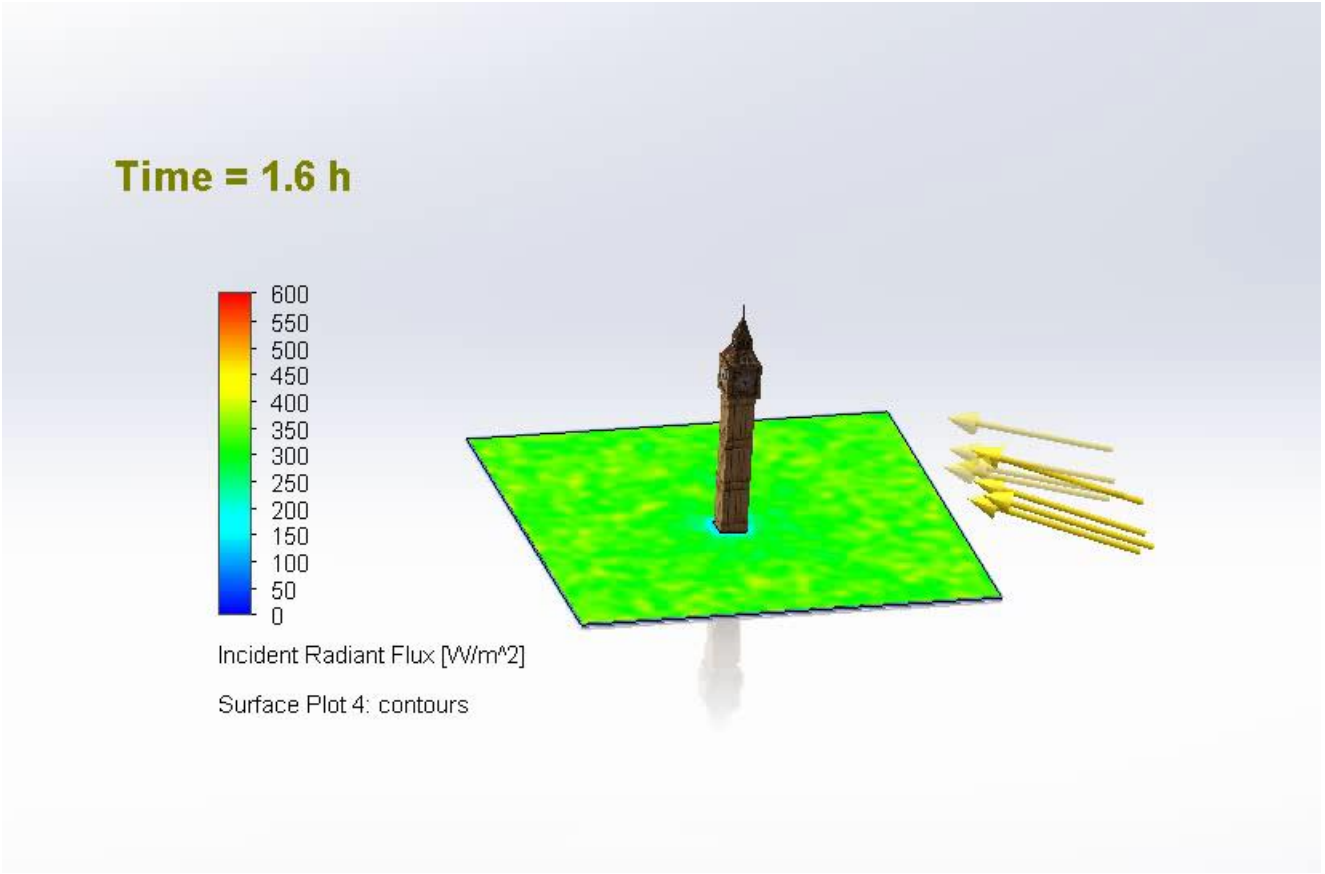
- Solar radiation direction is visualized to account for the loaded time moment. You can visualize the direction of solar radiation at the loaded time moment.



Radiation in Gases (Requires “Advanced” and “LED” or “HVAC” modules)

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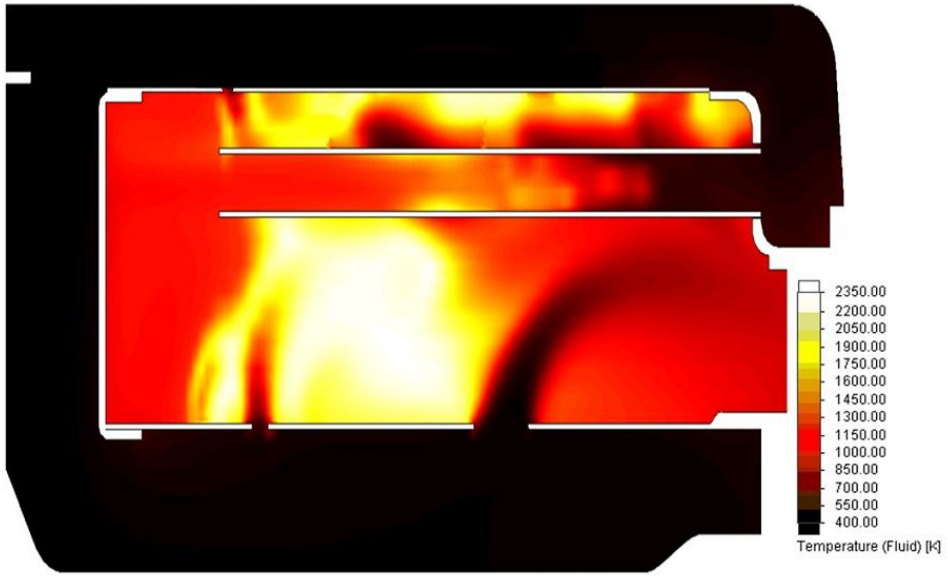
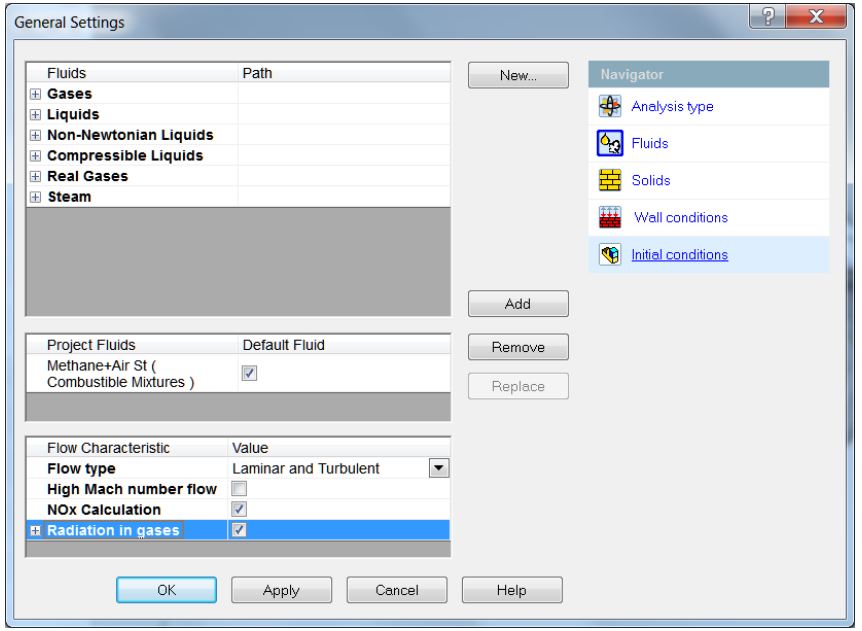
Radiation in gases

- Thermal radiation can be emitted/absorbed by gases (H20, CO и CO2) for a combustion analysis (available for DO or MC radiation models).





Thermal NO Formation (Requires “Advanced” module)

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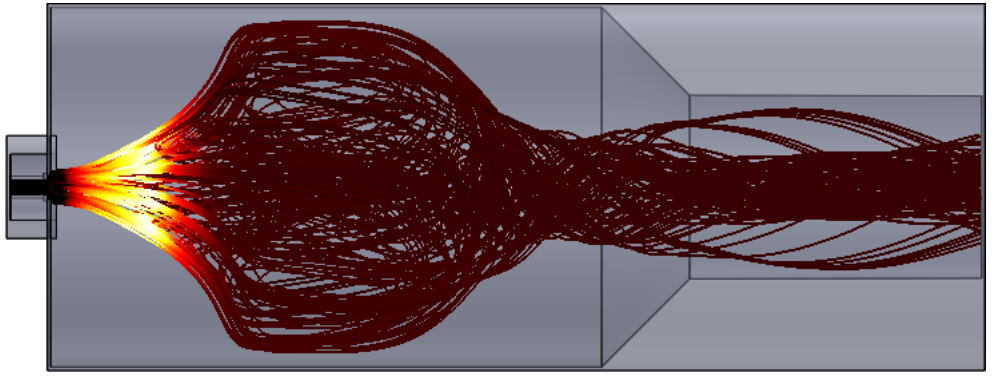
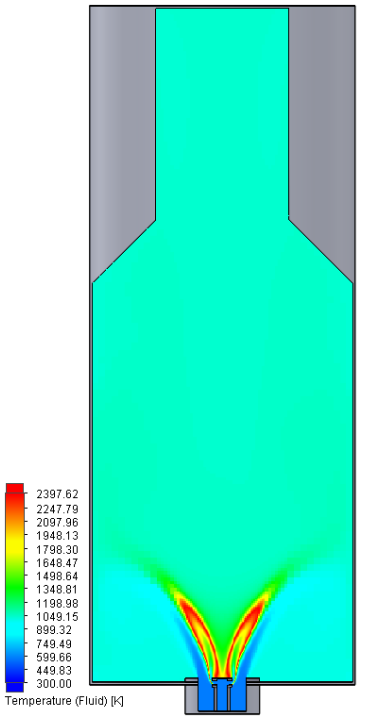
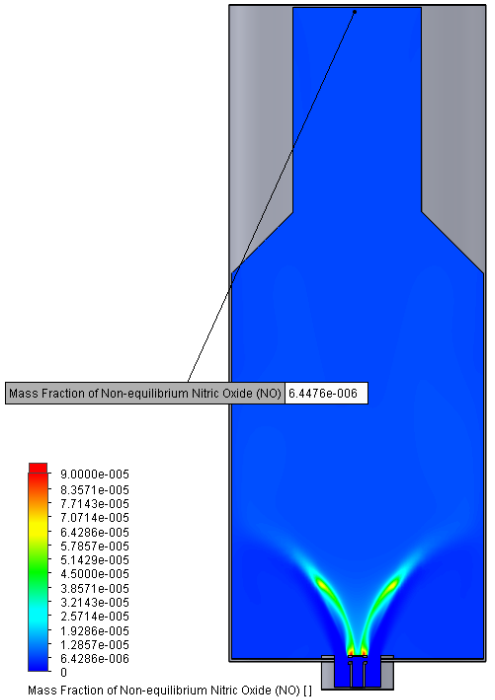
- For a combustion analysis you can estimate the mass fraction of non-equilibrium Nitric Oxide (NO) based on Thermal-NO (Zeldovich-NO) model. The Thermal NO mechanism is a predominant source of NOx in gas flames at temperatures above 1800 K.







Satellite Radiation (Requires “Advanced” module)

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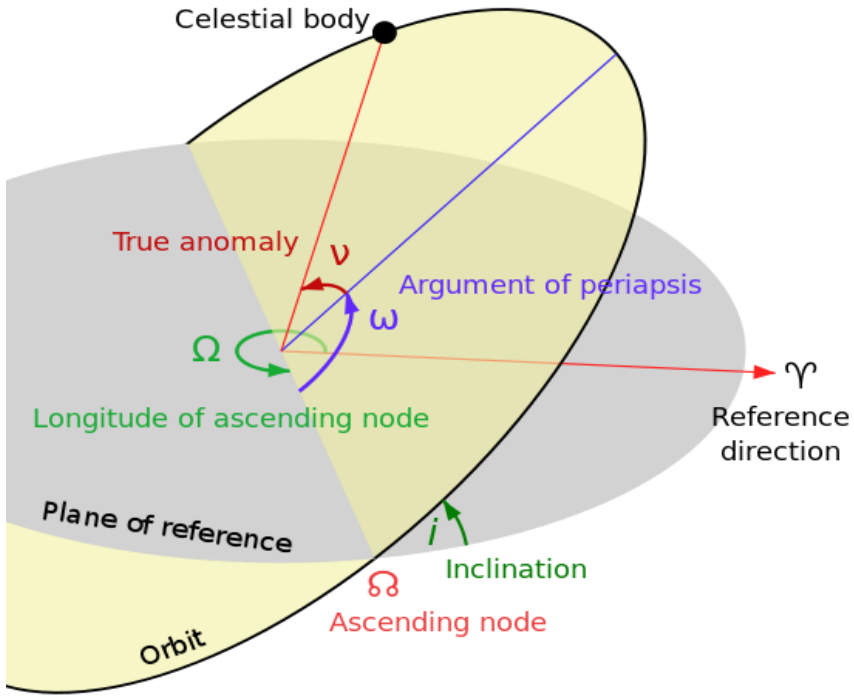
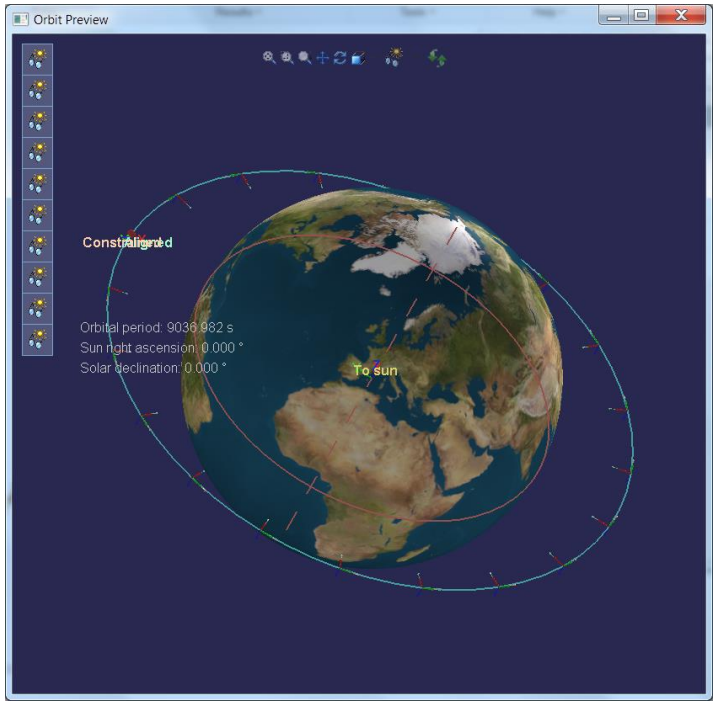
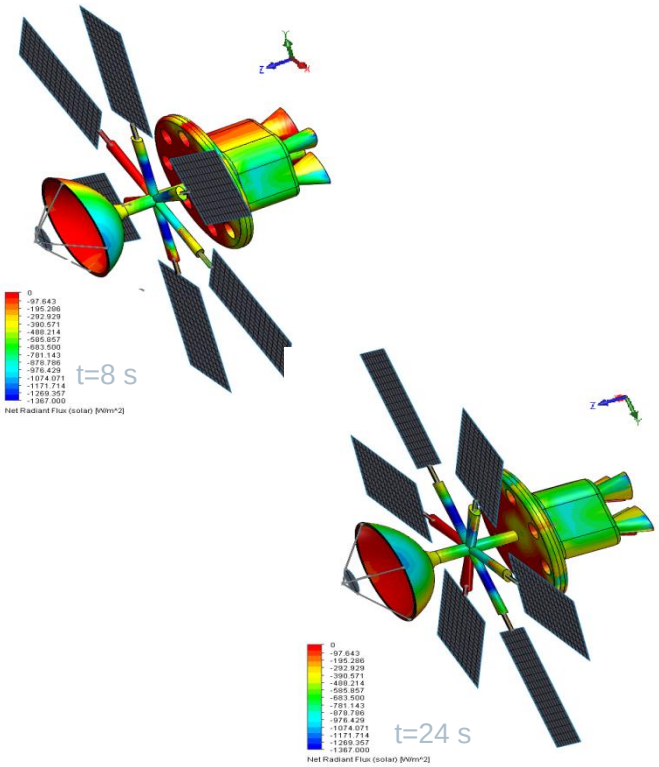
Satellite radiation

- Radiation load for an object on a planet’s orbit.







File | Analysis | Application | Curve | Developer | Render | Tools | View | Assemblies | Flow Analysis

Wizard | New | Clone Project | General Settings | Project
Boundary Condition | Global Goals | Insert
Global Mesh | Local Mesh | Mesh
Run | Batch Run | Calculation Control Options | Solve
Load/Unload | Cut Plot | Geometry | Probe | Save Image | Results
Check Geometry | Engineering Database | Create Lids | Export Results | Tools
FloEFD Help Topics | Online Support | Help

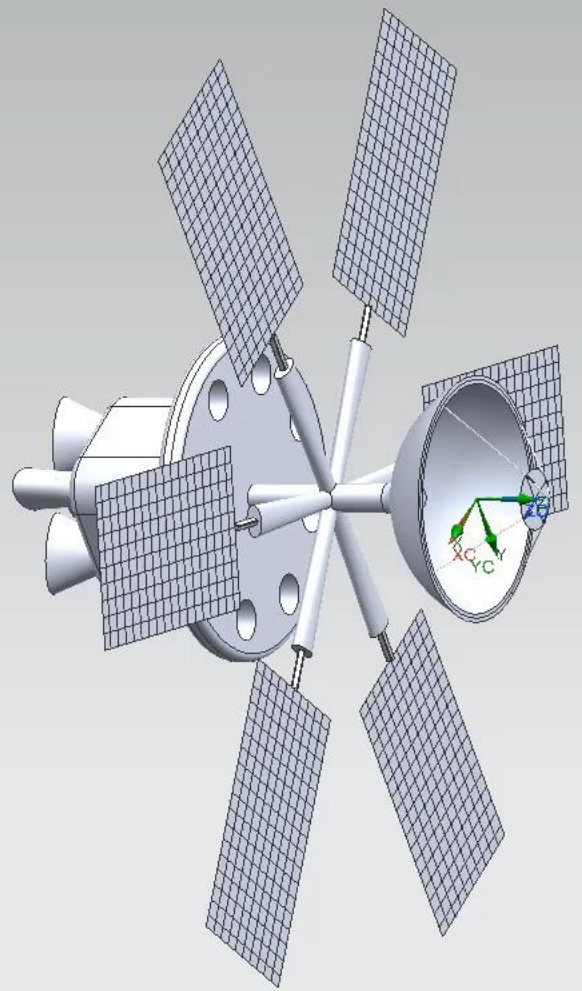
Menu | No Selection Filter | Entire Assembly

FloEFD

- Projects
  - Artificial Satellite_x_t
    - Shadow (X to nadir and around pi)
    - Aligned and Constrained (X to Sun)
    - Full revolution (Z to nadir and around pi)
    - Full revolution (Z to nadir, J2000)
    - **1 revolution (Z to nadir, J2000)**

1 revolution (Z to nadir, J2000)

- Input Data
  - Computational Domain
  - Fluid Subdomains
  - Boundary Conditions
  - Goals
    - SG Average Net Radiant Flux (solar) X+
    - SG Average Net Radiant Flux (solar) X-
    - SG Average Net Radiant Flux (solar) Y+
    - SG Average Net Radiant Flux (solar) Y-
    - SG Average Net Radiant Flux Z+
    - SG Average Net Radiant Flux (thermal) Z+
    - SG Average Net Radiant Flux (solar) Z+
    - SG Average Net Radiant Flux Z-
    - SG Average Net Radiant Flux (thermal) Z-
    - SG Average Net Radiant Flux (solar) Z-
    - SG Average Net Radiant Flux X+
    - SG Average Net Radiant Flux (thermal) X+
    - SG Average Net Radiant Flux X-
    - SG Average Net Radiant Flux (thermal) X-
    - SG Average Net Radiant Flux Y+
    - SG Average Net Radiant Flux (thermal) Y+
    - SG Average Net Radiant Flux Y-
    - SG Average Net Radiant Flux (thermal) Y-
  - Mesh
    - Global Mesh
- Results (Not loaded)



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Design Exploration & Productivity

Surface Parameters in Plane

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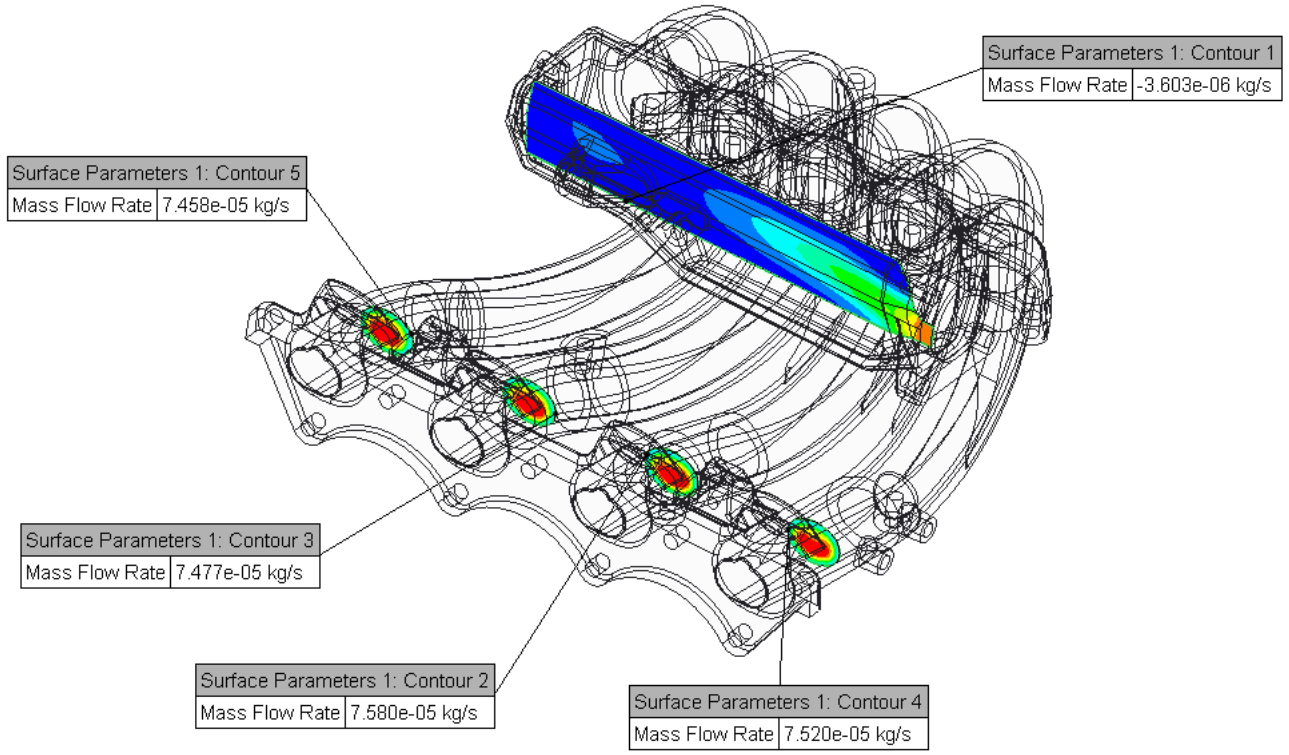
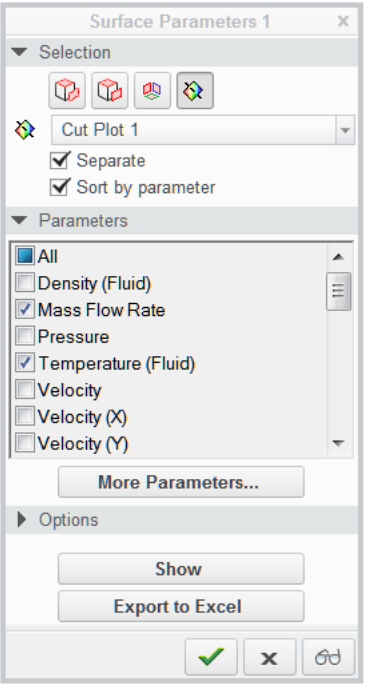
- Surface parameters can now be calculated in a section plane. Can be linked to cut plot.
- If a section plane divides model into several closed contours, parameters can be calculated separately for each contour.





NX 11 - FloEFD Simulation - [Simulation.prt (Modified, Read Only)]

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File | Analysis | Application | Curve | Developer | Render | Tools | View | Assemblies | Flow Analysis

Find a Command

Wizard | New | Clone Project | General Settings — Project

Boundary Condition | Global Goals — Insert

Global Mesh | Local Mesh — Mesh

Run | Batch Run | Calculation Control Options — Solve

Load/Unload | Cut Plot | Lighting | Probe | Save Image — Results

Check Geometry | Engineering Database | Create Lids | Export Results — Tools

FloEFD Help Topics | Online Support — Help

Menu | No Selection Filter | Entire Assembly

FloEFD

- Projects
  - intake_manifold_x_t
  - Simulation
- Simulation
  - Input Data
    - Computational Domain
    - Fluid Subdomains
    - Boundary Conditions
      - Outlet Volume Flow 15 l_s
      - Environment Pressure 1atm
    - Goals
      - GG Av Static Pressure
      - GG Av Velocity
      - SG Bulk Av Total Pressure Outlet
      - SG Mass Flow Rate Outlet
      - SG Bulk Av Velocity Outlet
      - SG Bulk Av Total Pressure Inlet
      - Total Pressure Drop
    - Mesh
      - Global Mesh
  - Results (1.fld)
    - Mesh
    - Cut Plots
      - Cut Plot 1
    - Surface Plots
    - Isosurfaces
    - Flow Trajectories
    - Particle Studies
    - Point Parameters
    - Surface Parameters
    - Volume Parameters
    - XY Plots
    - Goal Plots
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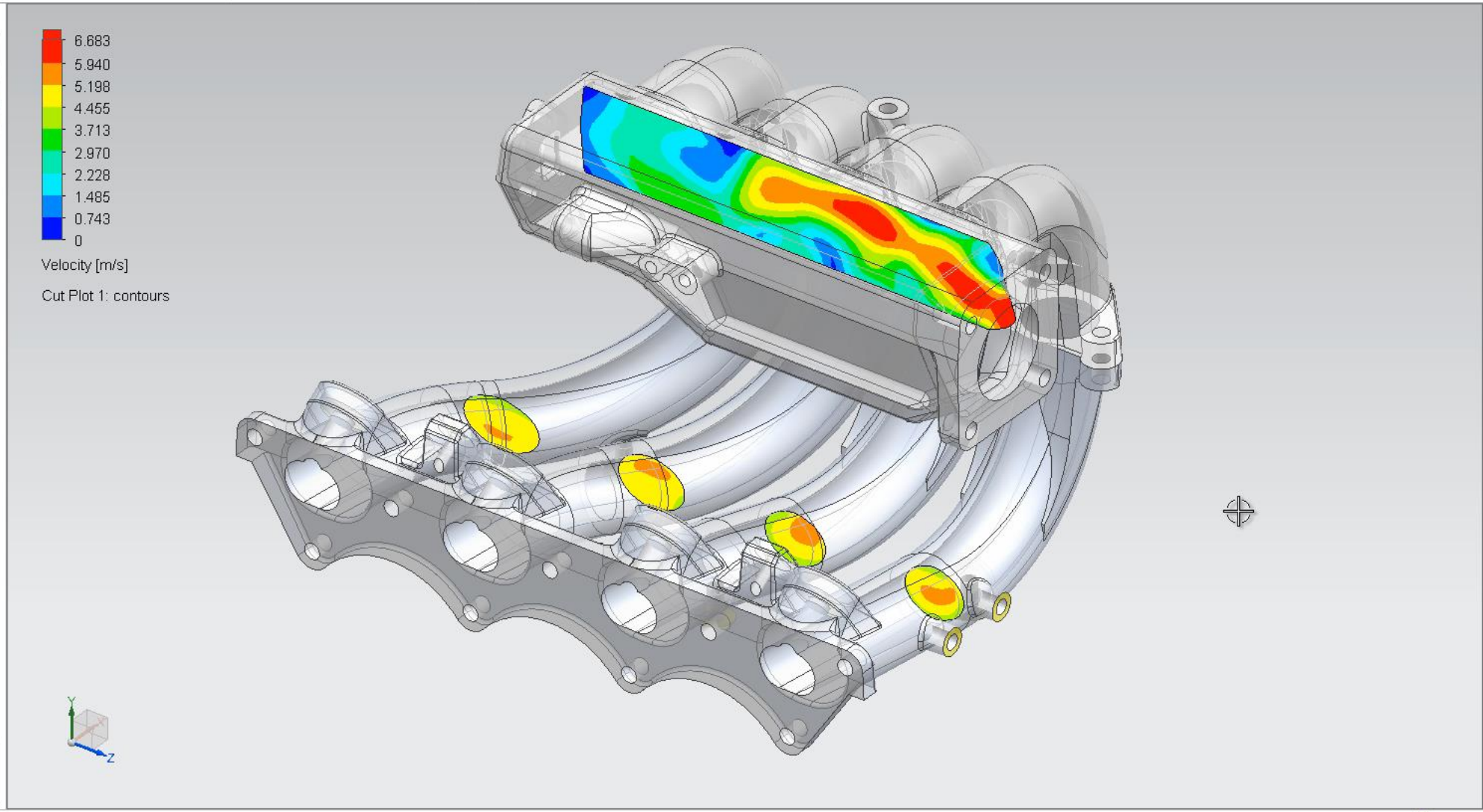
    - Animations



Move cursor to browse objects and MB1 to select object

Flow Trajectories: Start From Line, Rectangle

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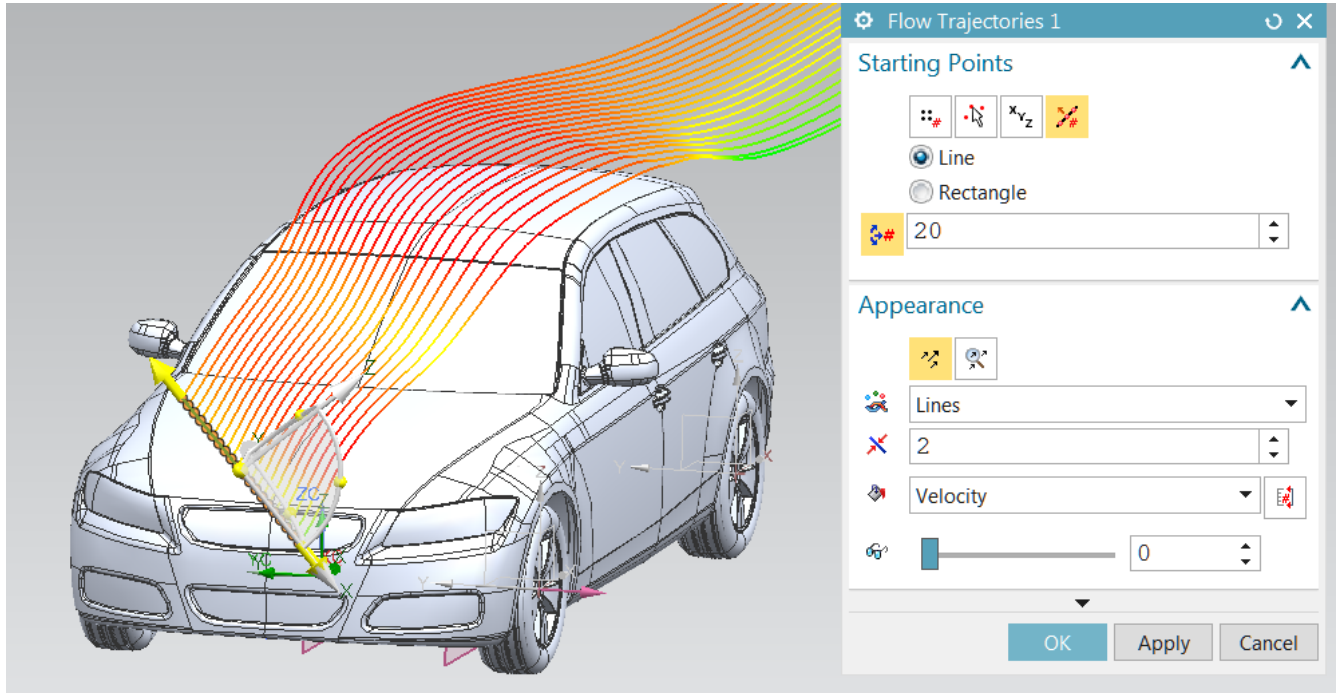
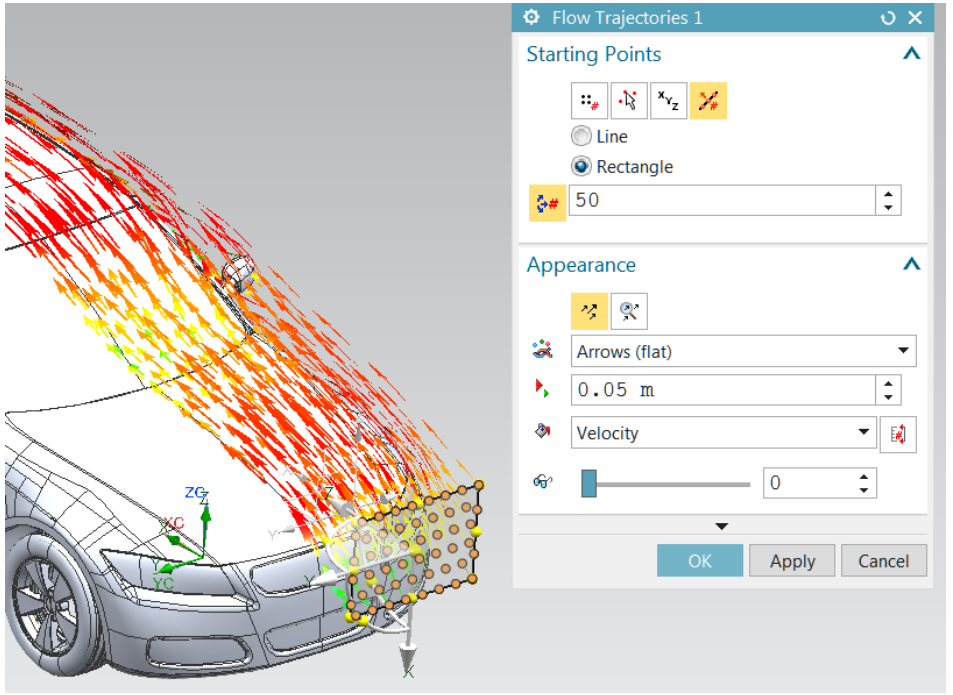
- Flow Trajectories can start from linear or rectangular virtual objects (not a CAD geometry), which you can interactively move, rotate, and resize in the graphics area.





NX 11 - FloEFD Simulation - [estateback_id16_x_t.prt in Assembly General_x_t.prt]

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File | Analysis | Application | Curve | Developer | Render | Tools | View | Assemblies | Flow Analysis

Find a Command

Wizard | New | Clone Project | General Settings — Project

Boundary Condition | Global Goals — Insert

Global Mesh | Local Mesh — Mesh

Run | Batch Run | Calculation Control Options — Solve

Load/Unload | Cut Plot | Lighting | Probe | Save Image — Results

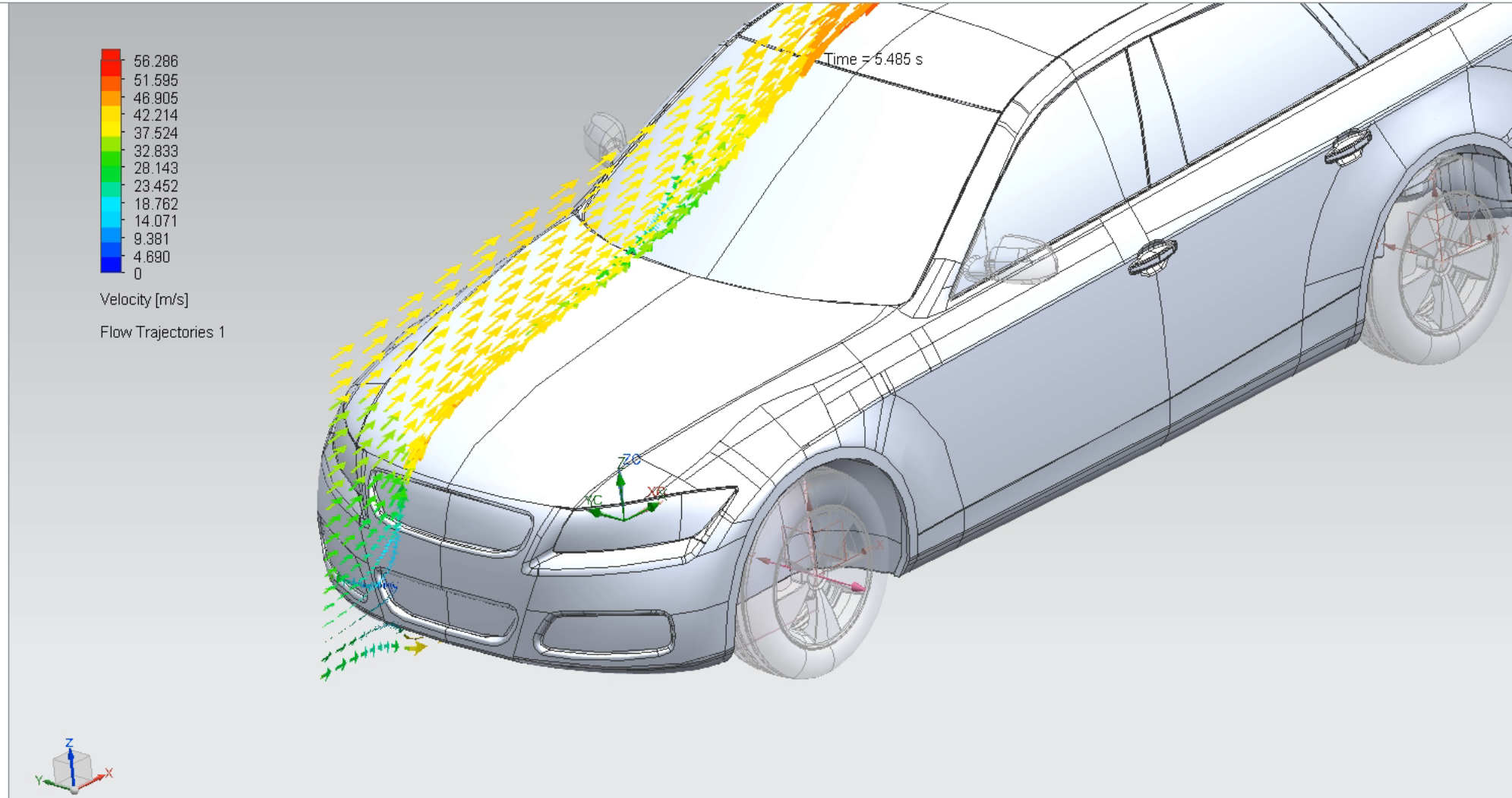
Check Geometry | Engineering Database | Create Lids | Export Results — Tools

FloEFD Help Topics | Online Support — Help

Menu | No Selection Filter | Entire Assembly

FloEFD

- Projects
  - General_x_t
    - Cy
    - Mesh
      - Global Mesh
      - Local Mesh 1
    - Results (2.fld, 5.485 s)
      - Mesh
      - Cut Plots
        - Cut Plot 1
        - Cut Plot 2
        - Cut Plot 3
        - Cut Plot 4
      - Surface Plots
        - Surface Plot 1
      - Isosurfaces
      - Flow Trajectories
        - Flow Trajectories 1
      - Particle Studies
      - Point Parameters
      - Surface Parameters
        - Surface Parameters 1
        - Surface Parameters 2
        - Surface Parameters 3
        - Surface Parameters 4
        - Surface Parameters 5
      - Volume Parameters
      - XY Plots
        - График 1
        - График 2
        - XY Plot 3
      - Goal Plots
        - Goal Plot 1
      - Report



Cut Plot Normal to Curve

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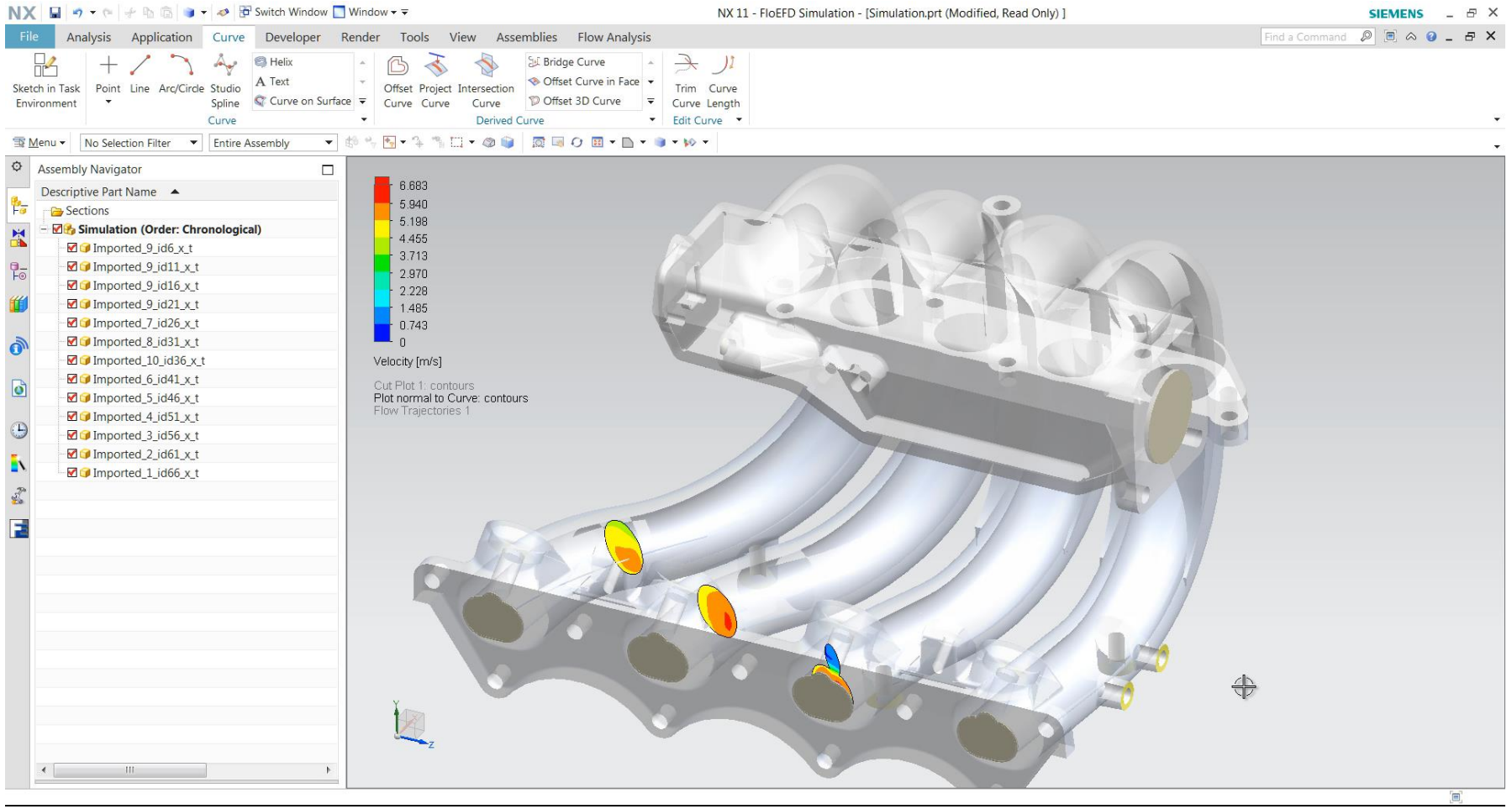
- You can now create Cut plot normal to a curve.



Complex Custom Visualization Parameters

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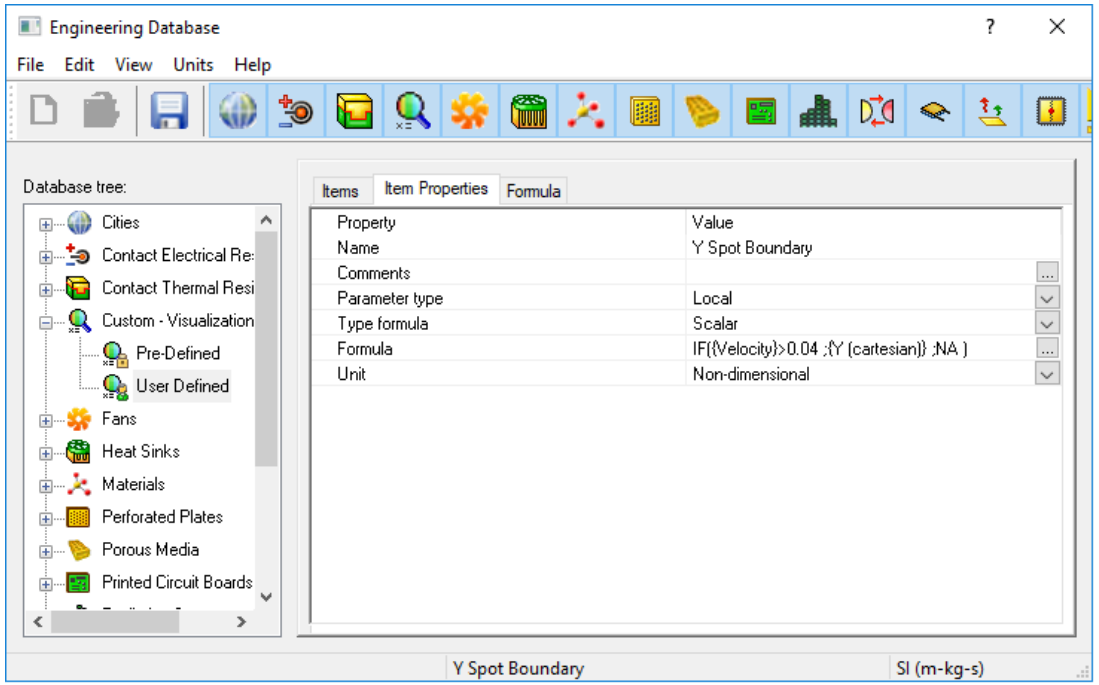
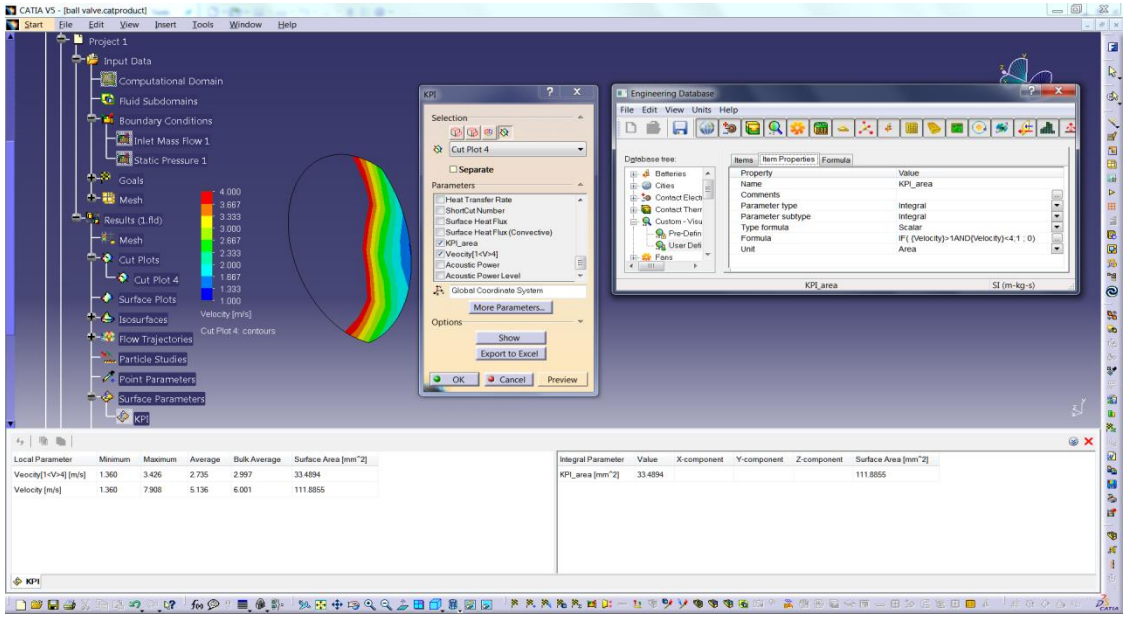
- You can now use complex mathematical functions and logical expressions (IF, OR, XOR, AND, NOT, NA (not available or undefined), “more than” >, “less than” <) to define custom visualization parameters. With such parameters you can get much more information from the calculated field, for example you can calculate an area where a desired parameter is greater than specified value.





Linked Goals (Feature Goals)

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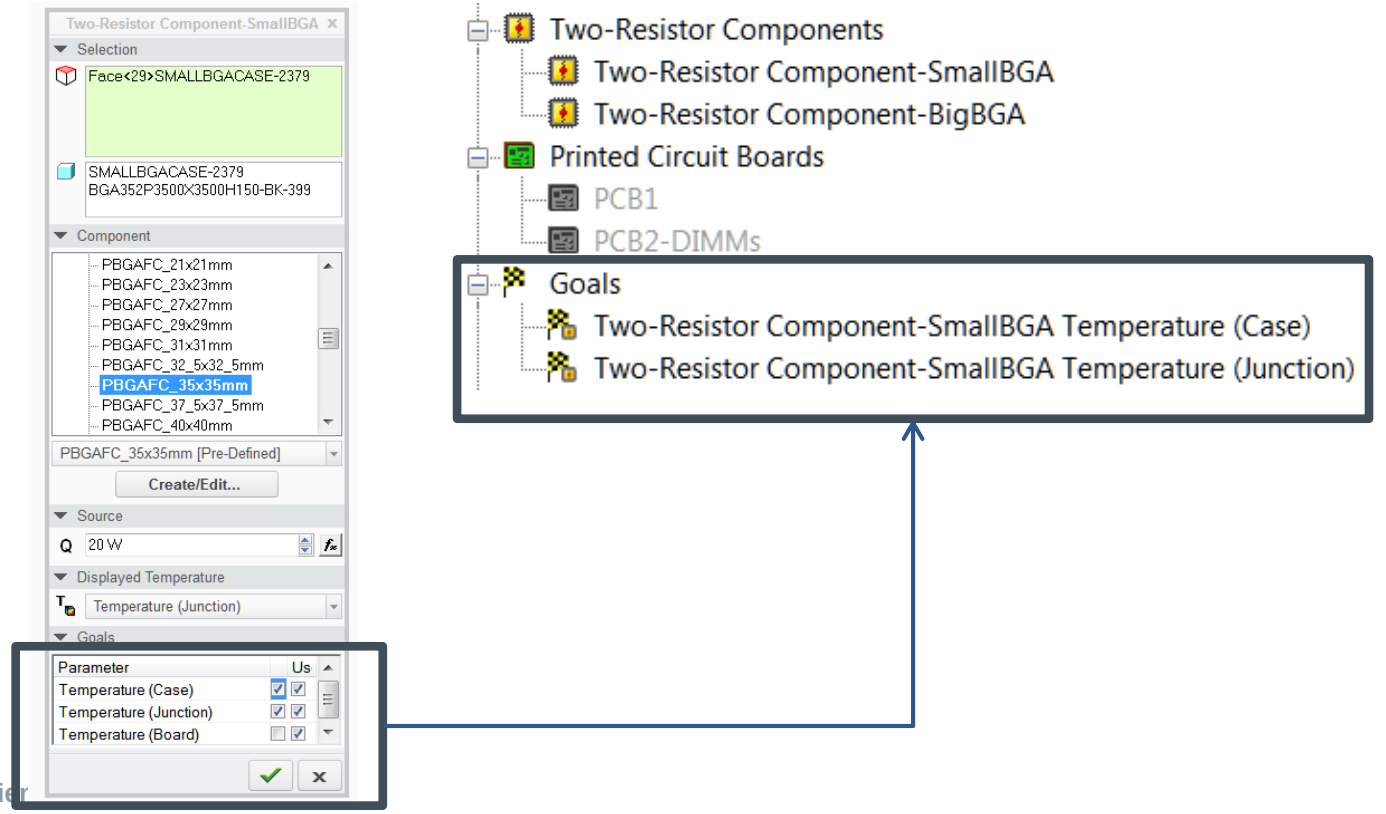
- From the boundary condition dialog you can now select goals which will be automatically applied to the condition's reference face or body. This goal is linked to the boundary condition, so changing the reference in the condition you don't need to redefine the corresponding goal. Removing condition will remove the goal associated with it.



Parametric Study

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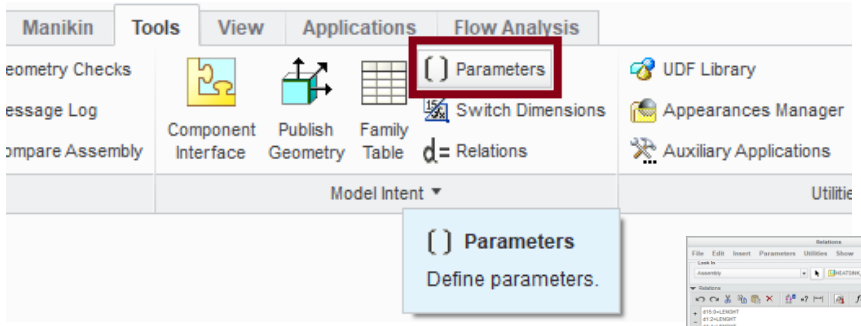
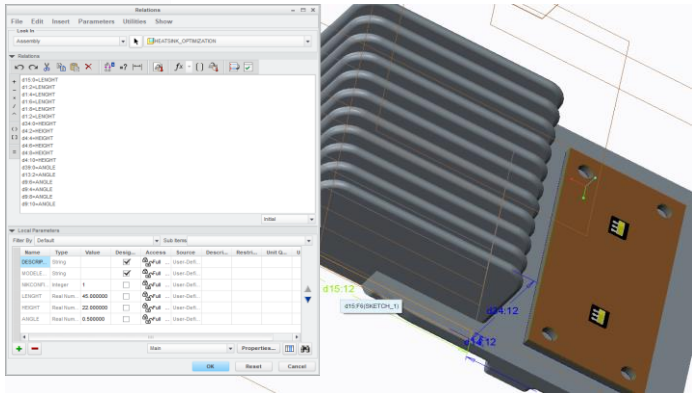
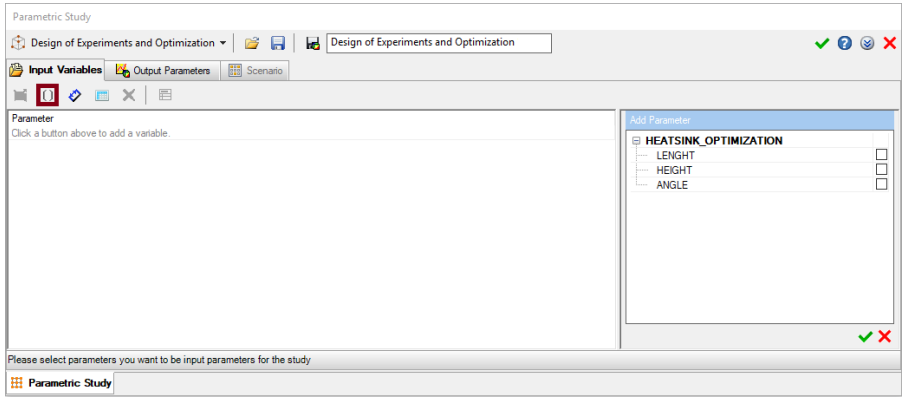
Improve geometry variation: remove limitations

- Support Variables in Solid Edge
- Support Expressions in NX (from 17.2)
- Support Parameters in Creo
- Support Equations in FLOEFD Standalone







Project Parameters and Others

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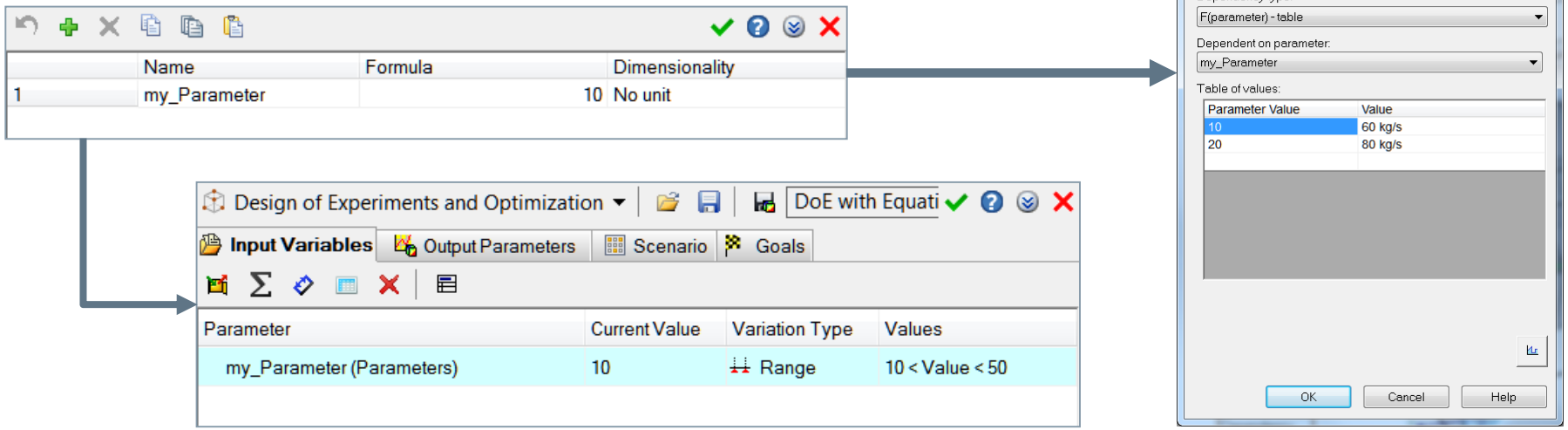
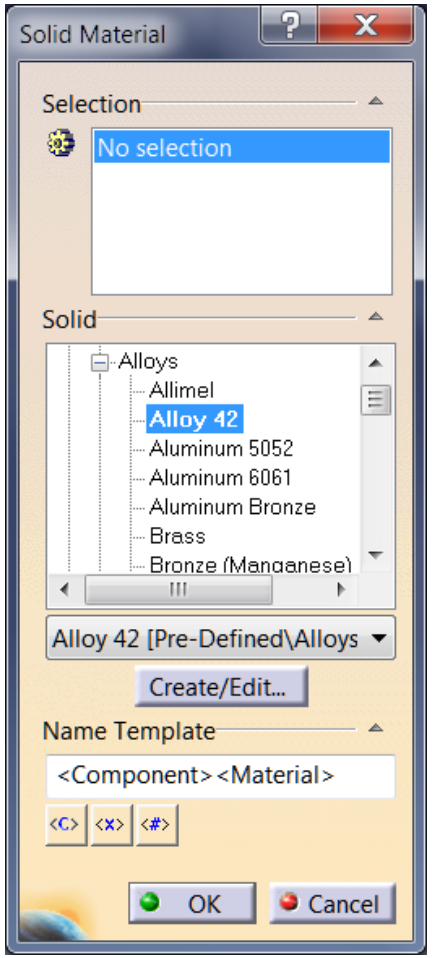
Name Template for BC

- Define BC name at creation.

Project Parameters

- A project parameter is a user defined constant or variable which can be used for definition of boundary conditions throughout the project. You can use parameters in dependencies and vary parameters in parametric study.





Import material definition from NX

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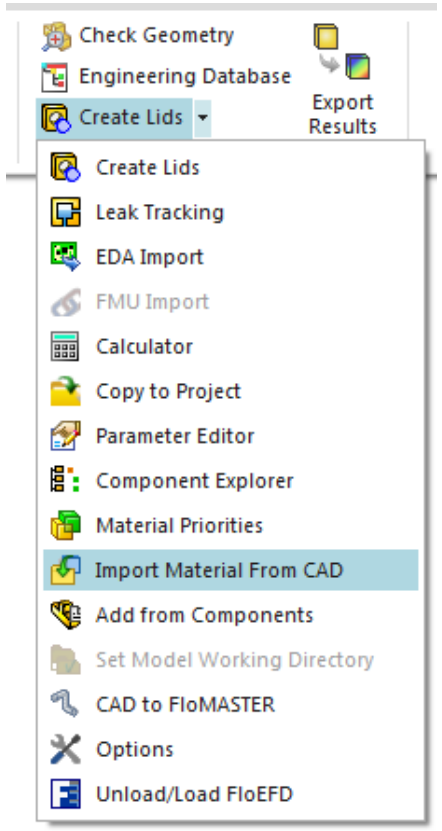
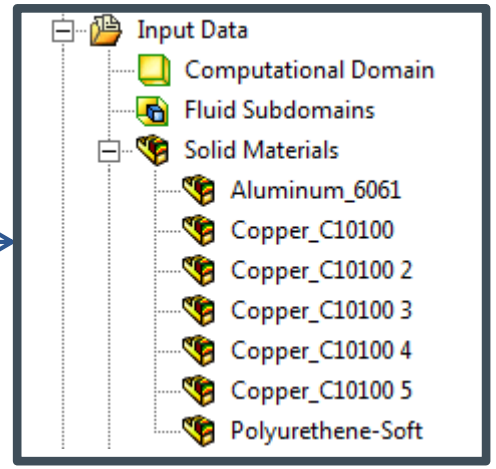
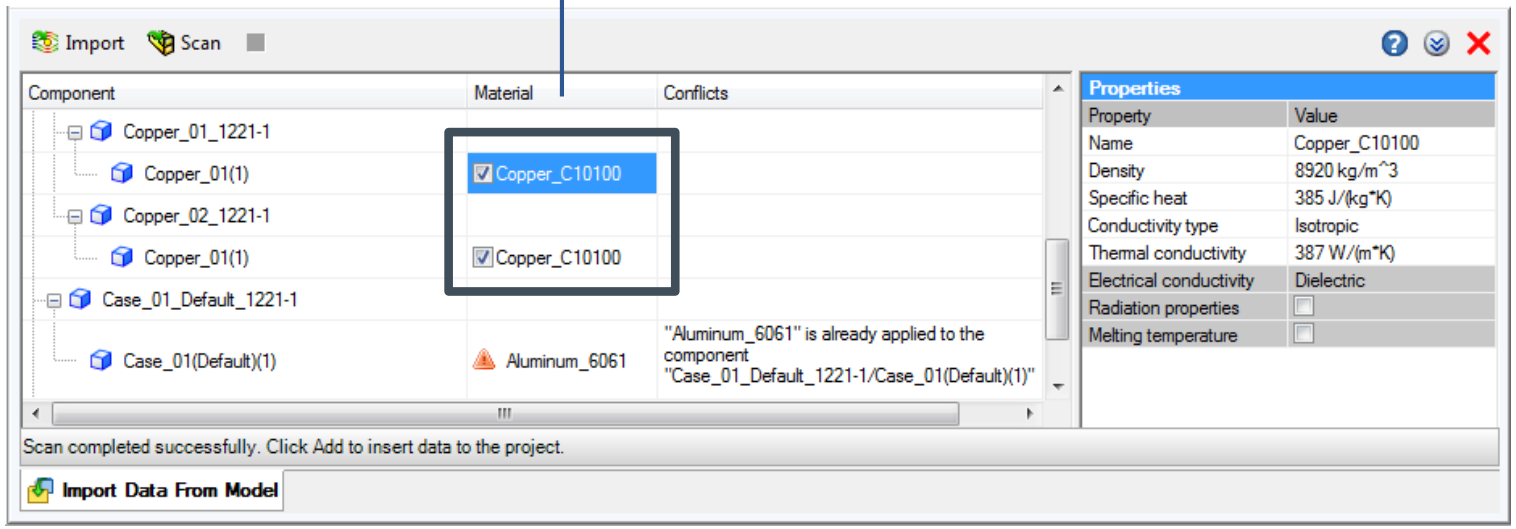
- Materials defined in NX can be imported into FLOEFD as Solid Material conditions.







Scenes and Batch Results Processing

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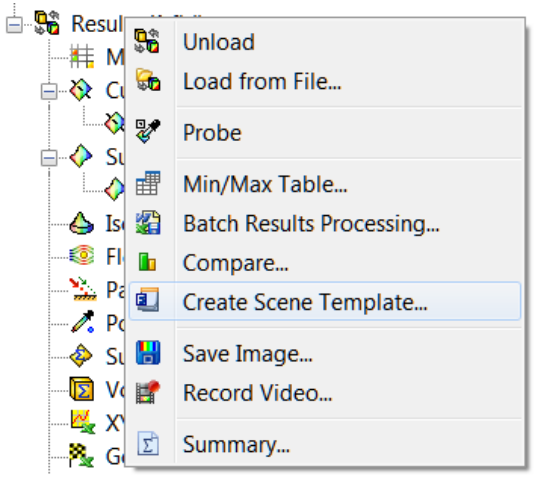
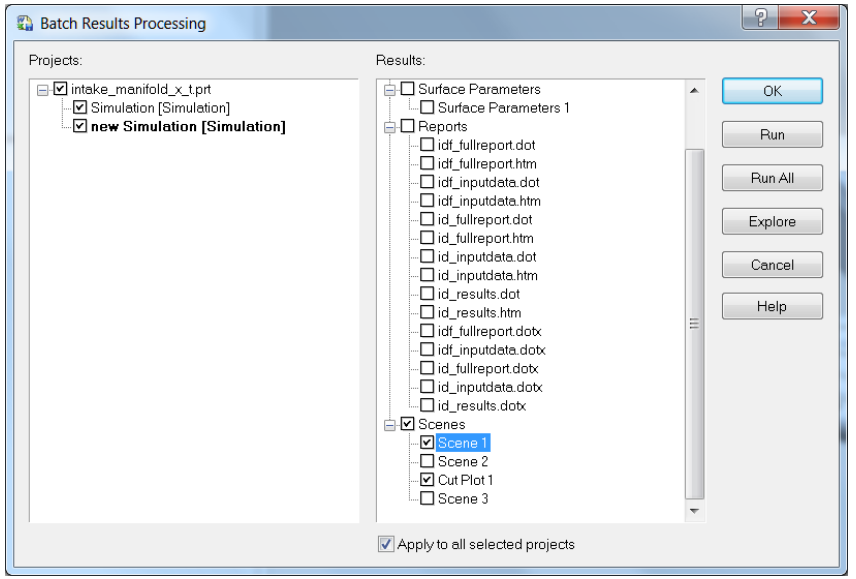
- **Scene template**. You can create scene templates from individual plot or the whole scene (a scene consists of all currently displayed plots).
- **Scene in Batch Results Processing**. The Batch results Processing feature creates multiple images for different projects and models. You can now create a FloEFDView 3D image (including XY plots and Goal charts) from a scene template for multiple models and projects using the Batch Results Processing.
- **Apply to all selected project in Batch Results Processing**. The “Apply to all selected project” option creates results (images, reports, tables) for all the selected projects automatically.





Compare Different Models

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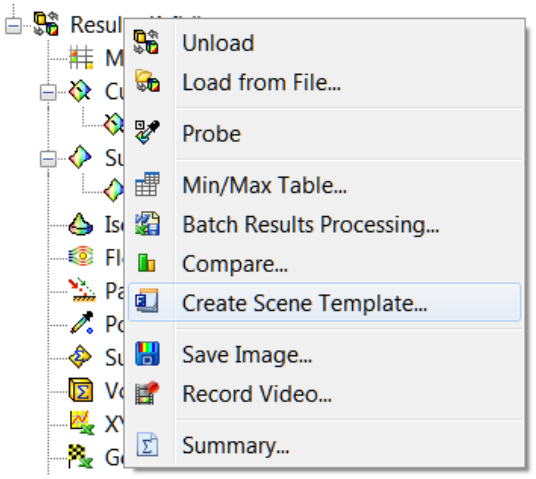
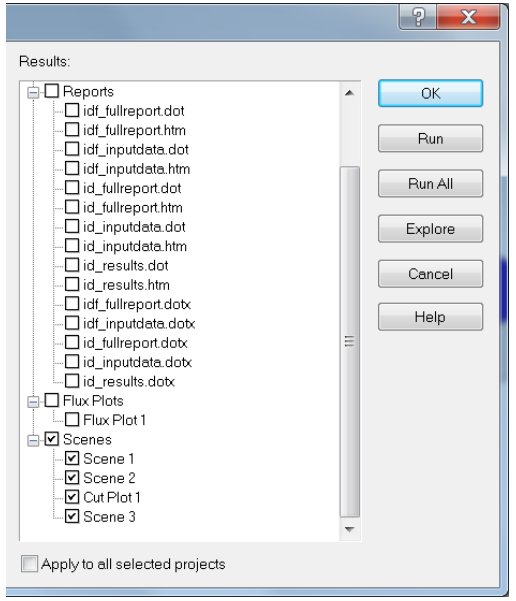
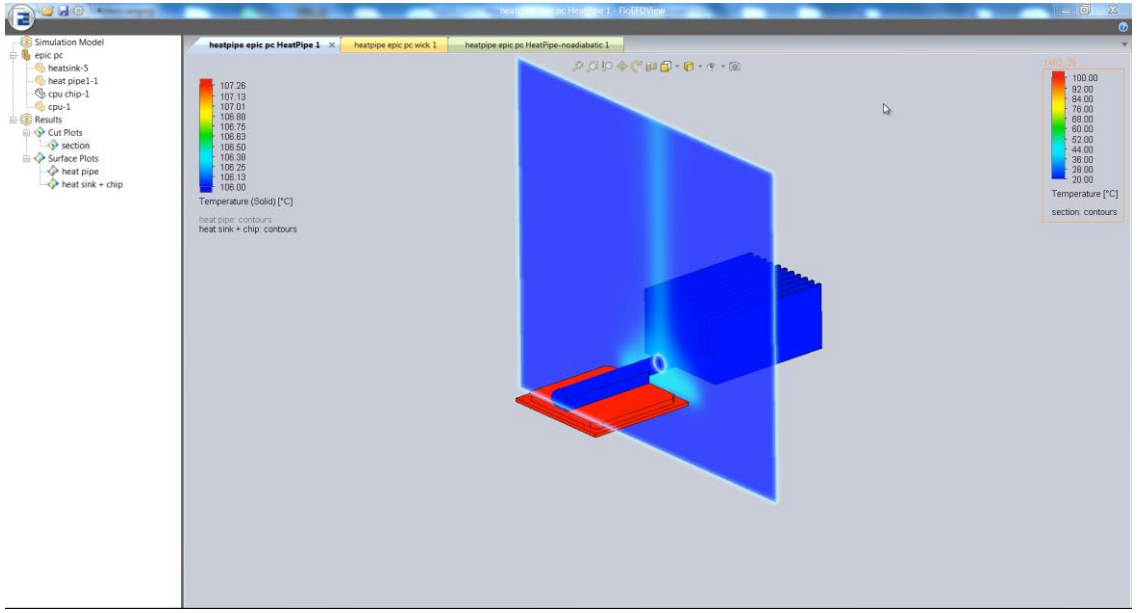
- Different models can be compared via multi-Scene comparing in **FloEFDView**.
- A Scene template can be used for easy generation of comparable plot(s) between different models. Scene is added into Batch results Processing.







Small but Useful

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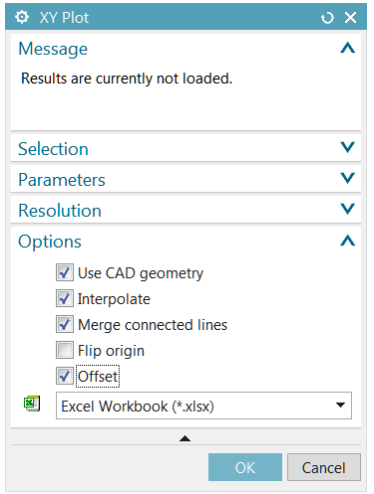
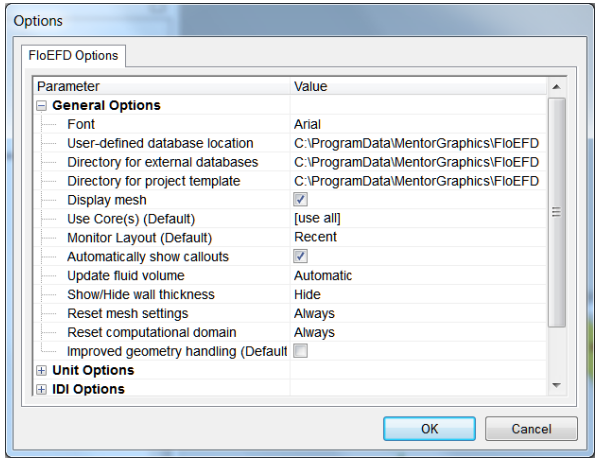
- **Offset option in XY Plots**. This option is only applicable for the XY plots located on the solid-fluid interface (wall). It defined either to take values on the wall or in the fluid.
- “Improved geometry handling” default state in Option.
- **Integral Contact Thermal Resistance**. For the thermal contact resistance you can now set integral (K/W) resistance values and FloEFD automatically recalculates and applies the specific value based on the area of surface contact.
- Display **computational domain size** in the Project Summary.
- LED: **Luminous Flux** goal.





Small but Useful

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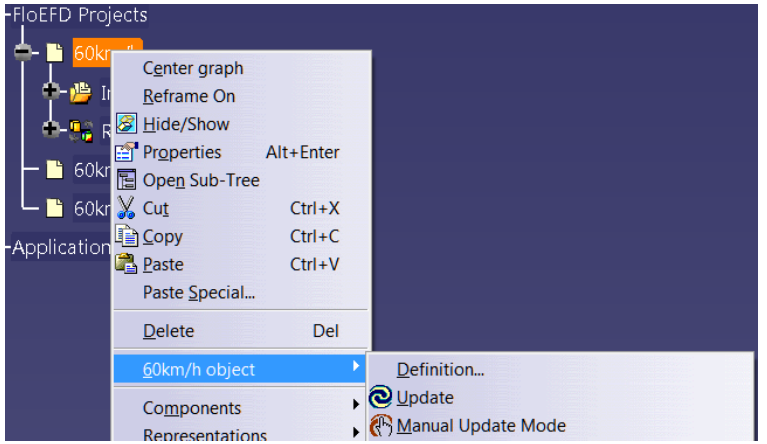
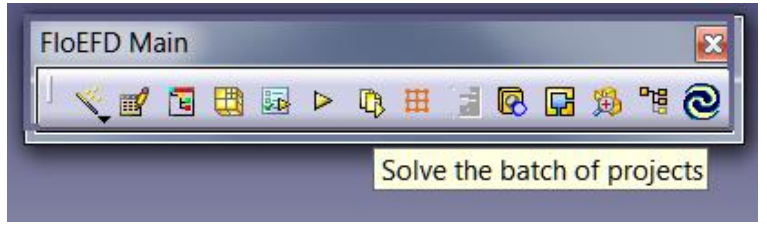
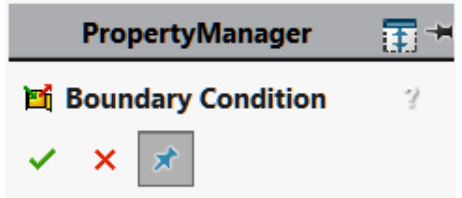
Ingenuity for life

- **Manual Update Mode**. The new "Manual Update Mode" command (accessible from the Edit, FloEFD Project menu or from the right-mouse click at the project folder in the FloEFD analysis tree) allows you to switch off automatic checking and rebuild processes every time when geometry is changed. This results in minimizing the number of messages that occur during intensive work with the model geometry (CATIA V5).
- **Batch Run command on toolbar**. The “Batch Run” command is now available on the Main toolbar (CATIA V5).
- Pin dialog while creating a condition in FLOEFD Standalone. Allows to create new condition without closing the dialog.
- Creo 5, CATIA 28







API Improvement

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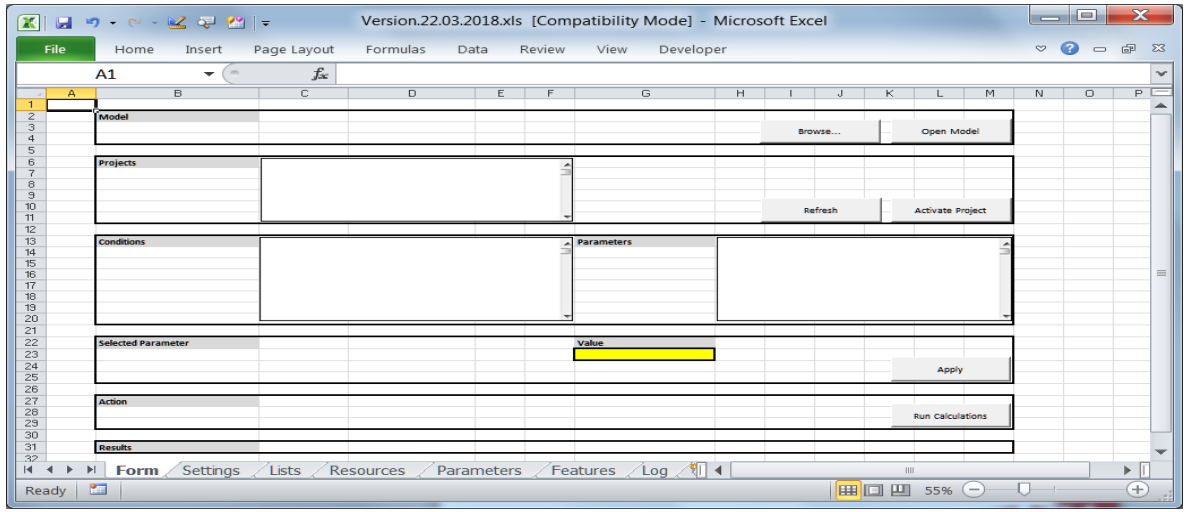
- With API (available for C++, VBA, VBS) you can create scripts to automate your workflow. You can now create a project from template and create various boundary conditions such as materials, sources, openings, radiative surfaces, fluid subdomains, etc. A volume boundary condition (such as material property) is created using the name of component or body. A face-based boundary condition (such as radiative surface) is created using a face name or color. You can also attach a face condition to the active face selection. With the ability to edit project data and get results, the new API can be used to create highly automated workflows.




```
Const nikMassFlowrate = 17
Dim logstr As Integer
Private Sub RunAPI_Click()

    Dim NCASrv As NIKCommonApiSrvLib.BaseApiObject
    Dim NCA As Object
    Dim IA As Object
    Dim MD As Object
    Dim MC As Object
    Dim FDAPrj As Object
    Dim EFDAResFiles As Object
    Dim FDAReshandler As Object
    Dim EFDAGoalsCalcRes As Object
    Dim FDAGoalsCalcRes As Object

    Set Srv = New NIKCommonApiSrvLib.BaseApiObject

  ' Set NCASrv = NIKCommonApiSrvLib.BaseApiObject
    Set NCA = Srv.LoadNIKCommonApiLibrary
    If NCA.LoadProductAPI2("FloEFD FEV", 17) <> False Then
        Call myLog("Loading API - OK")
    Else
        Call myLog("Can't Load Product API")
        NCA.UnloadProductAPI
        Exit Sub
    End If

    ' Open product
    CATIApath = "C:\Program Files\Dassault Systemes\R20\win_b64\code\bin\CNEXT.exe"
    FloEFDPath = "C:\Program Files\FloEFD\FloEFD FEV17\bin"
    Set IA = NCA.RunProduct2(CATIApath, FloEFDPath)
    If Not IA Is Nothing Then
        Call myLog("Running Product - OK")
    Else
        Call myLog("Can't Run Product")
        NCA.UnloadProductAPI
        Exit Sub
    End If
```

FLOEFD+Flomaster OneSimulation (OneSim)

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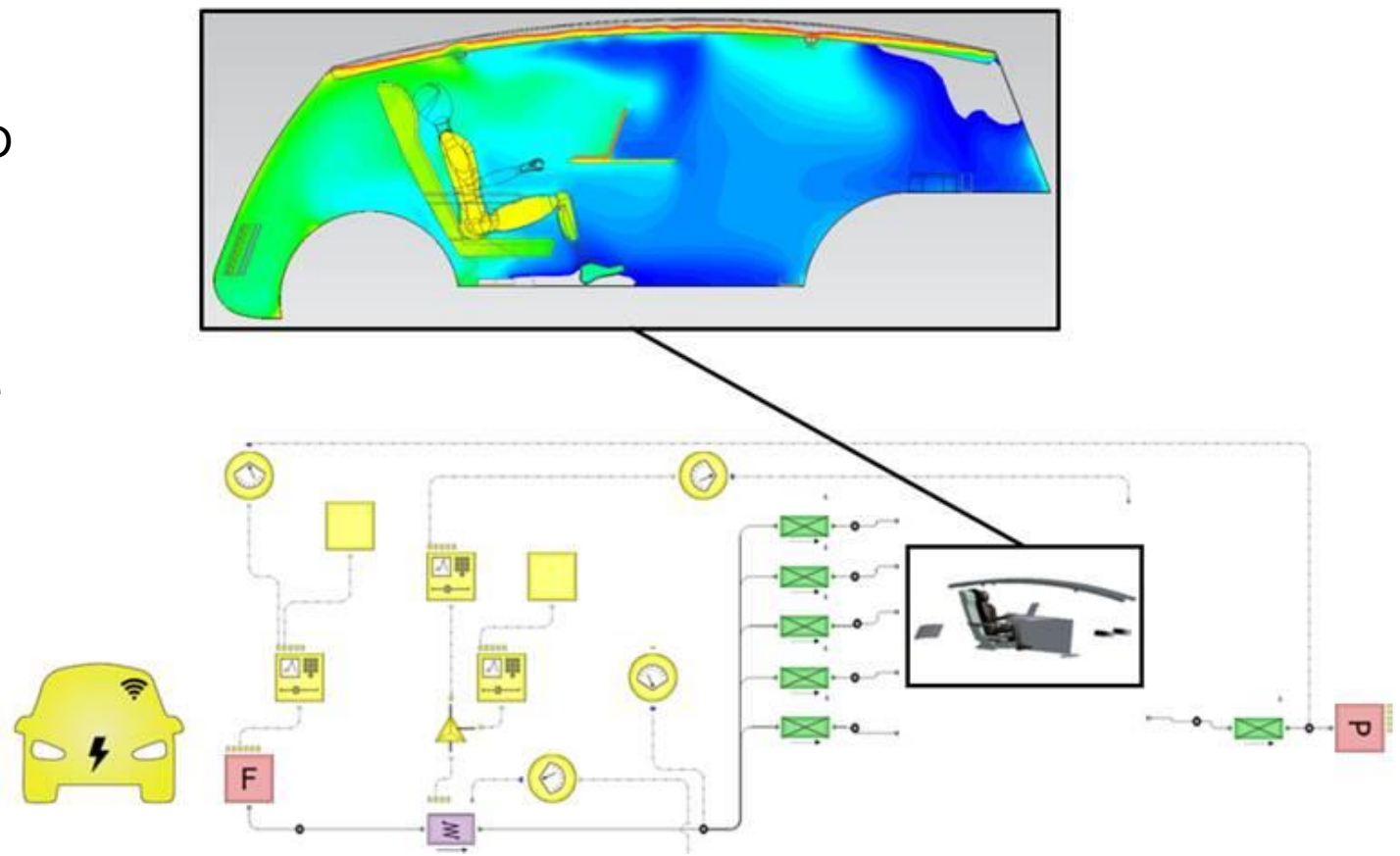
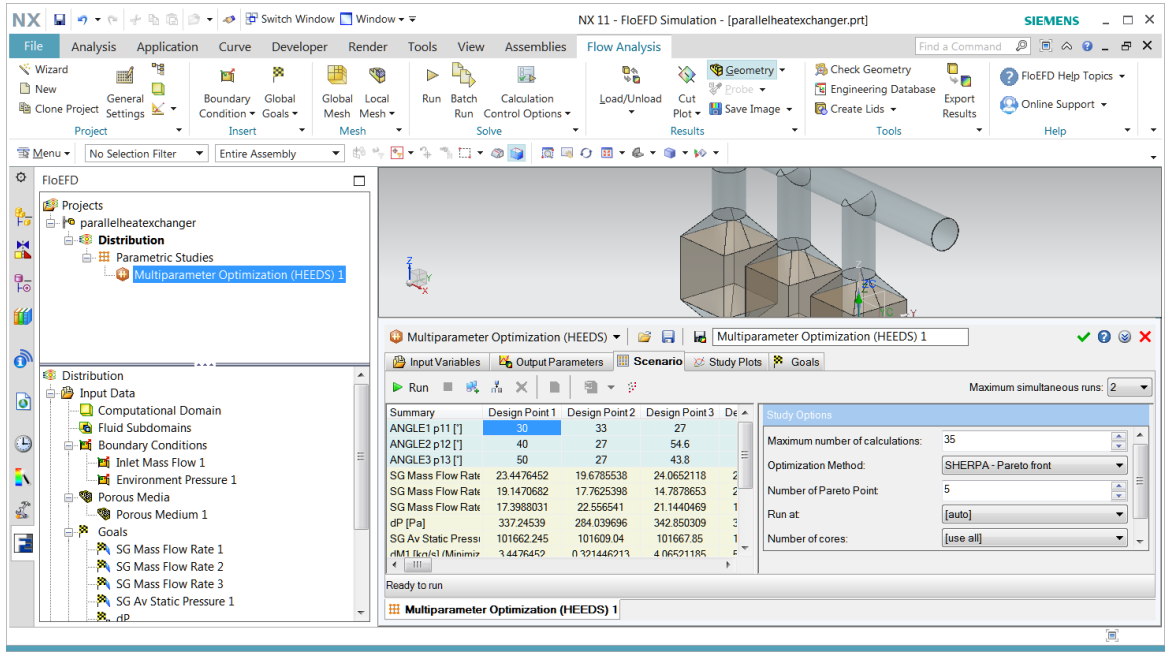
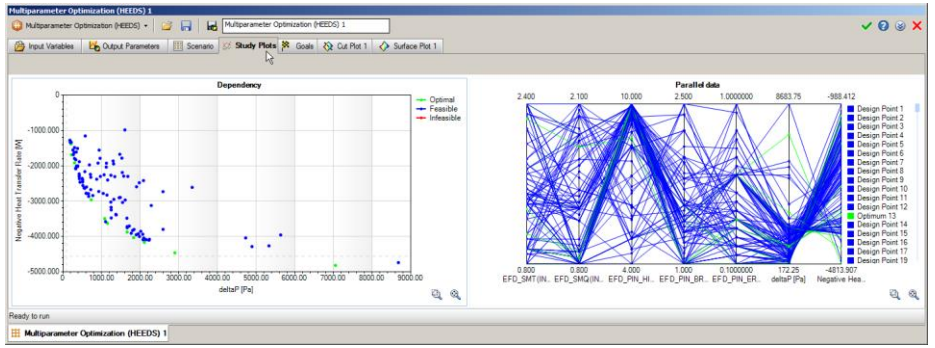
- ‘OneSim’ is a tightly coupled co-simulation workflow that enables a FLOEFD model to be considered as part of a Simcenter Flomaster network. One or more FLOEFD hydrodynamic boundary conditions are nominated for linking to the Flomaster network. Once connected, a simulation instigated from within Flomaster will solve both the FLOEFD model and the Flomaster network concurrently, until steady state or transient convergence. Flow rates, pressures and fluid temperatures will be communicated through the linked boundary conditions / hydraulic nodes throughout the solution process.

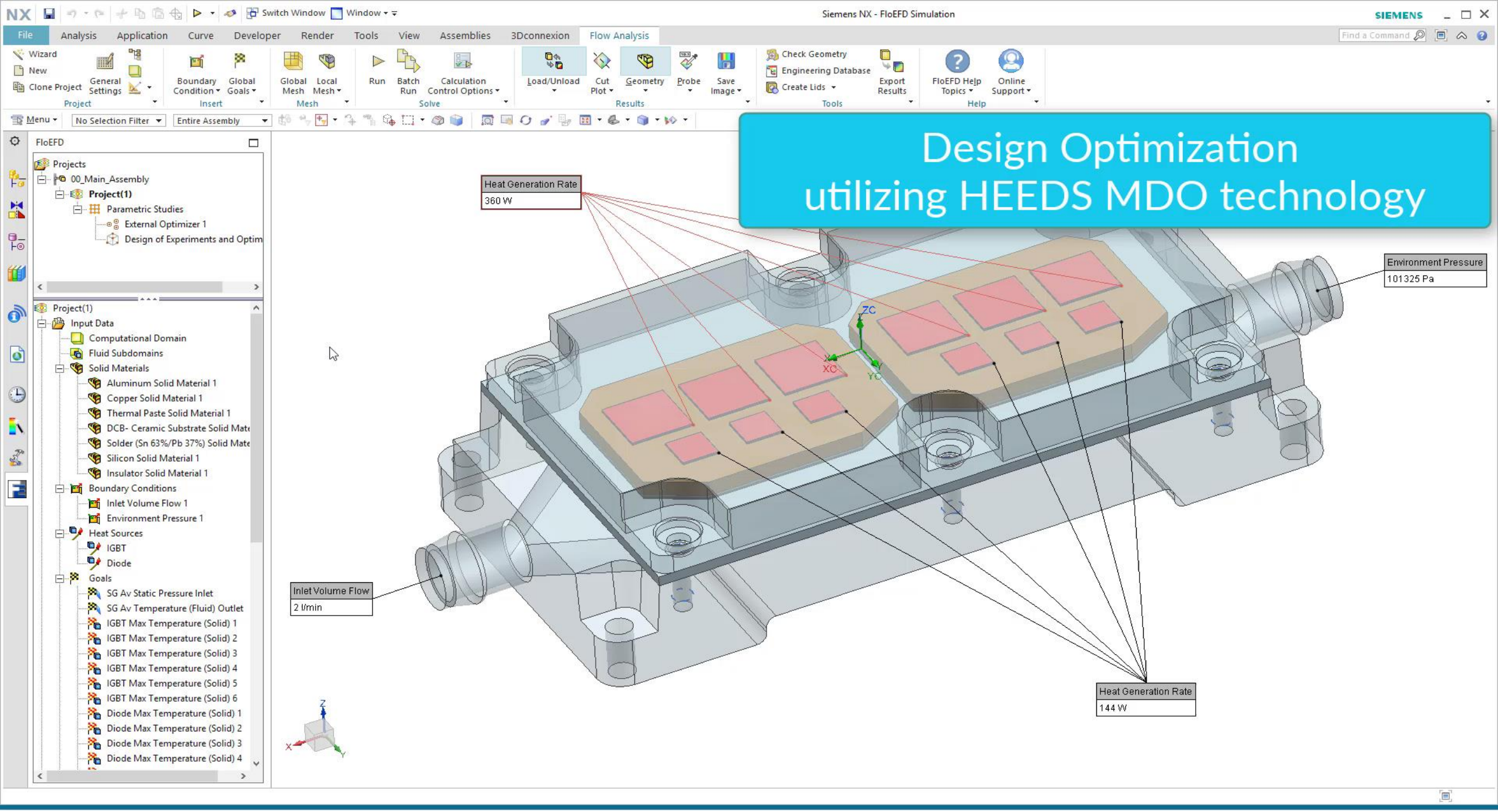


Embedded HEEDS(Requires “Embedded HEEDS” module)

- A new mode in Parametric Study allows conducting multiparameter optimization with HEEDS SERPHA solvers embedded into FloEFD:
  - SHERPA – Pareto Front
  - SHERPA – Weighted Sum
- Pareto Front and Parallel Data plots can be displayed.






Siemens NX - FloEFD Simulation
SIEMENS
File
Analysis
Application
Curve
Developer
Render
Tools
View
Assemblies
3Dconnexion
Flow Analysis
Wizard
New
Clone Project
General Settings
Project
Boundary Condition
Global Goals
Insert
Global Mesh
Local Mesh
Mesh
Run
Batch Run
Calculation Control Options
Solve
Load/Unload
Cut Plot
Geometry
Probe
Save Image
Results
Check Geometry
Engineering Database
Create Lids
Export Results
Tools
FloEFD Help Topics
Online Support
Help
Menu
No Selection Filter
Entire Assembly
FloEFD
Projects
00_Main_Assembly
Project(1)
Parametric Studies
External Optimizer 1
Design of Experiments and Optim
Project(1)
Input Data
Computational Domain
Fluid Subdomains
Solid Materials
Aluminum Solid Material 1
Copper Solid Material 1
Thermal Paste Solid Material 1
DCB- Ceramic Substrate Solid Mate
Solder (Sn 63%/Pb 37%) Solid Mate
Silicon Solid Material 1
Insulator Solid Material 1
Boundary Conditions
Inlet Volume Flow 1
Environment Pressure 1
Heat Sources
IGBT
Diode
Goals
SG Av Static Pressure Inlet
SG Av Temperature (Fluid) Outlet
IGBT Max Temperature (Solid) 1
IGBT Max Temperature (Solid) 2
IGBT Max Temperature (Solid) 3
IGBT Max Temperature (Solid) 4
IGBT Max Temperature (Solid) 5
IGBT Max Temperature (Solid) 6
Diode Max Temperature (Solid) 1
Diode Max Temperature (Solid) 2
Diode Max Temperature (Solid) 3
Diode Max Temperature (Solid) 4
Heat Generation Rate
360 W
Environment Pressure
101325 Pa
Inlet Volume Flow
2 l/min
Heat Generation Rate
144 W
ZC
XC
YC
Z
X
Y
Design Optimization
utilizing HEEDS MDO technology

Film Motion (Requires “LED” or “Advanced” modules)

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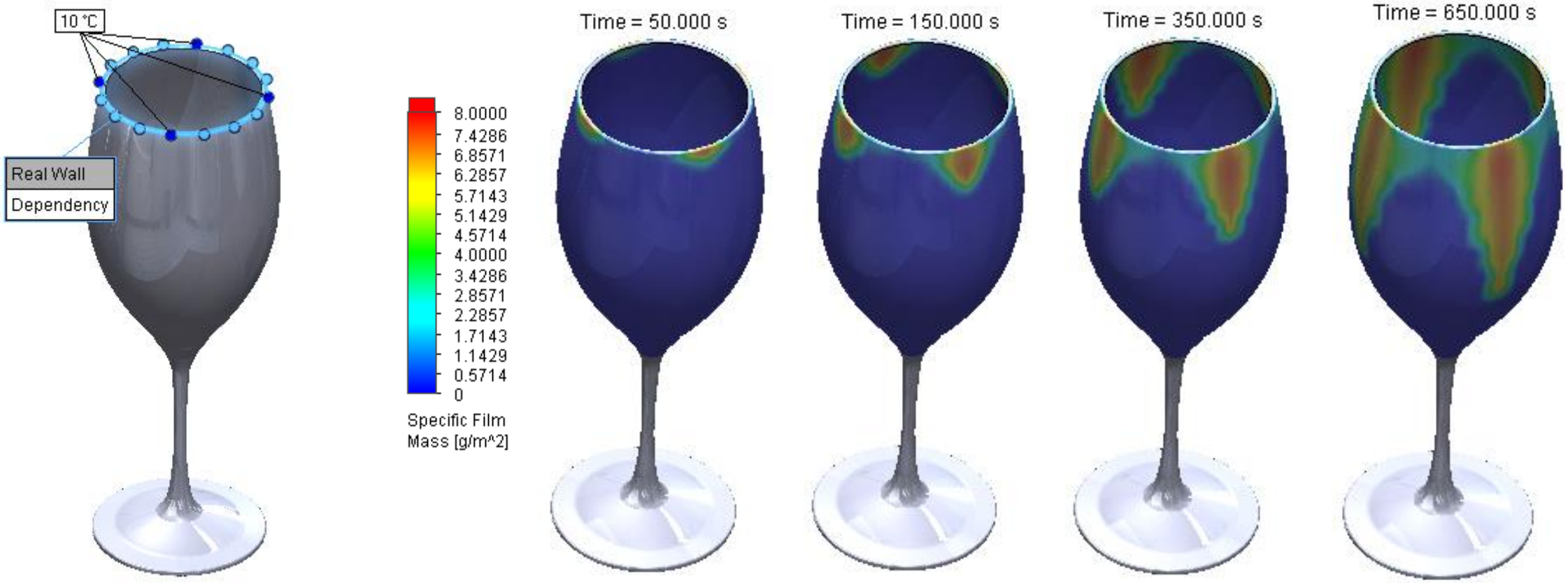
- For fogging/defogging analysis you can optionally consider water film motion on surfaces due to gravity and aerodynamic forces.



FMU Interface 2.0 support (Beta, available with a special Environment variable on demand)

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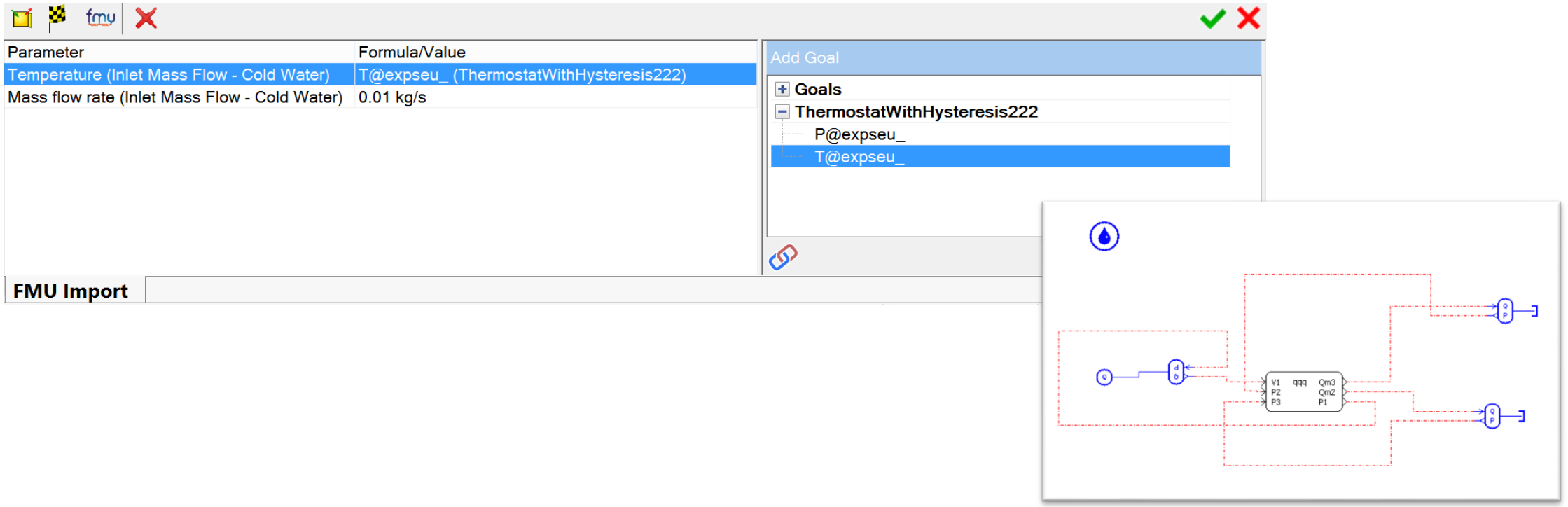
- FLOEFD can co-simulate complex task as a master product with Functional Mock-up Interface. Tool for input/output parameters mapping is available now as a beta feature.



FLOEFD New Release Policy

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- FLOEFD 2019.1 – March 2019
- FLOEFD 2019.2 – June 2019
- FLOEFD 2019.3 – September 2019
- FLOEFD 2019.4 – December 2019

There is no more division into major and minor releases. All four releases are assumed to be more less of equal volume with regard to the new enhancements added. New enhancements are added upon readiness and will not wait for the major release at the end of the year.

Hot fixes with bug fixing may appear in between of these four releases.

The releases can coexist.

FLOEFD Modules

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Module	North Star PN	NX PN	SE PN	License Feature
Electronics Cooling	MG238154FL	NX30563	SE451F	efdelectro
HVAC	MG247371FL	NX30565	SE452F	efdhvac_c
LED	MG253703FL	NX30567	SE453F	efdledmodule
Adv CFD (Advanced)	MG238395FL	NX30569	SE454F	efdadvanced_c
EDA Bridge	MG273852FL	NX30570	SE455F	efdeda
T3STER AutoCalibration (new for FLOEFD)	MG265217FL	NA	NA	ftcalibrator
Power Electrification (new)	MG276241FL	NA	NA	efdbattery
Embedded HEEDS (new)	MG277155FL	NA	NA	efdheeds

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Thank You