



SIMUCAD

# Simcenter FLOEFD 2020.1

What's New 新功能

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# Agenda 目录



- BCI-ROM 边界独立的降阶模型
- Thermal Net List 热网列表
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- New Modules 新的功能模块
- CAD Versions Support CAD版本支持
- Rebranding 品牌再造

# SIMUCAD

**BCI-ROM**  
**边界无关的降阶模型**

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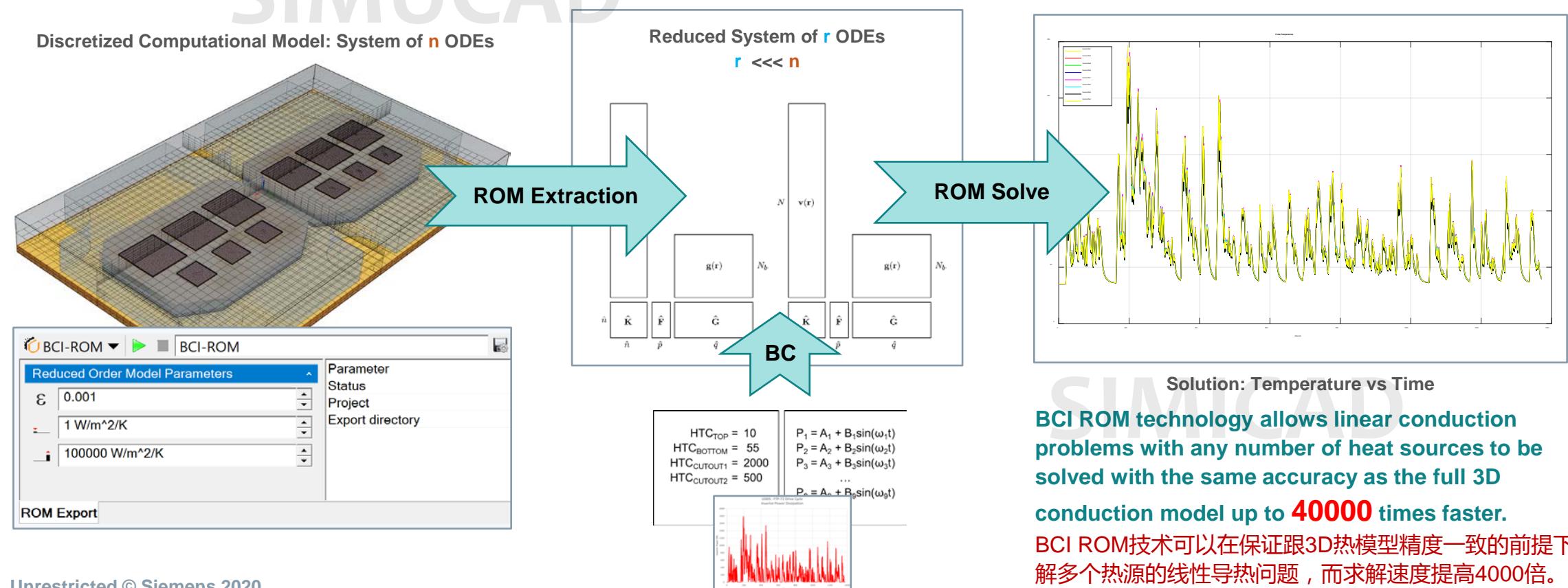
# BCI-ROM

## Boundary Condition Independent Reduced Order Modeling

边界无关的降阶模型

Reduced Order Modeling is an approach to derive a dynamic compact thermal model from a thermal simulation model. The objective is to create a model that solves much faster, while maintaining predictive accuracy in space and time.

讲解模型是一种从热仿真模型获取动态压缩热模型的方法，目的是为了在保证空间和时间上精度的同时快速获取计算结果。





# BCI-ROM: Why?

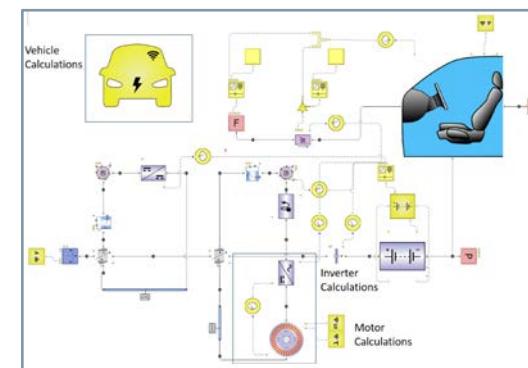
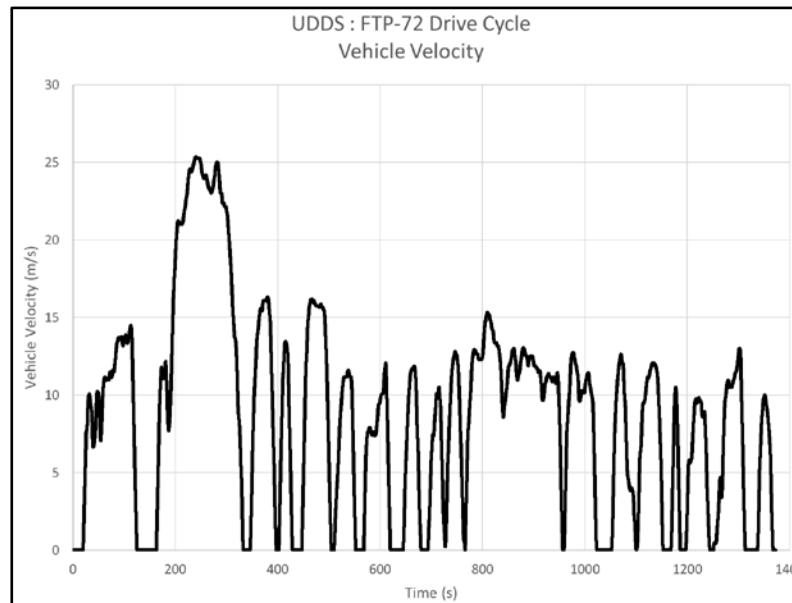
## Automotive Example: UDDS Drive Cycle 汽车案例：城市工况循环

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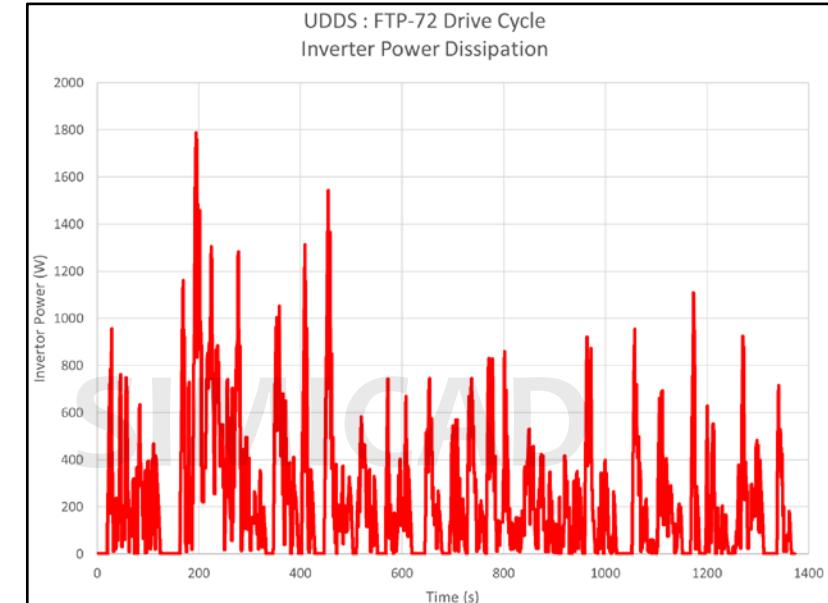
A real-life process can pose challenges for numerical simulations due to complexity and large size and time scale. Model order reduction aims to lower the computational complexity of such problems thus allowing for faster solving while maintaining predictive accuracy in space and time.

受限于复杂度和时间尺度，实时工况很难用数值仿真来描述，而ROM技术可以在保证计算精度的同时，用更快的计算速度来求解这些问题。

### UDDS: FTP-72 Drive Cycle. Velocity vs time for 1372s



Convert Vehicle Velocity to Inverter Power Dissipation (Simcenter Flomaster EV model)  
将车辆速度脉谱转化为逆变器功率脉谱  
Flomaster 新能源汽车模型

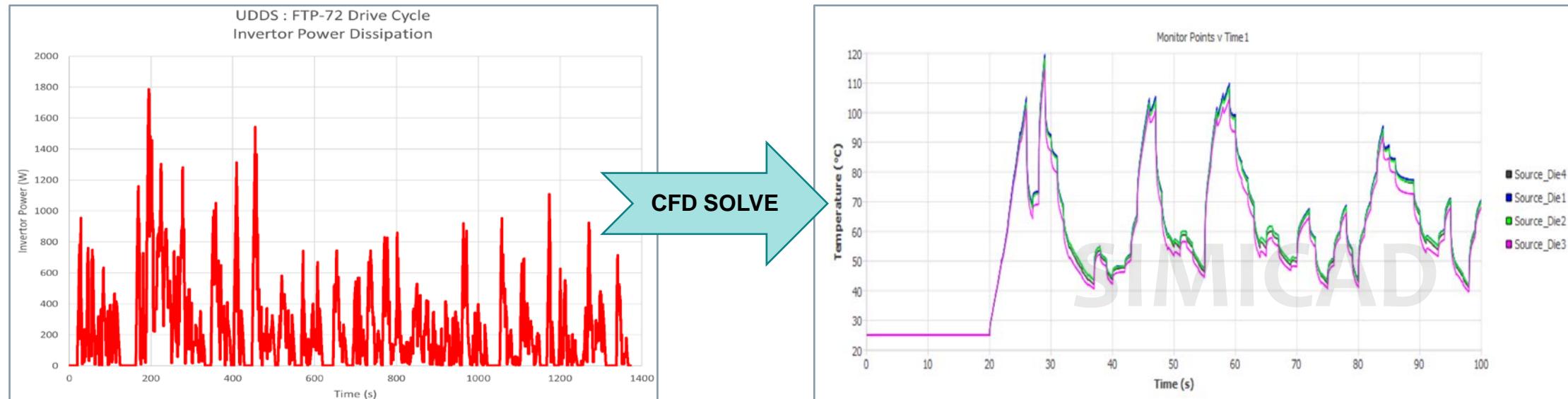


# BCI-ROM: Why?

## Automotive Example: UDDS Drive Cycle 汽车案例：城市工况循环

### UDDS: FTP-72 Drive Cycle

- A very fine time grid is required to calculate directly. The example below uses a uniform time step of 0.05 s. 时间步长要求非常细，下面案例采用的是0.05s。
- Solving only the first 100s required more than 4 days CPU time. The entire cycle would require more than **2 months** of CPU time. 求解前100s就用了4天，整个过程需要2个月。



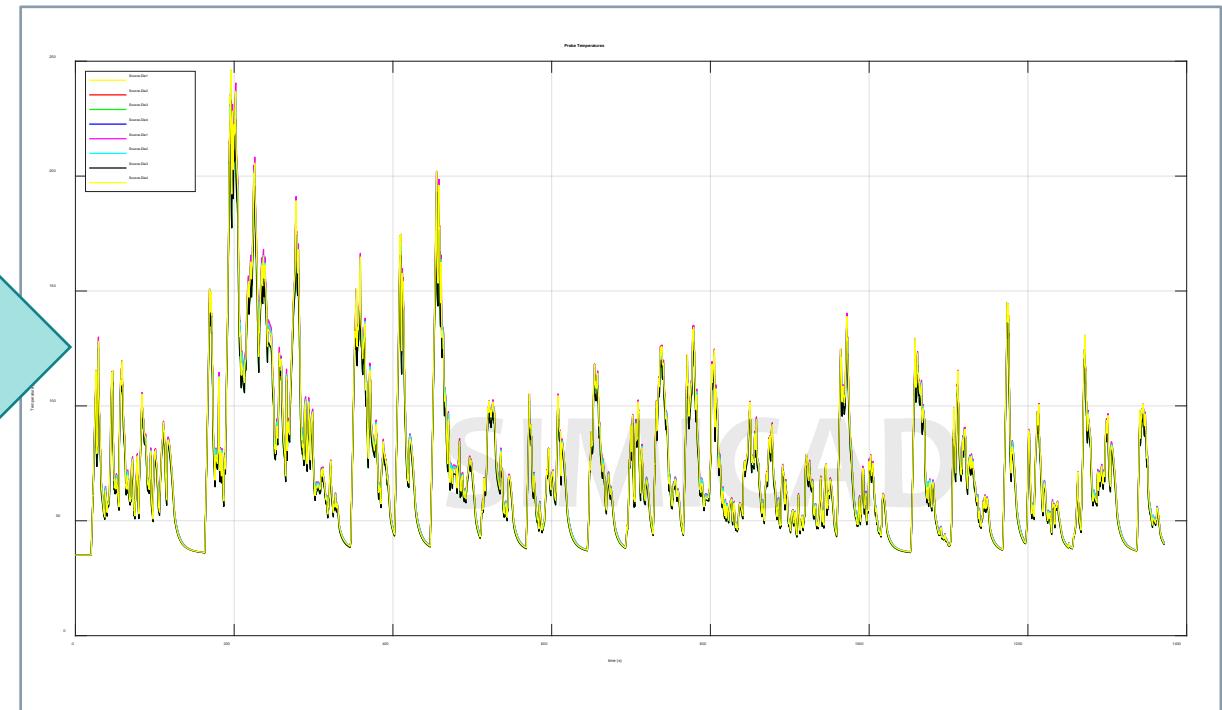
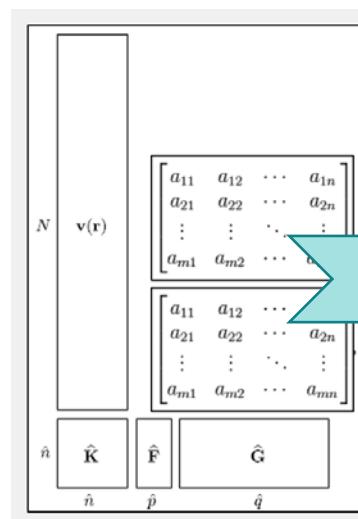
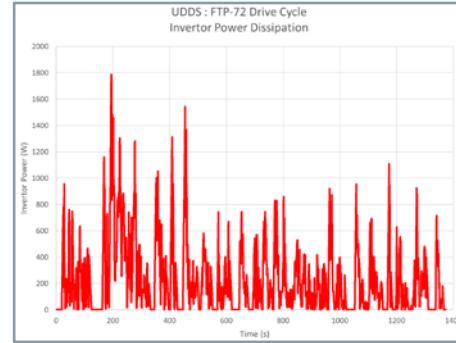
# BCI-ROM: Why?

Automotive Example: UDDS Drive Cycle 汽车案例：城市工况循环

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## UDDS: FTP-72 Drive Cycle

- Solve the ROM with the drive cycle power profile to predict Temperature vs Time for all IGBT chips within 0.5% of direct calculation results. ROM的计算瞬态温度，与直接计算结果误差为0.5%。
- ROM solve time: less than **3 minutes**. ROM求解时间不到3分钟。





# BCI-ROM: How?

## Prerequisites 前决条件

BCI-ROM is a linear, conduction only model: Fluids, radiation, joule heating, temperature dependent BC and specific heat generation rate are not supported.

BCI-ROM是个线性导热模型，不支持流动、辐射、焦耳热、与边界相关的温度和发热率定义。

### Not Supported

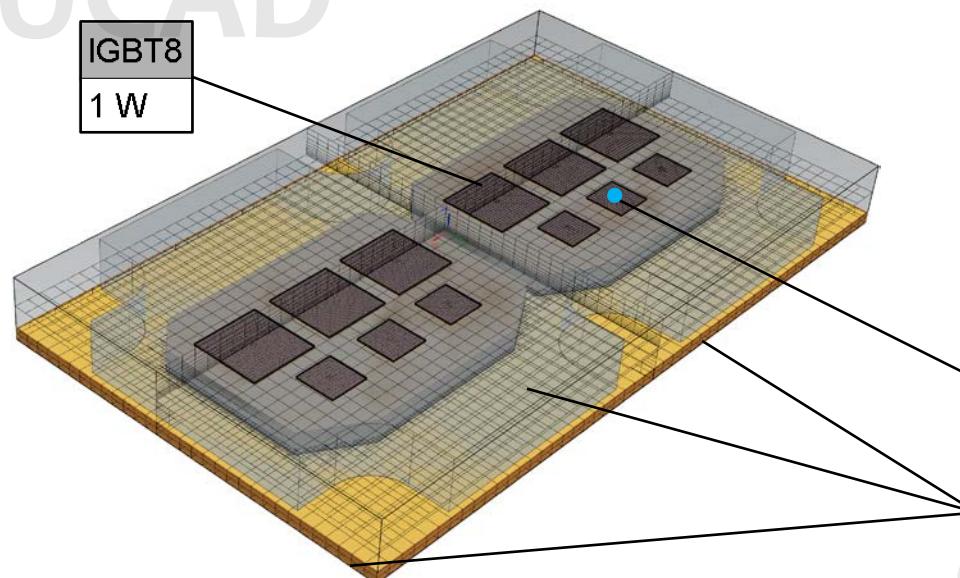


$q \text{ (W/m}^2)$

$Q = f(T)$

$K = f(T)$

$HTC = f(x)$



BCI (Boundary Condition Independent) means that exact values of conditions are not used, only location of sources, point goals, HTC and mesh are used to extract the model. The exact values are defined later when the extracted model is used.

BCI的意思是，提取模型参数只含热源、目标、HTC和网格，边界条件只在模型后续使用时再添加。

### Required



Solid Materials



Heat Source (W)



Point Goals (T)



HTC (W/m<sup>2</sup>/K)

### Optional



Contact Resistance



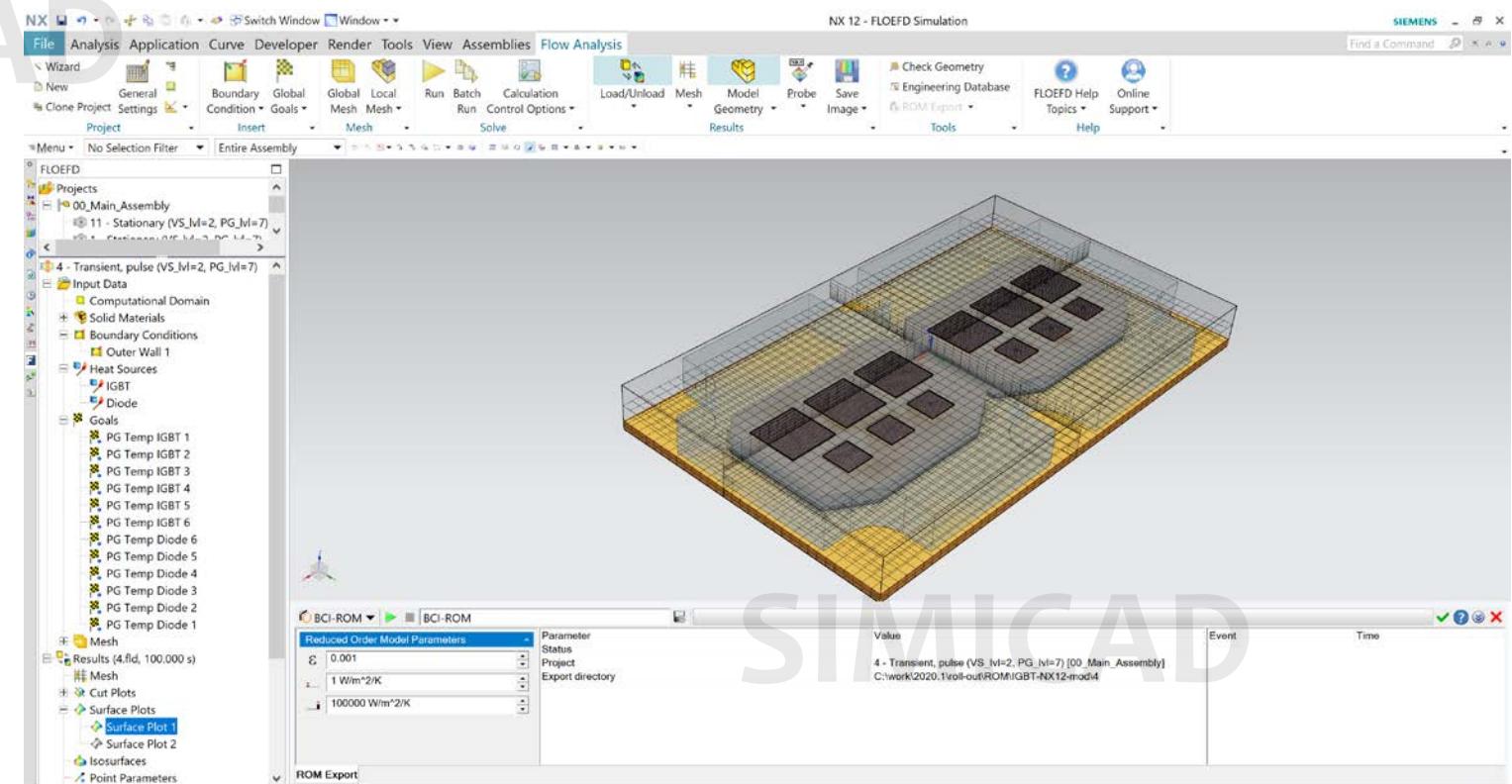
# BCI-ROM: How?

## Workflow 流程

First you extract the ROM model from the 3D definition (conduction only analysis)

首先从3D模型（仅计算导热）中提取ROM模型

- Set materials, goals, sources and HTC BCs  
定义材料，目标，热源和HTC
- Define Mesh 定义网格
- Set ROM settings under Tools, ROM Export
  - Accuracy 精度
  - Minimum HTC HTC最大值
  - Maximum HTC HTC最小值
- Define BCI-ROM folder 路径
- Click Export to run 输出



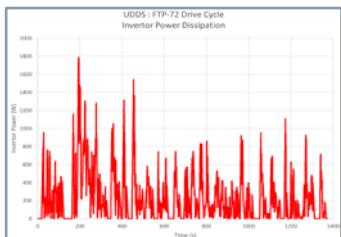
# BCI-ROM: How?

## Workflow 流程

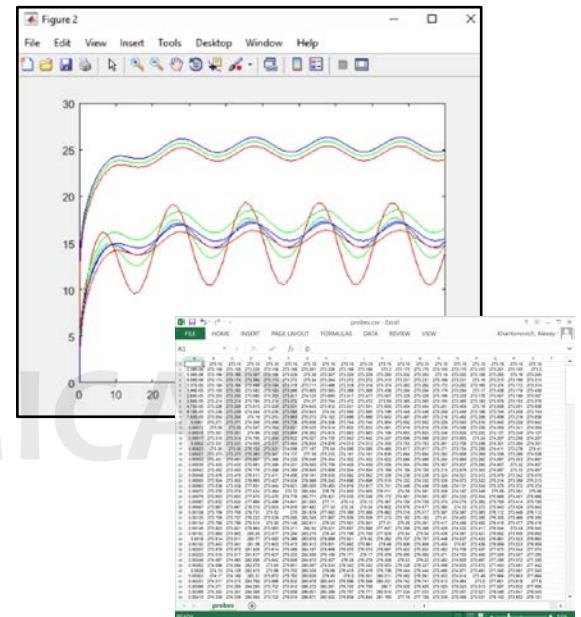
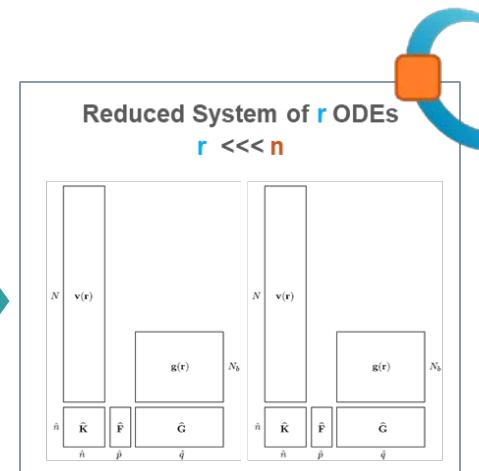
As a results of ROM extraction you get a set of matrices which you can solve with **MATLAB®** or **GNU Octave** software. Specify HTC sets and Power = f(t) and get transient results in seconds  
ROM提取出来的结果为一组矩阵，可以由MATLAB或者GNU Octave软件来求解，定义好HTC和功率脉谱就可以快速获取瞬态计算结果。

- Time (total duration)
- HTC,  $T_{amb}$  exact values
- Initial Temperature
- Heat dissipation for each source as  $W = f(\text{time})$

HTC<sub>TOP</sub> = 10  
HTC<sub>BOTTOM</sub> = 55  
HTC<sub>CUTOFF1</sub> = 2000  
HTC<sub>CUTOFF2</sub> = 500



$$\begin{aligned}P_1 &= A_1 + B_1 \sin(\omega_1 t) \\P_2 &= A_2 + B_2 \sin(\omega_2 t) \\P_3 &= A_3 + B_3 \sin(\omega_3 t) \\&\dots \\P_9 &= A_9 + B_9 \sin(\omega_9 t)\end{aligned}$$

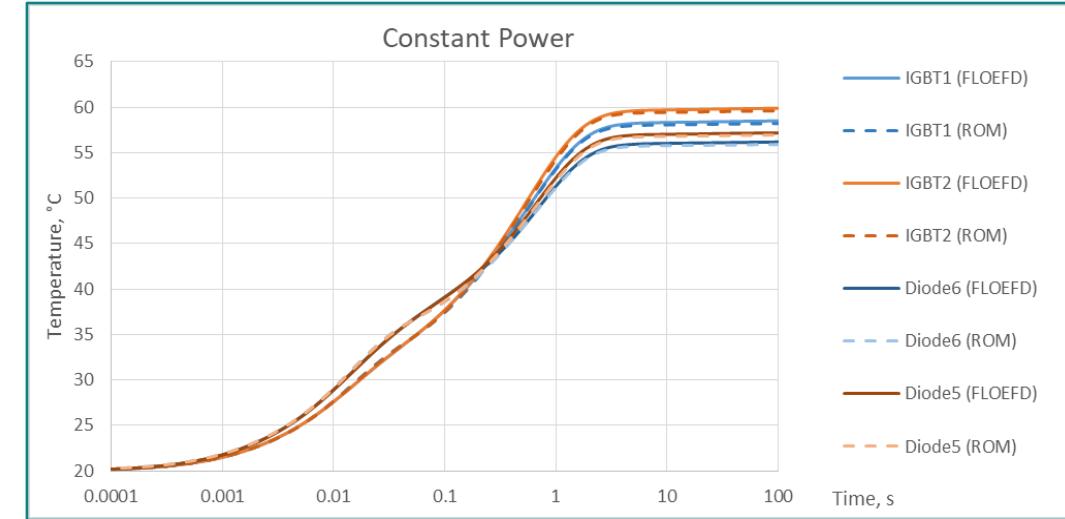
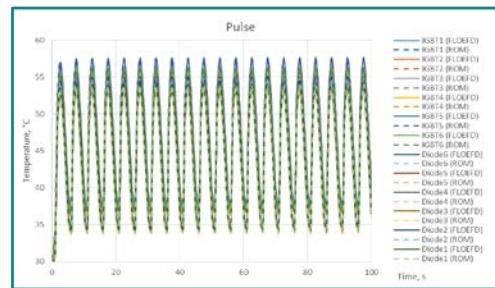
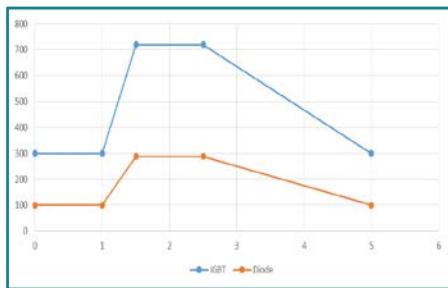
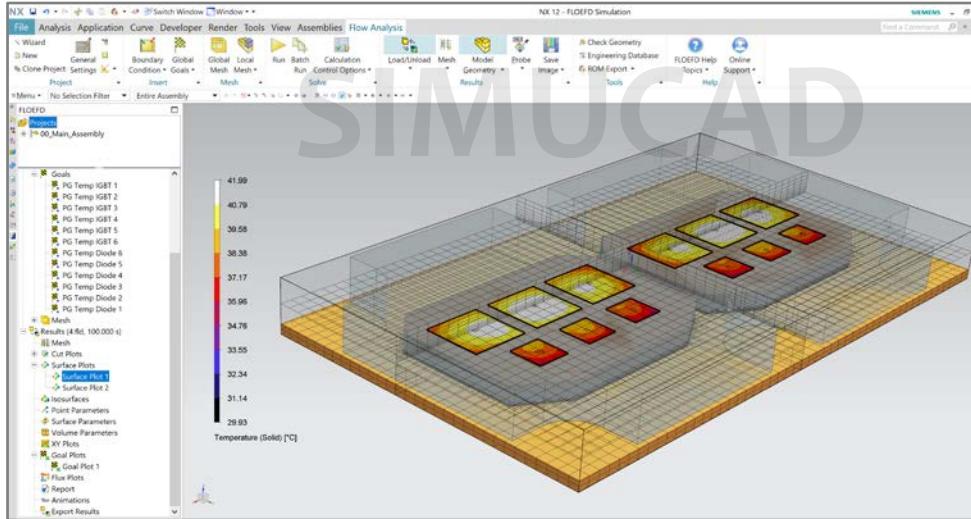




# BCI-ROM: How?

## Results 结果 (与FloEFD直接计算对比)

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Goal Name	Unit	FLOEFD (transient)	Octave (transient)	diff, %
PG Temp IGBT 1	[°C]	58.493	58.176	0.54%
PG Temp IGBT 2	[°C]	59.885	59.632	0.42%
PG Temp IGBT 3	[°C]	57.713	57.366	0.60%
PG Temp IGBT 4	[°C]	57.712	57.365	0.60%
PG Temp IGBT 5	[°C]	59.886	59.632	0.42%
PG Temp IGBT 6	[°C]	58.494	58.176	0.54%
PG Temp Diode 6	[°C]	56.172	55.900	0.48%
PG Temp Diode 5	[°C]	57.181	56.923	0.45%
PG Temp Diode 4	[°C]	55.639	55.293	0.62%
PG Temp Diode 3	[°C]	55.639	55.294	0.62%
PG Temp Diode 2	[°C]	57.181	56.922	0.45%
PG Temp Diode 1	[°C]	56.171	55.898	0.49%

CPU Time	[s]	331
ROM Export (defaults)	[s]	617
ROM Solve (Octave)	[s]	1.1

The BCI-ROM extraction method is an extension of the FANTASTIC method pioneered by Prof. Lorenzo Codecasa. The literature below generally describes the method and presents several validation examples. 此方法由Lorenzo Codecasa教授首创，下面是相关论文。

- 1. L. Codecasa, D. D'Amore, and P. Maffezzoni, "Parameters for multi-point moment matching reduction of discretized thermal networks", in Proc. IEEE THERMINIC, 2002, pp. 151-154.
- 2. L Codecasa, V d'Alessandro, A Magnani, N Rinaldi, PJ Zampardi, "Fast novel thermal analysis simulation tool for integrated circuits (FANTASTIC)", 20th International Workshop on Thermal Investigations of ICs and Systems (THERMINIC) article 6972507 United Kingdom, 2014.
- 3. Lorenzo Codecasa, Vincenzo d'Alessandro, Alessandro Magnani, Niccolò Rinaldi, "Matrix reduction tool for creating boundary condition independent dynamic compact thermal models", Thermal Investigations of ICs and Systems (THERMINIC) 2015 21st International Workshop on, pp. 1-5, 2015.
- 4. JHJ Janssen, L Codecasa, "Why matrix reduction is better than objective function based optimization in compact thermal model creation", Thermal Investigations of ICs and Systems (THERMINIC) 2015 21st International Workshop on, pp. 1-6, 2015.

- BCI-ROM technology allows linear conduction problems with any number of heat sources to be solved with the same accuracy as the full 3D conduction model up to **40000** times faster.

BCI-ROM技术能在保持与3DCFD模型精度相同的前提下求解多热源的线性导热问题，且速度提高40000倍。

- BCI-ROM is a linear and conduction only model: fluids, radiation, joule heating, specific heat generation rate and temperature dependent material properties are not supported.

BCI-ROM只是个线性导热模型，不支持流体、辐射、焦耳热、与材料属性相关的温度和发热量定义。

- BCI (Boundary Condition Independent) means that exact values of conditions are not used, only location of sources, point goals, HTC and mesh are used to extract the model. The exact values are defined later when the extracted ROM model is used.

边界条件无关是指只提取热原位置、目标、HTC和网格，而边界条件值在后续ROM使用过程中再定义。

- You extract BCI-ROM from 3D definition: specify the range of HTCs and the relative accuracy of the model. **导出BCI-ROM的3D设置：定义HTC值范围和相对精度。**

- The extracted matrices can be solved with MATLAB or freeware GNU Octave tools providing you transient results in seconds. **导出的模型（矩阵）可以由MATLAB或者GNU Octave软件快速求解。**

- BCI-ROM is available in the “BCI-ROM and Package Creator” or “Electronics Cooling Center” license modules, and in the “Ultra” license.

**BCI-ROM功能需要BCI-ROM and Package Creator或者Electronics Cooling Center模块支持。**

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Thermal Netlist  
热网列表

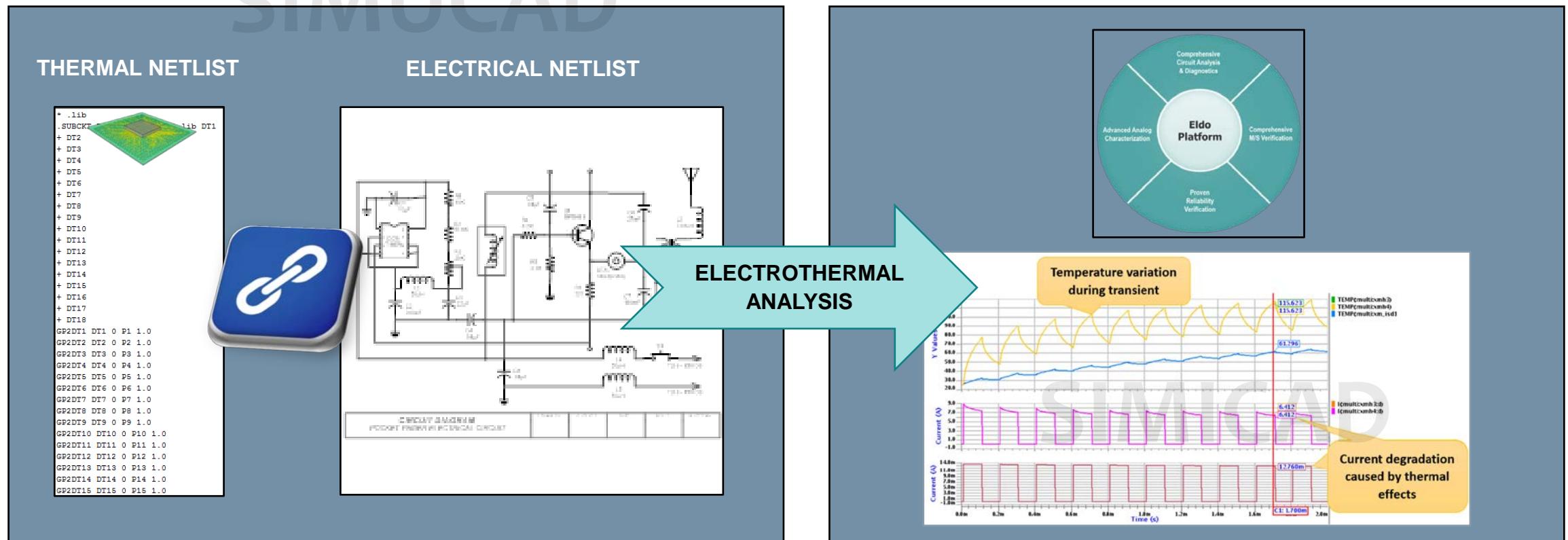
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# Thermal Netlist Extraction 热网列表提取

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Using ROM you can convert a 3D task into a thermal netlist (in SPICE \*.sp format) which can be used by an electro-thermal system simulation tool such as Mentor Eldo®, SystemVision®.

用ROM可以将3D任务转化为热网列表（SPICE\*.sp文件），提供给电热系统仿真工具，如Mentor Eldo , SystemVision。



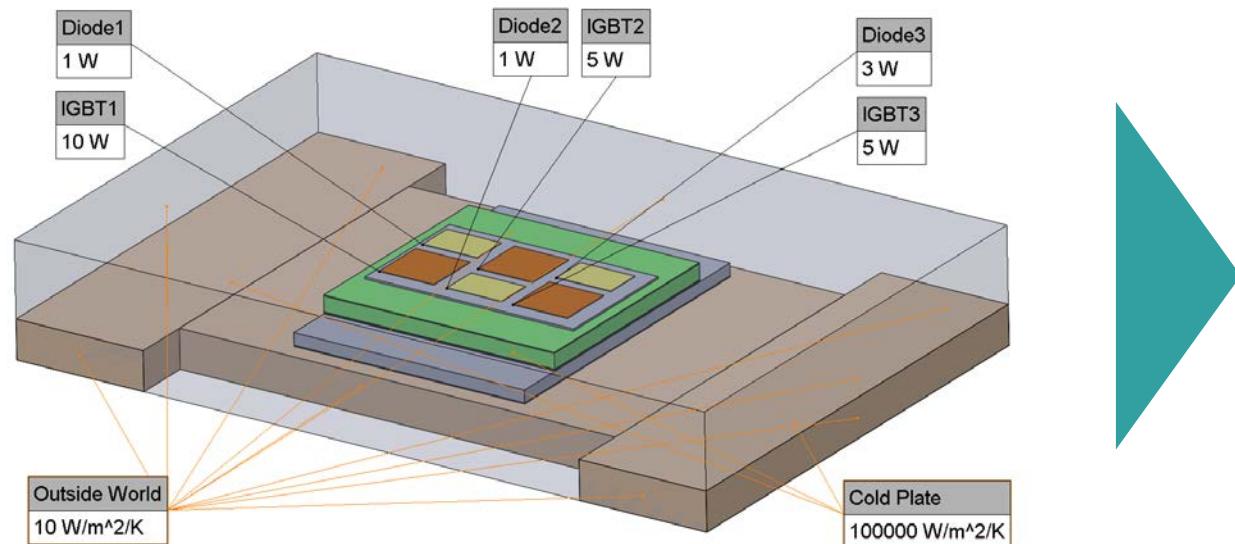
# Thermal Netlist Extraction 热网列表提取

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The thermal netlist extraction feature uses exactly the same method as the BCI-ROM calculation, however the thermal netlist is valid only for the boundary conditions in the original 3D model. 热网列表提取采用的方法是跟BCI-ROM一样，不同的是只能针对边界条件可用。

So the resulting thermal netlist is created for the **exact** boundary conditions you specified in Simcenter FLOEFD. Goals are not required.

产生的热网列表只包含FloEFD里定义的**确切的**边界条件，不需要目标。



```
Thermal_Netlist.sp
1 * .lib
2 .SUBCKT thermalRC P_Diodel
3 + P_Diode2
4 + P_Diode3
5 + P_IGBT1
6 + P_IGBT2
7 + P_IGBT3
8 GP2DT1 P_Diodel 0 S_Diode2 0 1.0
9 GP2DT2 P_Diode2 0 S_Diode2 0 1.0
10 GP2DT3 P_Diode3 0 S_Diode3 0 1.0
11 GP2DT4 P_IGBT1 0 S_IGBT1 0 1.0
12 GP2DT5 P_IGBT2 0 S_IGBT2 0 1.0
13 GP2DT6 P_IGBT3 0 S_IGBT3 0 1.0
14 GDT2P1 0 S_Diodel P_Diodel 0 1.0
15 GDT2P2 0 S_Diode2 P_Diode2 0 1.0
16 GDT2P3 0 S_Diode3 P_Diode3 0 1.0
17 GDT2P4 0 S_IGBT1 P_IGBT1 0 1.0
18 GDT2P5 0 S_IGBT2 P_IGBT2 0 1.0
19 GDT2P6 0 S_IGBT3 P_IGBT3 0 1.0
20 Cn1 0 n1 1
21 Cn2 0 n2 1
22 Cn3 0 n3 1
23 Cn4 0 n4 1
24 Cn5 0 n5 1
25 Cn6 0 n6 1
26 Cn7 0 n7 1
27 Cn8 0 n8 1
28 Cn9 0 n9 1
29 Cn10 0 n10 1
30 Cn11 0 n11 1
31 Cn12 0 n12 1
32 Cn13 0 n13 1
33 Cn14 0 n14 1
34 Cn15 0 n15 1
Ln: 49 Col: $Windows (CR LF) UTF-8 IN .all
```



# Thermal Netlist Extraction: How?

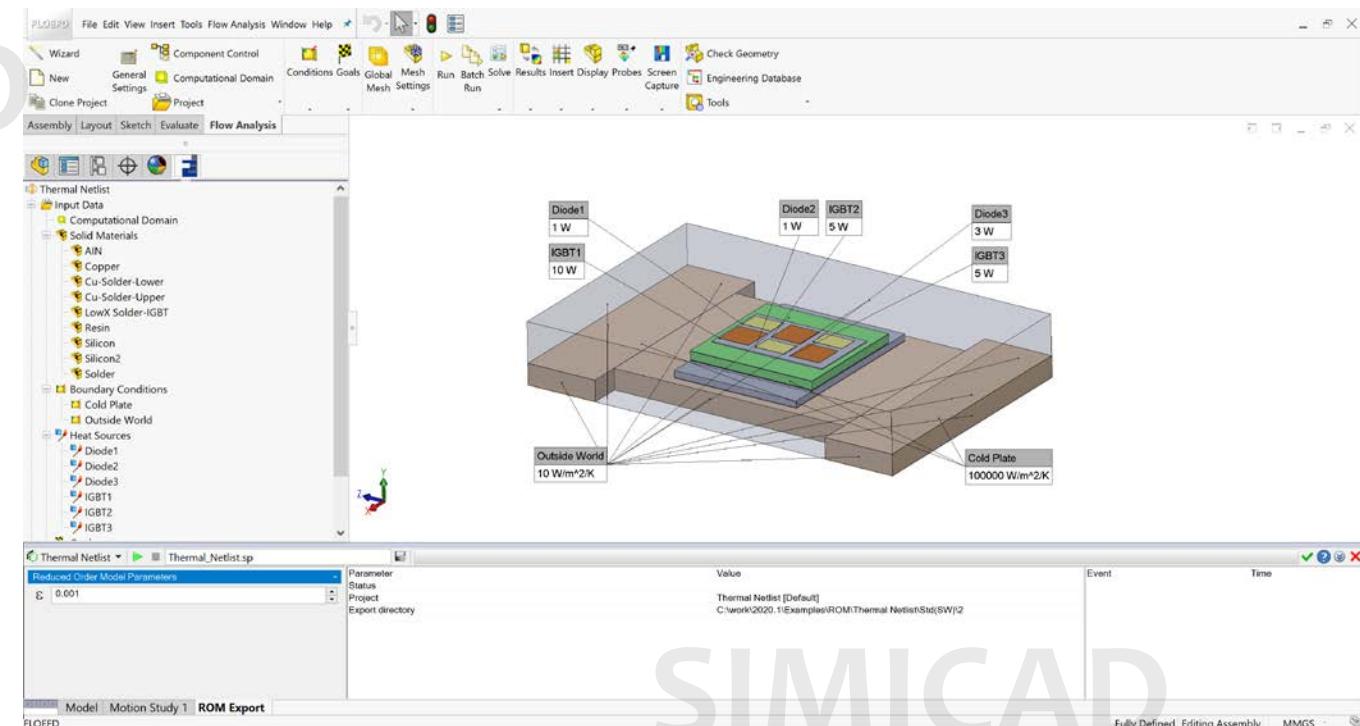
## Workflow 流程

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First you extract the ROM model from the 3D definition (conduction only analysis)

首先按照ROM的方法提取模型

- Set materials, sources and HTC BCs
- Define Mesh
- Open **Tools, ROM Export**
- Select **Thermal Netlist** and set
  - Accuracy
- Set folder, file name and
- Click **Run** to export



Before we can run an electro-thermal simulation, the thermal and electrical netlists must be linked. 运行电热仿真之前，必须先建立电网列表和热网列表之间的连接。

# Thermal Netlist Extraction: How?

## Workflow 流程

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### How to link thermal and electrical netlists (based on Mentor Eldo example):

1. Open the electrical netlist file (\*.cir) in any text editor and link to the thermal netlist file (\*.sp) by using .include command:

```
.include Thermal_Netlist.sp
```

2. Declare thermal nodes on subcircuits in your system to monitor temperatures of electrical components.

Example file contains only two subcircuits, “BJT” and “DIO”, hence:

```
.tempnode subckt=BJT thnode=thn  
.tempnode subckt=DIO thnode=thn
```

3. Thermal heat sources and electrical components must be interconnected.

```
xth MODEL: thermalRC PIN: P_Diode1=Xdio1.thn P_IGBT1=Xbjt1.thn  
.OPTION XBYNAME
```

4. Check that electrothermal simulation mode is set to 2:

```
.option etmode=2
```

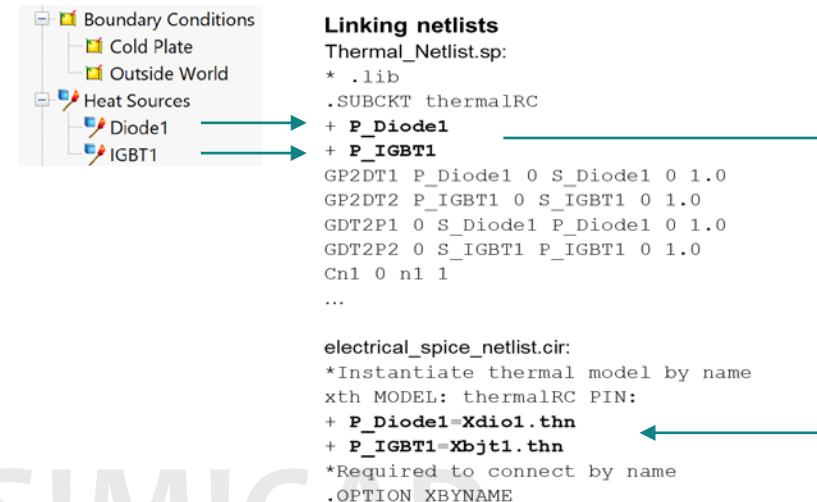
5. To store temperatures and powers of all devices, following command can be used:

```
.probe tran temp(*) pow(*)
```

6. To store the temperature and power data as CSV files:

```
.printfile TRAN temp(xbjt*) file=temp_file_electrothermal.csv  
.printfile TRAN temp(xdio*) file=temp_file_electrothermal.csv  
.printfile TRAN pow(xbjt*) file=pow_file_electrothermal.csv  
.printfile TRAN pow(xdio*) file=pow_file_electrothermal.csv
```

7. Now save both the .cir and the .sp files, and place them in the same folder. These files are now linked, and ready to be solved.



In Simcenter FLOEFD “Diode1” is represented as “P\_Diode1” in the thermal netlist. Thus “P\_Diode1” needs to be connected with the diode “Xdio1” in the electrical circuit. Same for “IGBT1”

# Thermal Netlist Extraction

## Overview 总结概要



- You can convert a full 3D conduction-only analysis into a thermal netlist (.sp format) using ROM technology. 可以使用ROM技术将3D导热分析模型转化为热网列表 ( .sp文件 )。
- Thermal netlist can be used by a electro-thermal system simulation tool such as Mentor Eldo®, SystemVision or other SPICE software.  
热网列表文件可以提供给热电系统仿真软件使用 ( 如Mentor Eldo , SystemVision或者其他SPICE软件 )。
- The extracted thermal netlist is created for the exact boundary conditions you specified. So unlike BCI-ROM, the thermal netlist is BC dependent.  
热网列表是依据确切的边界条件定义提取出来的，所以与BCI-ROM不同，他是与边界条件有关。
- This thermal netlist must be linked to an electrical netlist prior to electro-thermal analysis by adjusting the electrical list. 在电热仿真之前，需要通过修改电网列表来建立热网列表和电网列表的连接。
- Thermal Netlist extraction is available in the “BCI-ROM and Package Creator” or “Electronics Cooling Center” modules, and with the “Ultra” license. 需要特定模块license支持。

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Package Creator  
封装模型生成器

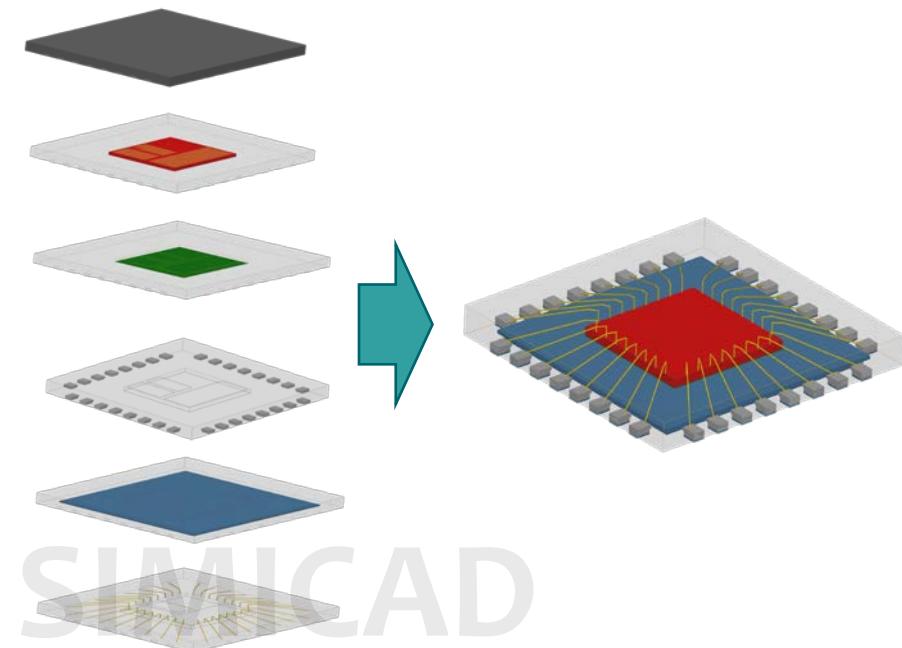
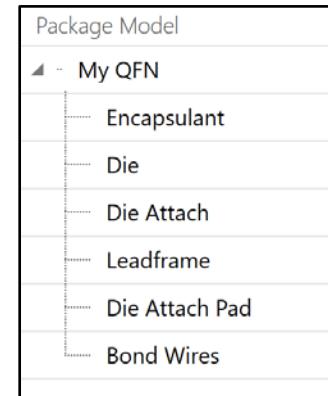
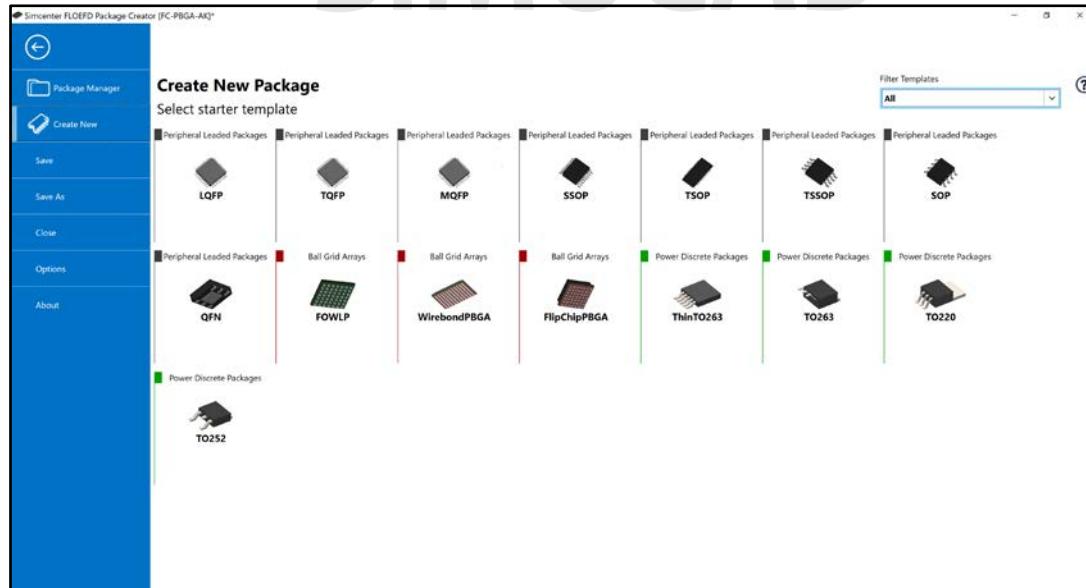
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# Package Creator

## 封装模型生成器

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A Package Creator tool specializes in the rapid creation of thermal models of electronic packages for use in Simcenter FLOEFD. 专业的快速生成包含详细几何结构的封装器件热模型。

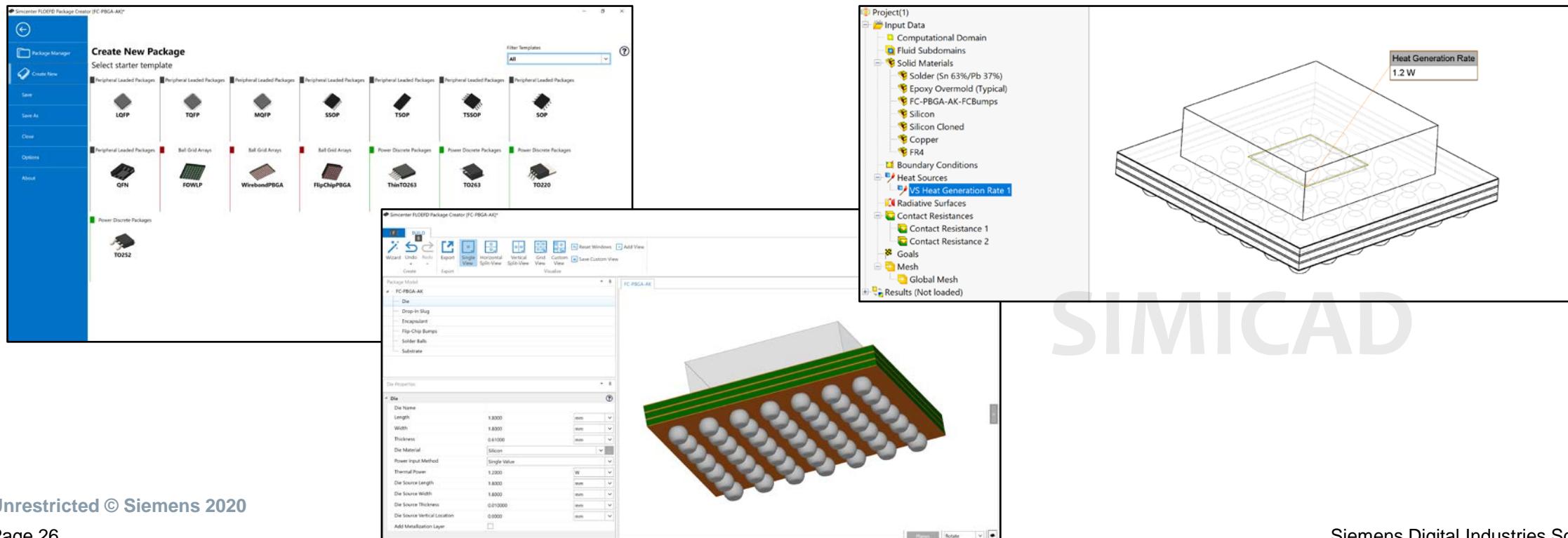


# Package Creator: How?

## Workflow 流程

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Starting from a template, you adjust geometric, material and thermal characteristics (thermal resistance, power) of your package. Then you create the package and put it into the library (as xml based file in XTXML format). Finally you import the package into Simcenter FLOEFD.  
由模板开始，定义几何、材料和特性参数（热阻、功率），然后创建封装模型并保存入数据库（基于xml格式的XTXML文件），最后将模型导入Simcenter FLOEFD。





# Package Creator

## Overview 总结概要



- The Package Creator tool specializes in the rapid creation of thermal models of electronic packages for use in Simcenter FLOEFD. 专业快速生成封装器件热模型供FloEFD使用
- Starting from a template you adjust geometric, material and thermal characteristics (thermal resistance, power) of your package, then create a package in XTXML format which you can import into Simcenter FLOEFD with the “PDML and XML Import” command.  
从模板开始，定义封装器件的几何、材料及热特性（热阻、功率），生成XTXML文件并通过PDML and Import功能导入Simcenter FLOEFD
- “PDML and XML Import” can also import ECXML - a general format to exchange data between thermal analysis tools. PDML and XML Import也可以导入ECMEL文件（热仿真软件通用文件格式）
- The resulting model in Simcenter FLOEFD is a detailed representation, so no two-resistor or network assembly compact models are created. 模型是详细的，所以不存在双热阻或热阻网络
- Package Creator is available in the “BCI-ROM and Package Creator” or “Electronics Cooling Center” modules, and with the “Ultra” license. ECXML import is license free.  
Packg Creator需要相关模块license，ECXML导入是免费的

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Electrical Element  
电学元件

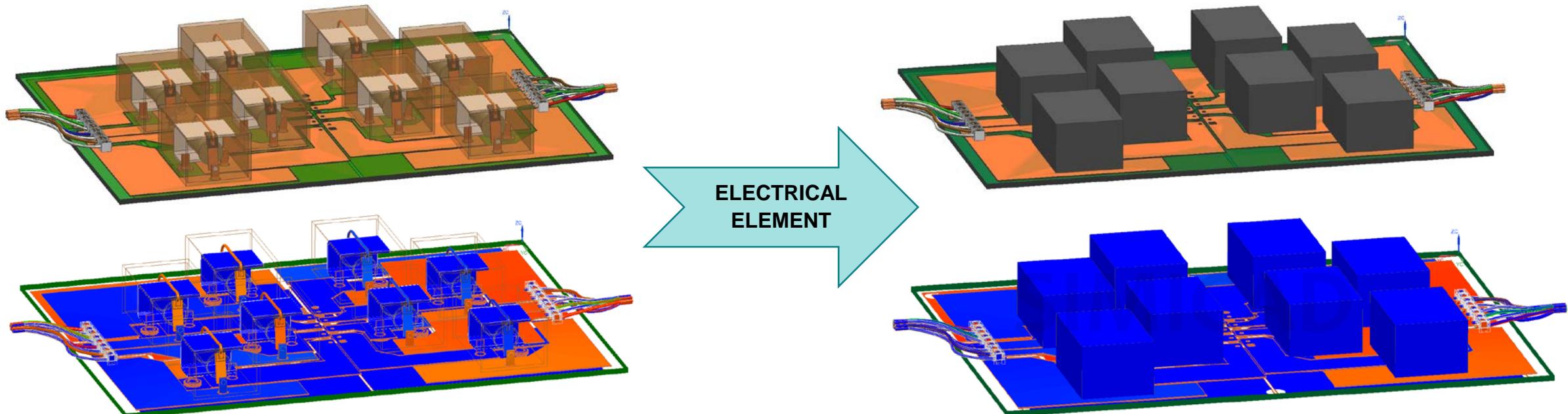
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# Electrical Element 电学元件

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A thermo-electrical compact model allows the addition of a component into a DC electro-thermal calculation by the given component's electrical resistance. The corresponding Joule heat is calculated and applied to the body as a heat source so you don't need to have a detailed model of a component to take it into account in the electro-thermal DC calculation.

电热压缩模型可以通过定义元件电阻的方式来引入元件给直流电热计算。相应的焦耳热会自动计算，并以体热源的方式附加到体上，所以不需要元件的详细几何模型了。



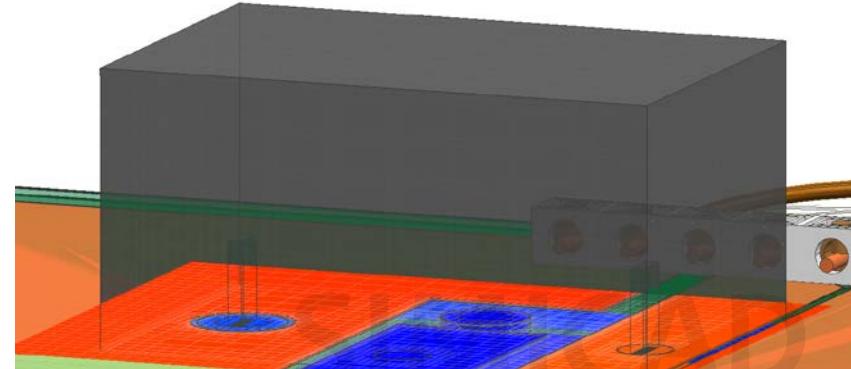
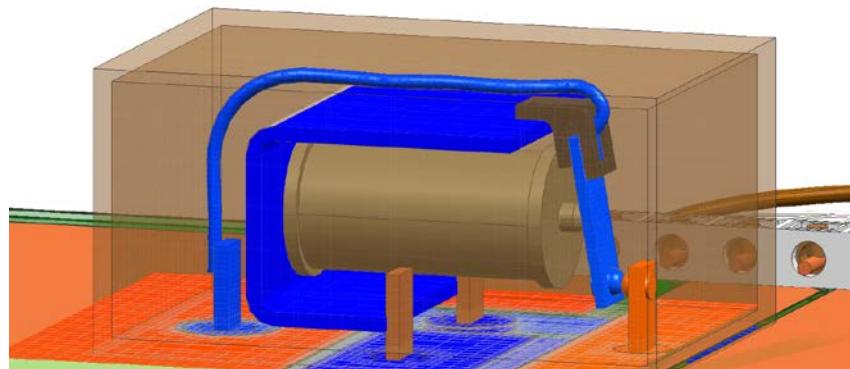
Relay components are replaced with Electrical Element compact model providing the same DC results of the board  
电学元件取代继电器并提供相同的直流电流结果

# Electrical Element: Why?

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In DC simulation, the circuit often can contains elements whose internal detailed structure is not known or is too complex for direct modeling of the electrical circuit. However the total electrical resistance of such elements is known. In that case use of an Electrical Element allows you to close the circuit with the correct electrical resistance and take into account the Joule heat dissipated.

在直流仿真中，电路中通常会包含内部结构复杂且未知（或难以建模）的元件，但它们的总电阻是已知的。这种情况下，使用电学元件通过定义电阻便可使电路闭环，并计算其焦耳热。



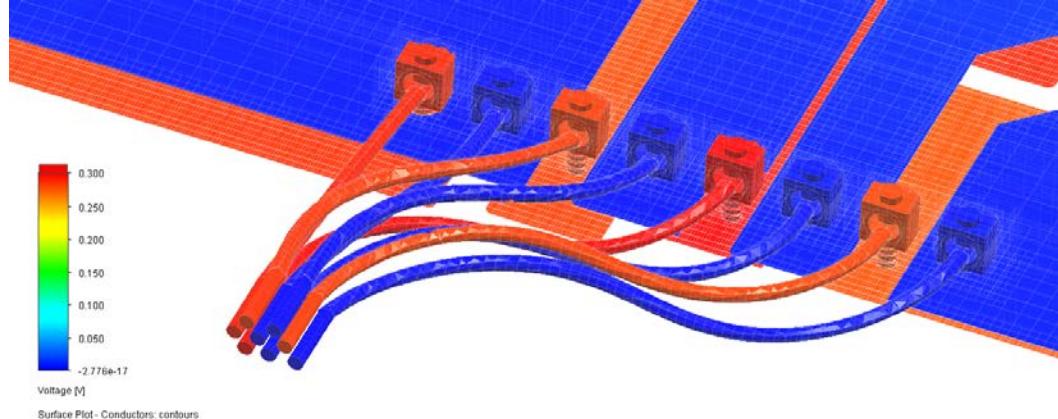
Detailed relay is replaced by compact model.  
电学压缩模型取代详细结构的继电器

# Electrical Element: Why?

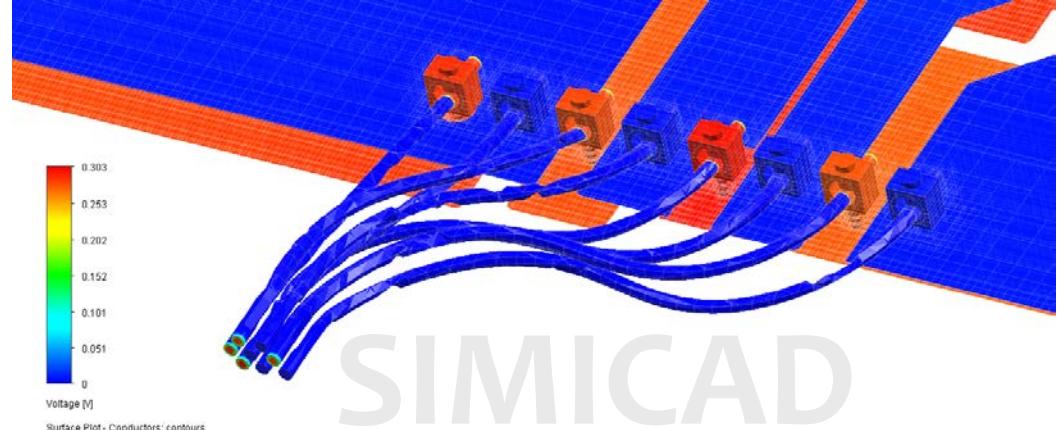
**SIEMENS**  
Ingenuity for life

The conductors require a good mesh to ensure that the correct cross-sectional area is captured and therefore that the Joule heating simulation is accurate. The Electrical Element compact model allows you to reduce mesh requirements for conductors while maintaining electrical and thermal accuracy.

导体（导线）通常要求很精细的网格来确保截面形状的准确，进而保证焦耳热计算的准确性。电学元件的使用，可以在保证电热计算精度的同时，摆脱网格精细度的限制。



Direct simulation 直接仿真



Electrical Element Compact model simulation 电学元件

Electrical element (right) defined for wires requires less mesh for wire resolution while keeping the same accurate electrical results

# Electrical Element: How?

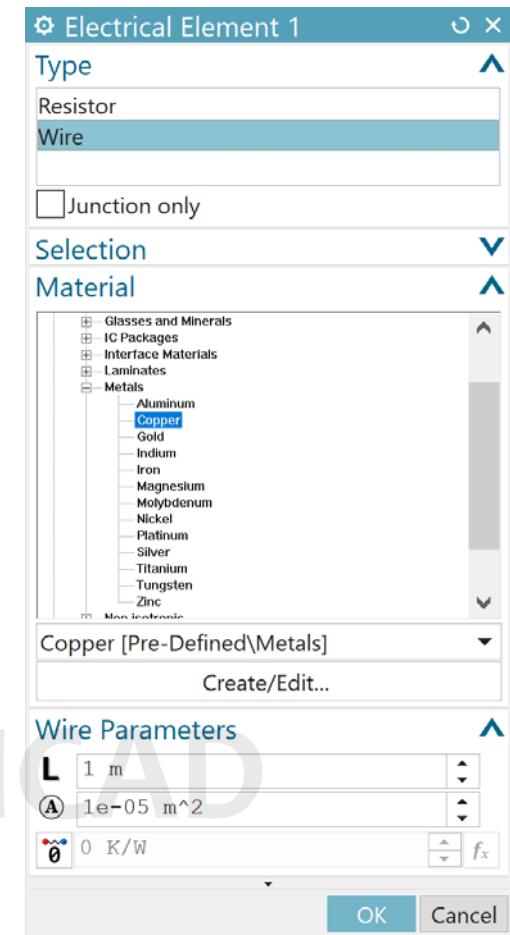
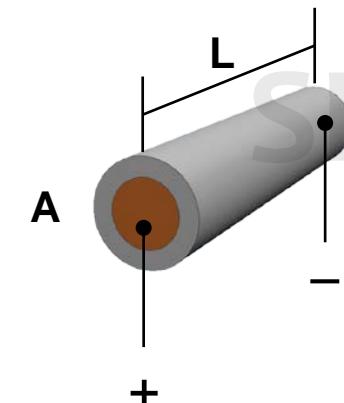
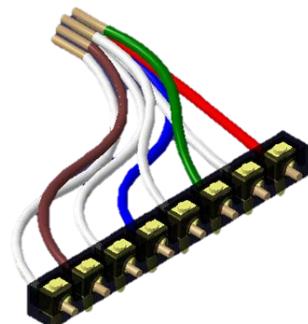
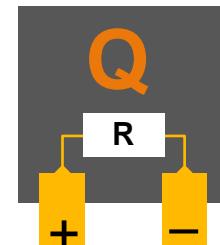
**SIEMENS**  
Ingenuity for life

A new Electrical Element condition can be of several types:

电学元件包含如下种类：

- A **Resistor** element uses the total electrical resistance specified between 2 contacts and dissipates the calculated joule heat uniformly inside the bodies selected to represent the element.  
电阻器：在两个接触之间定义总阻值，焦耳热自动计算并平均赋值在所选几何体上
- A **Wire** element is similar to a resistor with automatic calculation of the electrical resistance based on a wire's conductor material, length and cross sectional area, and optionally you can specify the thermal resistance of the wire's insulator.

导线：原理与电阻器类似，通过定义材料、长度和截面积自动计算电阻，同时还可以定义绝缘侧的热阻值。

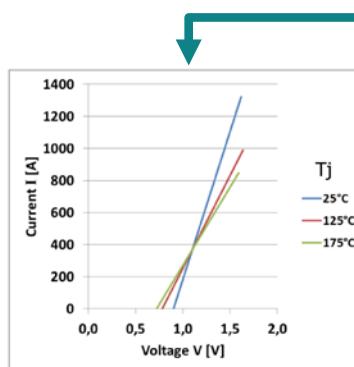




# Electrical Element: How?

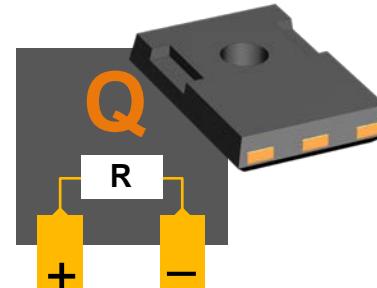
In addition, you can define an electrical Joint. **连接器**

- A **Joint element** virtually (no connector body is used) connects two faces and closes the circuit with the specified electrical resistance. The dissipated heat is not applied to any body but can be taken into account as a **Joule heat** feature goal and used for definition of a more complex electrical device. **连接器**：虚拟元件（不需要实体模型），通过定义电阻可连接两个不接触的面来闭合电路。其产生的焦耳热不赋予任何实体，但可以考虑进焦耳热目标，进而用来定义更复杂的电学控制条件。  
For example, you can use the **Joule heat** as a power for the two-resistor model representing a device whose Junction temperature impacts the resistance of the Joint element.  
例如，可以用此焦耳热来表征某个器件双热阻模型的热功率，而该器件的结温会影响此连接器的热阻。



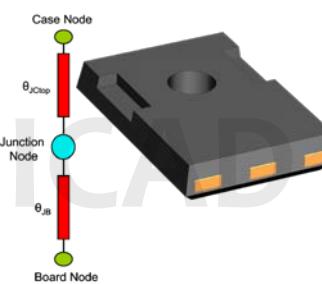
I-V Curves. Use Parameters to set R as  $f(T)$

$$R = f(T)$$



Electrical Element (EE)  
for electrical circuit

$$Q = f(R)$$



Two-resistor for thermal  
definition of the device

$$T_j$$

Junction T

- Electrical Element is a thermo-electrical compact model which allows the addition of a component into a DC electro-thermal calculation by the given component's electrical resistance.  
**电学模型是一个可通过定义电阻的方式引入直流电热计算的电热压缩模型。**
- Electrical Element allows you to close the circuit with the correct electrical resistance and take into account the Joule heat dissipated. **电学元件用户通过定义热阻来闭合电路并计算相应焦耳热。**
- You can use Electrical Element to minimize computational mesh requirements for electrical conductors while maintaining the accuracy of the electrical simulation.  
**电学元件能在保证电学仿真精度的同时，降低对导体网格精度的要求。**
- There are three types of Electrical Element: Resistor (user-defined resistance with lumped model for joule heat dissipation), Wire (same as Resistor but the electrical resistance is calculated from the wire characteristics) and Junction (closes electrical circuit with specified resistance).  
**一共有三种电学元件：电阻器，导线和连接器。**
- Electrical Element is available in the “Power Electrification” or “Electronics Cooling Center” modules, and with the “Ultra” license. **电学元件需要特定模块的license支持。**

# SIMUCAD

## Battery Model Extraction 电池模型提取

# SIMICAD

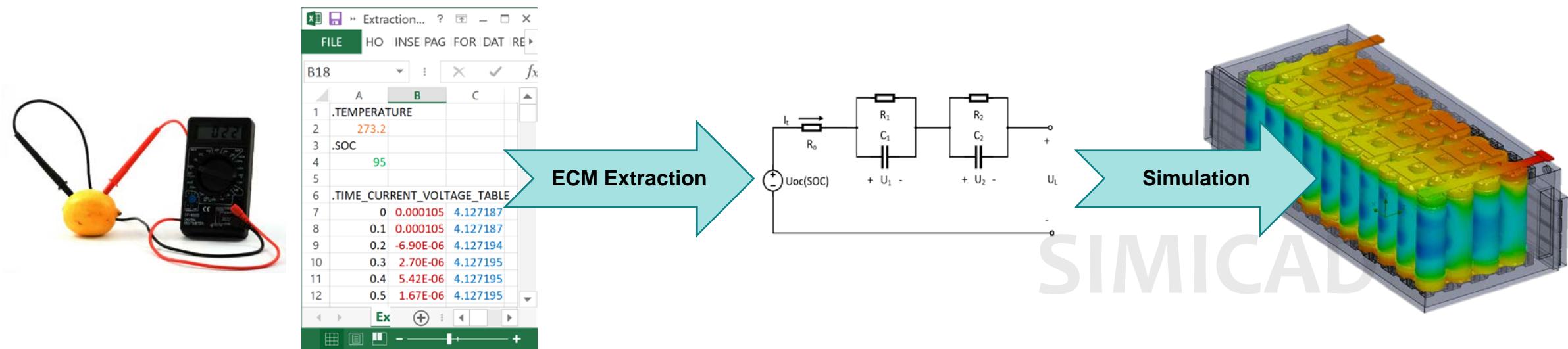
# Battery Model Extraction

## 电池模型提取

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Simcenter FLOEFD can simulate battery packages using electro-thermal Equivalent Circuit Model (ECM) and Electro-Chemical Thermal Model (ECTM). The new battery model extraction capability can get ECM parameters from experimental data. In addition, ECM of 3<sup>rd</sup> order and multi-edit is now possible.

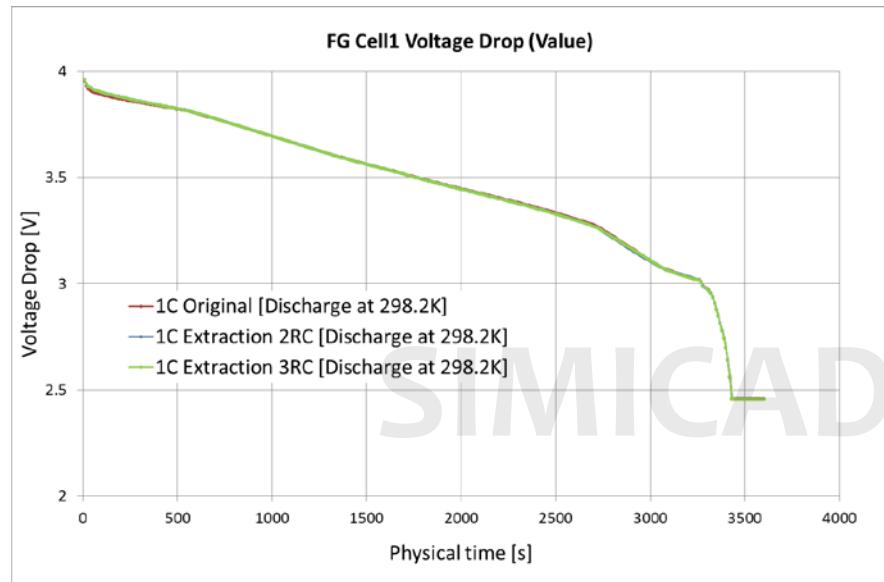
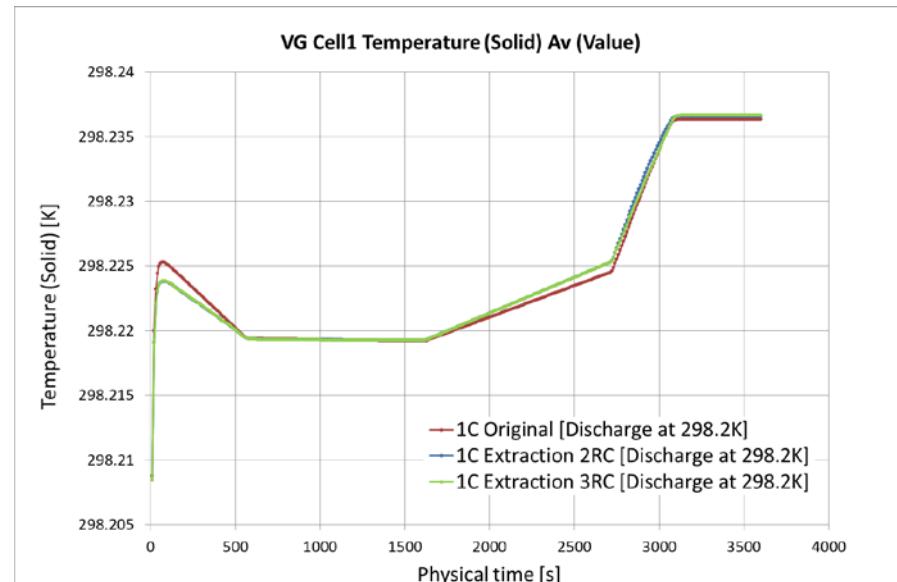
Simcenter FLOEFD通过等效电路模型（ECM）和电化学热模型（ECTM）来模拟电池包，新的模型提取功能可从实验数据提取ECM参数。另外，还增加了三阶等效电路模型和批量编辑功能。



# Battery Model Extraction: Why?

With the variety of battery cells today it can be challenging to find parameters describing your particular cell as a compact model. However conducting a simple experiment can be possible. Extraction of battery compact model from the measurement data solves the challenge of getting the correct compact definition of a battery cell thus providing high accuracy of battery cell electro-thermal simulation.

当今电池种类繁多，使用通用的压缩模型来描述用户特定的电池有一定困难，但对电池进行简单试验还是可行的。电池模型提取功能便解决了这个问题，通过提取实验数据来生成电池模型，提高电池的电热仿真精度。



# Battery Model Extraction: How?

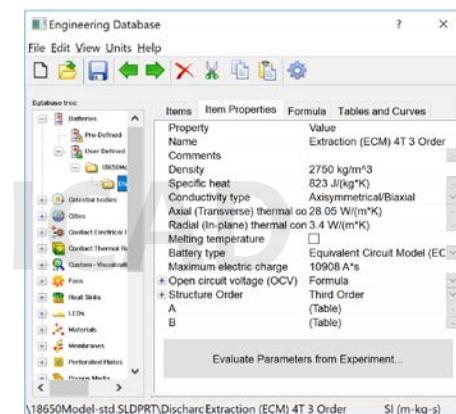
- Conduct battery cell experiment and record the **Voltage**(time) and the **Current**(time) data for various **Temperature** and **SOC**.
- Format the data in CSV in the following way:

```
.TEMPERATURE,,  
273.2,,  
.SOC,,  
95,,  
,,  
.TIME_CURRENT_VOLTAGE_TABLE,,  
0,0.000104522,4.127187244  
0.1,0.000104522,4.127187244
```

注意数据格式！

- In the Engineering database define SOC, select to use 2<sup>nd</sup> or 3<sup>rd</sup> order for ECM then click “Evaluate Parameters from Experiment”.  
**在工程数据库定义SOC，选择二阶或三阶模型，导入数据**
- In the Open dialog point to the CSV file with measurement data:  
The software conducts a search and fills equivalent resistor and capacitance (R, C) as well as non-linearity (A,B) parameters for different Temperatures and SOCs.

**软件会自动搜索并录入电阻、电热和不同温度及SOC的非线性参数。**



# Battery Model Extraction

## Overview



- Simcenter FLOEFD can simulate battery packages using electro-thermal Equivalent Circuit Model (ECM) and Electro-Chemical Thermal Model (ECTM).  
Simcenter FLOEFD的电池包模型包括等效电路模型（ECM）和电化学模型（ECTM）
- The battery extraction capability can get ECM parameters from the experimental data, so the compact model corresponds to your particular battery cell.  
电池模型提取功能可以从实验数据提取ECM参数，似的生成的电池模型能准确表征用户特定的电池特性。
- ECM of 3rd order and multi-edit for cells are now possible. 三阶等效电路模型和批量编辑功能
- Battery model is available in the “Power Electrification” module, and with the “Ultra” license.  
需要特定模块的license支持。

# SIMUCAD

## Other Improvements 其他改进

# SIMICAD

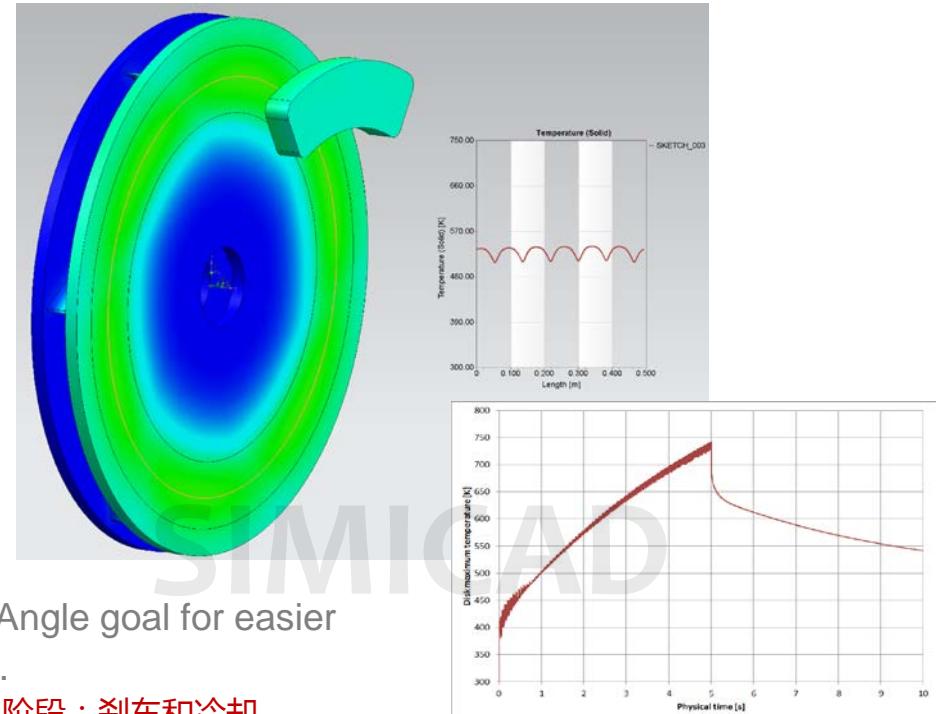
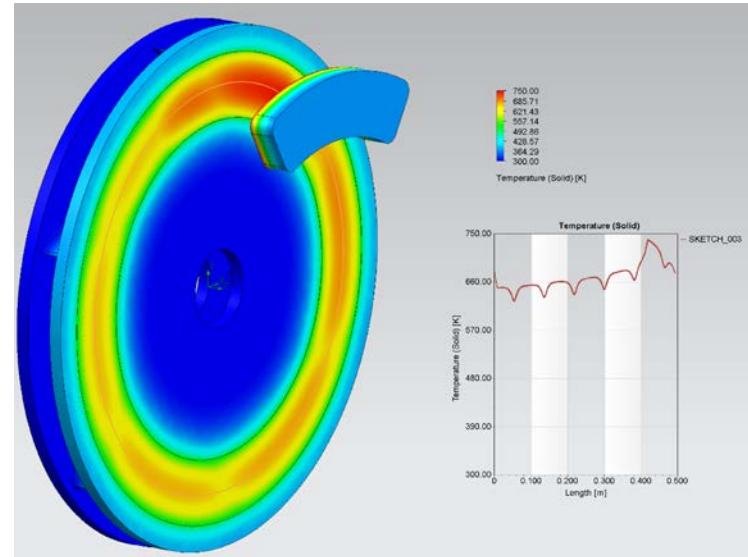
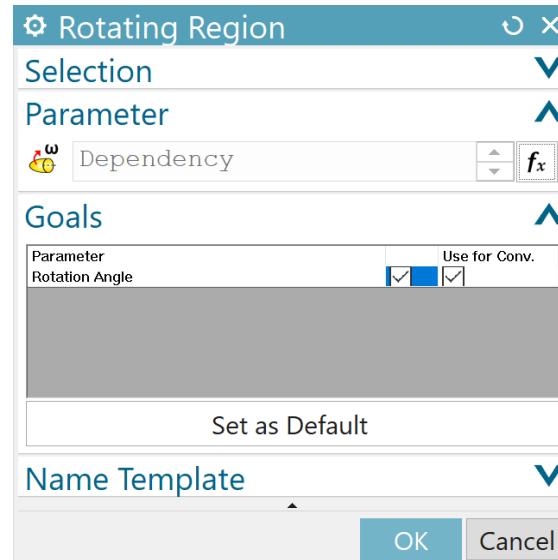
# Rotating Angle Feature Goal (Sliding)

## 转角目标（滑移）

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Rotating Region has a new Rotating Angle goal associated with the feature (Sliding only). You can use the goal for definition of complex rotating tasks.

在旋转区域中新增了一个转角目标，允许用户通过其实现复杂旋转工况的设定。



Disk brake cooling simulation uses Rotating Angle goal for easier definition of two phases: braking and cooling.

使用转角目标轻松完成刹车碟冷却仿真中的两个不同阶段：刹车和冷却

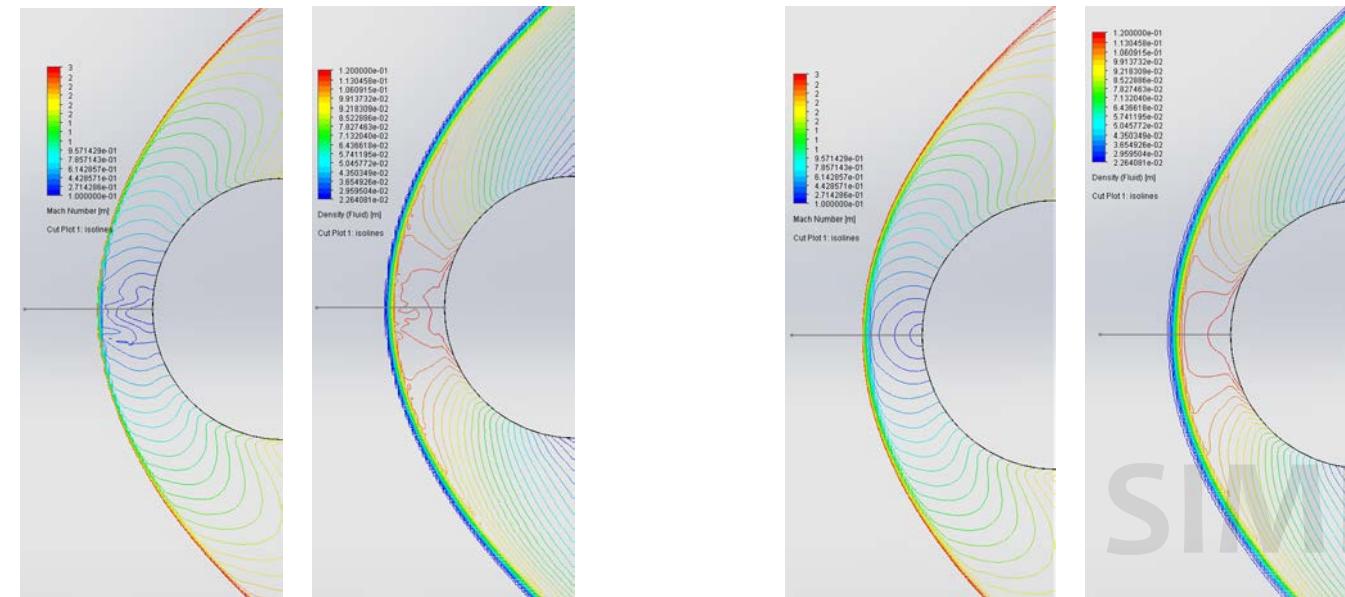


# Shock Waves Stabilization

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In flow with Mach number greater than five sometimes shock wave instability may occur. To dampen oscillations the new **Shock wave stabilization** option (in the Calculation Control Option) can be used. It introduces additional artificial viscosity in the area of the shock wave.

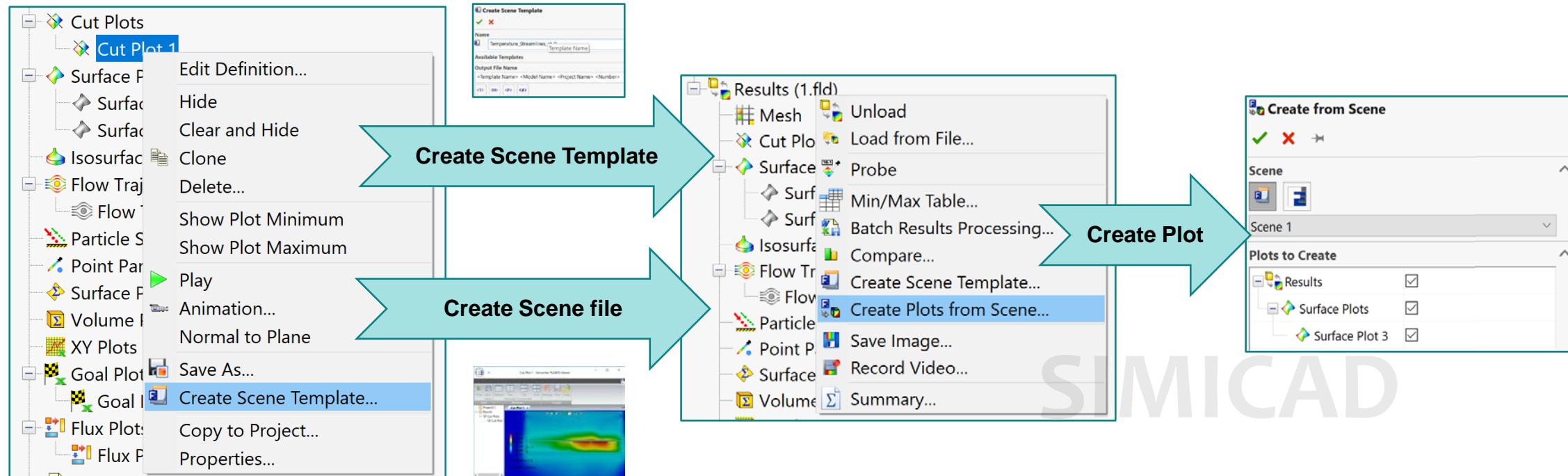
当马赫数大于5时可能产生激波震荡，新增的Shock wave stabilization功能（在计算控制选项里可以激活）可以通过引入人工粘度的方式来抑制震荡。



Shock wave visualization without (left) and with (right) stabilization enabled.

# Import Plots from Scene

You can copy a results feature (plots, parameters, etc) to other models by using Scene template or Scene Image (\*.efdscene) with the new **Create Plot from Scene** capability.  
支持用户通过场景模板或者场景图片 (\*.efdscene) 的方式将结果（云图、参数等）赋值给其他模型

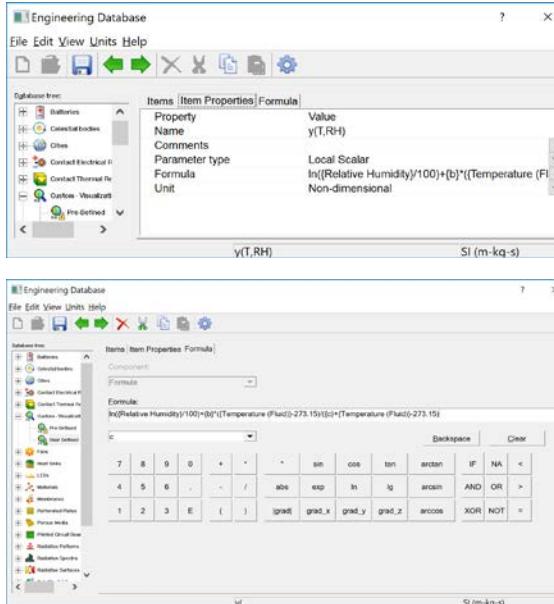




# Custom Visualization Parameters

**SIEMENS**  
Ingenuity for life

Specifying complex formulae for user-defined postprocessing parameters (Custom Visualization Parameters) becomes easier as now they can depend on other user-defined postprocessing parameters. 可以自定义公式更为复杂的后处理参数。

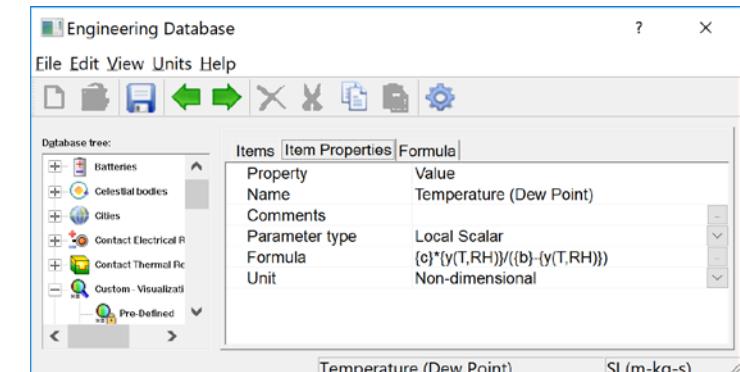
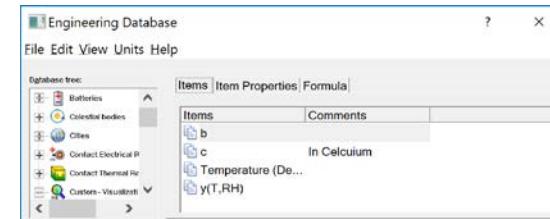


$$\gamma(T, RH) = \ln\left(\frac{RH}{100}\right) + \frac{bT}{c+T};$$

$$T_{dp} = \frac{c\gamma(T, RH)}{b - \gamma(T, RH)};$$

where

- $b = 18.678$ ,  $c = 257.14$  °C

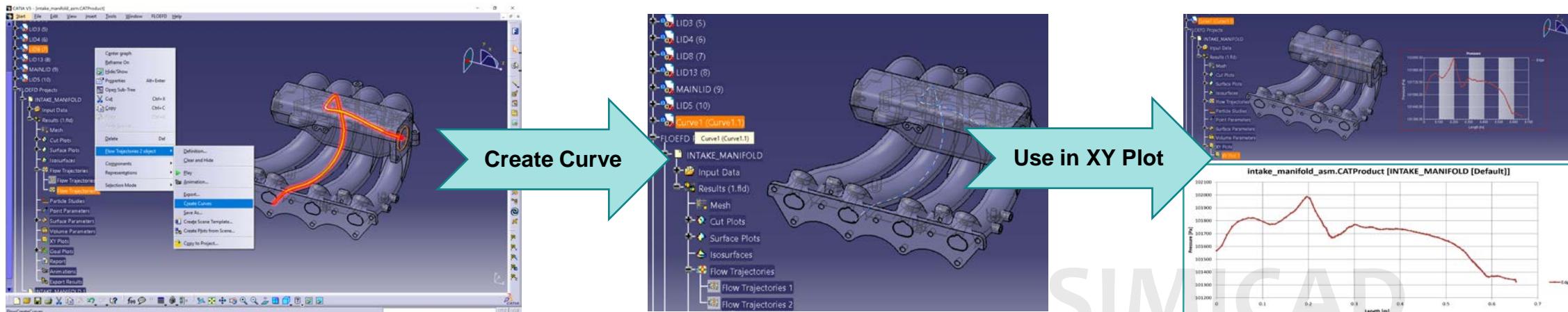


Dew point temperature definition (Magnus formula) uses complex dependencies of custom visualization parameters.

# Create Curve from Trajectories (for CATIA V5)

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You can now create a CATIA curve from a flow trajectory. This curve can be shared with other CAD engineers without access to Simcenter FLOEFD for them to make decisions on further geometry changes. This capability was previously available in Simcenter FLOEFD Standalone only. You can also use this curve in XY plots to track parameter changes along the trajectory.



Curve is created from trajectory and used in XY Plots.

# SIMUCAD

## New Modules

# SIMICAD

# Simcenter FLOEFD - 2 New Modules\*

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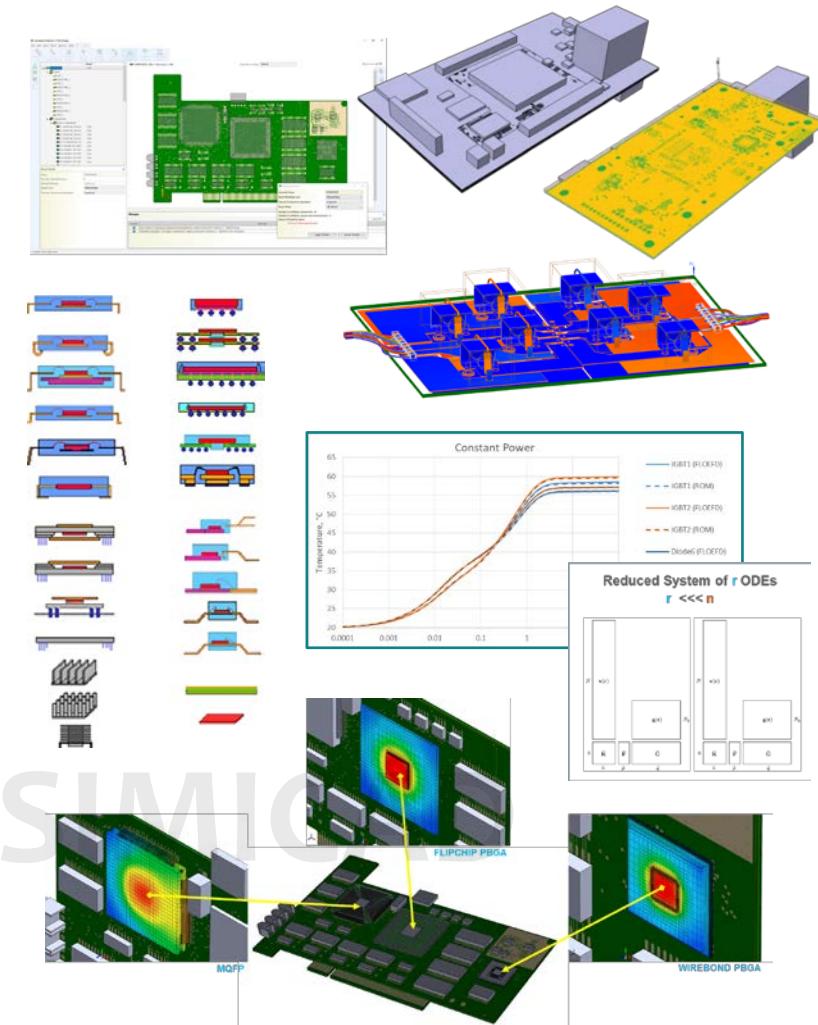
## Electronics Cooling Center

- EDA Bridge and SmartPCB
- BCI ROM and Thermal Netlist
- Package Creator
- PDML and XTXMLA import
- Network Assembly and Two-resistor compact models
- T3STER AutoCalibration
- PCB compact model
- Heat Pipe compact model
- Joule Heating
- Electrical Element compact model

## BCI ROM+Package Creator

- BCI-ROM and Thermal Netlist
- Package Creator
- PCB compact model

\* All existing modules whose functionality is available in ECC module (EDA Bridge, AutoCalibration, Electronics Cooling, and Electrical Element) are maintained as separate modules.



# SIMUCAD

SIMICAD  
CAD Versions Support Update



# CAD Versions Support Update



The following CAD versions are tested with 20.1:

- CATIA R19 to R29 (V5-6 2016)
- CREO v2.0 to v6.0
- Solid Edge 2019, 2020
- Siemens NX 8.5.1.3, 8.5.2.3, 8.5.3.3
- Siemens NX 9.0.1.3, 9.0.2.5, 9.0.3.4
- Siemens NX 10.0.0.24, 10.0.2.6, 10.0.3.5
- Siemens NX 11.0.0.33, 11.0.1.11, 11.0.2.7
- Siemens NX 12.0.0.27, 12.0.2.9
- Siemens NX 1872 (1872, 1876, 1880, 1884, 1888, 1892)
- Siemens NX 1899 (1899, 1903, 1904, 1907, 1911)



# CAD Versions Support Update



Note: Simcenter FLOEFD does not work with NX1903, 1904 and higher versions up to NX1907.

The “Routing” feature in NX1903 adds the following environment variables:

MGLS\_DLL=C:\Program Files\Siemens\NX1899\CAPITALINTEGRATION\capitalnxremote\MGLS64.DLL

MGLS\_PKGINFO\_FILE=C:\Program Files\Siemens\NX1899\CAPITALINTEGRATION\capitalnxremote\mgc.pkginfo

These global variables refer all Mentor products to a special version of MGLS (Mentor Graphics Licensing System) which other Mentor products may not support.

Workaround: It was fixed starting from NX1907 (variables are not created). To fix the issue you need to remove above mentioned environment variables or upgrade to NX1907.

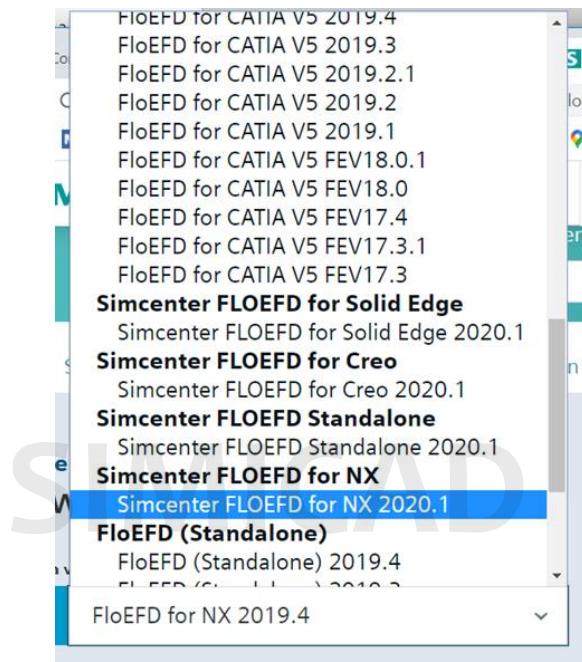
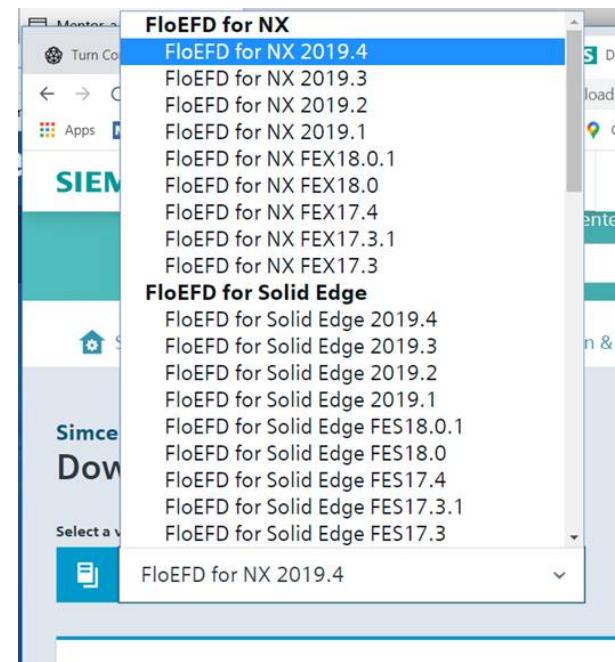
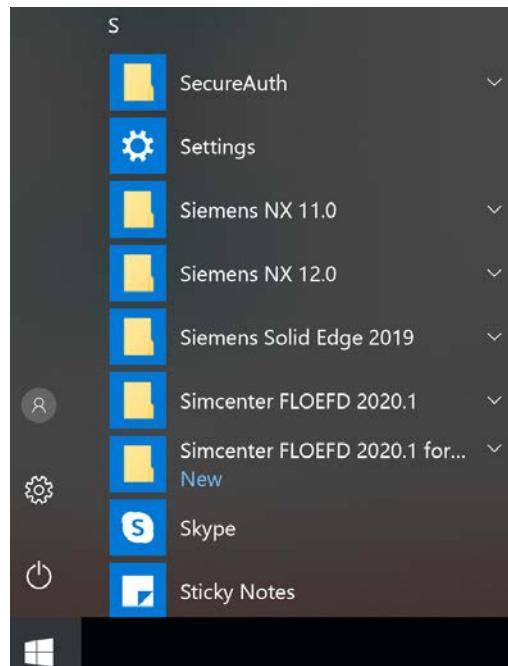
SIMUCAD

Rebranding FloEFD to  
Simcenter FLOEFD

SIMICAD

# Rebranding

FloEFD is now renamed to **Simcenter FLOEFD**. FloEFDView is renamed to Simcenter FLOEFD Viewer. The icon in the Start menu is now located into the Simcenter FLOEFD folder. The default files location in the Program Files folder is not changed, so API scripts referring to the setup folder are not affected.



Support Center Downloading: scroll down far enough to see 2020.1 version.



# SIMUCAD

## Thank You

# SIMICAD