2022 R1 What's New
Thermal Integrity

Agenda

- **Classic Icepak 2022R1 New Feature**
- **AEDT Icepak 2022R1 New Feature**
- **AEDT Mechanical簡介**

Classic Icepak

Ansys

Classic Icepak 2022R1 Summary

- **Scheduler enhancements**
  - Slurm support
  - Switch to FLUENT scheduler syntax
- **Modeling**
  - Transient junction temperature
  - DO solar irradiation model on flow boundary
- **Meshing**
  - Size function for 2d objects in 2.5D
  - Auto 2D Layer-by-Layer Mesh Separately (BETA)
  - Handle 2D object on mesh separately/mesh reuse objects (BETA)
- **Miscellaneous**
  - Network node names in Temperature Limits dialog
  - Option to merge ECXML file
  - Use CAD z-axis as flow direction for CAD fan

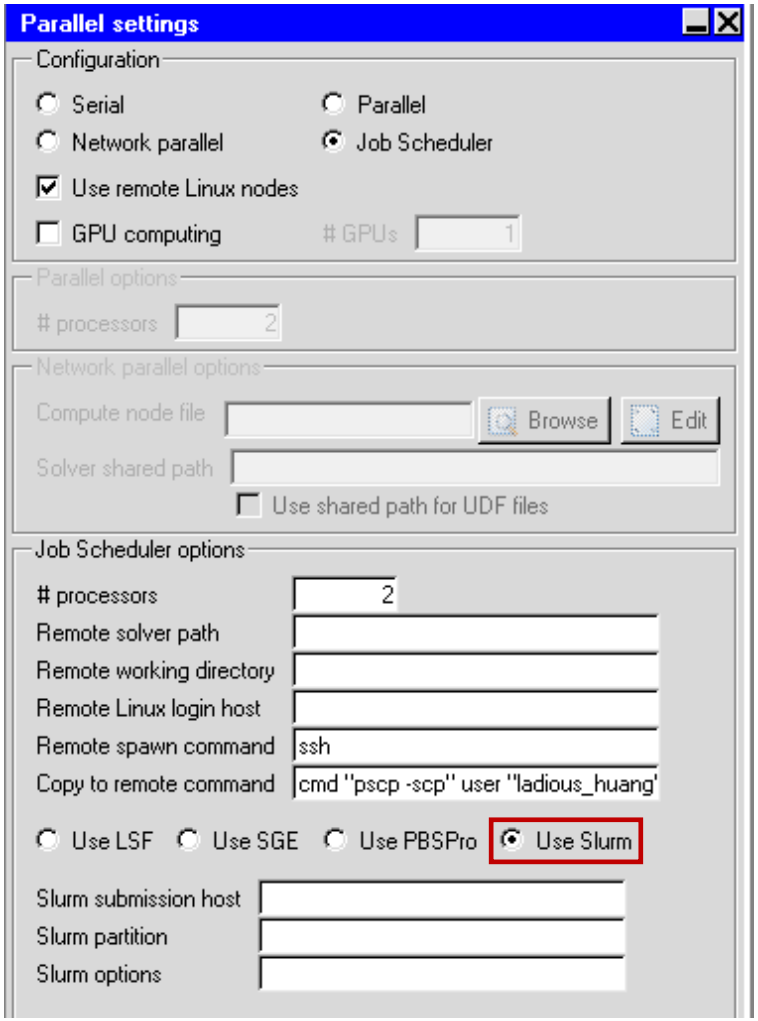
Scheduler enhancements

- Added the ability to specify SLURM for job scheduler on remote Linux machines.

- **Slurm scheduler support**
  - Remote Linux from windows
  - Native on Linux

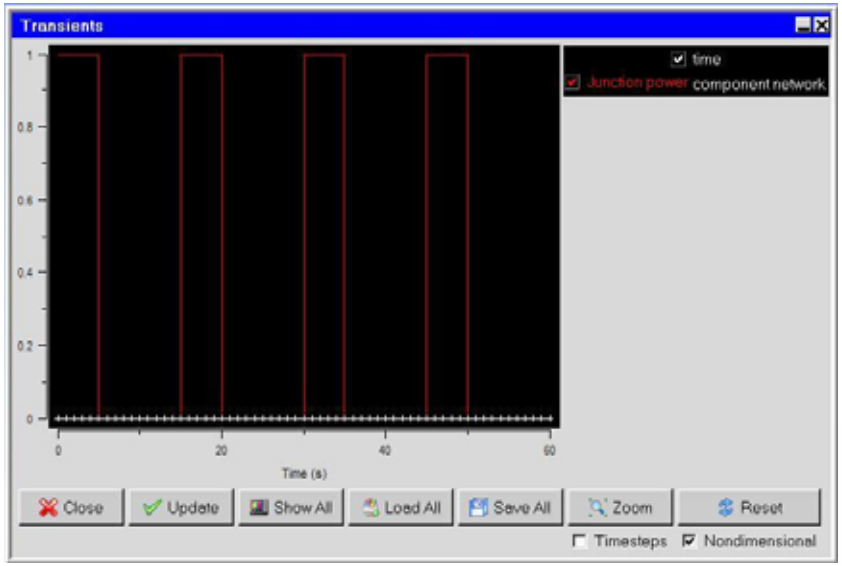
Slurm 任務調度工具
前身為Linux資源管理工具，Simple Linux Utility for Resource Management，是一個用於Linux和Unix內核系統的免費、開源的任務調度工具。它提供了三個關鍵功能：

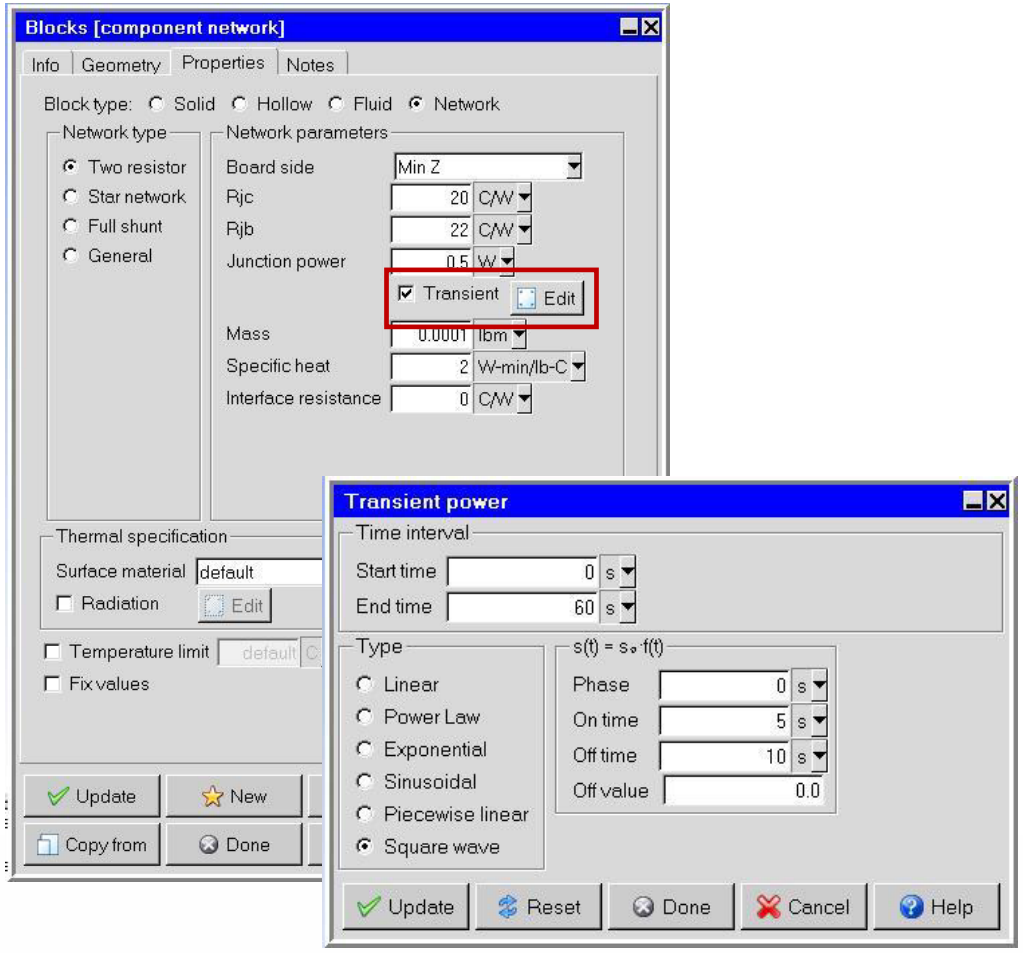
1. 為用戶分配一定時間的專享或非專享的資源(計算機節點)，以供用戶執行工作。
2. 提供了一個框架，用於啟動、執行、監測在節點上運行著的任務(通常是並行的任務，例如 MPI)。
3. 為任務隊列合理地分配資源。



Modeling

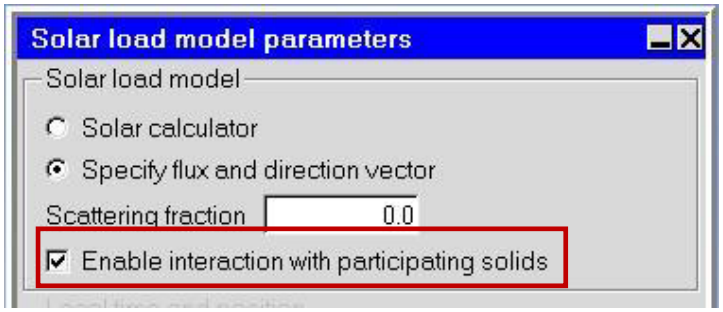
- **Transient junction power**
  - Two resistor, Star network and Full shunt
  - Save, Load, View updated in Transient Viewer





Modeling (Cont'd)

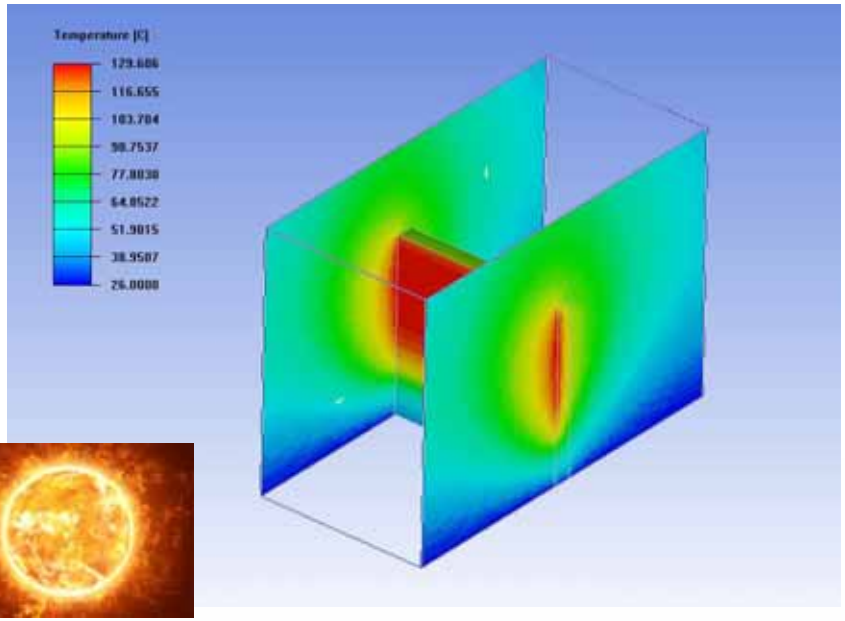
- **DO solar irradiation model on flow boundary**
  - 太陽輻照將DO 強度應用在流入/流出邊界上
  - 確認是否啟動 "Enable interaction with participating solids" 選項



Enabling DO solar model

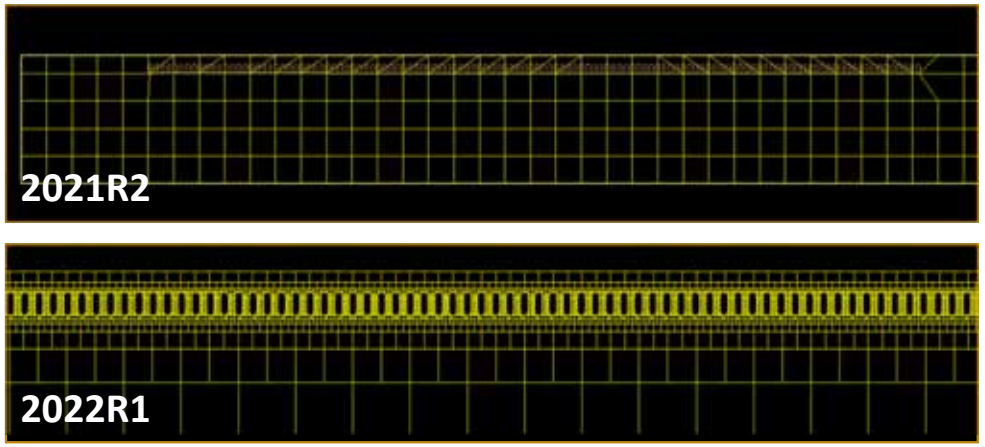
- **DO solar model vs Ray-tracing**
  - Not the same!
  - Ray-tracing利用太陽能吸收率將太陽輻射作為熱通量應用到入射壁面，並均勻分佈反射的太陽輻射
  - DO solar model通過將太陽熱通量添加到指定方向的強度來處理太陽輻射
    - RTE 解決了實體與不透明/透明邊界間的完全交互作用
    - Net wall radiation flux

$$q_{\text{rad}} = \epsilon \int_{\mathbf{s}.\mathbf{n}>0} \boldsymbol{I}(\mathbf{s})\, \mathbf{s}.\mathbf{n}\, d\Omega - n^2 \epsilon \sigma T_w^4$$

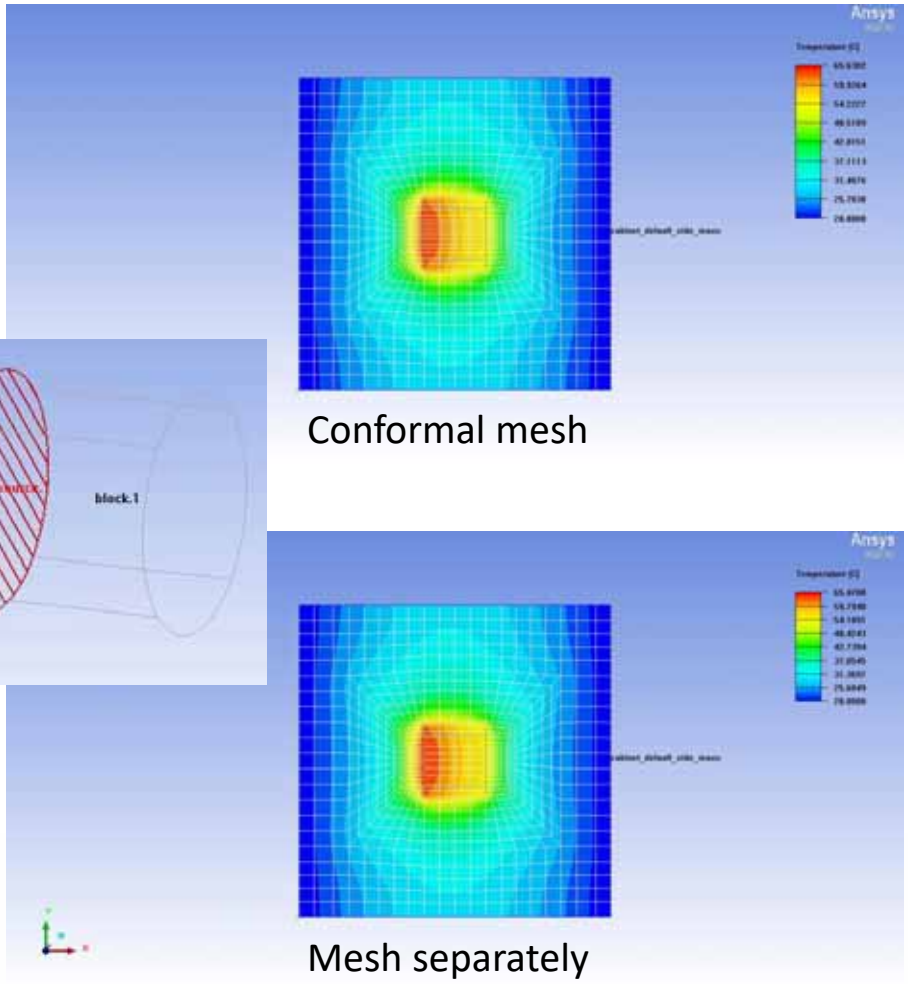


Meshing Enhancements

- **Size controls for 2d objects in 2.5D Meshing**
  - Level, proximity and curvature size functions



2D pads mesh



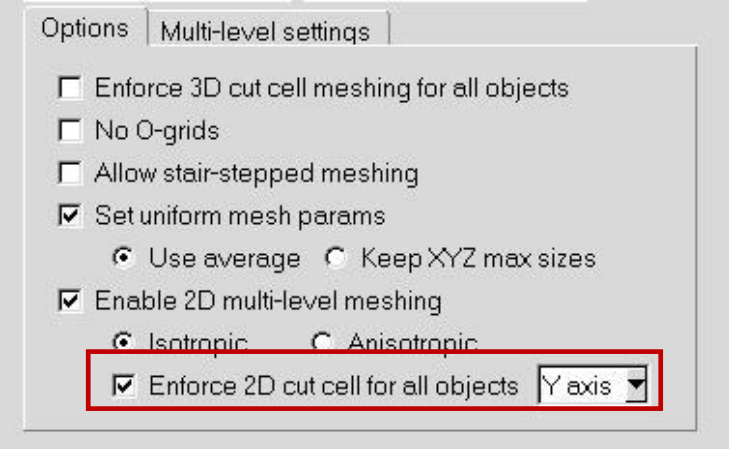
Conformal mesh

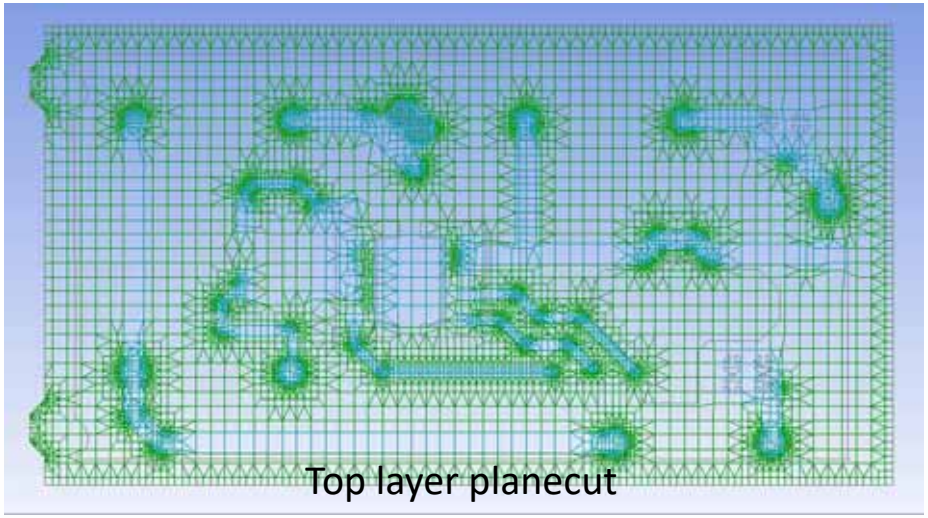
Mesh separately

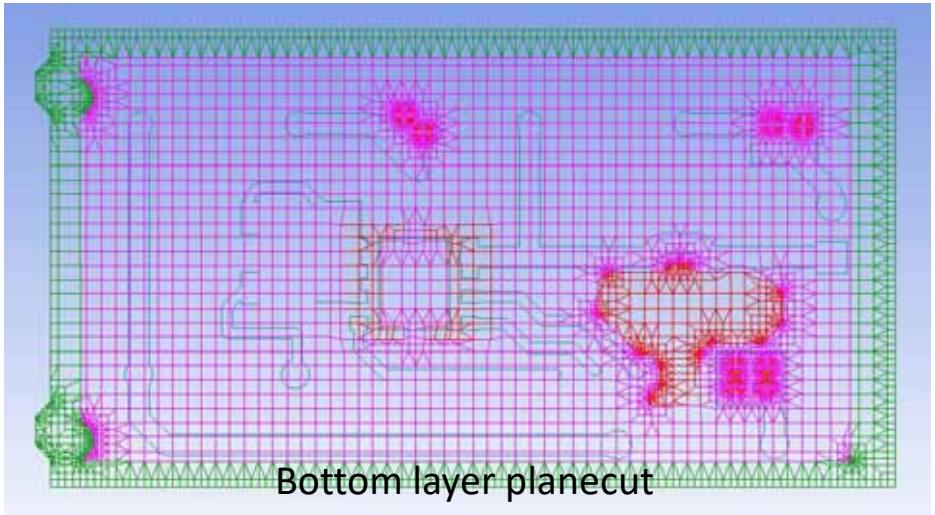
- **2D objects on internal couplings (BETA)**
  - Allows 2D object on meshed separately boundary
  - Set ICEPAK_MAKE_INTERNAL_COUPLING_MAP=1

Meshing Enhancements (Cont'd)

- **Auto mesh-separately for 2D objects (BETA)**
  - Applicable only when 2D direction is specified
  - Objects with common elevation ranges grouped into separate "assembly"
  - Local "assembly" avoids imprinting all outlines to single plane
  - Set ICEPAK_ENABLE_BETA_FEATURES="hdm_2.5d_blocking"

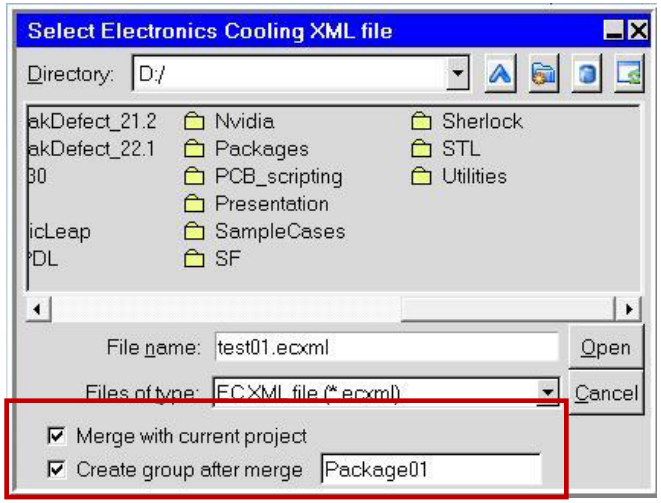


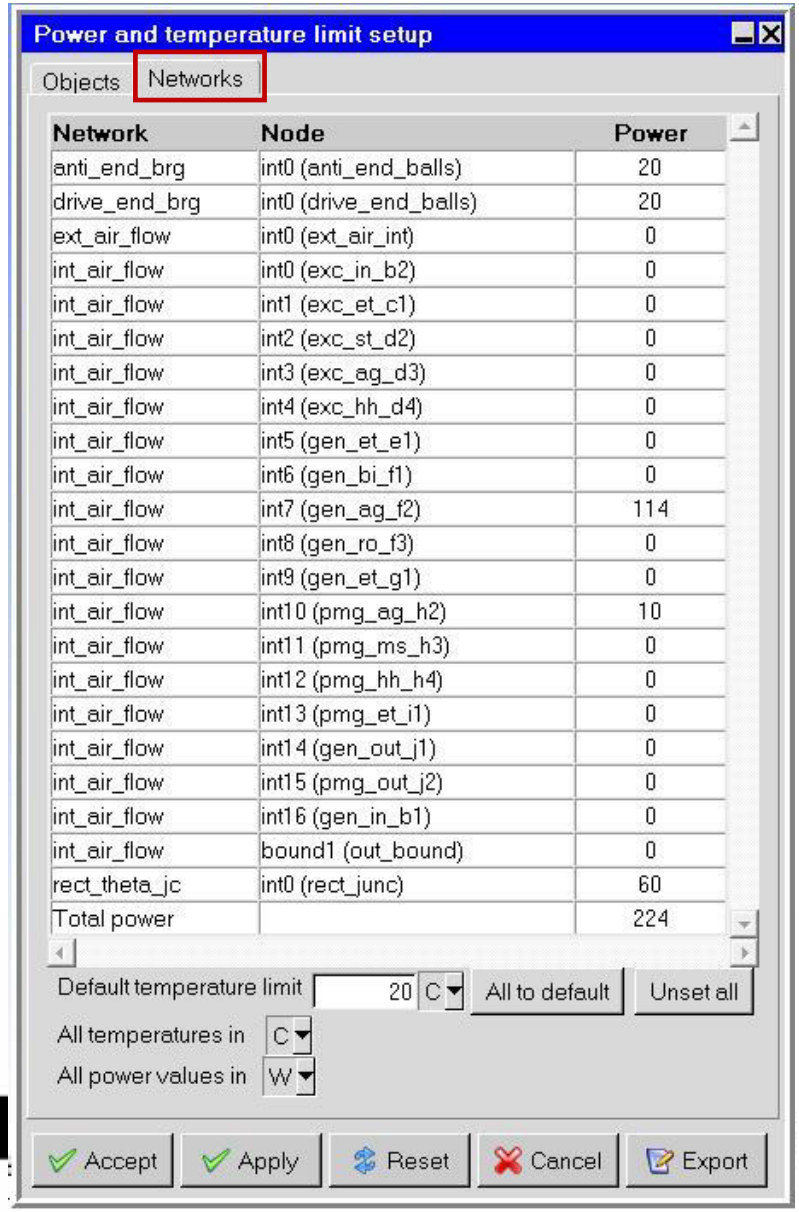

Top layer planecut


Bottom layer planecut

Miscellaneous

- **Network node names in Power/Temp limits setup**
  - Format: intN (name)
- **ECXML enhancements**
  - Select **Merge with current project** to import the objects into the existing project.
  - Select **Create group after merge** and enter a group name to group the imported objects.

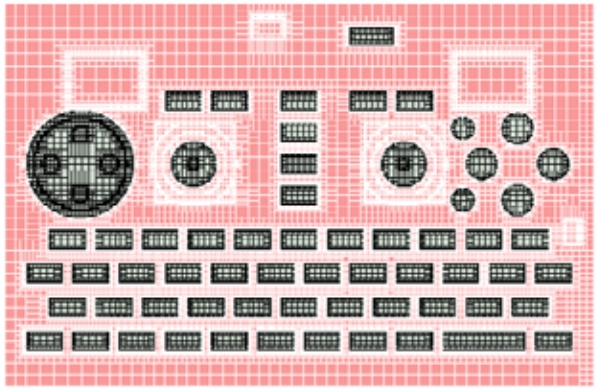




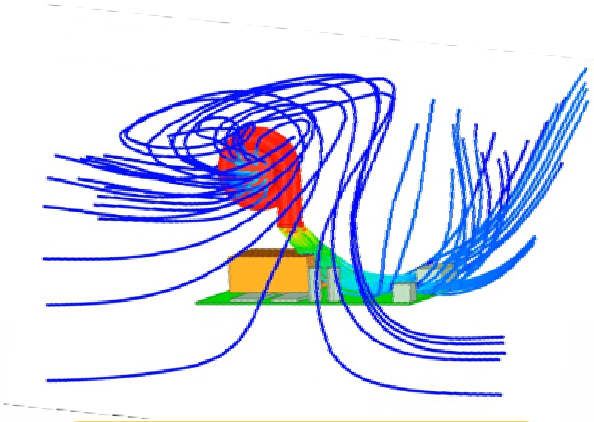
AEDT Icepak

Ansys

Icepak 2022 R1 Highlights



- **Reduced Order Modeling (ROM)**
  - Redhawk CTM 2-Way & New Delphi Network Creation
- **Blower Modeling**
- **ECAD Import -** Wirebond & IDX
- **Maxwell 2D** – Icepak EM Loss Coupling

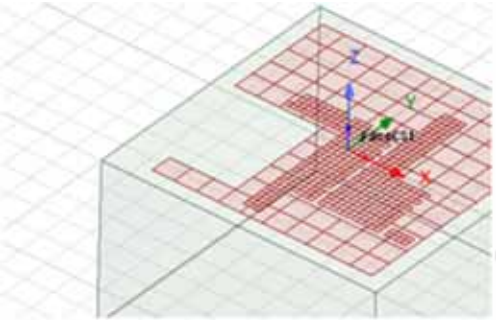


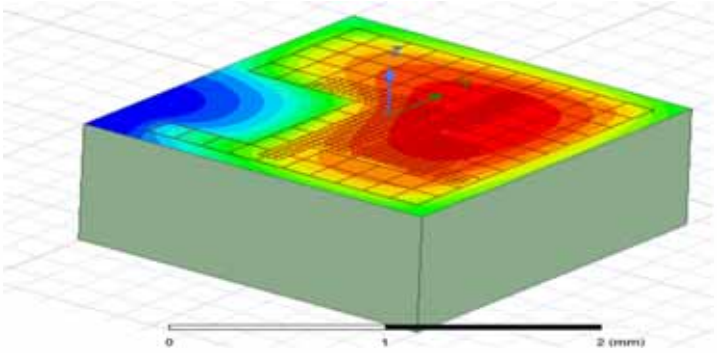
Streamlines into and out of a Centrifugal CAD Blower cooling a PCB assembly

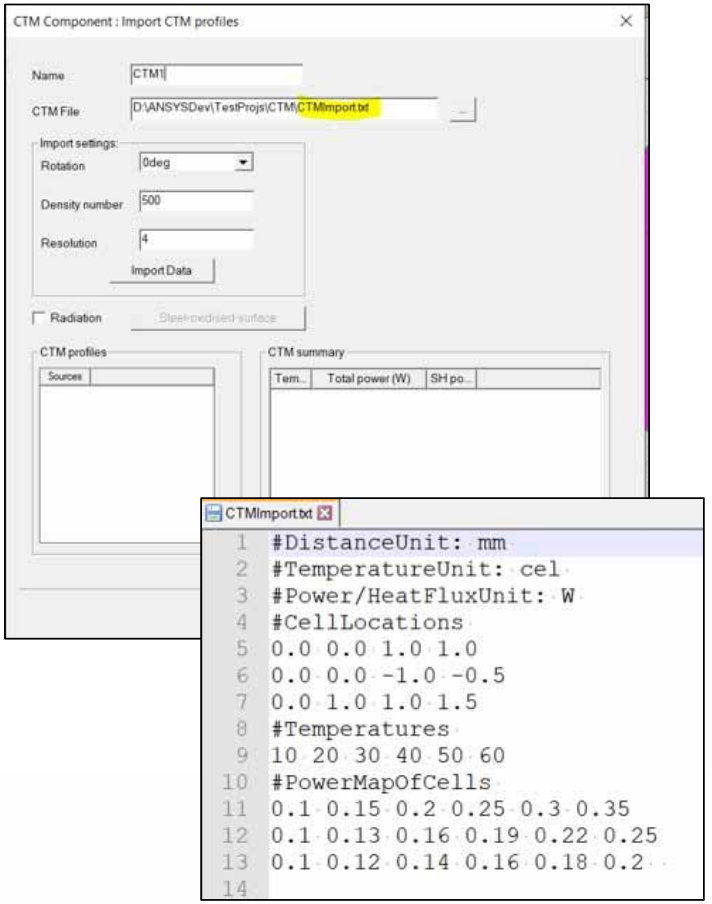
- **Mesher Enhancements –** 2.5D Improvements
- **User Experience**
  - Streamlines & Validation Enhancements
  - Improved Error messaging & troubleshooting
- **Migration**
  - Improve speed of TZR conversion
  - Network Schematic enhancements
  - Toolkit enhancements
    - PCB, Package parameterization

RedHawk CTM Two-Way Workflow

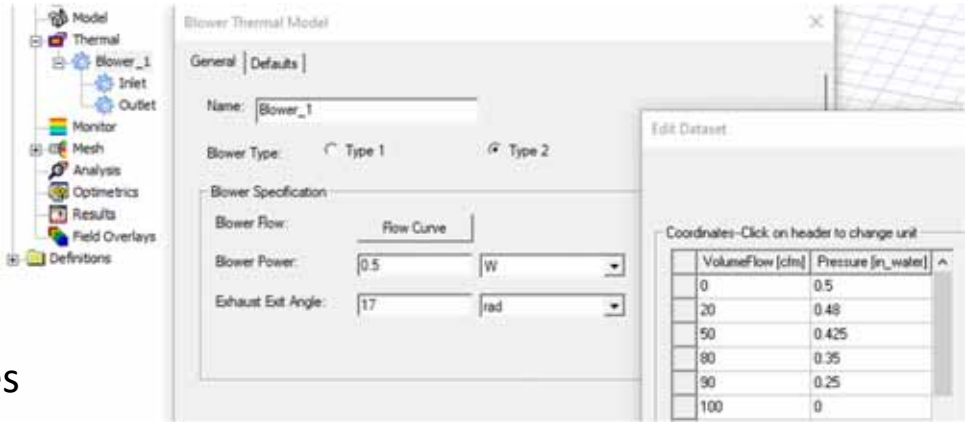
- **Chip Thermal Model (CTM) two-way co-simulation**
  - Chip-aware system design (2021R2)
  - System-aware chip design (2022R1)
  - Auto-export temperatures to RedHawk after simulation
    - Defaults to export folder specified under Design Settings
    - Binary format
  - CTM import using a 3rd party text file
    - CTM native component created
    - No temperature data export



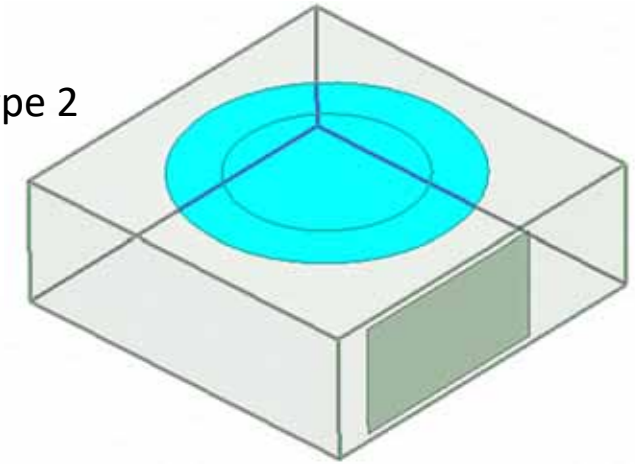


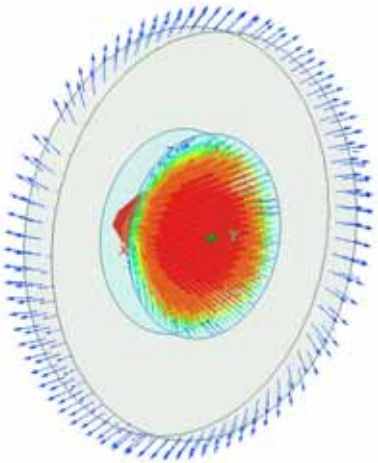


Blower Modeling



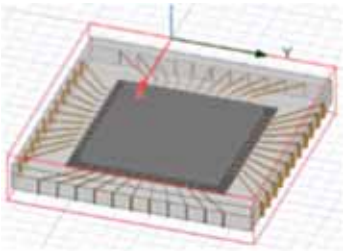
- Generalized Blower boundary
  - Impellers (type 1)
  - Centrifugal blowers (type 2)
  - Single and dual inlets for all geometries
- Blower toolkit
  - Geometry and BC for rectangular and cylindrical geometries
- Vendor Component Library
  - Adda, Jaro, Minebea, Sunon
- Blower Assignment
  - Polygonal approximation allowed for type 1
  - Multiple co-planar inlet faces allowed for type 2
  - Ability to toggle inlet/outlet faces
- Blower Specifications
  - Blower flow curve
  - Fan blade/exit angle
  - RPM (type 1)
  - Blower Power



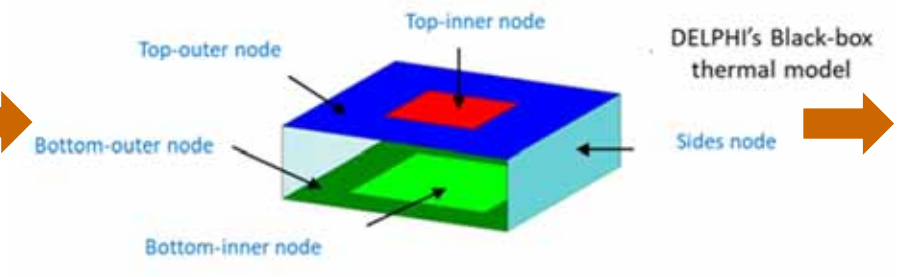


Reduced Order Modeling - Delphi Network Creation*

- Steady-state Delphi network creation for QFP packages



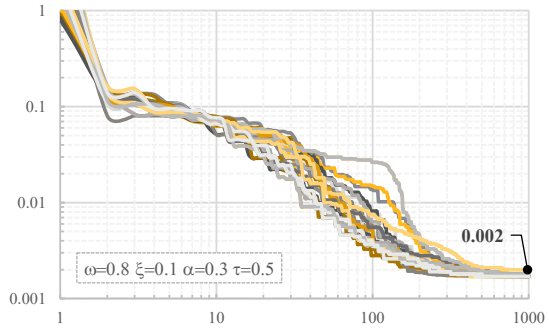
Detailed Package CFD Model



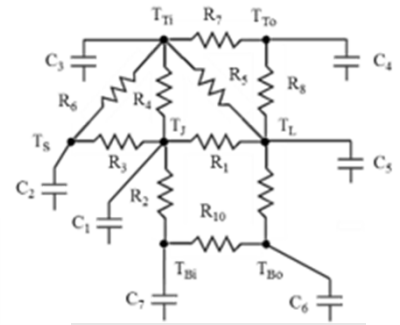
Delphi boundary condition setup

$$\begin{bmatrix} Case & \overline{h}_{TOP} & \overline{h}_{BOTTOM} & \overline{h}_{SIDES} & \overline{h}_{LEADS} \\ 1 & 5 & 1 & 5 & 1 \\ 2 & 15 & 1 & 15 & 1 \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ 48 & 10 & 1000 & 10 & 100000 \end{bmatrix}$$

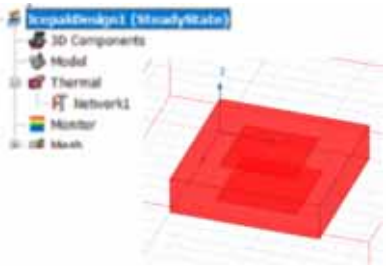
Parametric setups with training BCs



Delphi Optimizer



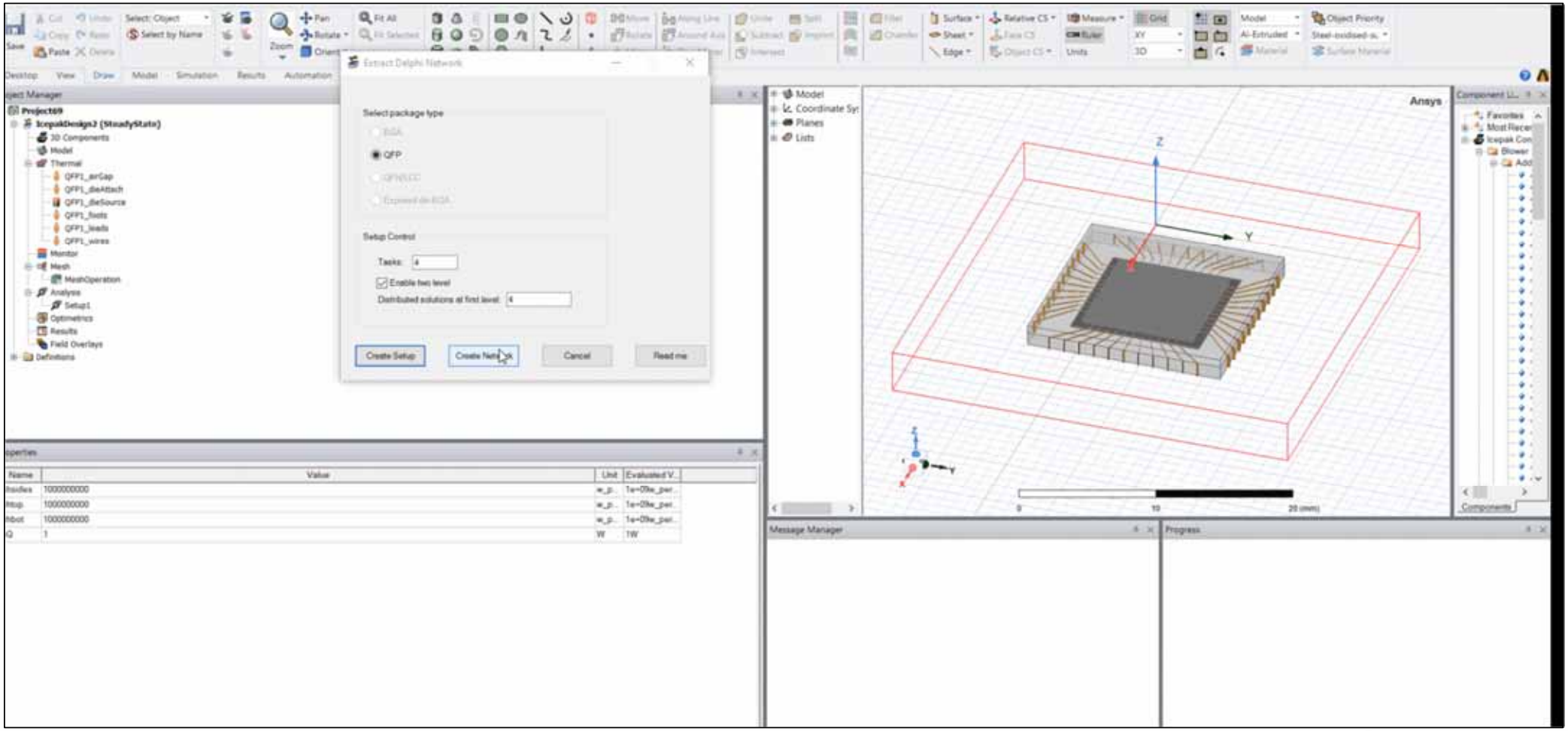
Delphi Network



Icepak Design

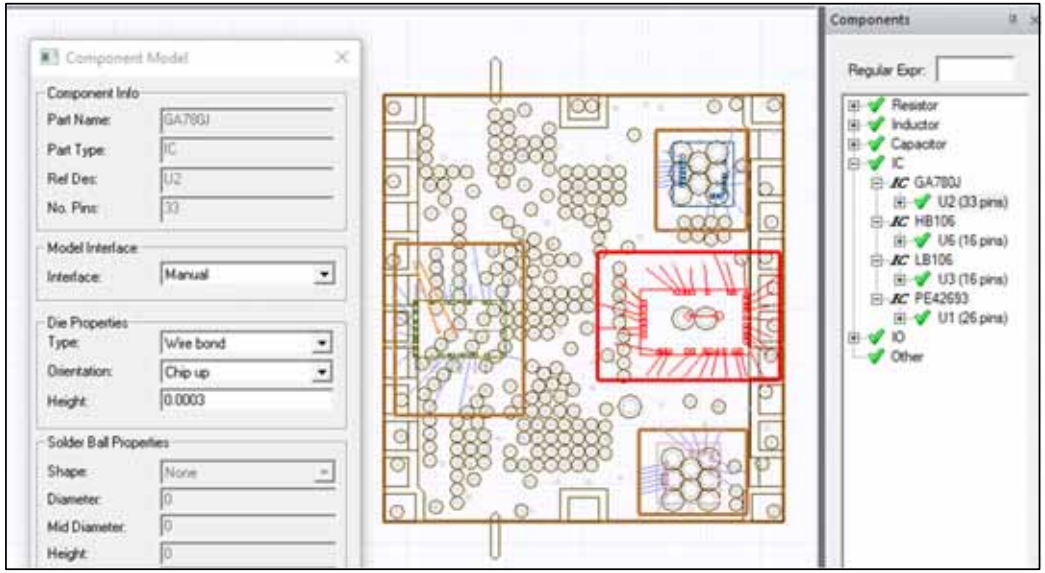
* Requires Feature Flag

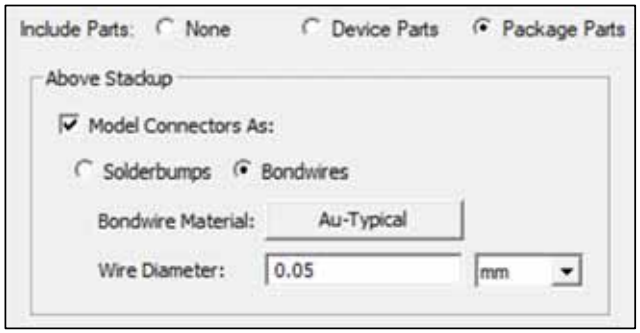
Automated Delphi Network Creation Workflow in AEDT



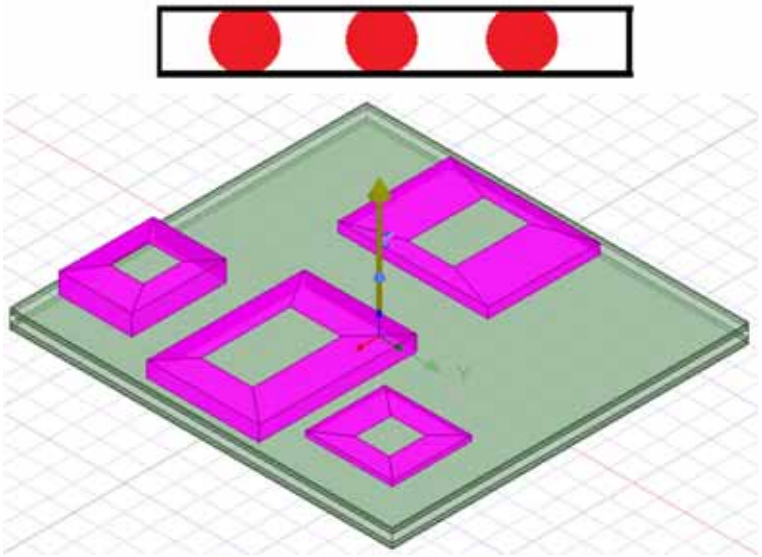
ECAD - Bondwire Import

- **Bondwire Import with PCB Component**
  - Bondwires attached to components with die properties
    - Material and wire diameter input options
    - Modeled as sheets with shell conduction plate BC



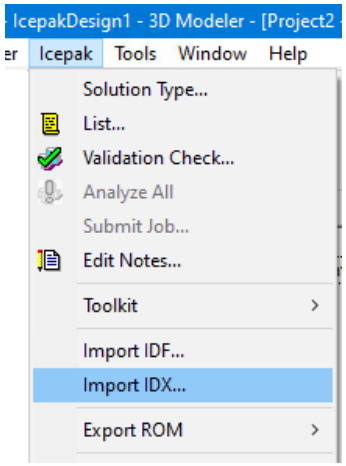


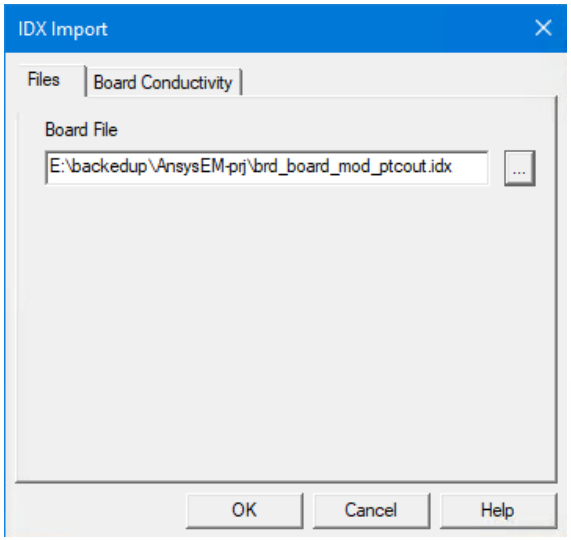
Cross-section View

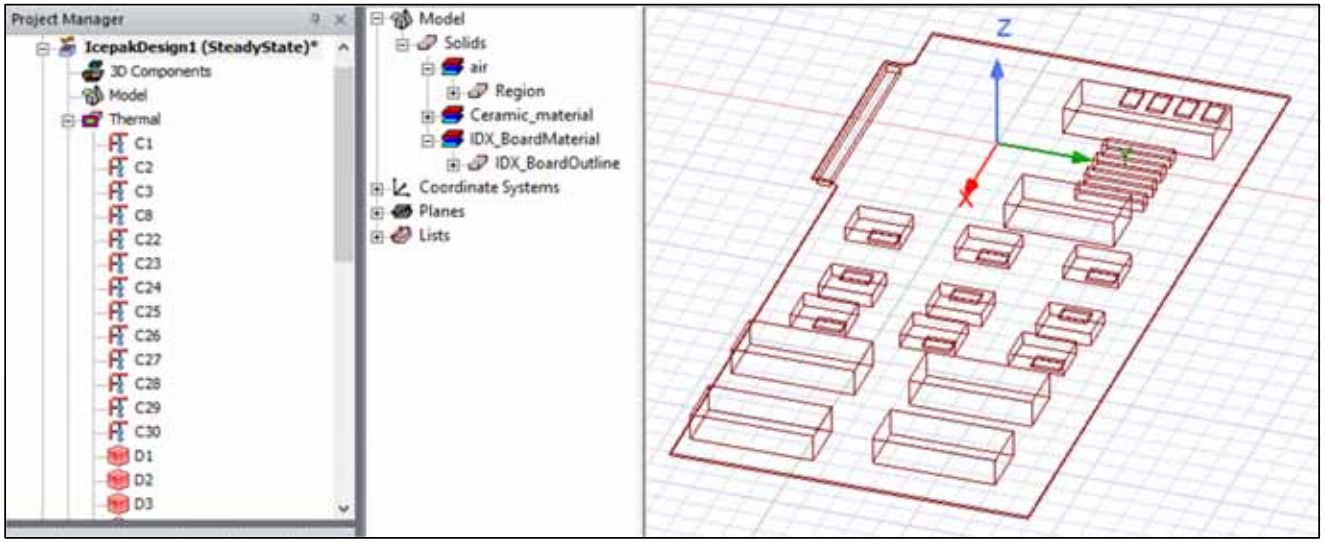


ECAD - IDX Import

- **IDX Import – XML based format consisting of ECAD and MCAD data**
  - Support geometry and boundary condition import (MCAD)
    - Like IDF import in Icepak AEDT
  - Limitations
    - ECAD data import not supported
    - Filters, Modeling options, Cutouts not supported

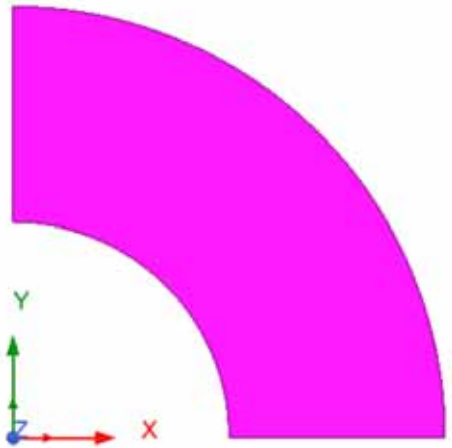




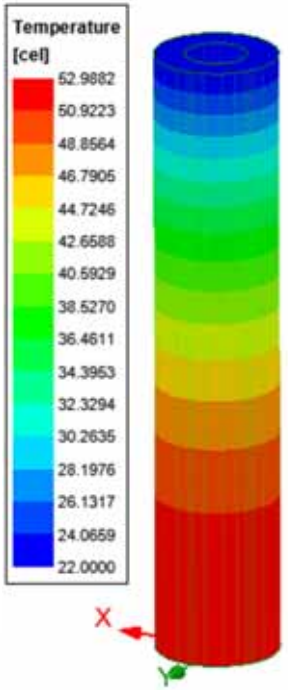


Maxwell 2D – Icepak EM Loss Coupling

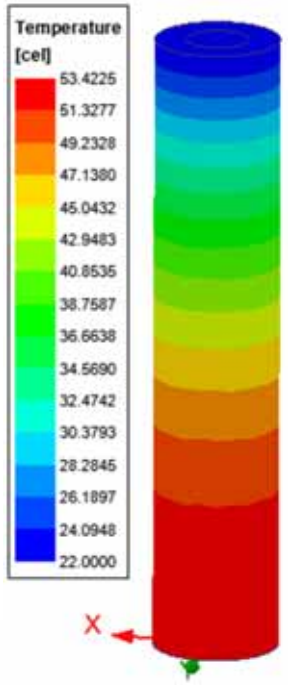
- Support EM Loss Import from Maxwell 2D
  - Extruded geometries of 2D representations
    - Support both +ve and –ve extrusions in XY
    - Can be partial geometries
  - Coupling projects 3D mesh points onto 2D geometry
  - Limitations
    - Extrusions need to be along Z axis
    - Losses not conservative



Maxwell 2D Geometry



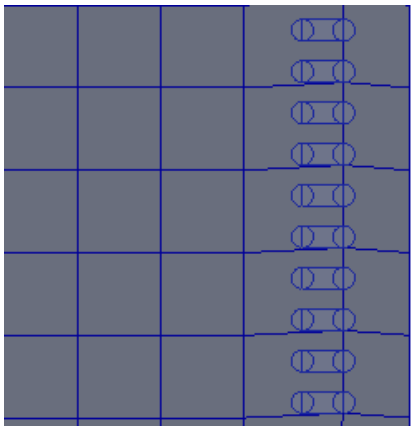
Maxwell 2D Coupling



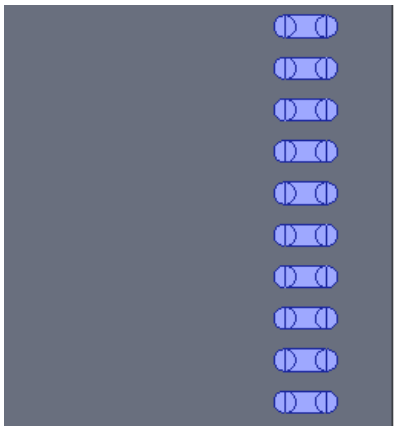
Maxwell 3D Coupling

Meshing Enhancements - 2.5D Meshing

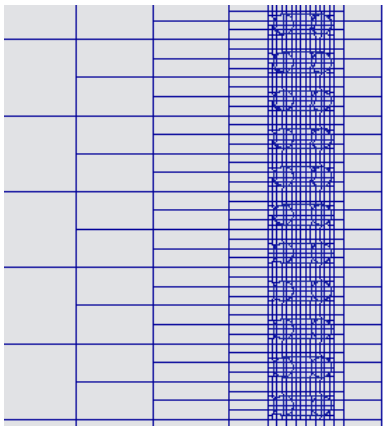
- Capturing Thin Objects in 2.5D Meshing
  - Refinement around 2D sheets parallel to the 2.5D meshing plane
    - Create additional refinement and multi-level around 2D sheets
  - Further mesh optimization using 2.5D mesh sub-blocking in following slide



2021R2: 2D Sheets not meshed



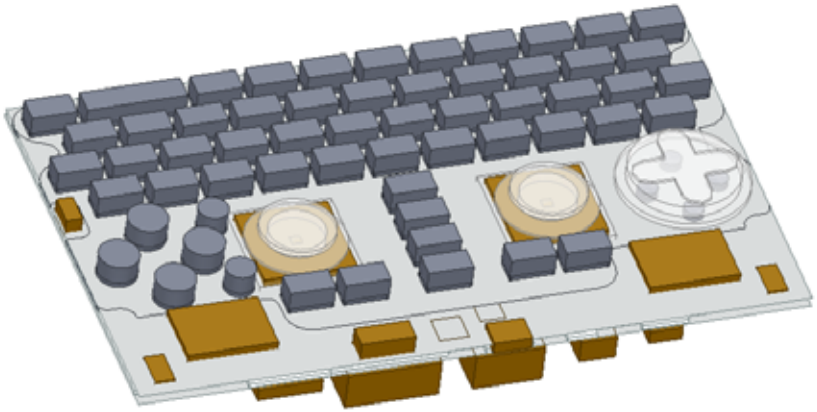
2D Sheets parallel to 2.5D meshing plane



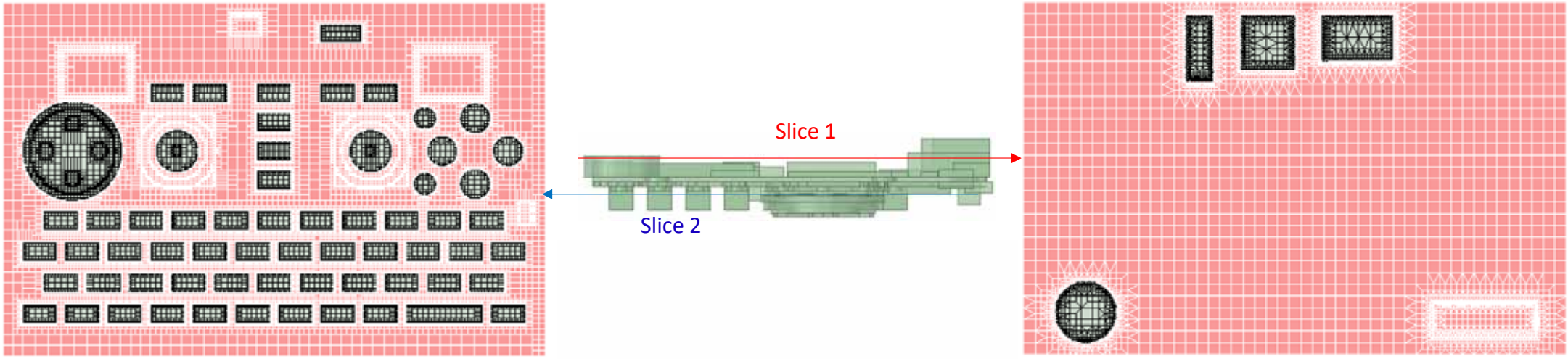
2022R1: 2D Sheets meshed

Meshing Enhancements - 2.5D Meshing*

- Domain Sub-blocking for 2.5D Meshing
  - Prevent refinement from being imprinted throughout extrusion
    - Domain split according to in-plane geometry features
    - Uses non-conformal interface to couple different meshing blocks
  - **Reduced mesh counts and improved performance (~50%)**



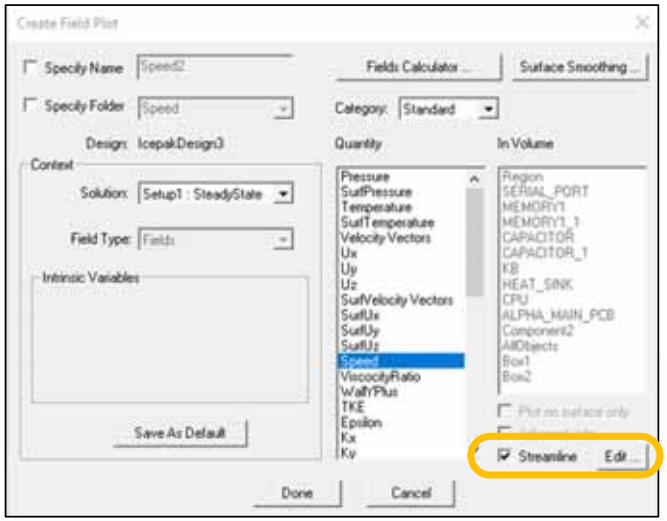
Keyboard model mesh count:
2021R2: **2.35M**
2022R1: **1.38M**

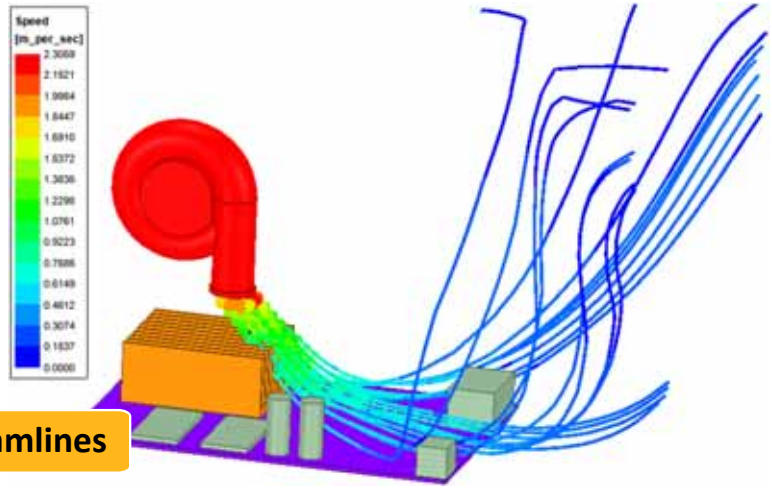


* Requires Feature Flag

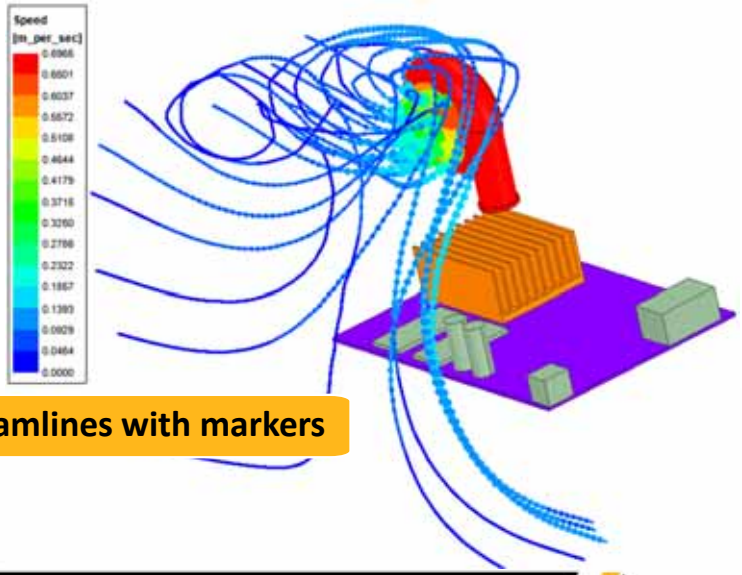
Fluid Flow Streamlines*

- Steady-state and transient particle traces
  - Forward and reverse direction
  - Uniform and mesh node seeding with skip option
    - Color by variable
    - Standard AEDT line and marker options
  - Animations are not supported yet





Forward streamlines

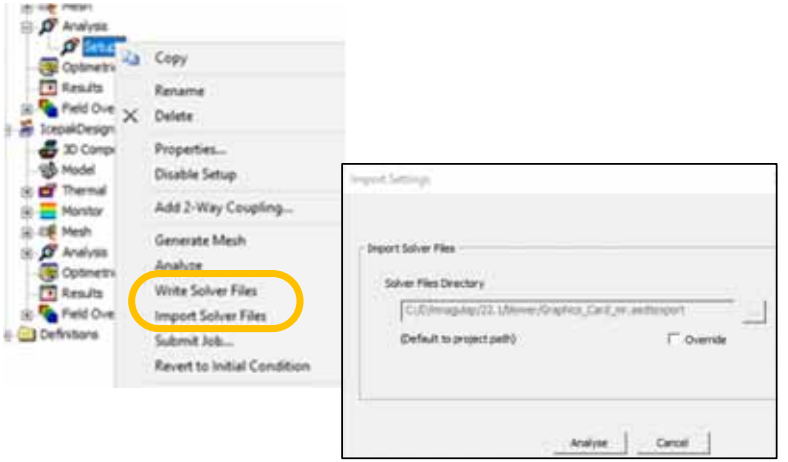


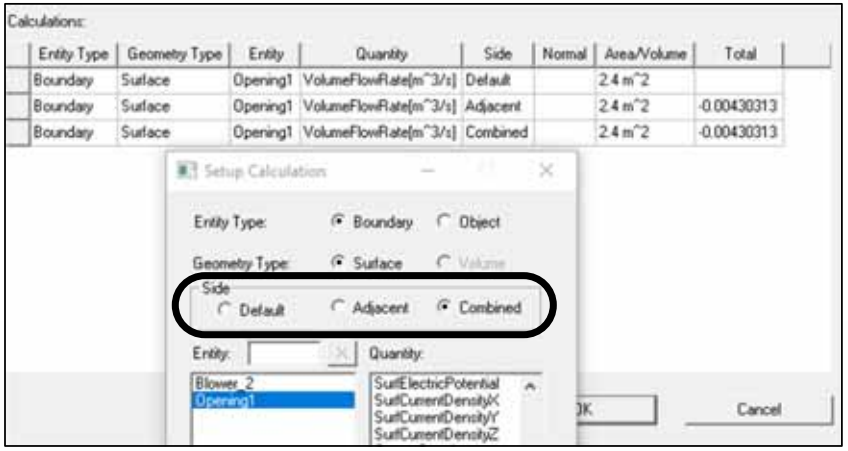
Reverse streamlines with markers

* Requires Feature Flag

Miscellaneous Enhancements

- Solver File Export / Import
  - Write Solver Files option
  - Import Solver Files option*
- Fields Summary
  - Combined side option for surface quantities
  - Algebraic sum of Default and Adjacent side values
  - Single option to report:
    - Non-zero values at all 1-sided surfaces
    - Ensure heat balance at 2-sided surfaces
- TZR File Import Speed Improvement
  - Synchronization & Validation*
  - Speed-ups up to 70x observed





* Requires Feature Flag

Toolkits Development

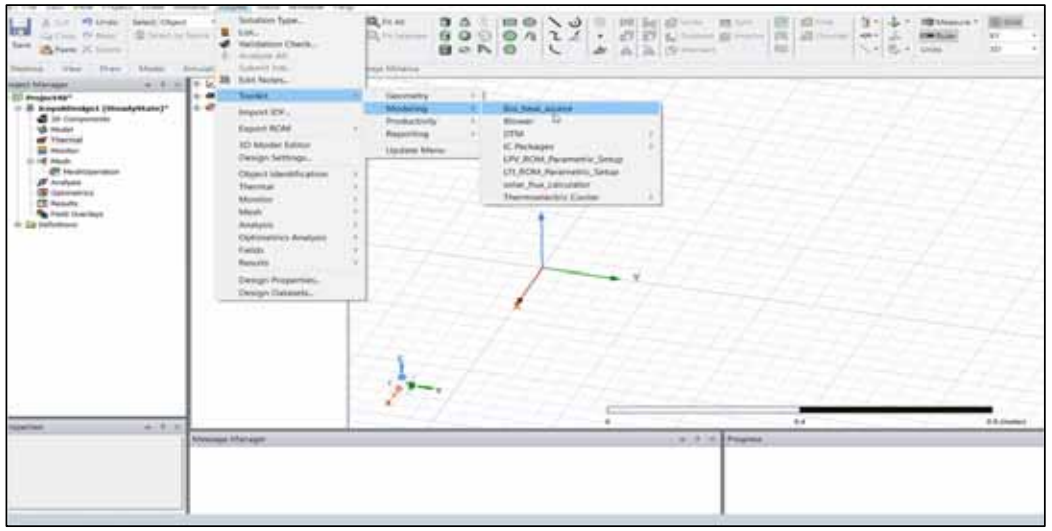
New Toolkits (10)

- Geometry Approximations(6)
- Blower
- Extract Delphi Network
- Contour File Export
- Cut Plane

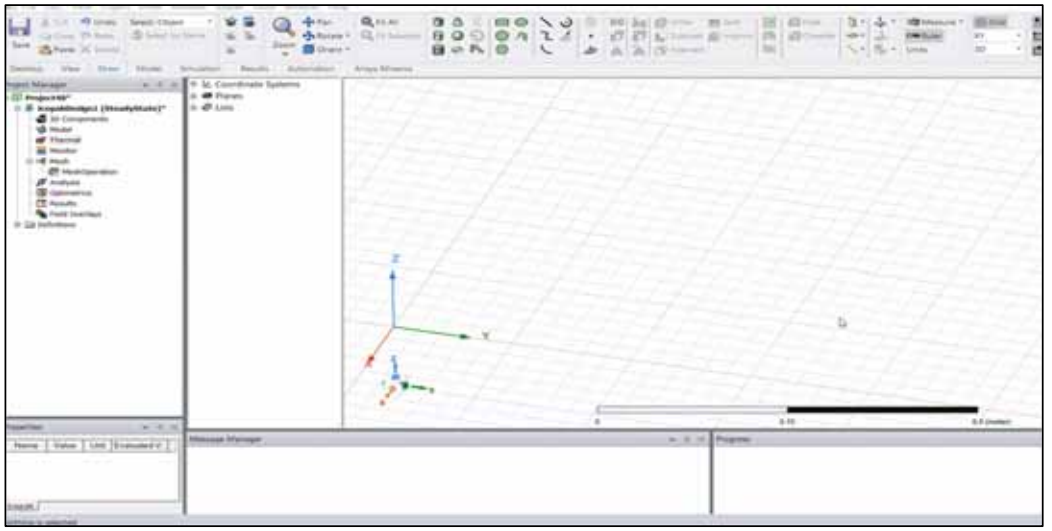
Enhancements (5)

- Variable support for Packages and PCB
- PCB
- DTM Monitor Support
- Dataset support for Power Budget
- Power density support for Bio-Heat Source

Blower Modeling - Toolkits

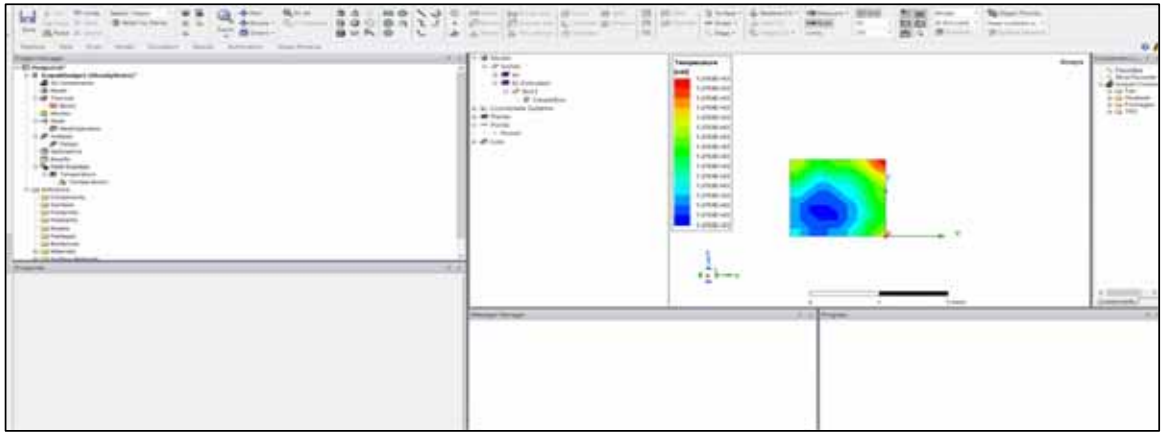


Type 1 Blowers

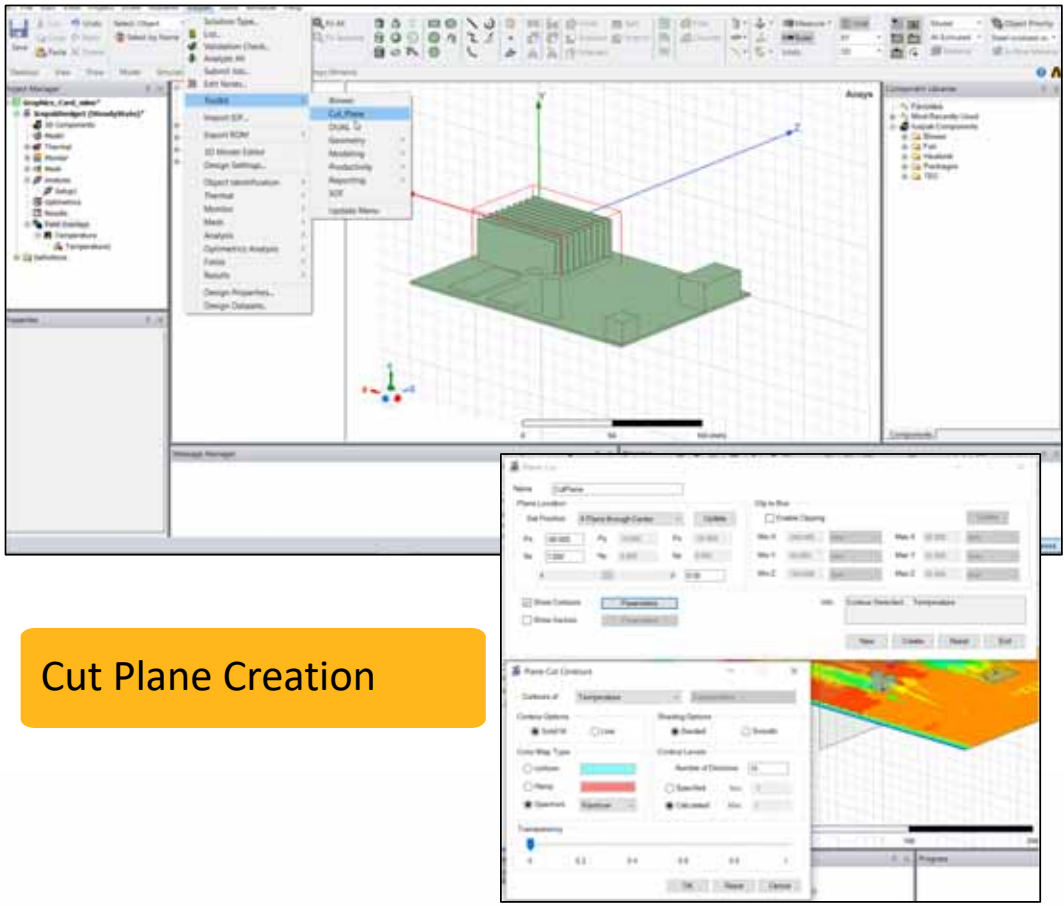


Type 2 Blowers

Post Processing Toolkits

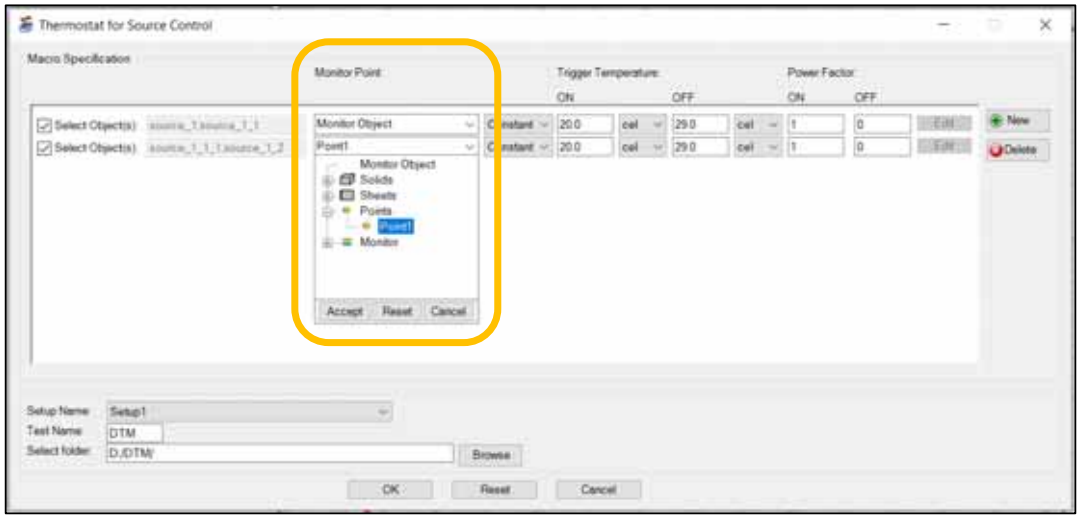


Field Plot ASCII Export

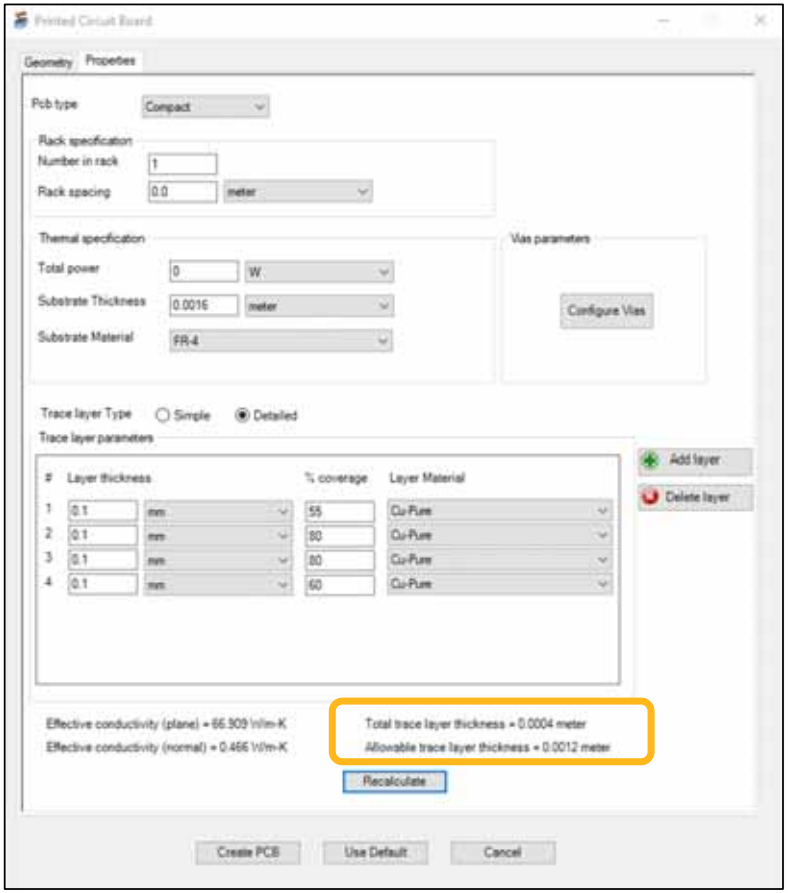


Cut Plane Creation

Other Toolkit Enhancements



DTM Monitor Support

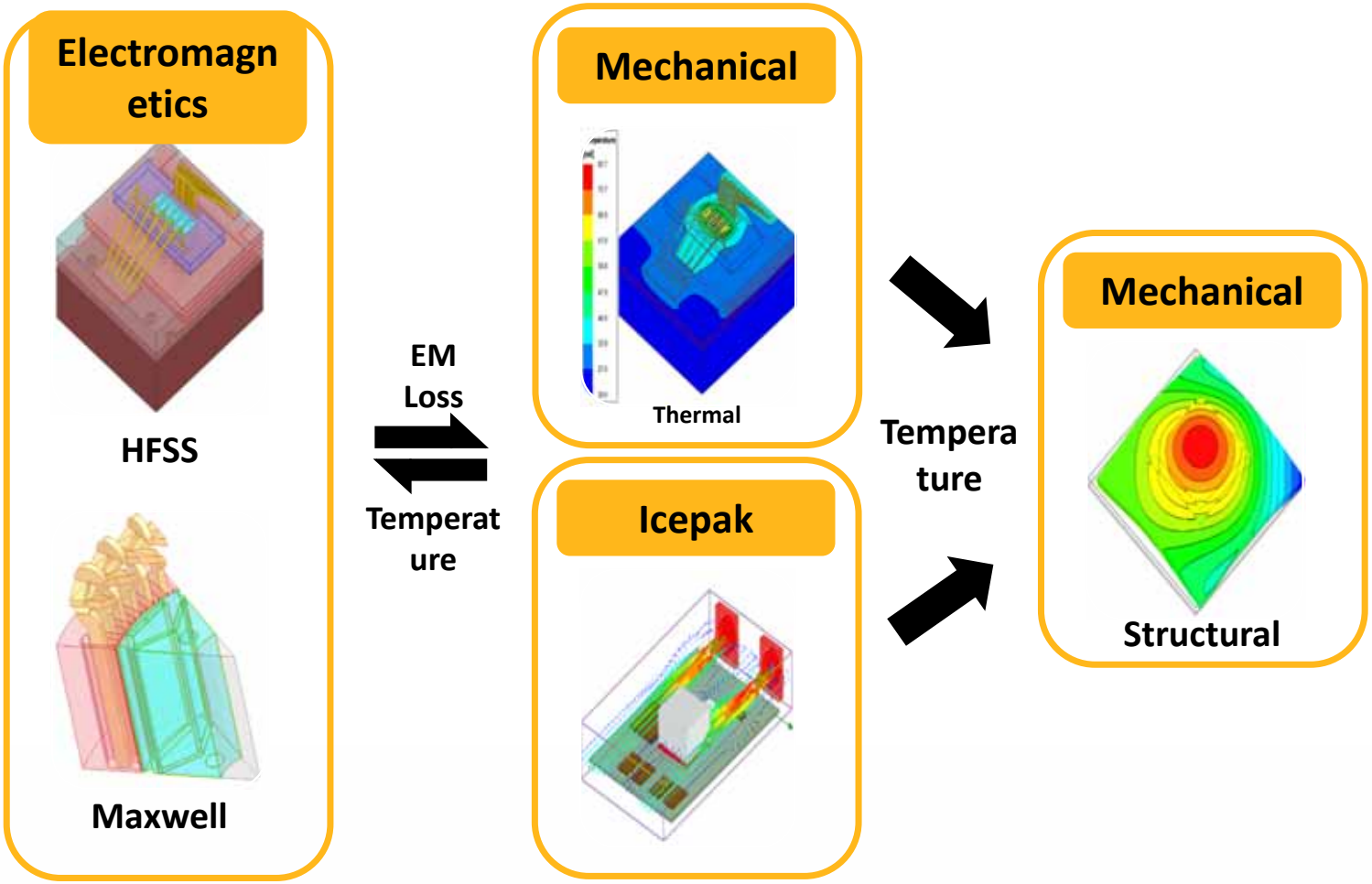


PCB

Mechanical in AEDT

Ansys

Electronics Desktop – Multiphysics Simulation Platform

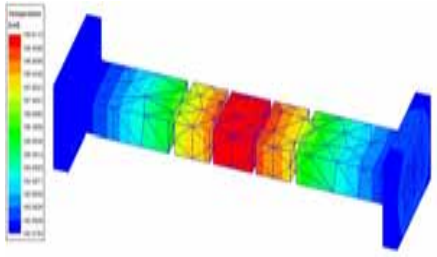


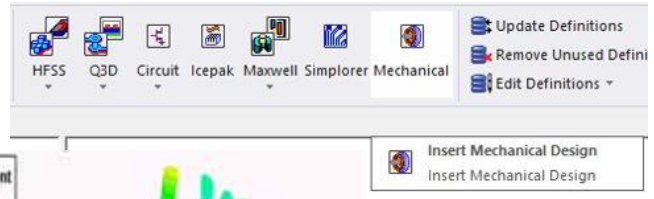
Thermal and Structural Analysis with AEDT

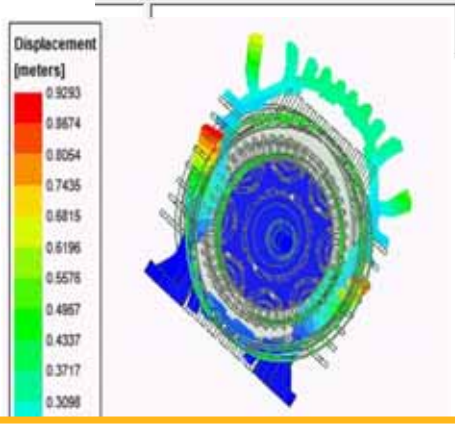
	Icepak	Mechanical – Thermal	Mechanical – Structural
Numerical Method	**F**inite **V**olume **M**ethod (CFD)	**F**inite **E**lement **M**ethod (FEM)	**F**inite **E**lement **M**ethod (FEM)
Analysis	Heat Transfer and/or Fluid Flow	Heat Transfer	Thermo-Mechanical Stress
Domains	Solid, Fluid	Solid	Solid
Input	Temperature, Heat Flow Rate, EM Loss, Flow Rate, Convection etc.	Temperature, Heat Flow Rate, EM Loss, Convection etc.	Temperature Distribution, Mechanical Force, Constraints
Output	Temperature, Heat Flux, Fluid Velocity, Pressure Drop	Temperature, Heat Flux	Displacement, Strain, Stress
License	Electronics Icepak Premium/ Electronics Enterprise	Electronics Icepak Premium/ Electronics Enterprise	Ansys Mechanical PPE

AEDT Mechanical Thermal/Modal

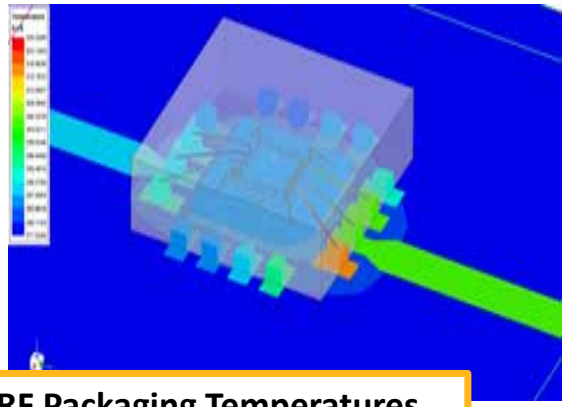
- Included in AEDT Installation
  - No need for separate WB installation
- Compatible with Electronics Pro/Premium/Enterprise HPC
- Windows and Linux
- AEDT user flows
  - MCAD editor
  - 3D Component
  - Scripting, Undo/Redo, Archive, …
  - Mesh
    - Classic/TAU/Phi mesher
    - Easy to use mesh operations
    - Mesh Import from HFSS 3D & Maxwell 3D
  - Optimetrics
  - Post processing







Modal Natural Frequencies Mode Shapes

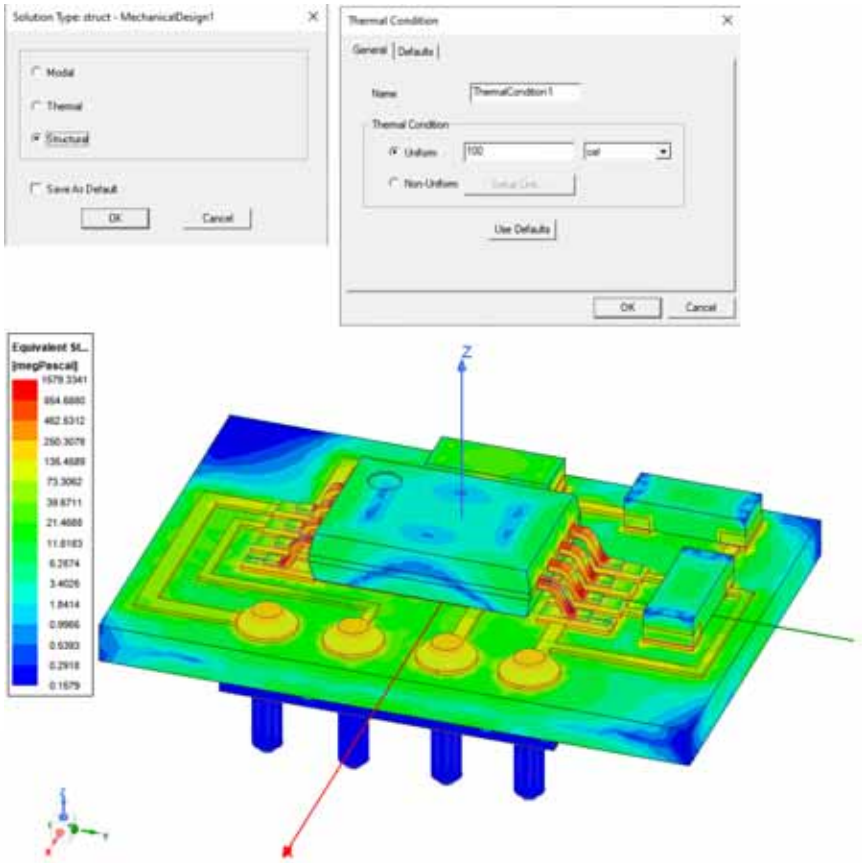


RF Packaging Temperatures

Mechanical Design Type in AEDT

- New Structural Solution type Supported boundaries
  - Fixed support/Frictionless support/Cylindrical support
- Excitations
  - Thermal condition: Uniform/Non-uniform via link to Icepak
- Post processing
  - Displacement/Equivalent stress/Temperature
- Heat Flux Excitation extension
  - Added surface flux input for heat flux
- Temperature Dependent Materials
  - Dataset-based thermal modifiers
    - Thermal/Structural

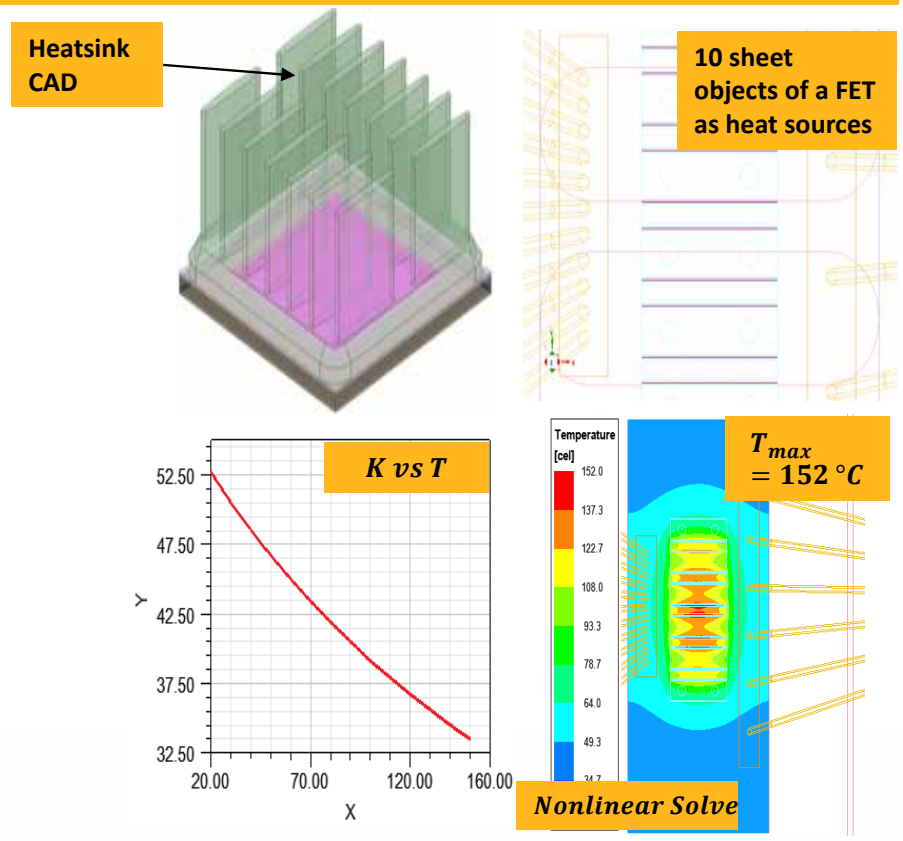
Structural Solution Type



Key Features of AEDT Mechanical – Thermal Solution

- **Geometry Creation and Preparation**
  - AEDT's native CAD Modeler
  - Direct link to SpaceClaim
- **Modeling Objects**
  - Solid and Sheet objects
- **Materials**
  - Temperature-dependent conductivity
  - Isotropic and Anisotropic conductivity
- **Boundaries**
  - Known thermal conditions such as temperature and convection assigned to selected geometry

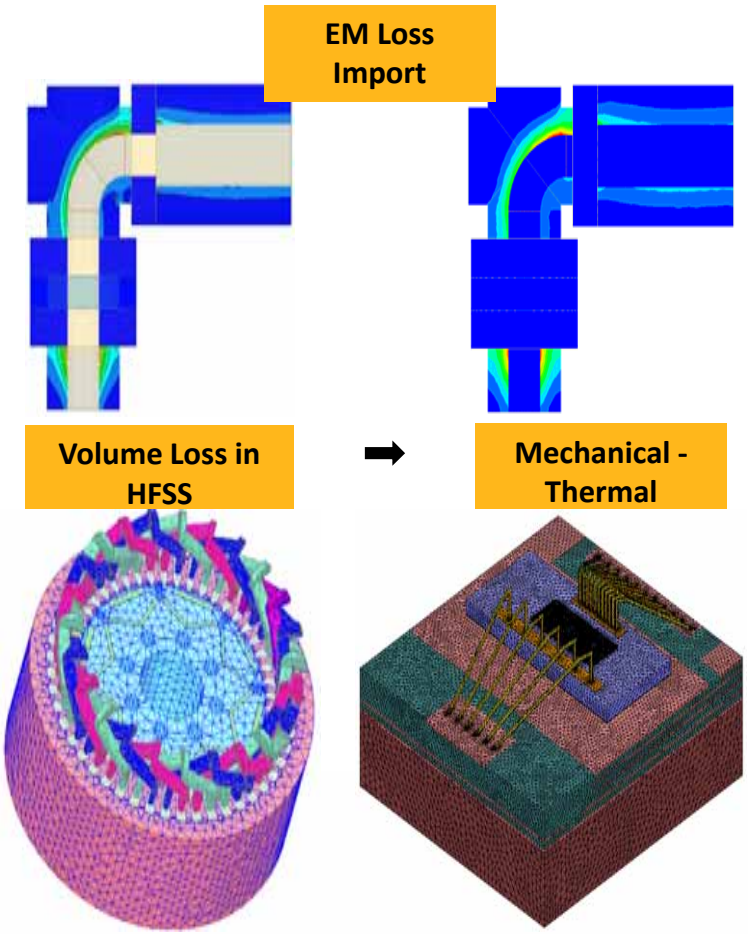
Unified Platform for Electro-Thermo-Mechanical Analysis



Temperature-dependent Thermal Conductivity (K)

Key Features of AEDT Mechanical – Thermal Solution

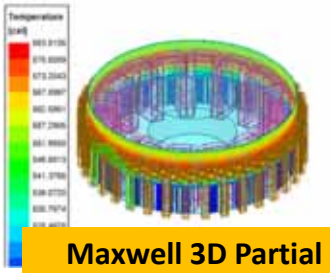
- **Excitations**
  - Electromagnetic Volume/Surface Losses
  - User-specified thermal power
- **Meshing**
  - Mesh import from HFSS 3D and Maxwell 3D
  - Native HFSS Mesher
- **Heat transfer modes**
  - Conduction
  - Convection
- **Analysis**
  - Steady-state
  - 1- and 2-way coupling
- **Optimetrics**
  - **Fast solution using HPC**



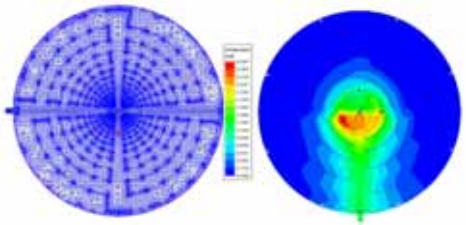
Mechanical Thermal Coupled Applications

Unified multiphysics platform for Electrical Engineers

- Rotating Fluid
  - Electrical machine air-gap modeling
  - Motion effect
  - Equivalent thermal conductivity considering convective heat transfer
- EM Volume/Surface Loss
  - Easy to use multiplier and offset
  - Multiple source designs for 5G and power converter applications
  - Surface loss on sheet object eliminates modeling and meshing challenges
  - Integrated Optimetrics and 2-way coupling
- Icepak Heat Transfer Coefficient
  - Efficient and accurate thermal modeling



Maxwell 3D Partial model simulation compatible

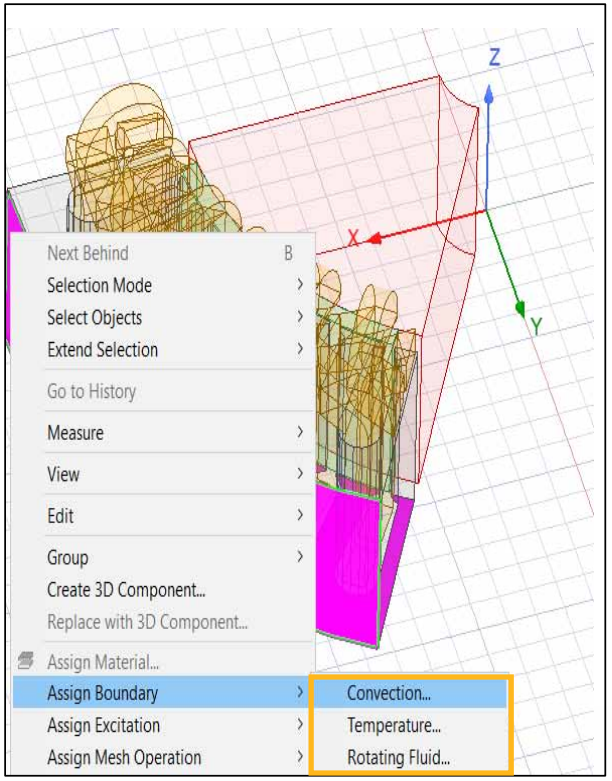


Planar Log-Periodic Antenna EMLoss Mapped

Licensed with Icepak Premium or Electronics Enterprise

Thermal Boundaries

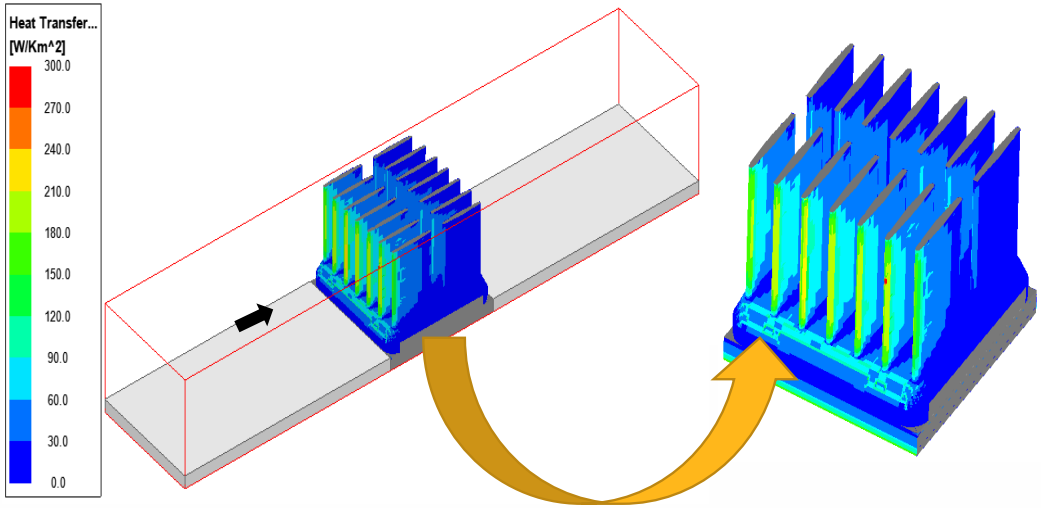
- **Temperature**
  - Assign fixed temperature to entities.
- **Convection**
  - To simulate heat transfer between **faces** of an object and surrounding fluid in motion.
  - Can map non-uniform convective heat transfer coefficients from an Icepak solution.
- **Rotating Fluid**
  - Rotational effects on the heat transfer across the airgap between the rotor and the stator.



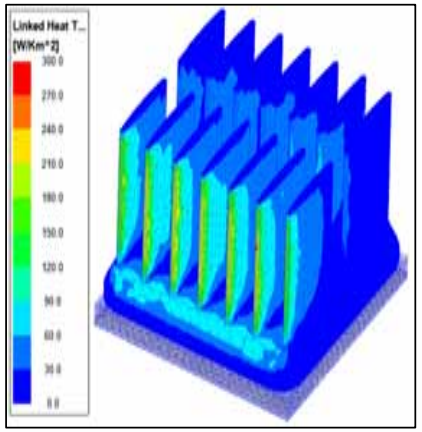
Thermal Boundaries – Non-Uniform Convective Boundary

- Heat flux and temperature at each element face are imported from Icepak into Mechanical – Thermal and the **film coefficients are then calculated in Mechanical.**
- Mapping will be good if the **surface mesh size is similar** between the two designs.

Icepak

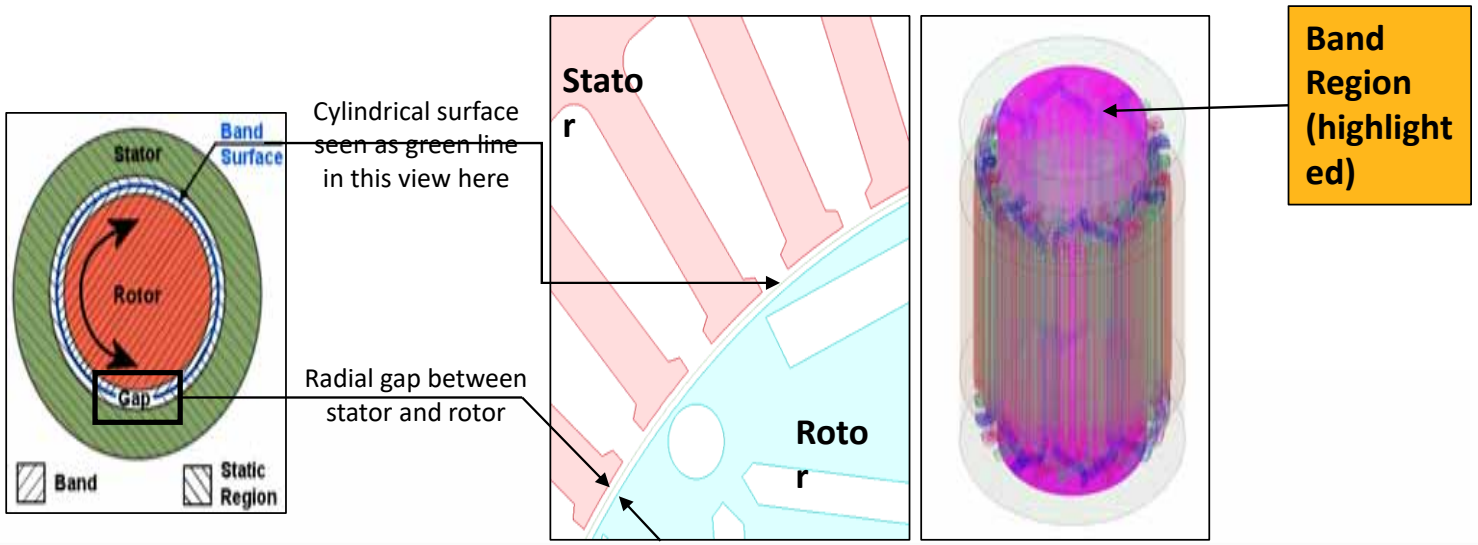


Mechanical - Thermal



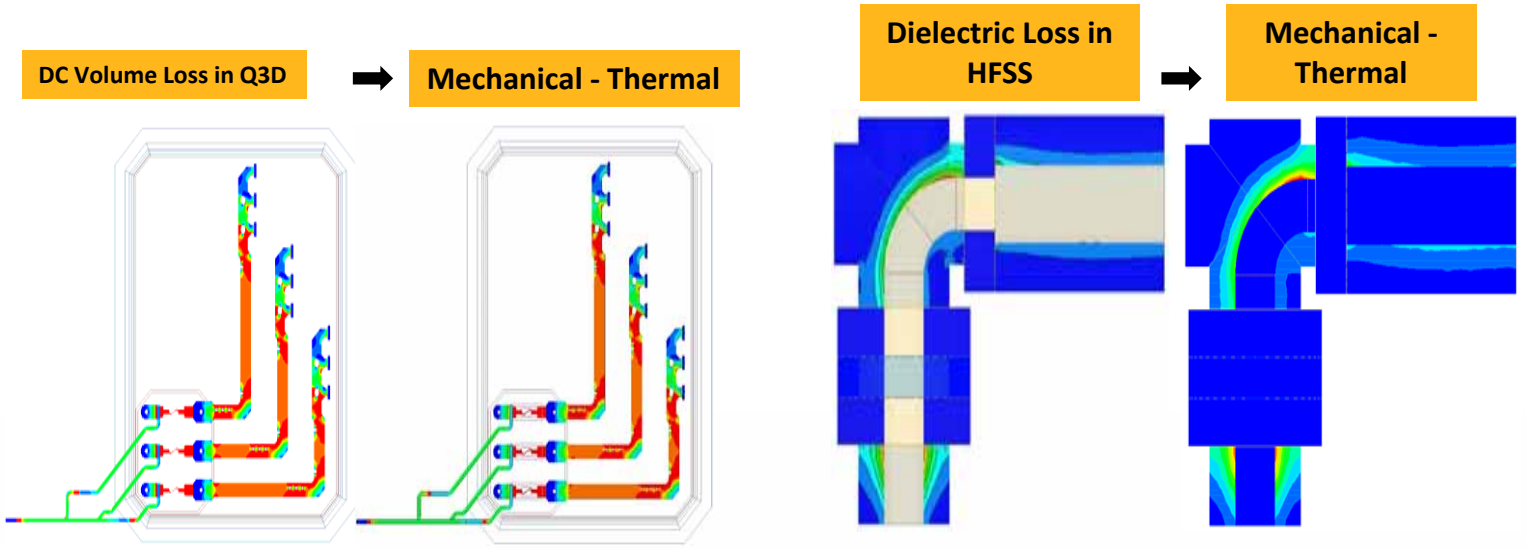
Thermal Boundaries – Rotating Fluid

- Used to account for heat transfer across the gap between rotor and stator.
- Meshing process **internally creates fluid elements** anywhere within this air gap that is not already occupied by solid objects.
- **Thermal conductivity** of the fluid elements in the airgap is calculated internally using
  - gap thickness, rotor speed, axis of rotation and location of rotor relative to stator.



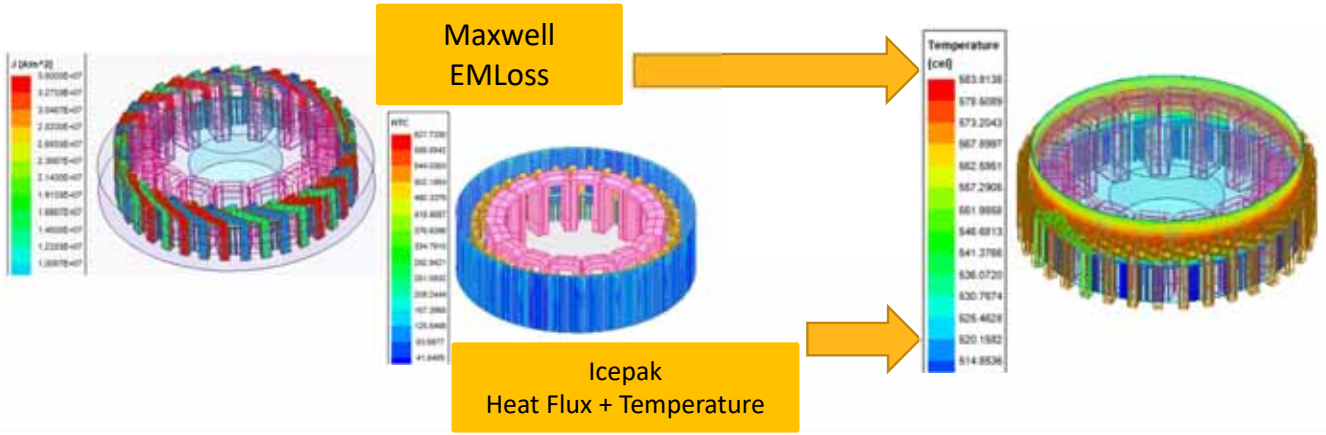
Excitations – EM Loss

- Import electromagnetic losses from EM designs as thermal power excitations into the target Mechanical – Thermal design.
- Can apply multiple EM Loss excitations different EM designs to the same object.
- Similar mesh size between the source and target designs improves the accuracy of the mapping.



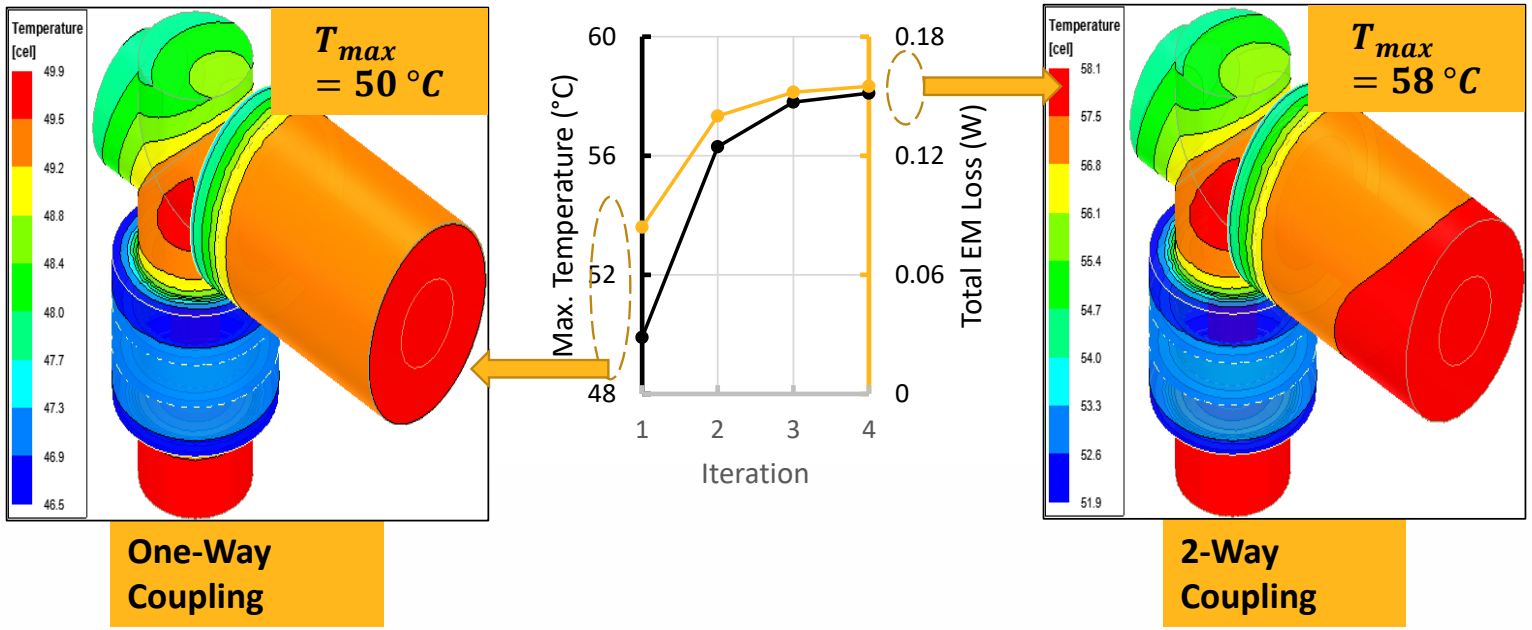
AEDT Mechanical-Icepak Heat Transfer Coefficient Coupling

- Use Mechanical Thermal to model conduction problem
- Use simplified Icepak model to solve fluid flow
- Seamless integration within a single Electronic Desktop



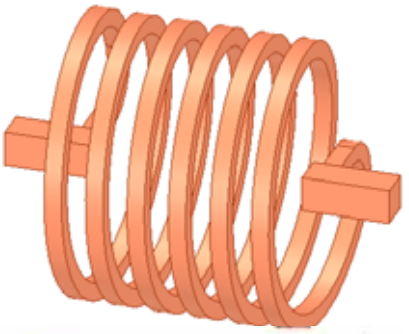
2-Way Coupling – Temperature-Dependency

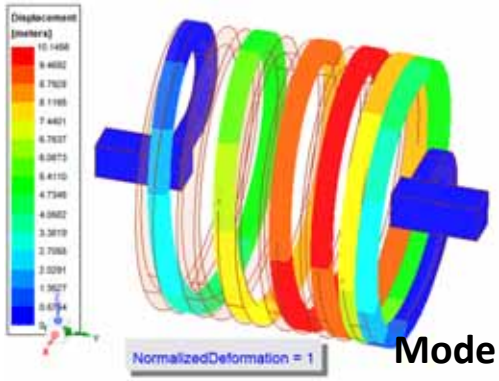
- Coupling for a coax connector between HFSS and Mechanical – Thermal designs.
- Dielectric Loss Tangent and Bulk Conductivity vary with temperature.
- 1-Way coupling underestimates maximum temperature in the resonator by 16%.



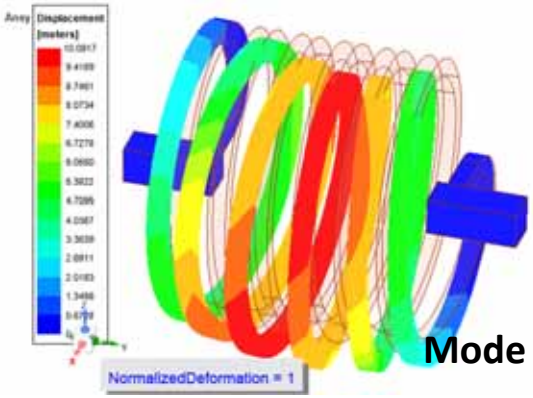
AEDT Mechanical - Modal Solution

- Natural frequencies of vibration, mode shapes, and mass participation.

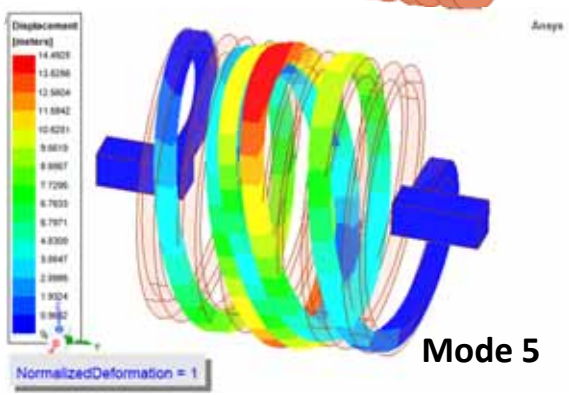




Mode 1



Mode 3



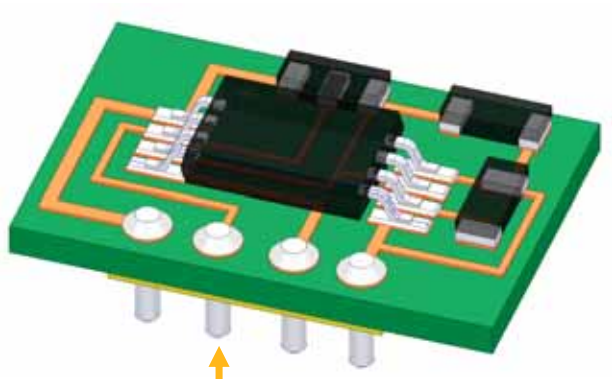
Mode 5

Frequency Table 1 — MechanicalDesign1 — Ansys

	Mode	ModeFreq [Hz] Setup1 : Solution	EffectiveMassRatio_DirX Setup1 : Solution	EffectiveMassRatio_DirY Setup1 : Solution	EffectiveMassRatio_Di... Setup1 : Solution	EffectiveMassRatio_RotX Setup1 : Solution	EffectiveMassRatio_RotY Setup1 : Solution	EffectiveMassRatio_RotZ Setup1 : Solution
1	1	97.91	0.000000	0.671600	0.003012	0.000022	0.002413	0.000004
2	2	118.69	0.000000	0.002193	0.002628	0.000019	0.806151	0.007077
3	3	152.40	0.563900	0.000000	0.000011	0.016727	0.000000	0.004037
4	4	153.51	0.000010	0.001825	0.596489	0.004176	0.000204	0.001094
5	5	186.92	0.012299	0.000000	0.000001	0.183131	0.000000	0.000024
6	6	193.00	0.000001	0.000068	0.011345	0.000141	0.002051	0.450220
7	7	196.76	0.015045	0.000000	0.000001	0.280516	0.000000	0.000304
8	8	232.09	0.001376	0.000000	0.000000	0.004489	0.000000	0.000009

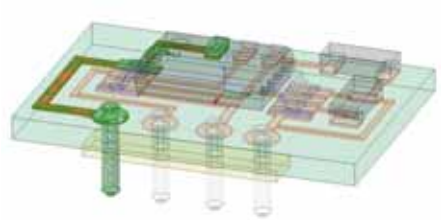
Electro-Thermal-Stress Workflow

- Coupled Thermal Stress Analysis
  - Linked to Icepak design
  - Temperatures imported for objects
    - System Coupling mapper
- Temperature plotting enabled



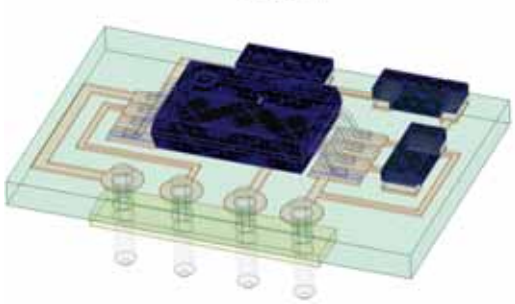
Fixed Support
Icepak Thermal Load

Ansys
ICEPAK



2A DC Current Excitation
DC-RL Solver

Ansys
Q3D EXTRACTOR

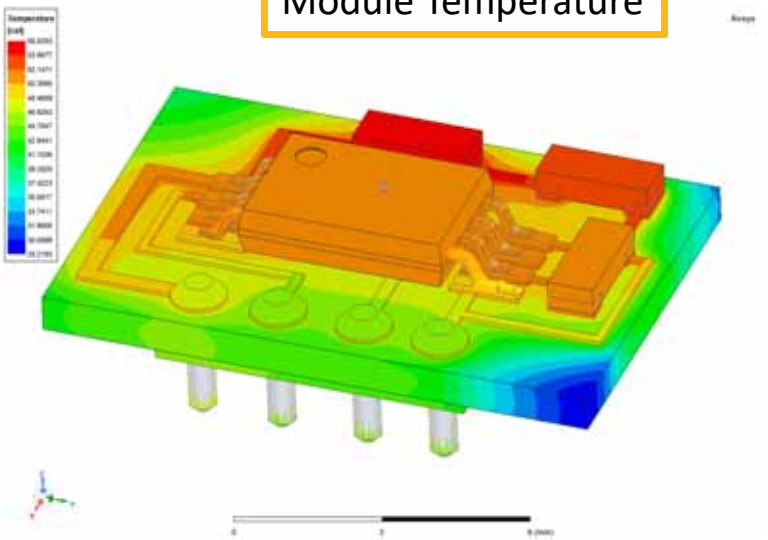


50, 25, & 40 mW Sources
Q3D EM Loss

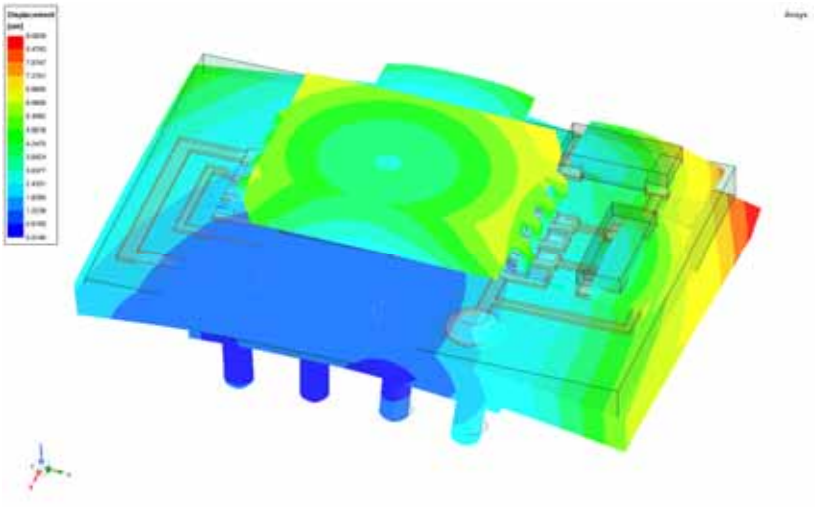
Ansys
MECHANICAL

Electro-Thermal-Stress Workflow

Module Temperature



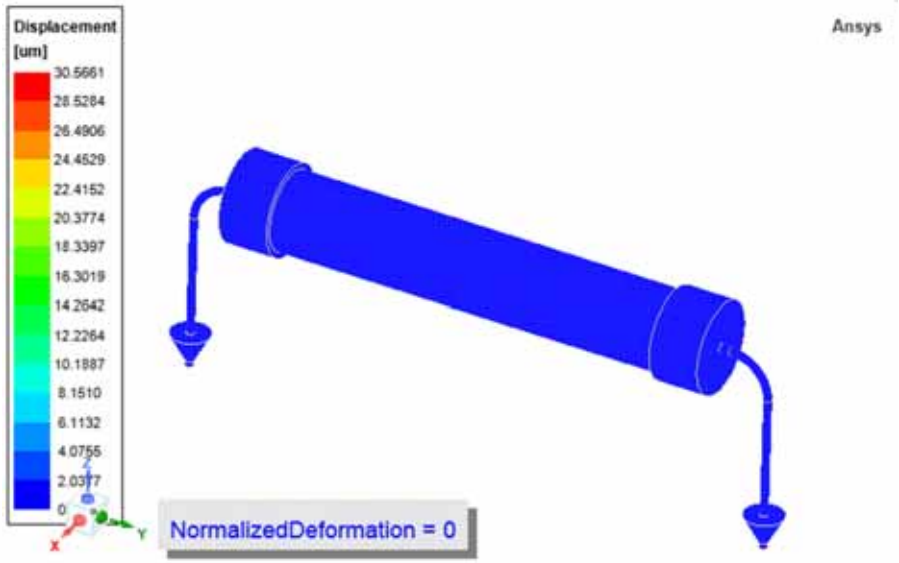
Displacement

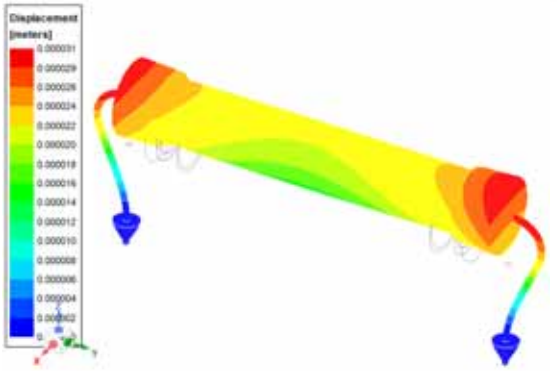


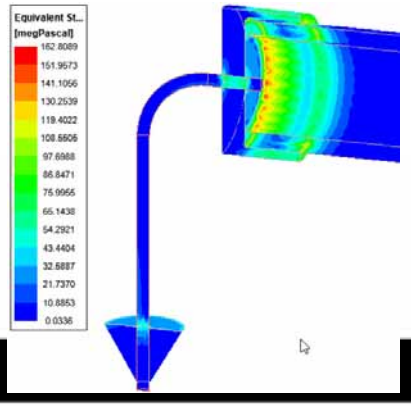
AEDT Mechanical - Structural

- **Displacement and stresses caused by thermal expansion**

Power Resistor

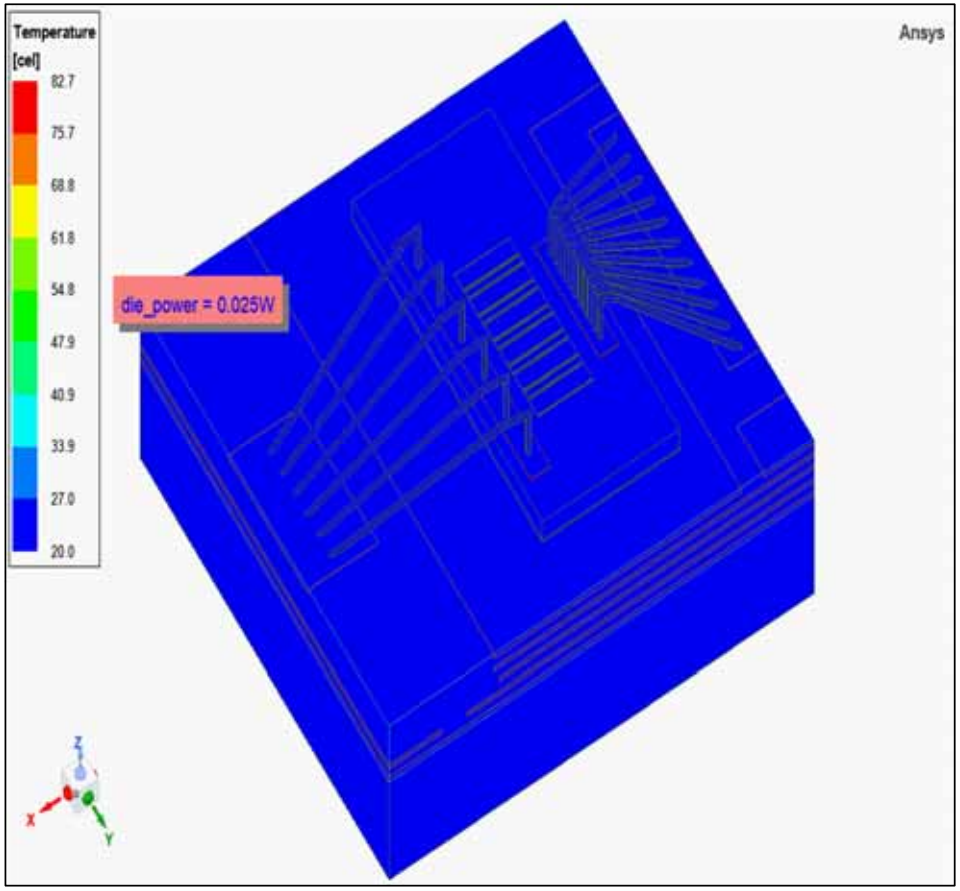






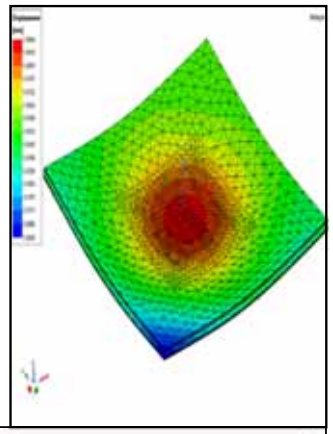
Case Study: Thermal Analysis of Die-Level Packaging

- **Parametric sweep** of power dissipation.
- Power dissipation of the active area is assigned to the sheet objects using excitation of type **Heat Flux**.
- Bottom face of the heatsink is assigned a fixed **Temperature** to model dissipation.
- To resolve objects with different length scales and contact areas, several **length-based mesh operations** are defined.
- **Field Calculator** is used to analyze various thermal paths linking the source to sink.

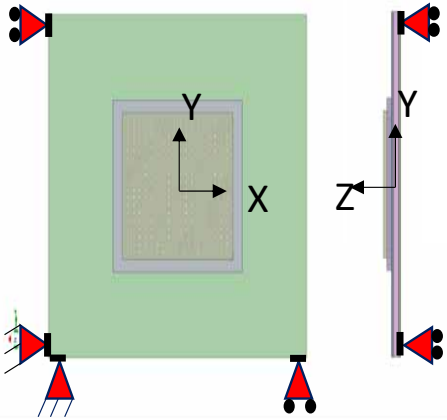


AEDT Mechanical – Structural Simulation

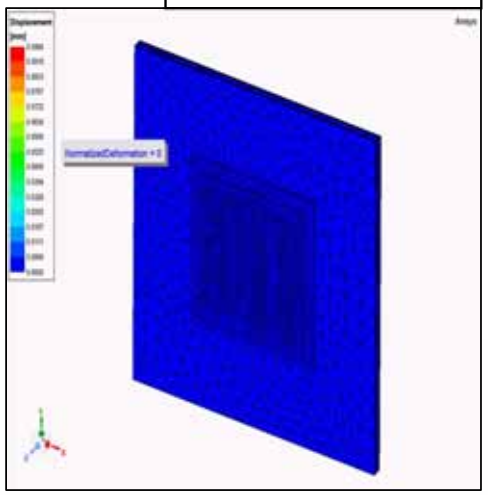
- Predict out-of-plane deformation (warpage) in a package due to disparities in the thermal expansion of the materials
  - Boundary Conditions
    - To constrain rigid body displacement
  - Excitation
    - ramp up temperature of all the components from 25 °C to 220 °C



Displacement Constraints

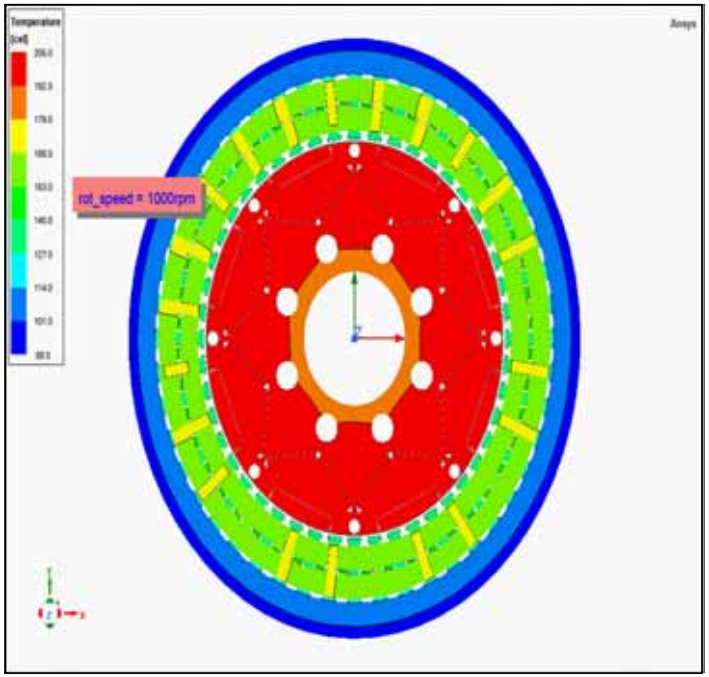


Temperature Ramp-up



Case Study: Thermal Analysis of Electric Motor

- **Parametric sweep** of rotor speed.
- **1-way linking** with Maxwell 3D analysis.
- Copper, Iron and Magnet **losses mapped** from the Maxwell 3D design.
- **Convective boundary** is defined on the external cylindrical face of the stator and flat faces of rotor and shaft to model dissipation to the ambient.
- Effect of rotor speed on the convection in the gap between the rotor and stator is modeled using **Rotating Fluid boundary**.
- Thin air gap is resolved with additional layers through mesh refinement technique of **Cylindrical Gap Treatment**.



CADMEN
Taiwan Auto-Design Co. (TADC)
虎門科技股份有限公司

×

SUPERMICRO

NVIDIA QUADRO RTX 4000

即時即刻加速改變

透過 GPU 加速光線追蹤、深度學習和進階著色，滿足現今嚴苛的專業工作流程需求。採用 NVIDIA Turing™ 架構和 NVIDIA RTX™ 平台的 NVIDIA® Quadro RTX™ 4000，提供單插槽 PCI-e 尺寸同級最佳的效能與功能。加速獲得深入分析和解決方案的時間，以前所未有的方式設計與創造。

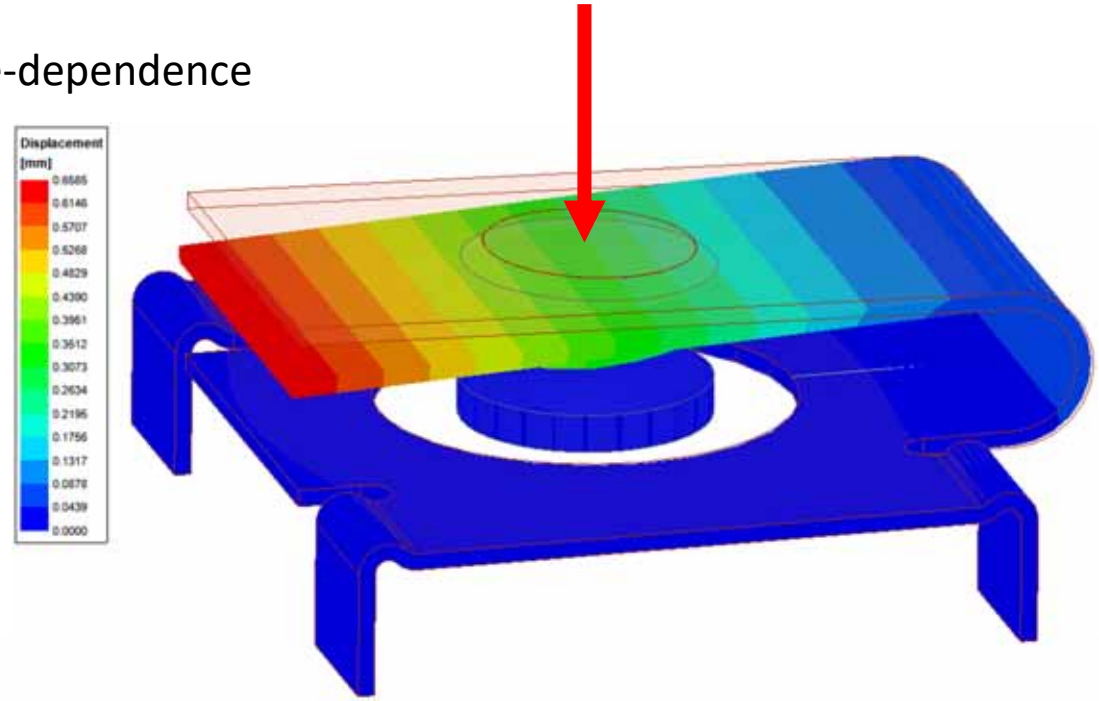
立即購買

最佳CAE運算設備供應商
-請洽虎門科技業務團隊-


Ansys

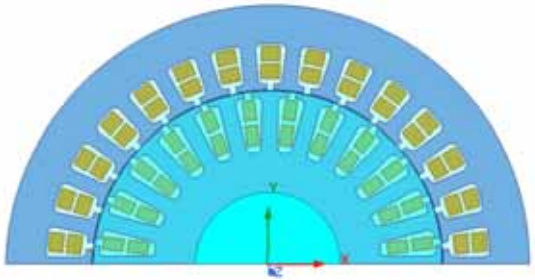
Mechanical 2022R1 Highlights

- Coupling
  - Maxwell 2D – Thermal EM Loss Coupling
- Materials
  - General expression support for temperature-dependence
- Structural - Beta
  - Boundaries
    - Displacement
    - Pressure/Force
  - Coupling
    - Mechanical Thermal-Structural Link
    - EM Force – Structural Coupling
- Meshing - Beta
  - Thermal Slider bar Meshing
- Reporting
  - Fields Summary

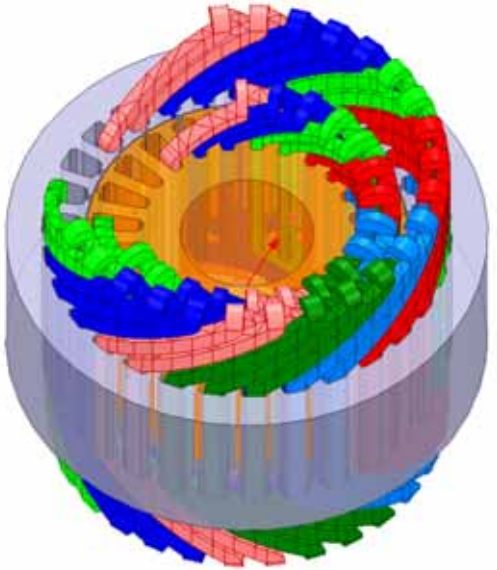


Maxwell 2D – Thermal EM Loss Coupling

- Support EM Loss Import from Maxwell 2D
  - Extruded geometries of 2D representations
    - Support both +ve and –ve extrusions in XY
    - Can be partial geometries
  - Coupling projects 3D mesh points onto 2D geometry
  - Limitations
    - Extrusions need to be along Z axis
    - Losses not conservative
    - 2-way coupling not supported



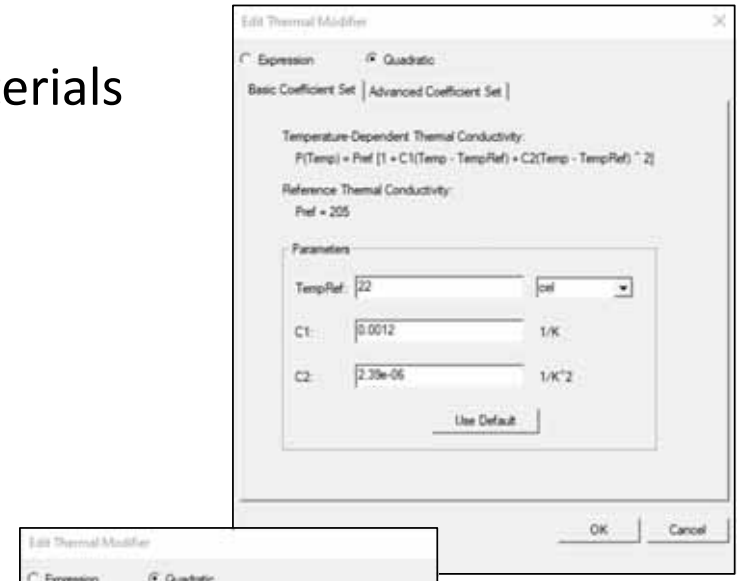
Maxwell 2D Geometry

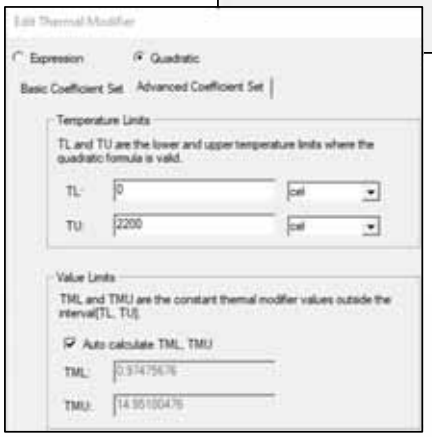


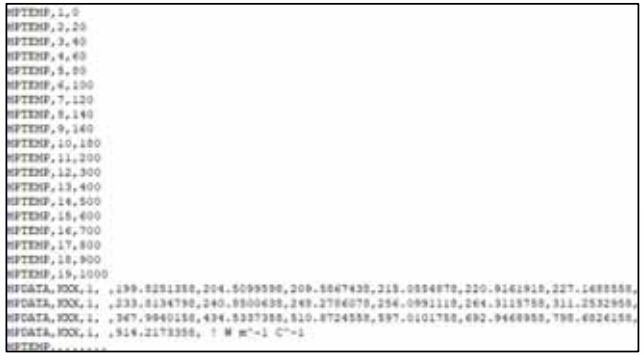
Thermal 3D Geometry

Temperature-Dependent Materials

- Temperature Dependent Materials
  - General expression support
  - Quadratic expressions
    - Advanced coefficient support
  - Converted to datasets for solver
  - Thermal & Structural

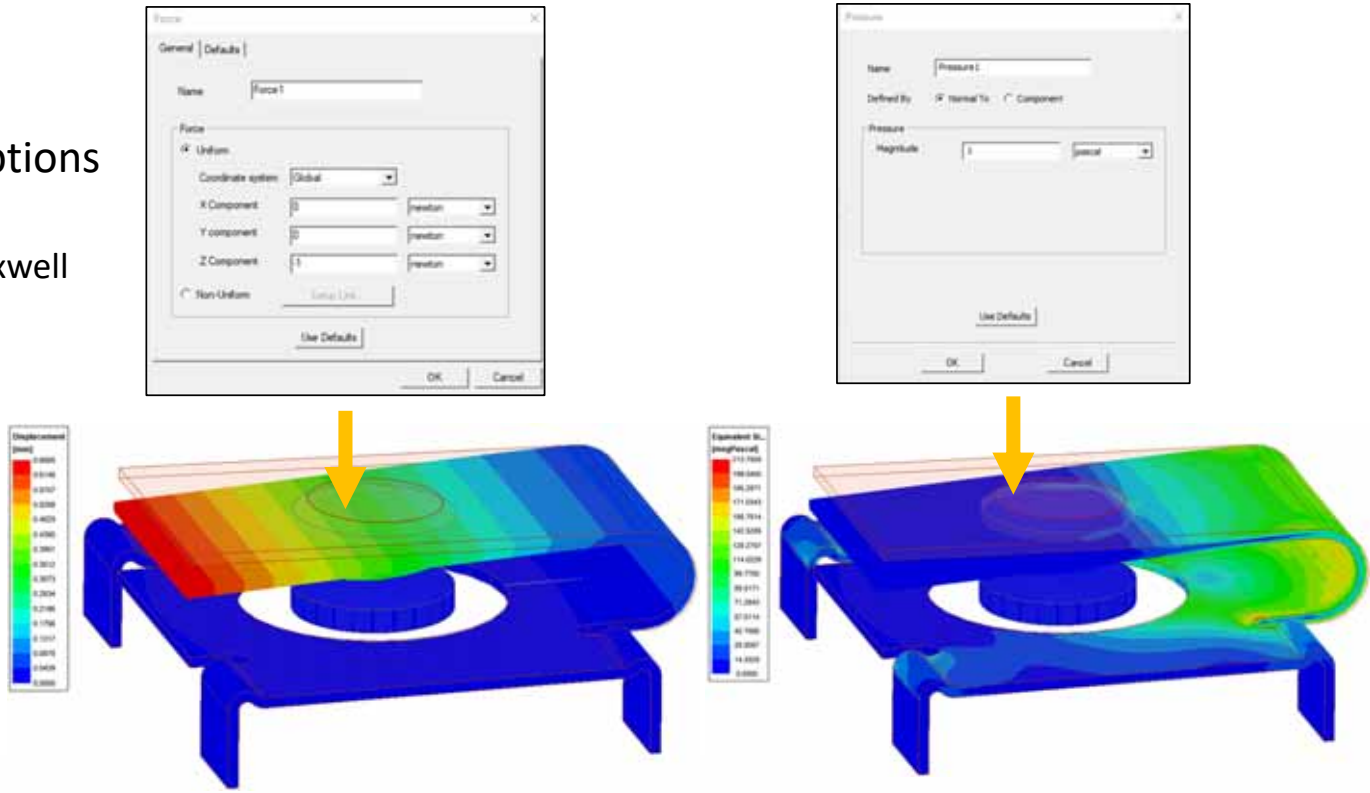






Mechanical Structural - Pressure/Force Excitations

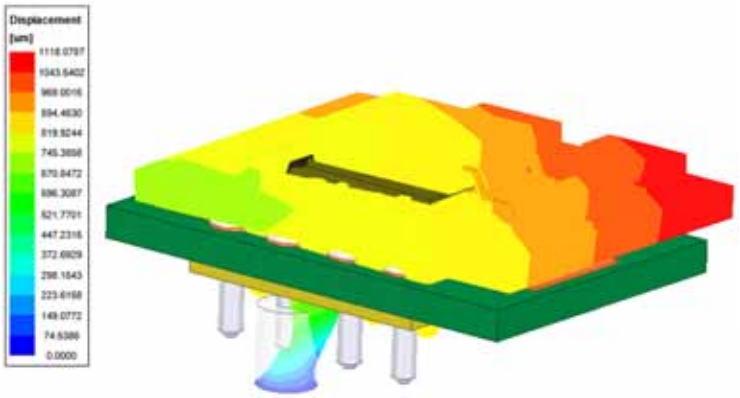
- Force Excitation
  - Face and Object assignment
  - Uniform and Non-uniform Force options
    - Uniform (face): X, Y, Z components
    - Non-uniform via Setup Link to HFSS/Maxwell
- Pressure Excitation
  - Face assignment
  - Normal To or Component options
    - Normal To: Magnitude
    - Component: X, Y, Z components
  - Support curved faces



Assembly under 1N vertical force

Structural - Displacement Excitation

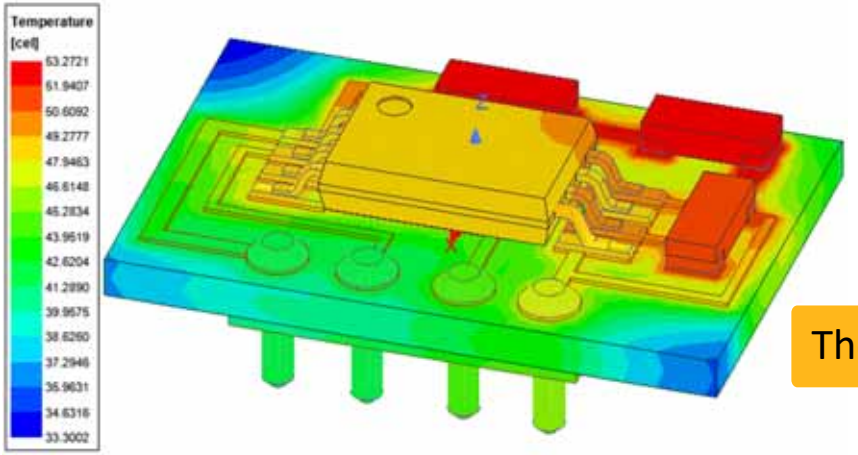
- Displacement Excitation
  - Assignment: Faces and Edges
  - Normal To (faces)
    - Magnitude
  - Components (faces and edges)
    - X, Y, Z components
    - Each component can be fixed magnitude or free



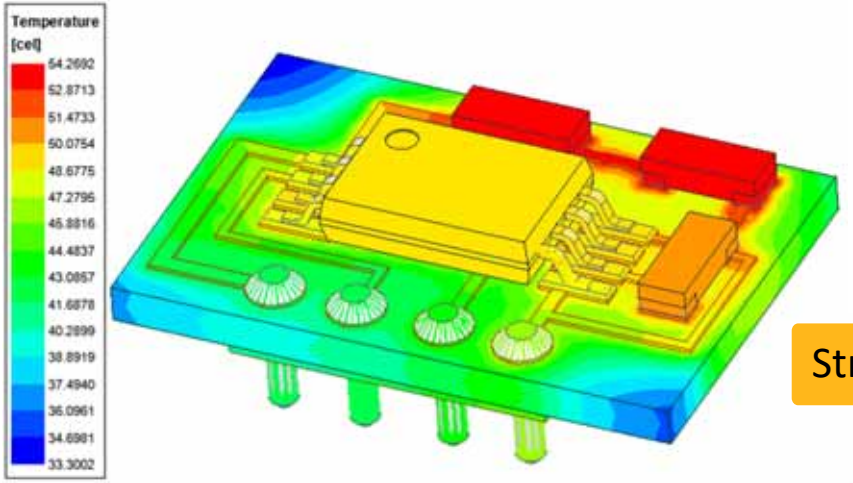
PCB Assembly with Y, Z displacements along edge

Thermal Stress Analysis - Link to Mechanical Thermal

- Coupled Thermal Stress Analysis
  - Linked to Thermal design
    - Thermal condition excitation
  - Temperatures imported for objects
    - System Coupling mapper
  - Temperature field plots



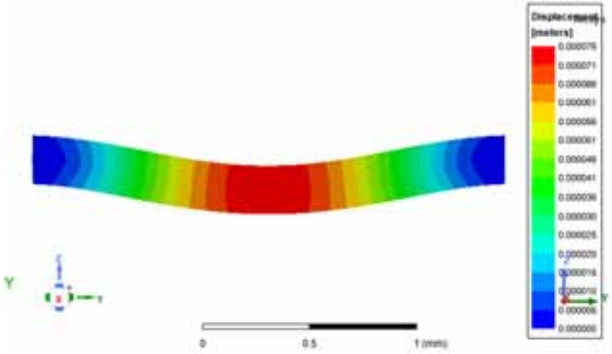
Thermal



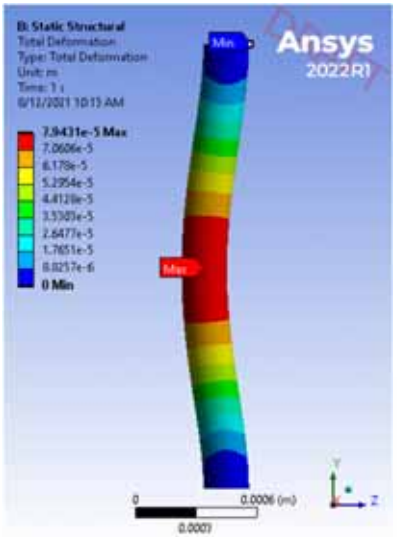
Structural

EM Force – Structural Coupling

- Coupled EM Force - Structural Analysis
  - Linked to Maxwell 3D
    - Surface and Volume assignment
  - Linked to HFSS
    - Surface assignment
  - Assignment: Faces and Objects
  - 1-way coupling support



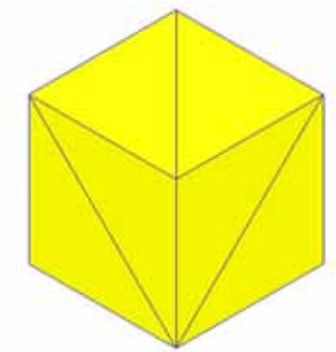
AEDT

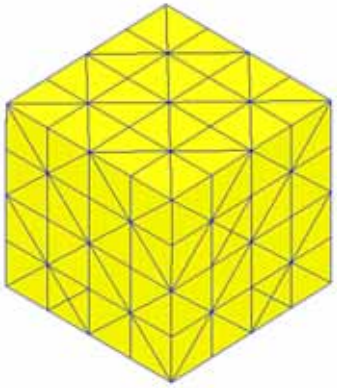


Workbench

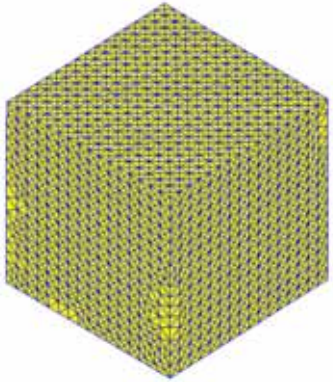
Automated Slider-bar Meshing – Mechanical Thermal [Beta]

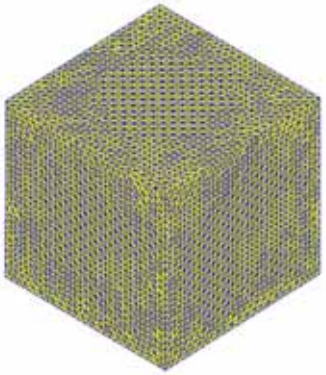
- Automated refinement based on slider position
  - Length-based refinement inside and on surfaces of all objects
  - Refinement tailored to curvilinear and rectilinear geometries
- Restrict the need for user-defined mesh operations
- **Improved solution accuracy**





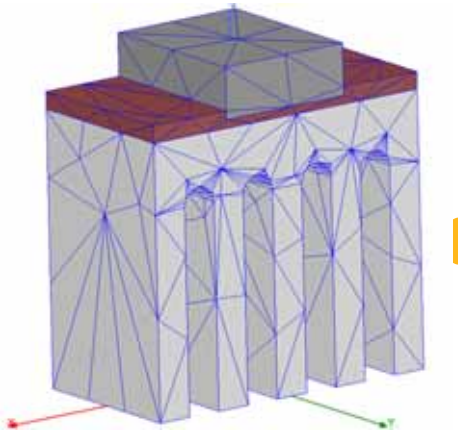
2021R2 (All slider positions)



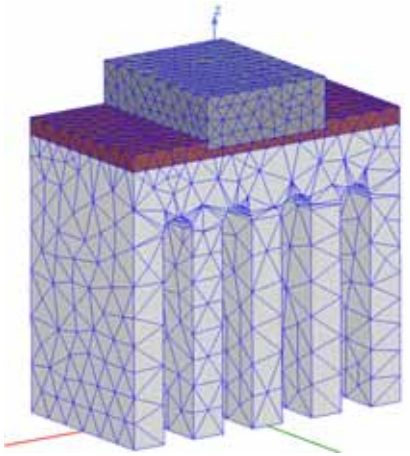


2022R1 Auto refinement

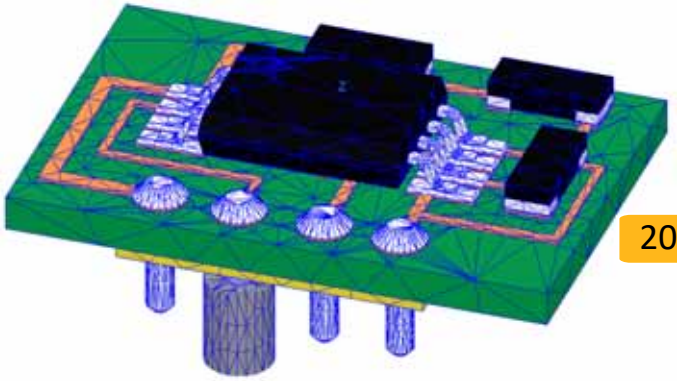
Automated Slider-bar Meshing – Mechanical Thermal [Beta]



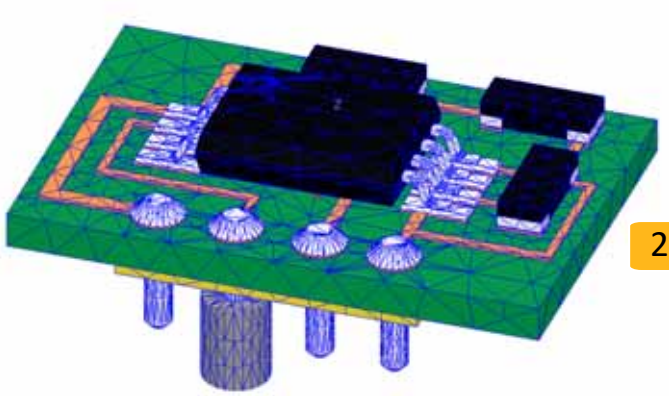
2021R2 (Count: 2k)



2022R1 (Count 11k)



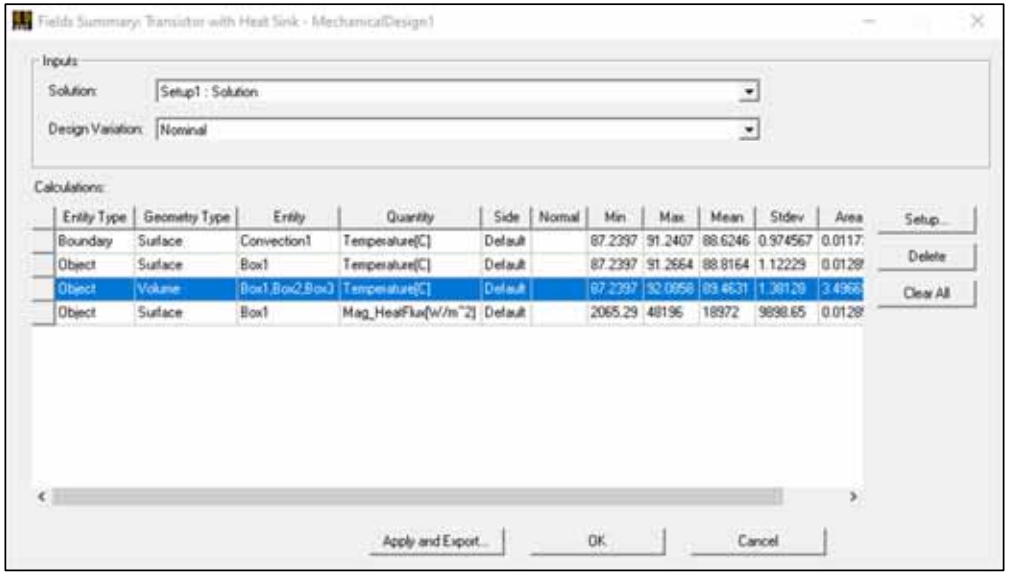
2021R2 (Count: 13k)



2022R1 (Count 14k)

Fields Summary

- User-friendly report calculation capability
  - Supports all Fields Calculator variables
  - Boundary and Object selection
  - Surface and Volume calculations
  - Min, Max, Mean, Standard Deviation, Total**
  - Multi-select and multiple calculations
  - Export to CSV format



** Total and Heat Flow Rate available for Objects, but not boundaries


Ansys