# VIAS3D – Modeling and Simulation Partner

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https://vias3d.com/
https://vias3d.com/services/scientific-simulation/high-tech/

# Who We Are

- Multiple Industry Experience – Hi-tech, CPG, Oil & Gas, Petrochemical & Process, Nuclear, Aerospace, Medical Devices, Machinery & Equipment, Manufacturing and Automotive

- Global Presence: USA (HQ), CANADA, INDIA, MEXICO, and TURKEY

- Global team of +190 professional with Engineering Consulting team consisting of +40 professional with majority having PhDs and MSc/MTechs with expertise in Design & Manufacturing, Structural & Solid Mechanics, Fluid Mechanics, Electromagnetics, Optimization & Reliability, Data Analytics, System Architecture, Bioscience and Materials, Automation, ..

- Dassault Systèmes Platinum Partner – Global Presence – Part of DS Advisory Group

- Provide Engineering consulting & technical resource augmentation, PLM implementation, Training, Software Sales and Support, Automation and Customization
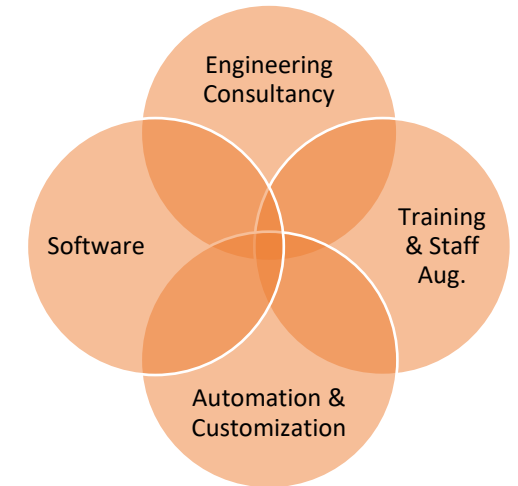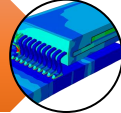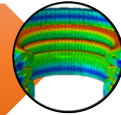
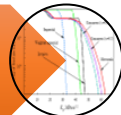# FEA, CFD,EMAG and Design Capabilities

Component Design

Structural Analysis
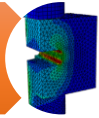
Electronics Packaging

Fracture and Damage

Nonlinear FEA

Fatigue and Vibration Analysis

Optimization and Reliability

Simulation Automation

Flow, Heat Transfer and Thermal Analysis
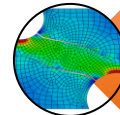
**Acoustic Modeling**

Heat Exchangers
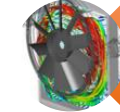
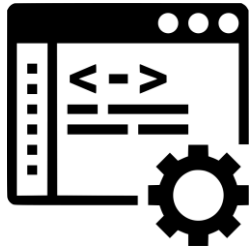Battery Thermal Management

EMI/EMC
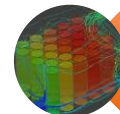
Signal Integrity (SI)/Power Integrity (PI)
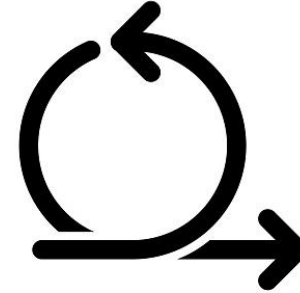
Optical Components

Machining

# Engagement Overview

**Methodology Development**
- R&D+I
- Technical deep dive in nature of problem
- Modelling validation

**Development of iterative processes**
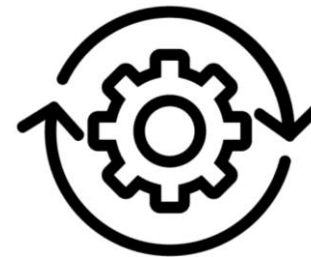- Optimization
- Material calibration

**Training and Knowledge-Transfer**
- Standard Training - Basic and Advanced
- Industry Customized
- Project-based – Execute, Train, Hand-over and Quality watch

**Support to perform MODSIM work**
- Regular projects
- Overflow work
- Urgent needs
- Dedicated Support / On-site / FTE
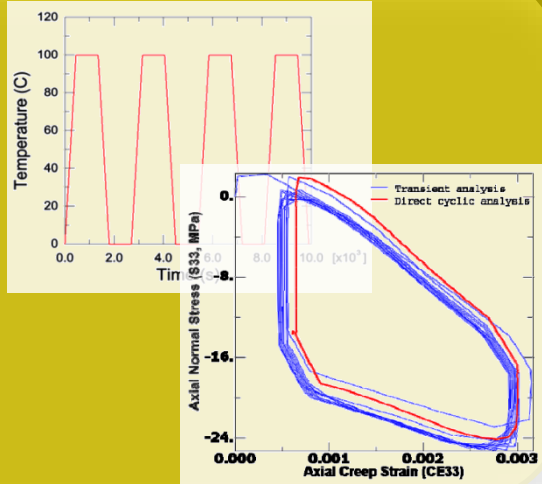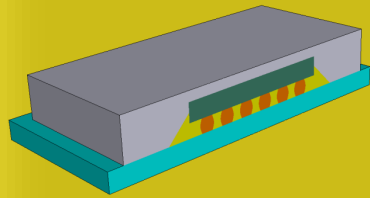- Implementation, On-boarding, and Maintenance

**Democratization**
- Automation (GUI) and templatization
- Web App Solutions
- 3DX Workflow Development
- Best practices + data management on 3DX
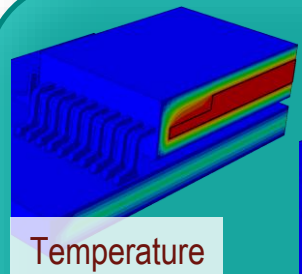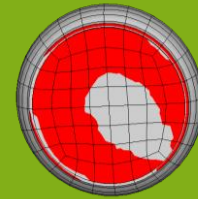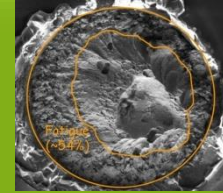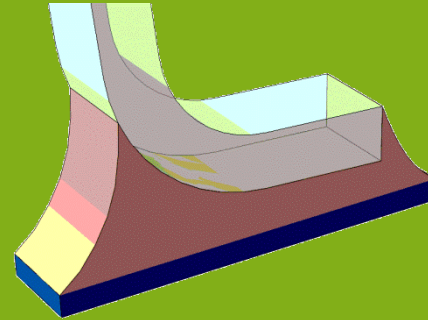- Add-ons
- Automatic Reports

# Thermal-Structural Analysis

# Thermal Analysis
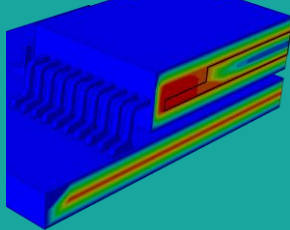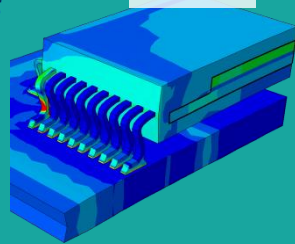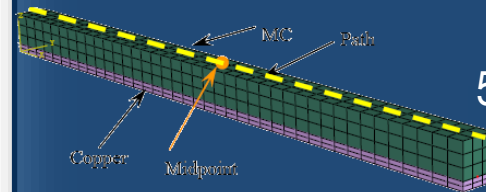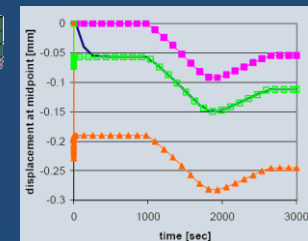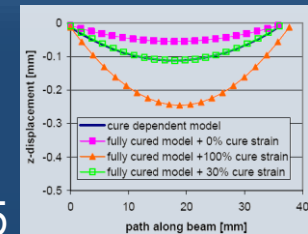
# Vibration, Wear and Acoustics



**Vibration**

**Wear**

**Thermal/Electrical**

263
267

245
269

Relay lead
148.5°C
0 V

289
287

290
285

Terminal
114°C
16 A
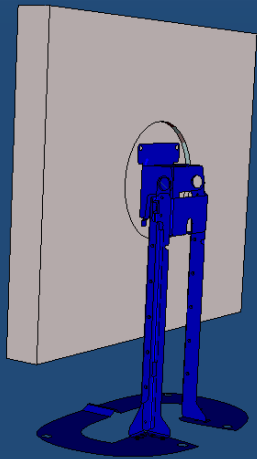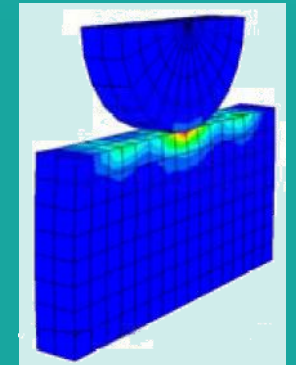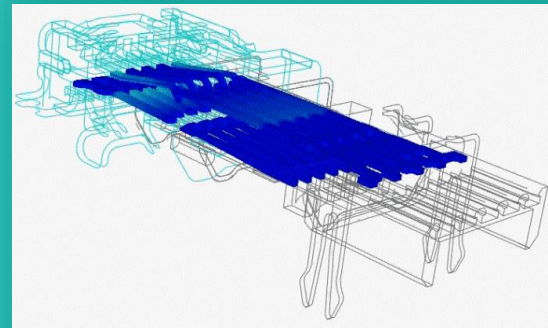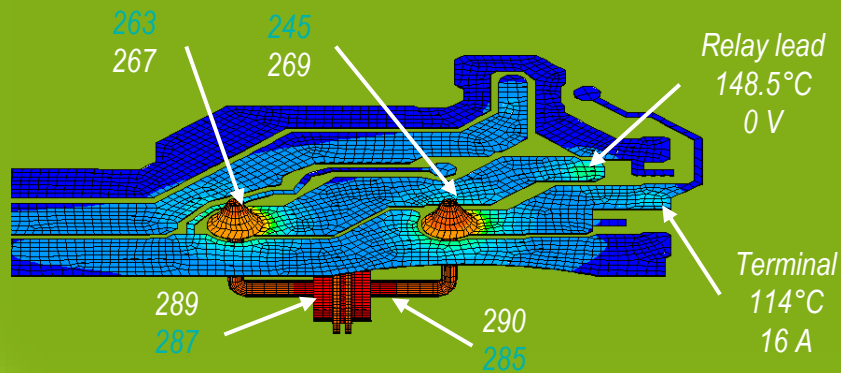
**Acoustics**

Verification of model - Sound pressure level in 2cc coupler

dBSPL Measured
dBSPL Simulated
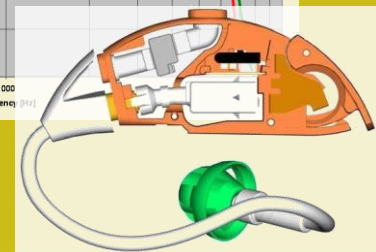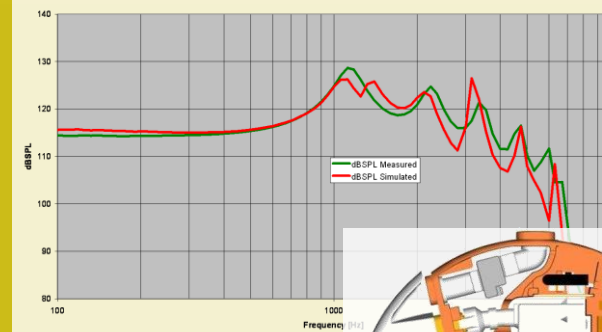
# Structural Strength of Electronic Equipment

**Assembly stress**
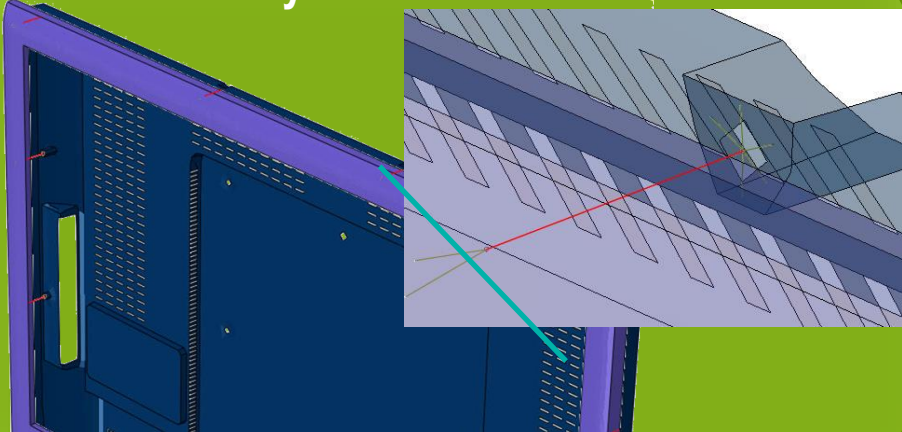


**Mechansims**
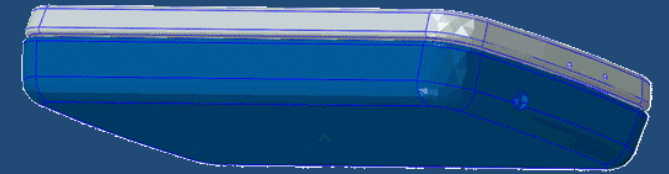


**Cable fatigue**
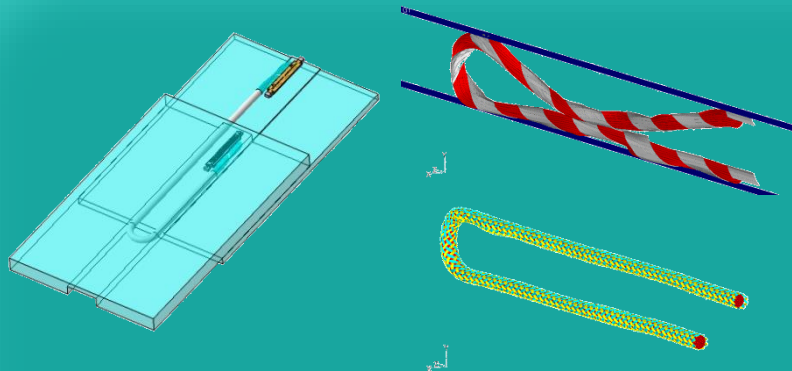


**Structural load cases**
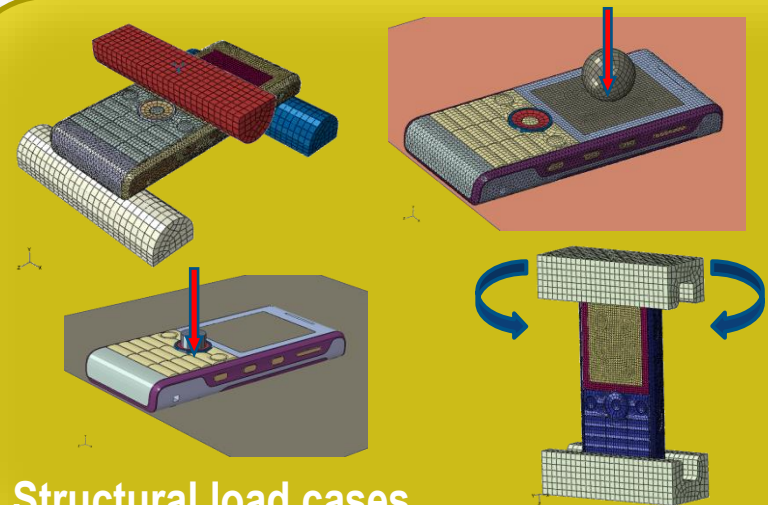
# Drop Test

Phone
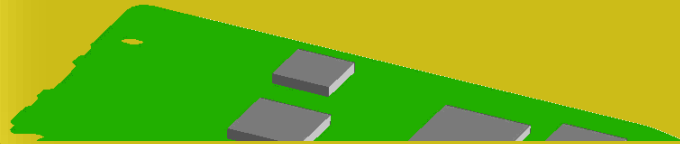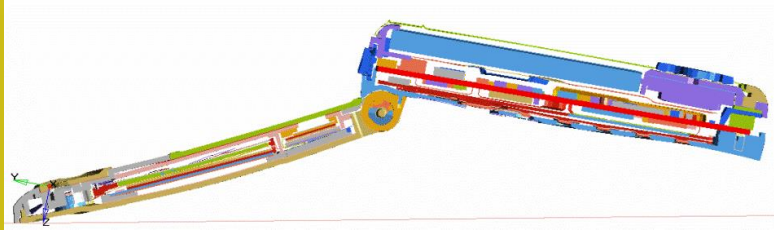
TV
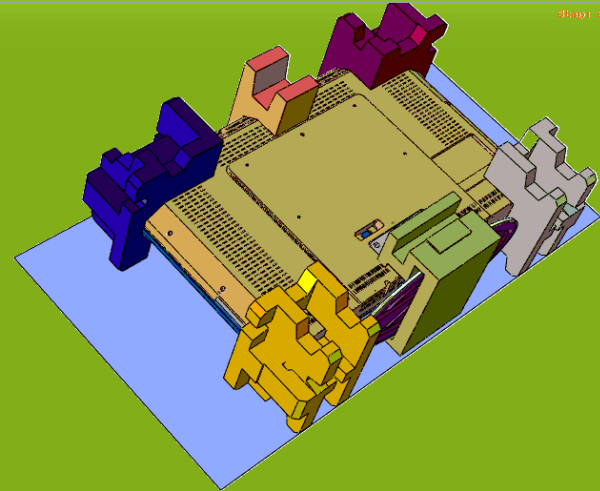
Digital camera
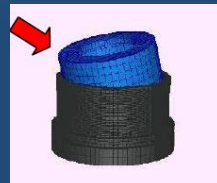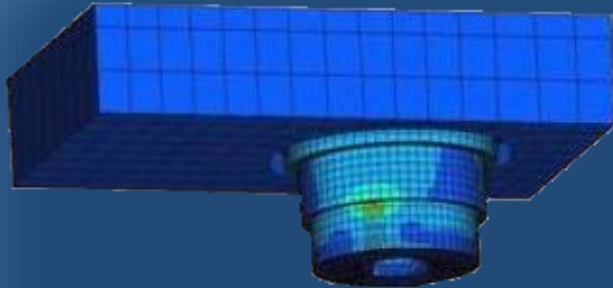
Laptop
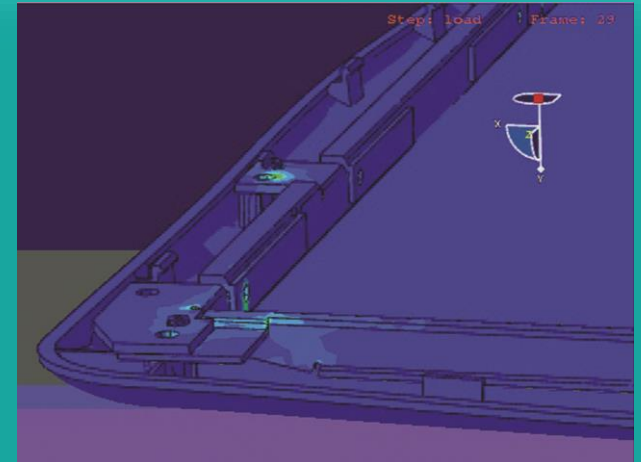
# Fracture & Failure Analysis

# Semiconductor Analysis

- Abaqus/CAE analysis for Semiconductor

  - Geometry import or build native

  - Patterning

  - Fracture mechanic meshing

  - Minimizes need for input file editing

  - Customization/automation

  - Material Subroutines

  - Drop and Impact
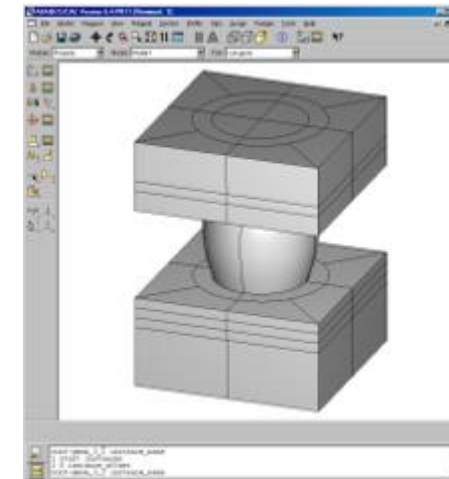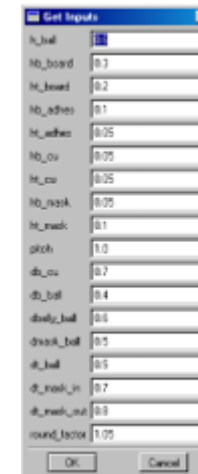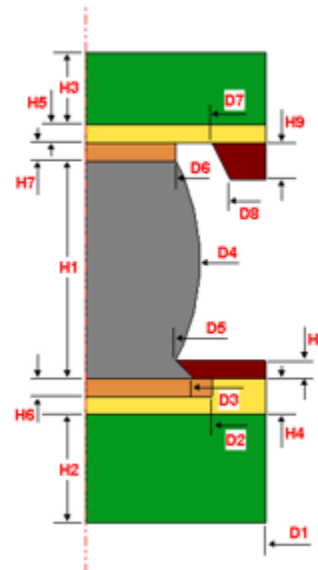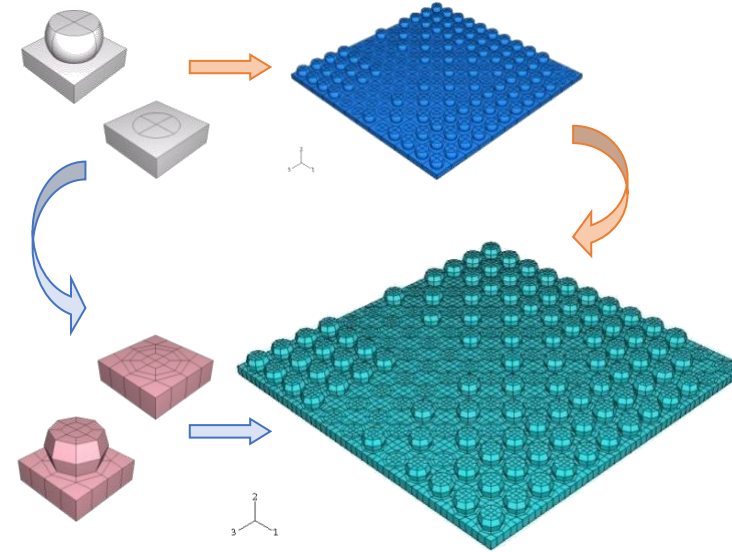
# Solder Joint Fatigue Analysis

- BGA solder joint fatigue analysis

- Mechanical loading prior to cyclic thermal loading

- Effects of mismatching thermal expansion coefficients
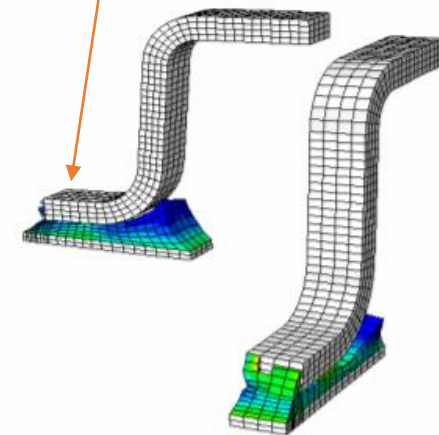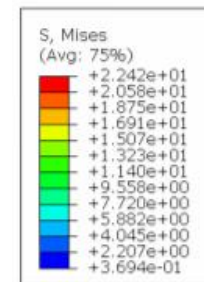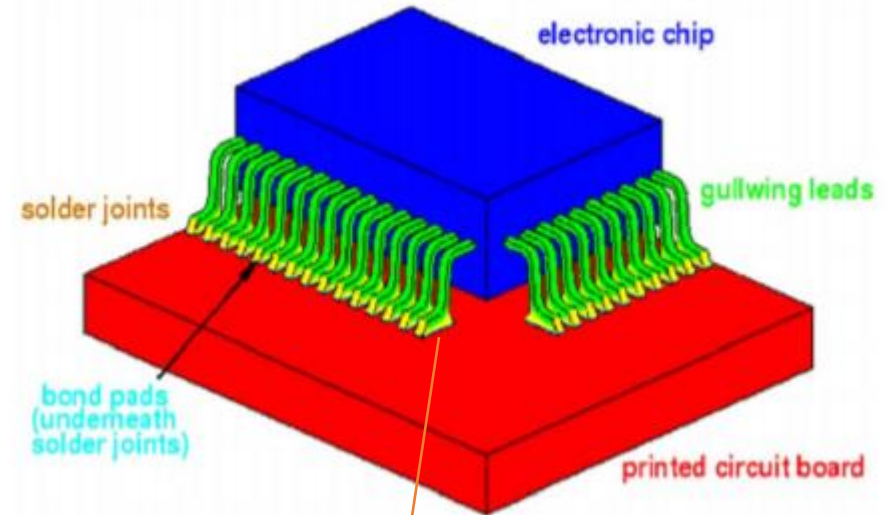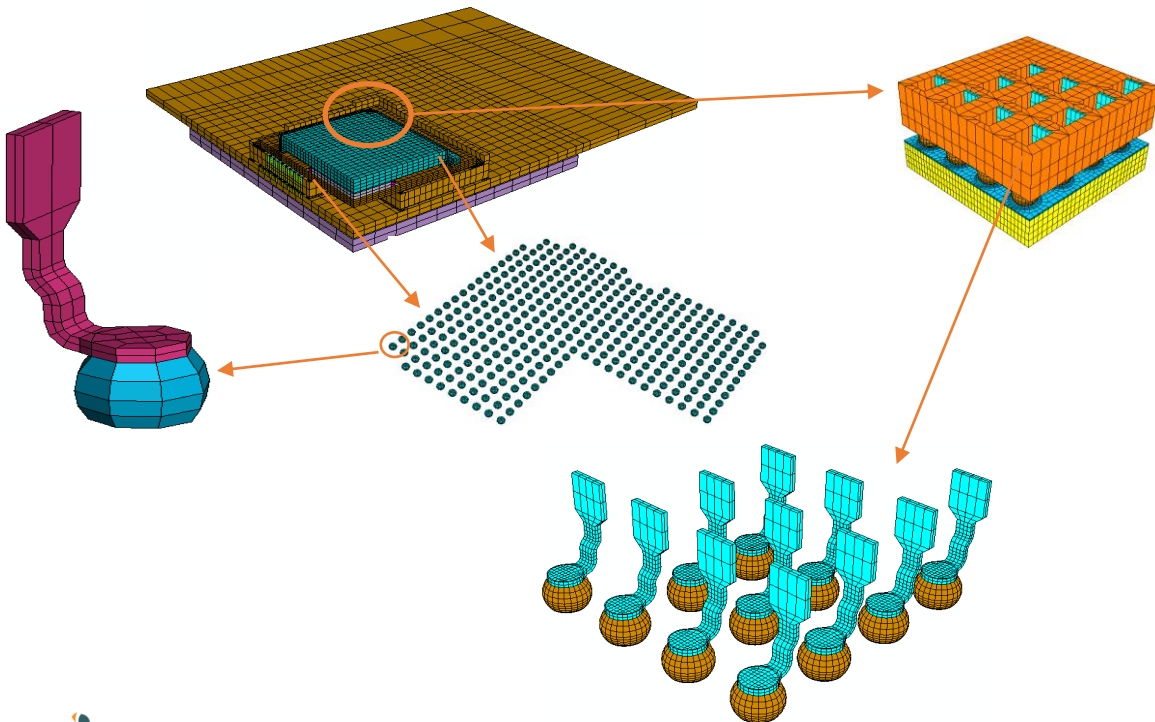
# Coupled Thermal-Mechanical Analysis

- Creep Analysis of Lead-free Solders Undergoing Thermal Loading

  - Example uses uniform prescribed temperatures

  - Temperatures could come from previous heat transfer analysis

  - Fully coupled thermal-mechanical procedure is applied
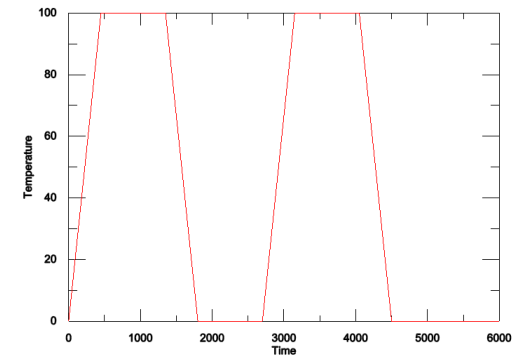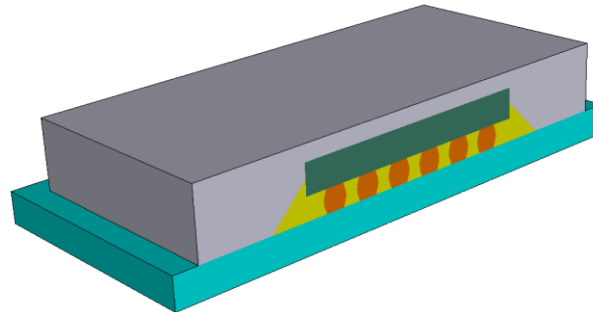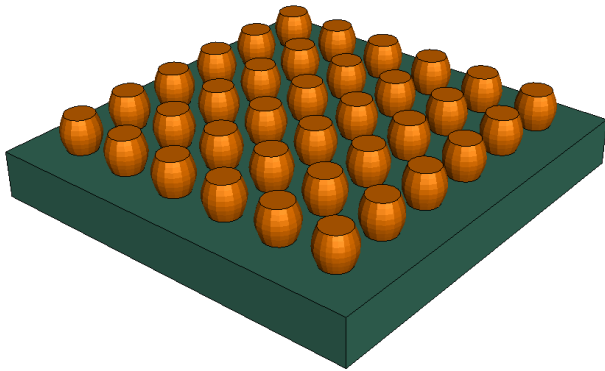
# Coupled Thermal-Electrical-Stress Analysis

- Extension of existing thermal-electrical procedure to include structural response

- Gap electrical conductivity can depend on separation and contact pressure

**Electrodes**

**Sheets**
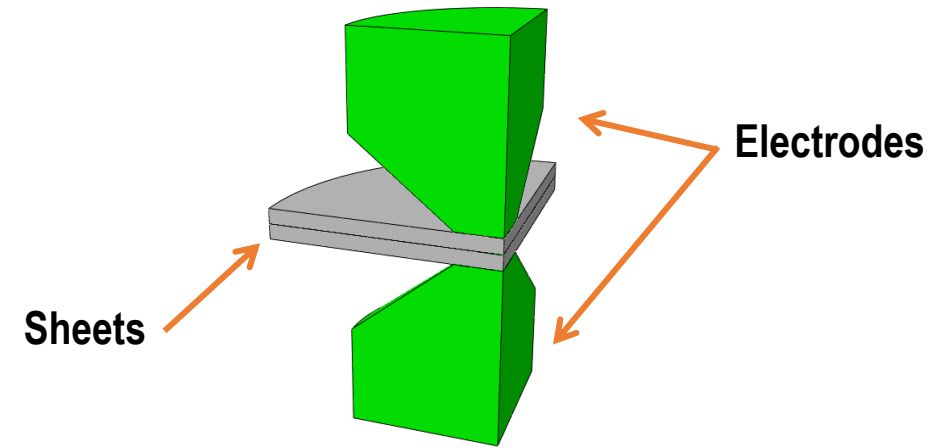
**Spot welding**
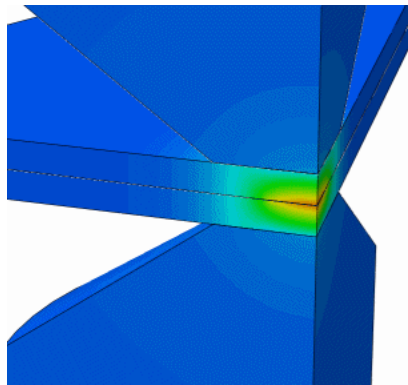
**Temperature**
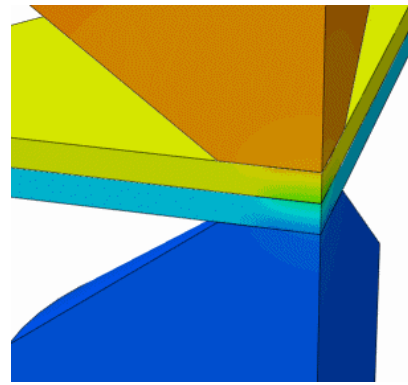
**Electrical potential**
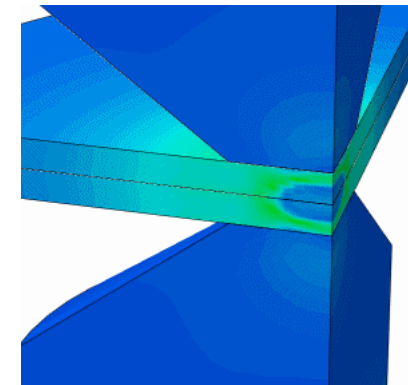
**Stress**

# Flow and Thermal Analysis

# Plastic Injection Simulation

- Predict and avoid manufacturing defects during the earliest stages of part and mold design

- Get the best design without doing "trial and error" prototyping

- Improve the physical qualities of the part

- Improve and optimize the manufacturing process

- Optimize the molding cycle

- Eliminate costly mold rework

- Decrease time to market
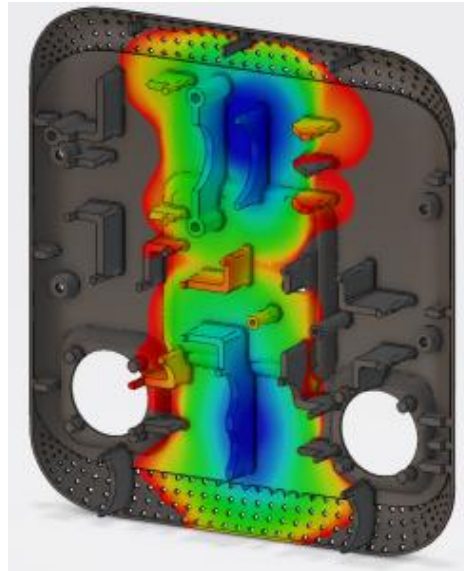
# Conjugate Heat Transfer and Thermal Management

- Multi-material heat transfer

- All cooling approach

- Conduction

- Isotropic or orthotropic solids

- Contact heat resistance

- Convection

- Radiation

- Surface-to-Surface (S2S) and Participating Media

- Inclusion of heat sources, pressure settings for inlets and outlets, the effects of any fans, ambient temperature, etc.
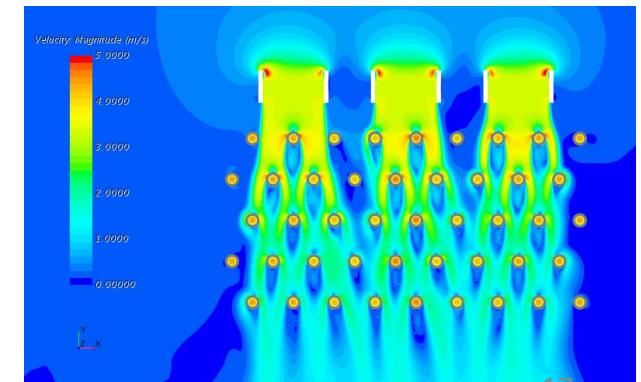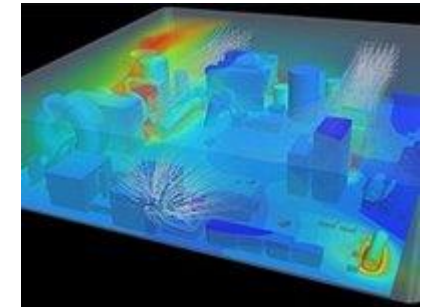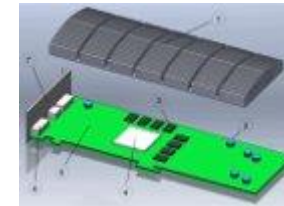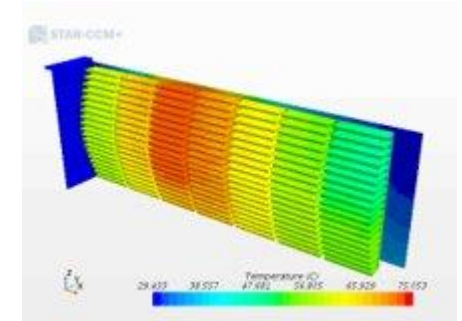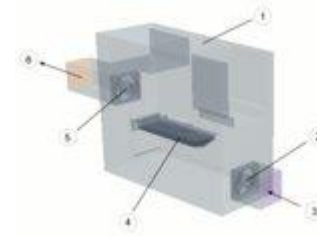
# PCB-Level Design

- Transient thermal analysis of printed circuit board.

- Thermally guide component placement decisions

- CFD analysis help to advise if board real estate needed for heatsink mounting

- Joule (Ohmic) heating analysis

- Improved cooling efficiency at lower cost
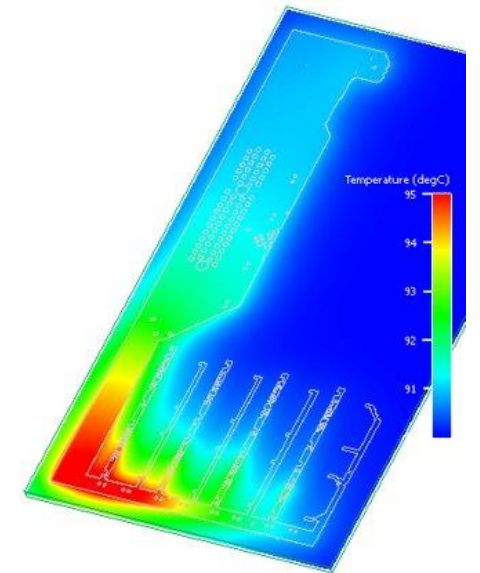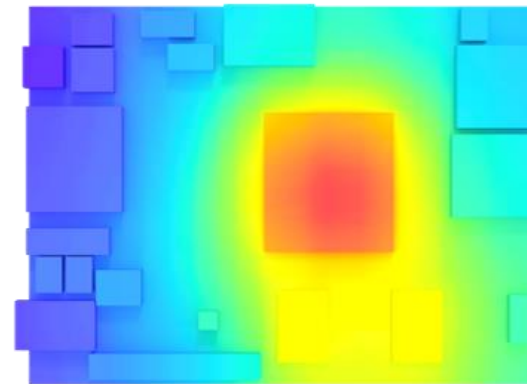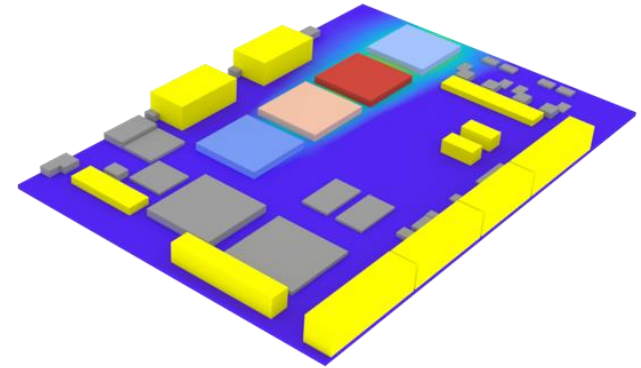
# Liquid-Cooled Power Electronics

- Find the optimal pin fin shape, spacing, and arrangement to minimize the IGBT chip temperature without exceeding the allowable pressure drop within liquid cooling

- Automated design exploration process that drives the CAD geometry and runs the liquid cooling simulation to achieve the specified objectives
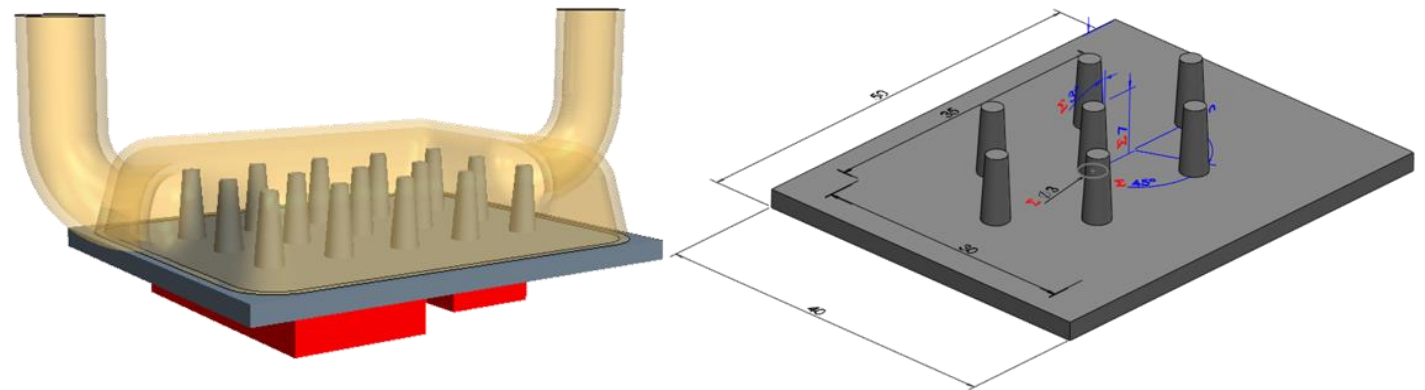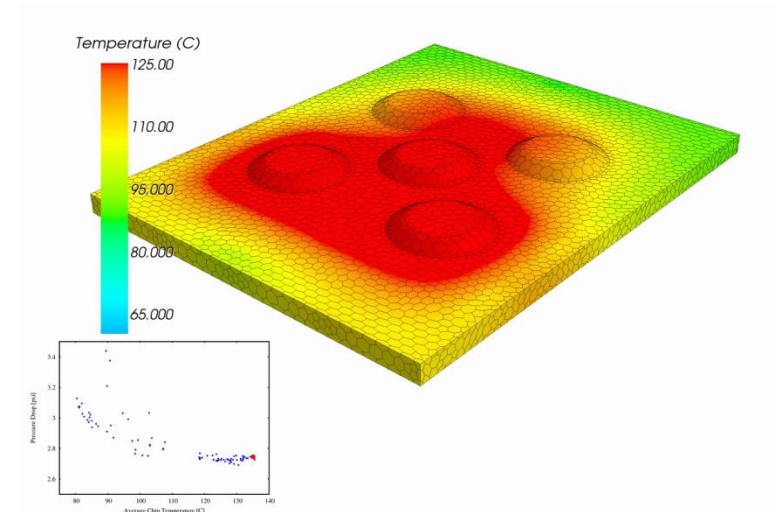
- Physical tests are slow, difficult to set up, costly, and provide very limited data when designing a new cold plate.  Little insight into how the design can be improved is gained.

- Accurate detailed simulation provides detailed insight into design performance, and improvements can be quickly verified
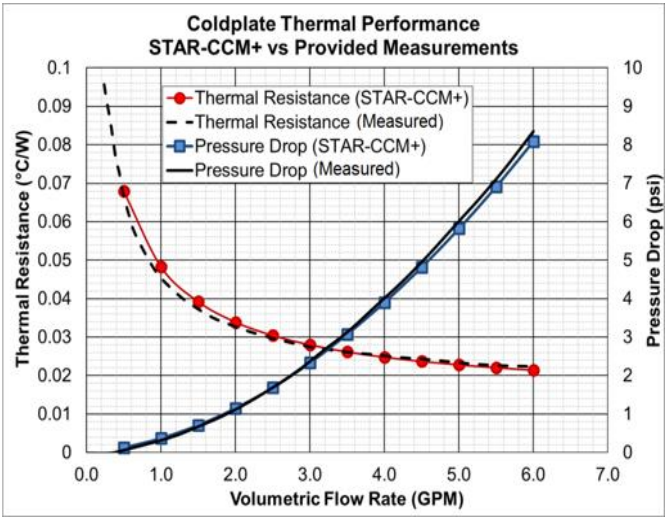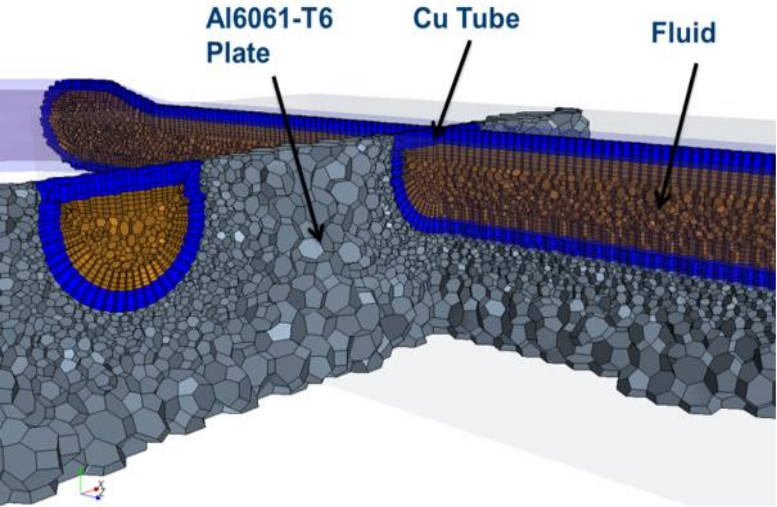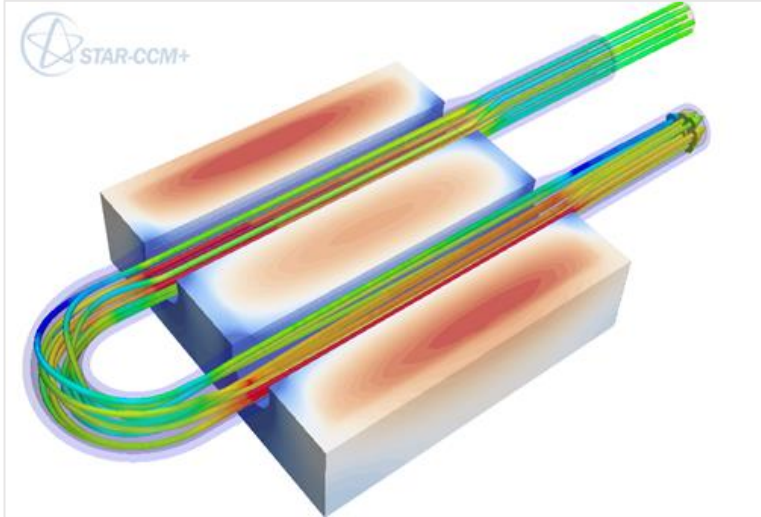
# Compact Heat Sink Modeling

- Characterize a single heat sink in virtual wind tunnel to extract pressure drop vs. flow rate and thermal resistance vs. flow rate curves.

- Implement the extracted curves into the full system model.

- Heat sink thermal resistance

$$R_{t,hs} = (T_{surf,ave} - T_{bulk,hs}) / Q$$



Warm flow out

H

Cool flow in

Heat in
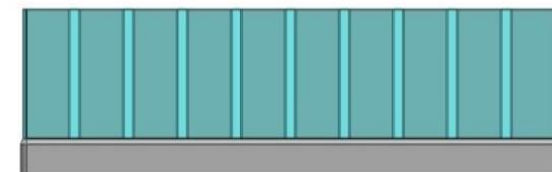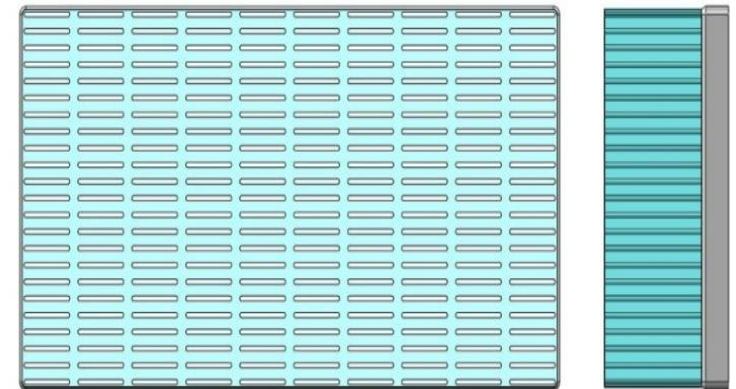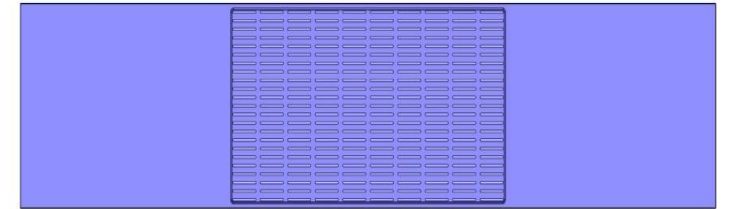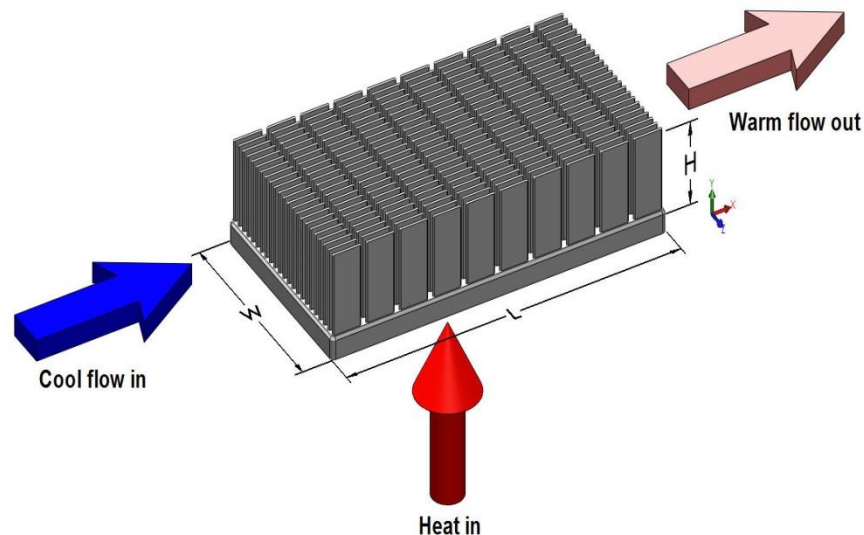
# Thermal Design of Electronic Products

- Electronics are increasing the complexity of products across all industry sectors

- While complexity is increasing, the time and budget for product design is shrinking.

- Miniaturization is forcing the mechanical and electronic design flows to converge, and is increasing power densities, making it harder to efficiently remove heat.

- Heat impacts product performance and reliability and can cause safety concerns.



Camera Modeling
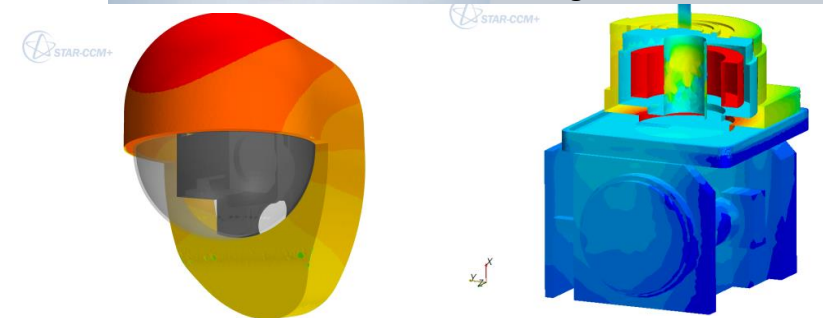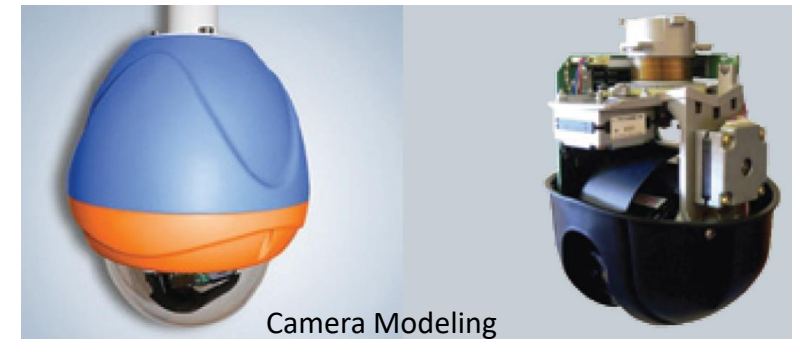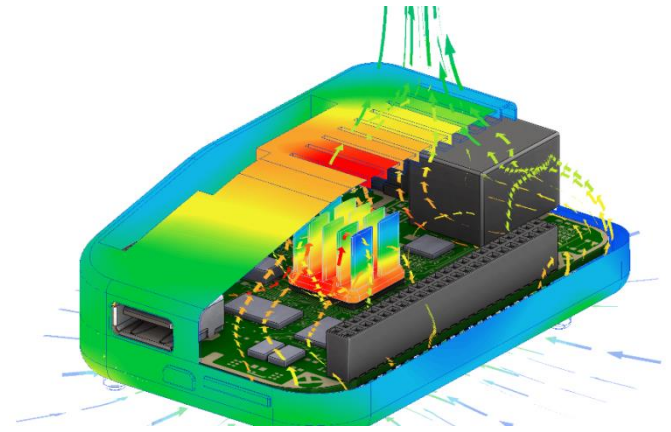
# Fans – Flow and Acoustics

- Predict steady and transient flow field characteristics (Pressure, Velocity, Thermal Fields) -  Fan Performance

- Obtain surface forces / noise sources to be used as an input for noise / vibration analysis

- Characterize and optimize blade geometry, flow angles, blade rotational speed, and flow approach velocities (Parametric study)

- Capture and visualize the flow turn and induced swirl / separation vortices

- Visualize the natural air-flow within the equipment

- Predict mass flow rate at outlet
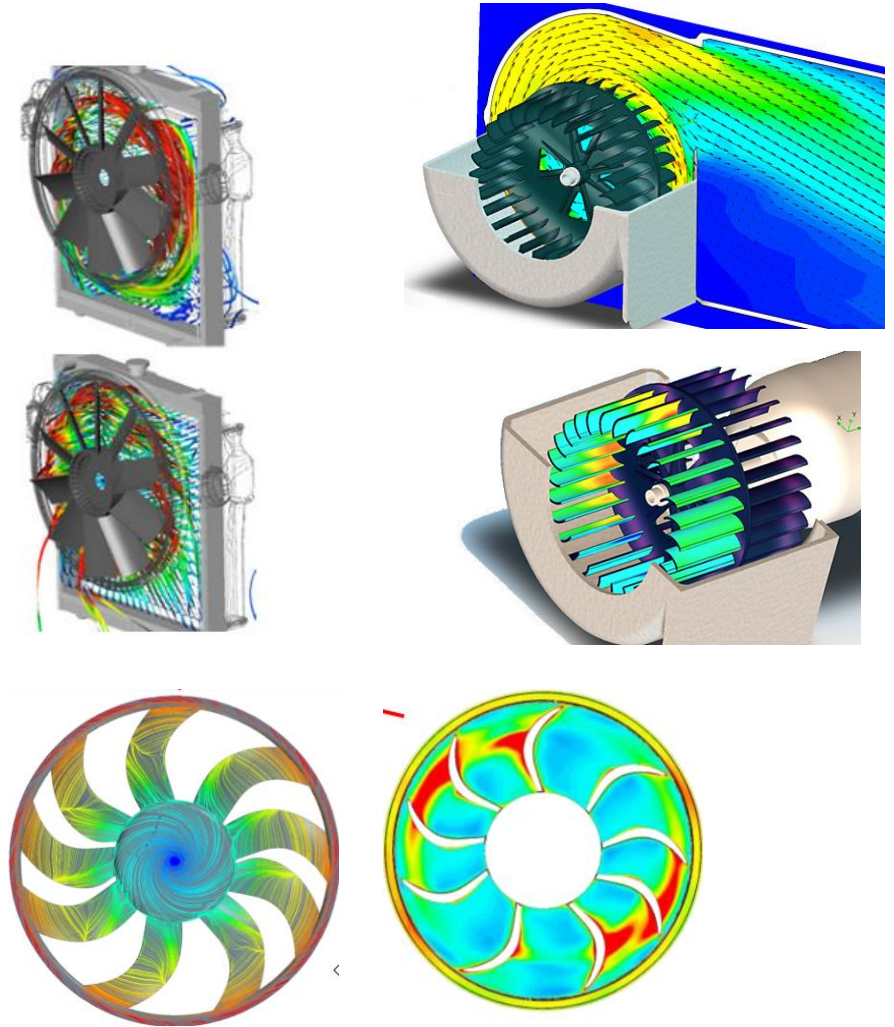
Constrained stream lines and Velocity Contour on an Axial Fan

# Optimizing Electronics Cooling

- The design of electronics devices is a complex task that necessitates balancing numerous competing objectives including cooling performance and weight.

- Best trade-offs between thermal performance and weight

- Better insight earlier in development

- Fewer costly physical prototypes

- Forced or natural

- Simulation scale from thermal boundary layer to bulk flow

- All flow and speed possible
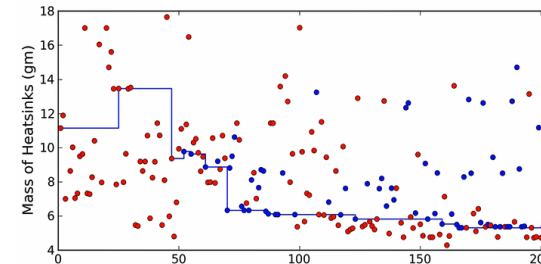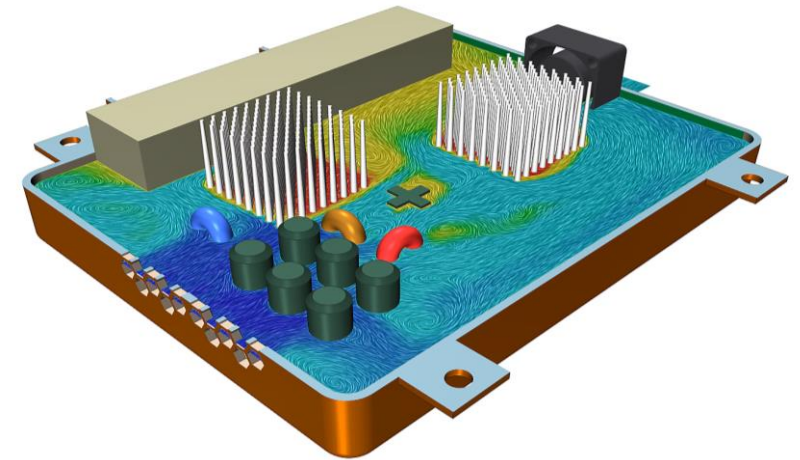
# Electromagnetic Capabilities

# EM-Thermal and Stress Analysis

- Perform Multiphysics analyses involving EM-Thermal-Mechanical problems.

- Steady state, transient and Conjugate Heat Transfer solvers.

- Uni-directional and Bi-directional coupling.

- Automatic layer simplification (average material properties)

- Components modeling

Temperature



D2 Temperature 66.5C
9M Mesh, ~3 hrs

D2 Temperature 64.4C
87K Mesh, <1 min
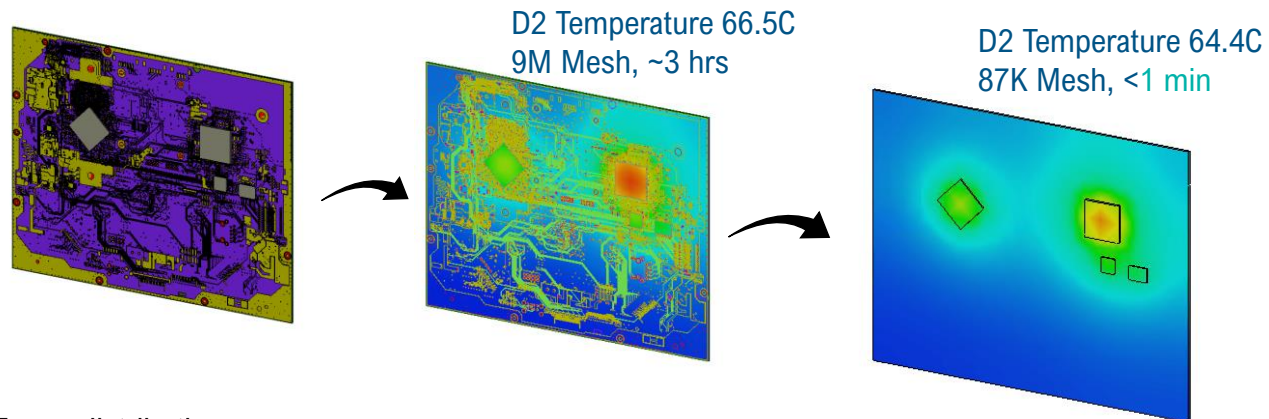
Velocity



Temp. distribution on IC/Packages
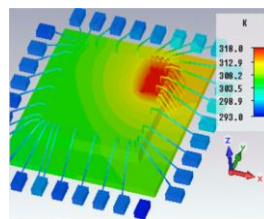
Von Mises Stress
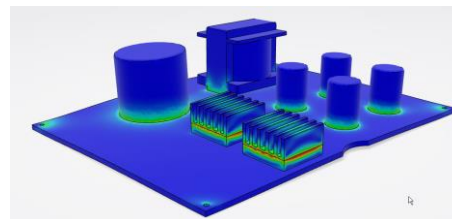
Deformation
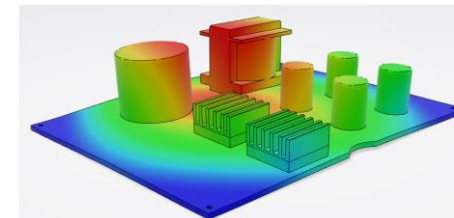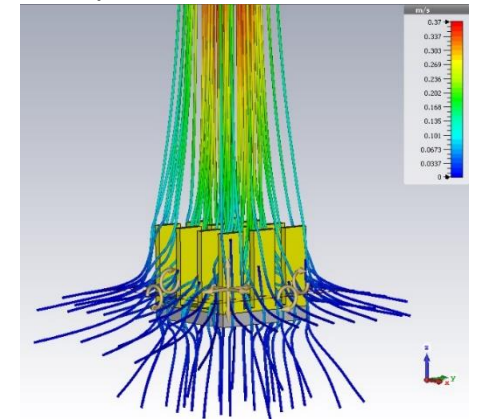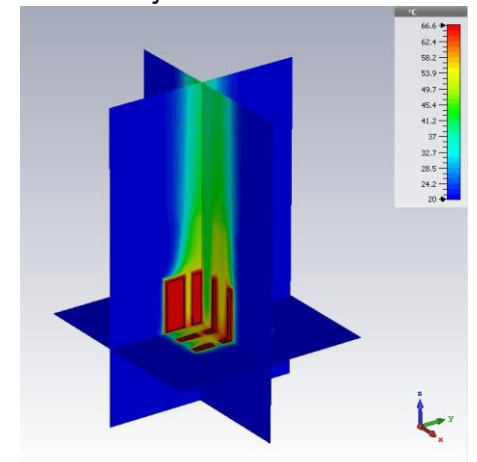
# Electronics Design Analysis

- Time-Domain Refractory (TDR) analysis

- Visualization of Electromagnetics (EM) fields and losses.

- Analysis of Signal and Power Integrity of PCBs.

- EM compatibility and interference compliance check

- Electrostatic Discharge (ESD) analysis

Model for ESD analysis

Bending and analysis of PCB

DDR4 Memory Channel Surface current at 10 GHz

Impedance profile versus time on connectors and lines

EM PCB Losses

Eye Diagram

EM emission
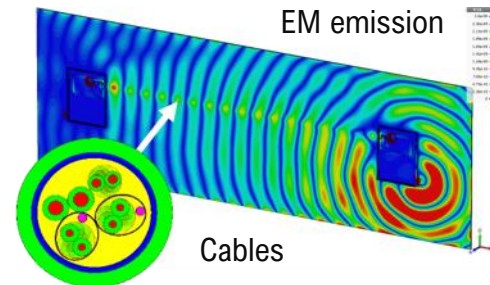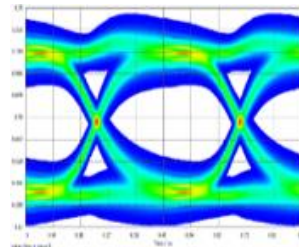
Cables
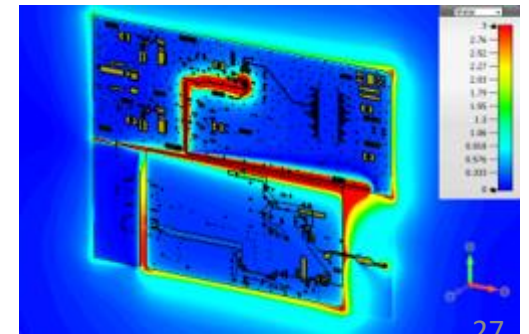
# Antenna Synthesis and Design Analysis

- Find, design/tweak, evaluate and export validated simulation-ready antenna design models.

- Synthesized and analyze antenna arrays.

- Evaluate installed performance and optimize antenna placement.

- Antenna radome analysis.

- Mitigate co-site interference



CAD model of cell-phone with several antennas installed



Proximity – Interference?

Interference violation matrix



Compare set of parametric antenna prototypes and performance comparison (top)



E-field at 28 GHz

mm – wave 5G antenna array

Reflection
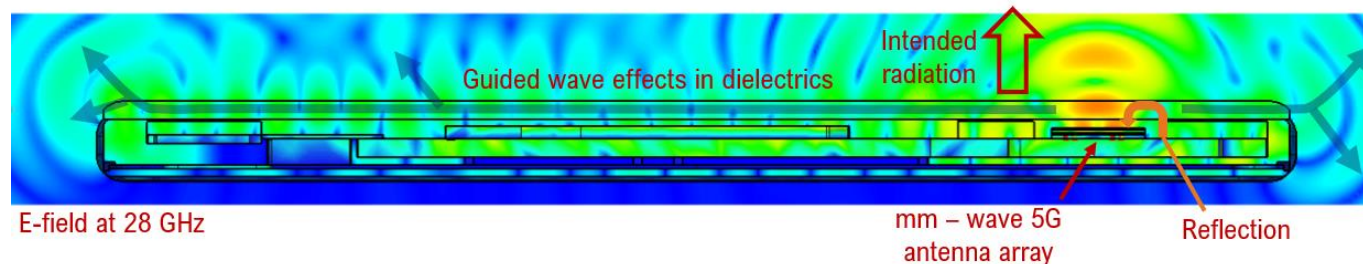
Radiation from array placed behind plastic cover

# Analysis of Optical Applications

- Design, analysis, and optimization of optical Metallic/Plasmonic structures:
  - Nano Antennas.
  - Plasmonic waveguides.
  - plasmonic solar cells, etc…
- Design and analysis and optimization of optical dielectric/photonic structures:
  - Optical waveguides, Couplers, Fibers
  - Photonic Bandgap structures.
  - Filters and resonators, etc…

**PIC blocks: Waveguide crossings, Couplers & Power Dividers, Terminations (from left to right), etc…**

E-field is shown in all the cases

**Polarization Beam Splitter**

TM-Mode    TE-Mode
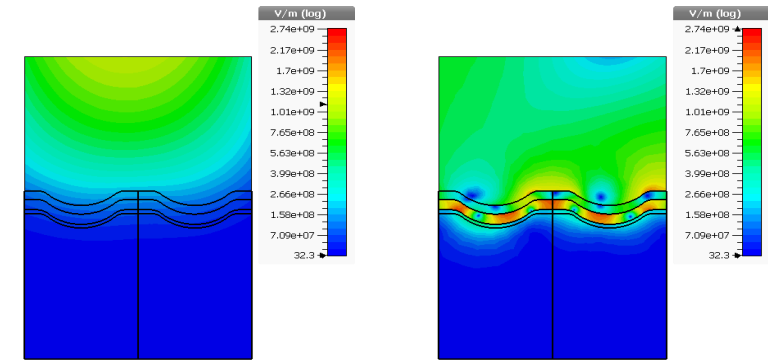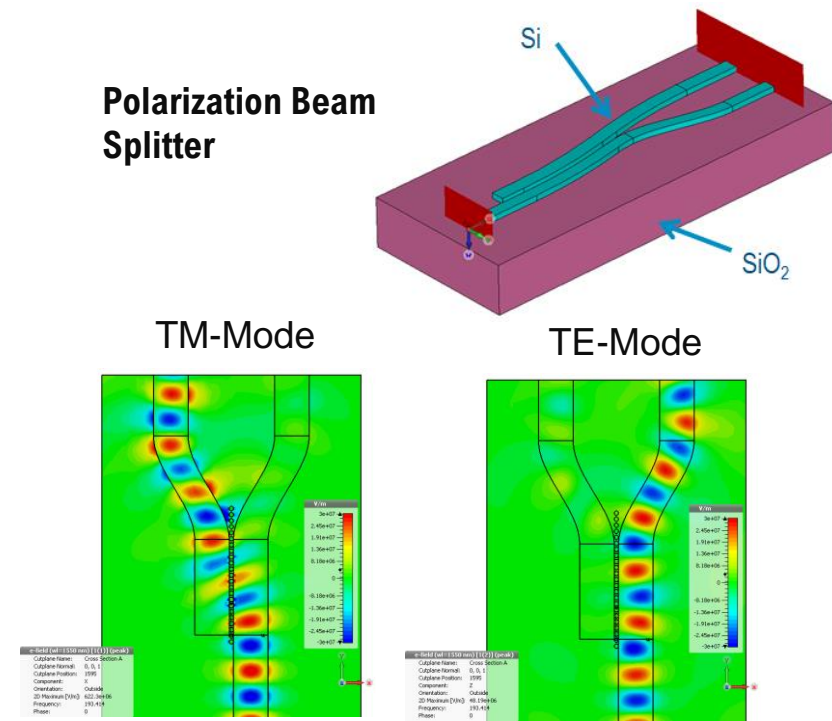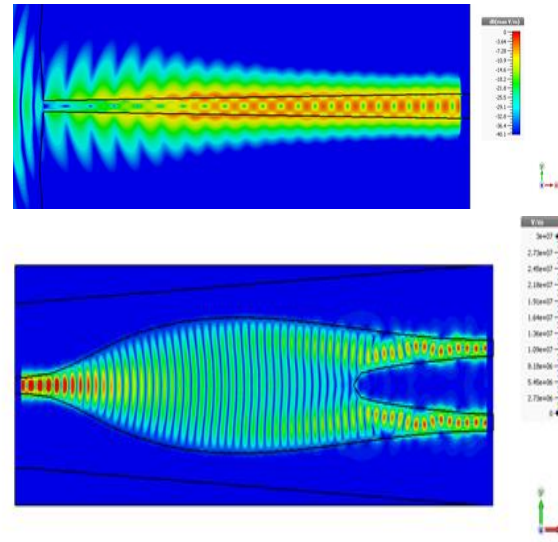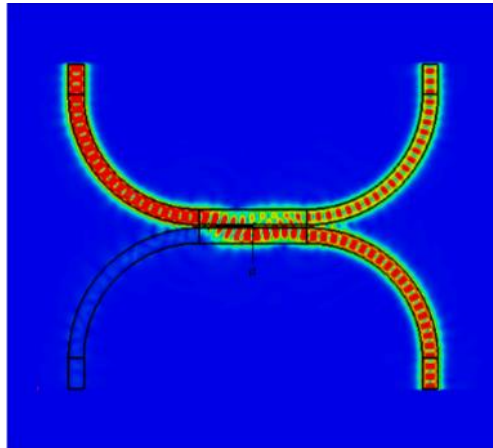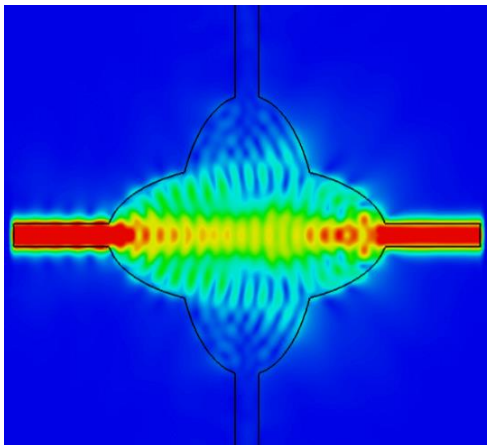
**Metal-Insulator-Metal Plasmon Coupling Diffraction Gratings**

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# Analysis of Optical Applications

- Use of higher order dispersive materials.

- Use of full Tensor, graphene and spatially varying materials.

- Perform coupled multiphysic EM-Thermal-mechanical deformation analysis.

**Convex Microlens Simulation**



**Model of a thermally Tuned PIC Ring Resonator**
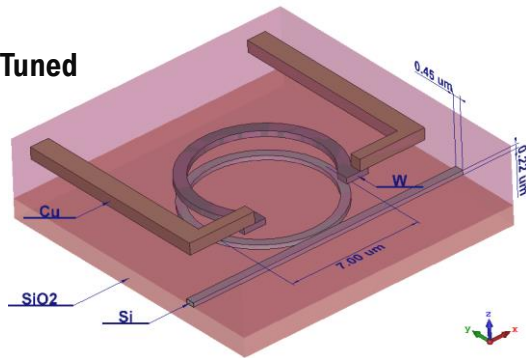


**Power Loss Density (@70 mA)**
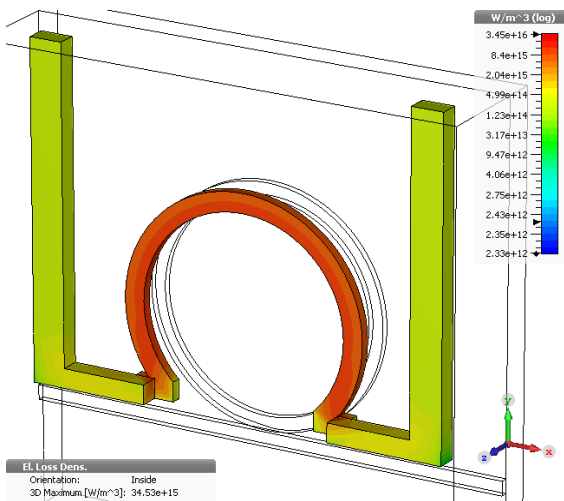


**Temperature Distribution (@70 mA)**



**Average temp. in Si core**



1  ( 0.04, 414.9 )
2  ( 0.07, 666.32 )

**Thermal Tuning Results**



1  ( 1546.8, 0.0064891 )
2  ( 1565, 0.0067832 )

T_2,1 (DCCurrent=0.04)
T_2,1 (DCCurrent=0.0475)
T_2,1 (DCCurrent=0.055)
T_2,1 (DCCurrent=0.0625)
T_2,1 (DCCurrent=0.07)

30
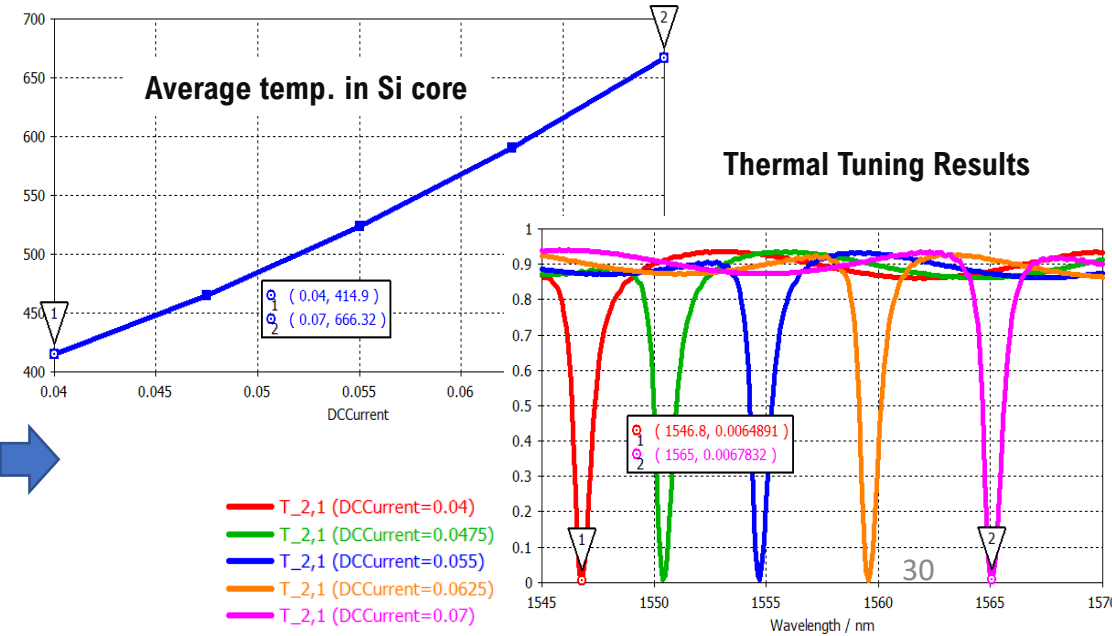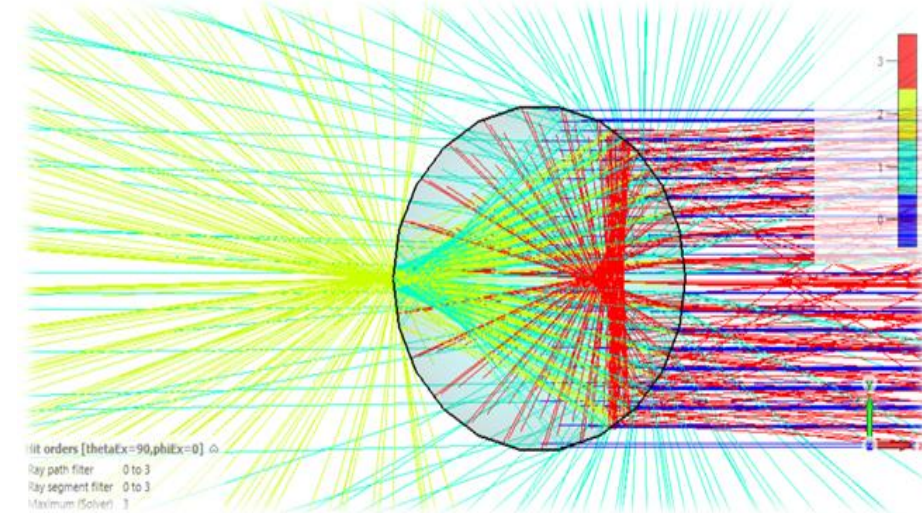
# Wireless Power Transfer – Low Power

## Ferrite Shielding

- Test/evaluate shielding effectiveness using different materials.

- Create necessary guidelines for magnetic and electric immunity in commercial and industrial environments.

- Optimize shielding size (width and length), reducing weight and footprint.

Ferrite Shielding

Without Shielding

With Shielding
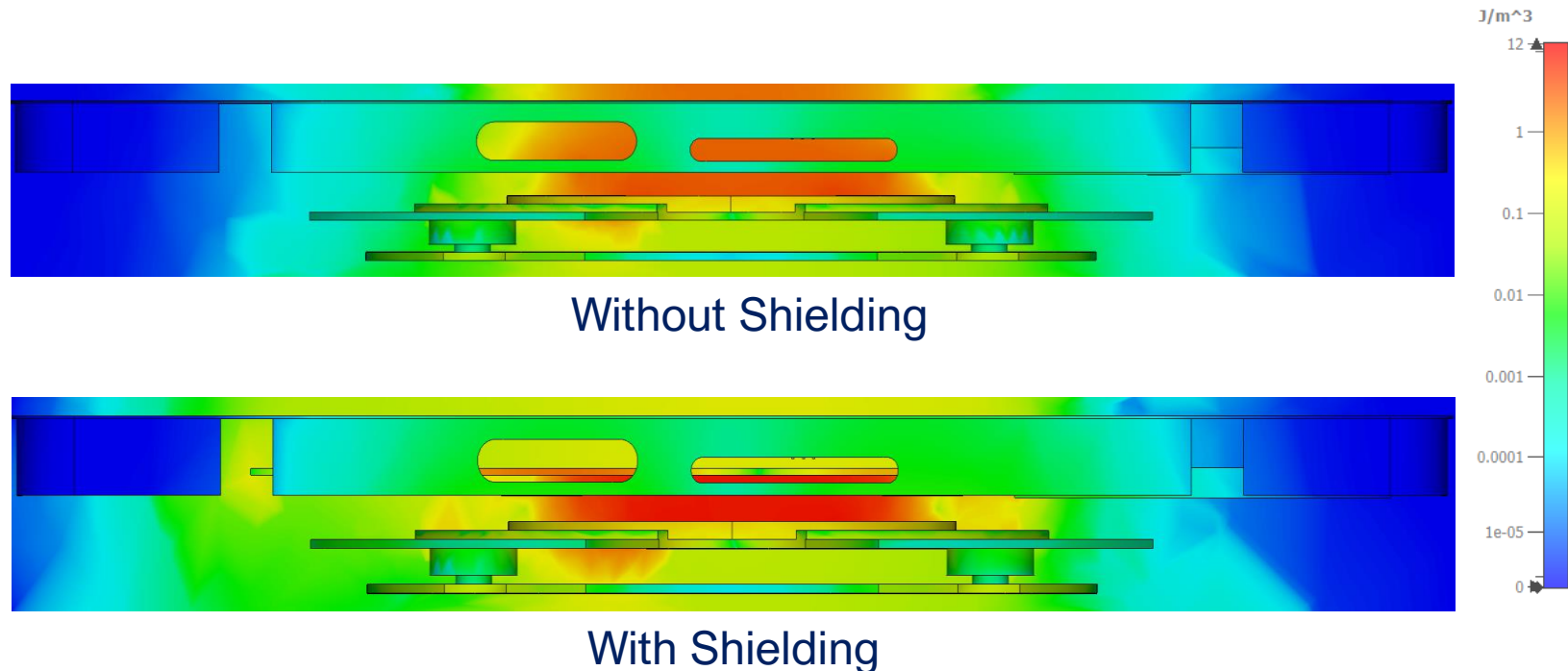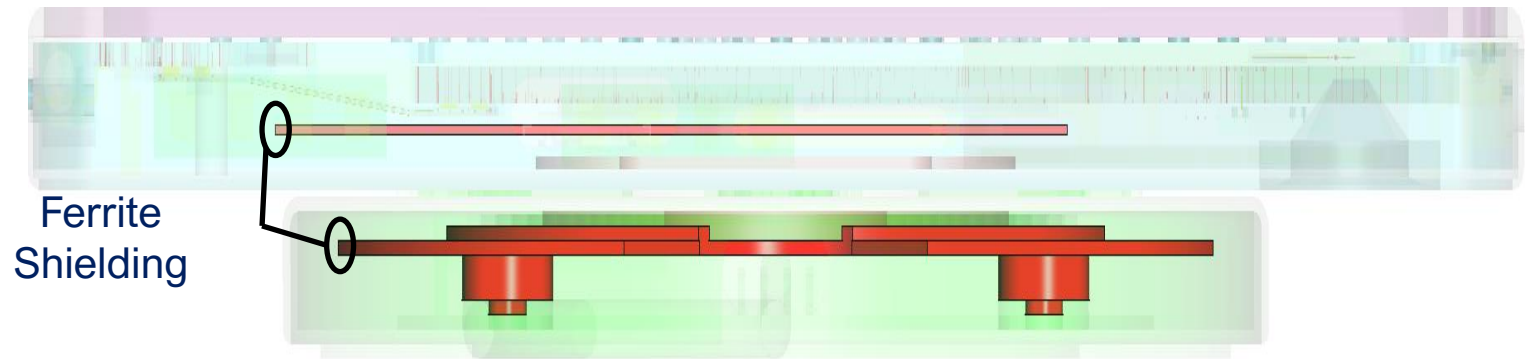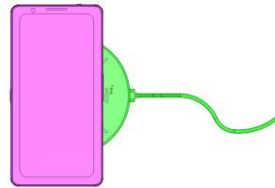
# Automation, GUI, Software Development
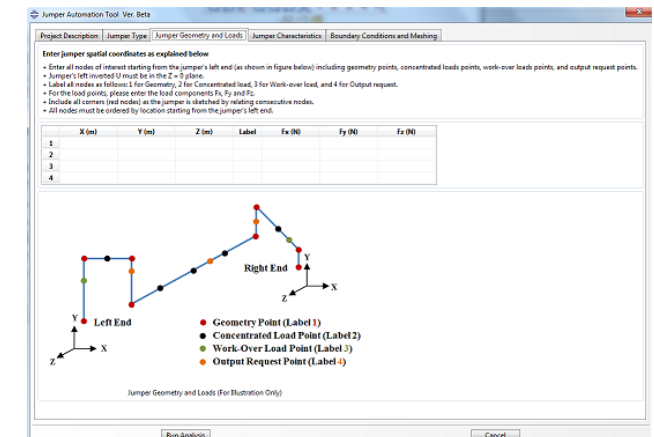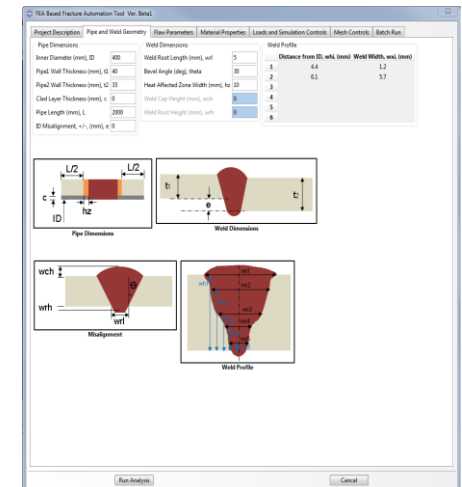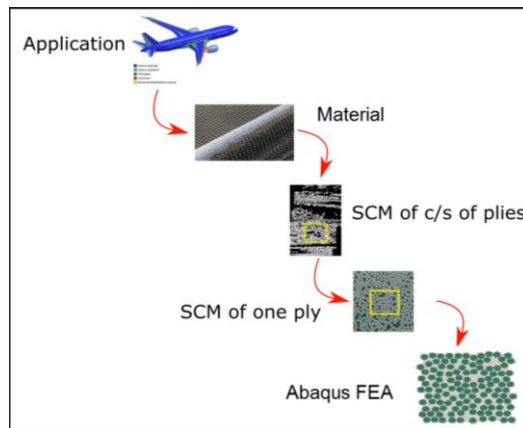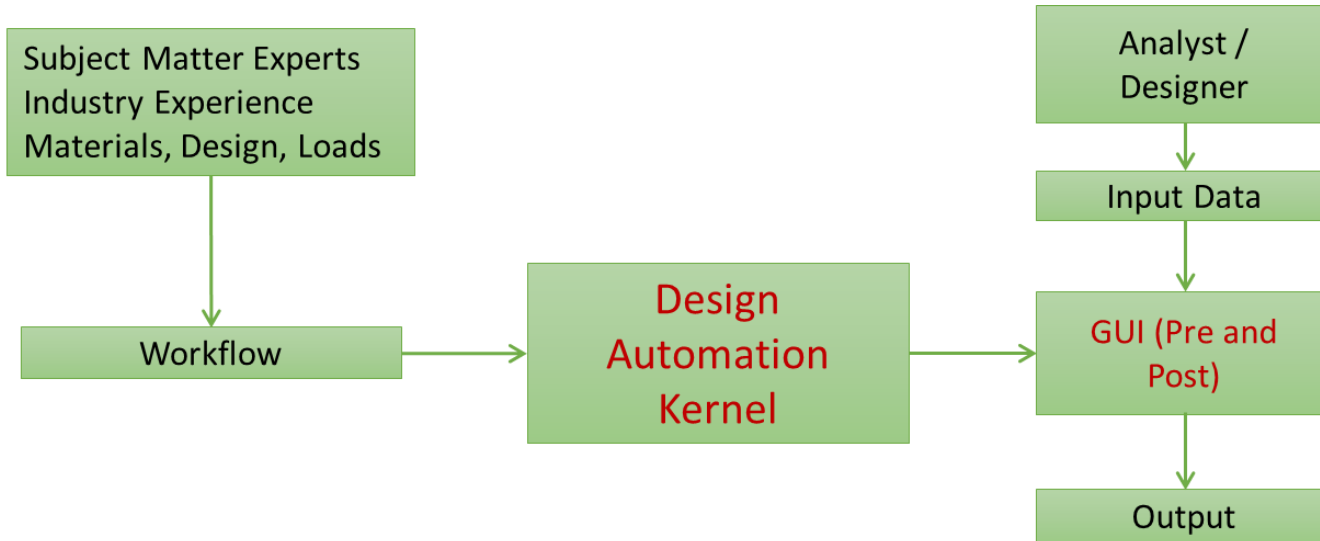
Examples: Abaqus Plug-in Tools

# Web Tools Solutions

- Assistance to support software development, testing, website monitoring, data processing and much more.

- Software Architecture and its Complete Implementation.

- The use of technologies according to the project needs (Python, GitHub, Visual Studio, etc.)
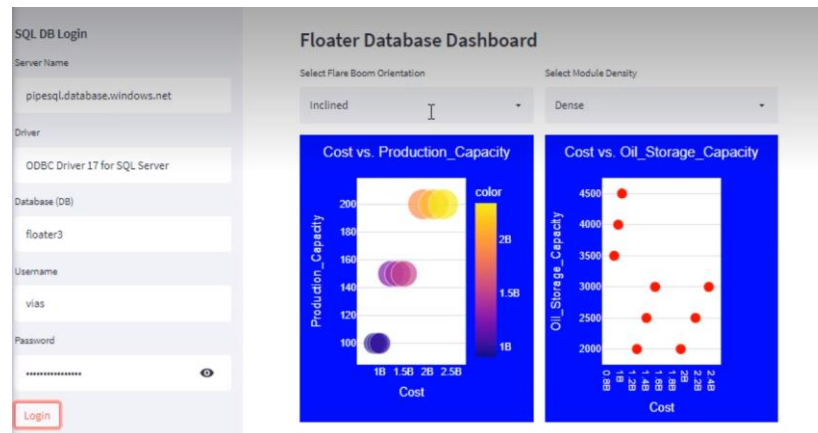
# Model Creation in CAE from GUI/Kernel Script

Overview

- Custom designed Abaqus/CAE Standard Plug-in
  - Creates clean interface for user input
  - Eliminates the need to edit kernel scripts
  - User does not need to be familiar with Python or coding
- Read/Write capability for input storage/access
- Modern look and feel with custom tool buttons
  - Link to User Manual
- Dynamic
  - Widgets update and respond to user interaction
- Project Description Tab allows user to customize job
  - Data can be exported to csv file

RAW DATA
(INPUT)

DATA
STRUCTURING

ML, ANN,
autoencoder

TRAINING
ML, ANN

PREDICTIONS

CNN, RNN

Output of
Interest (stress,
deformation,
pressure,..)
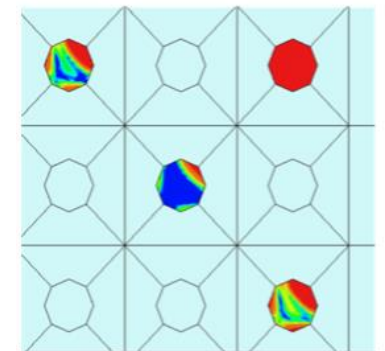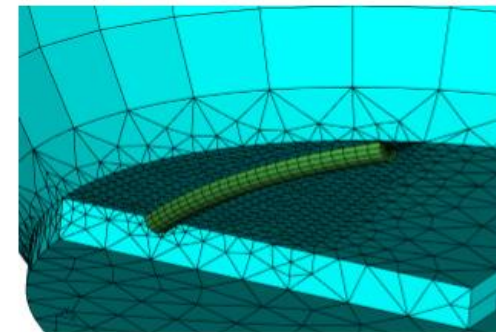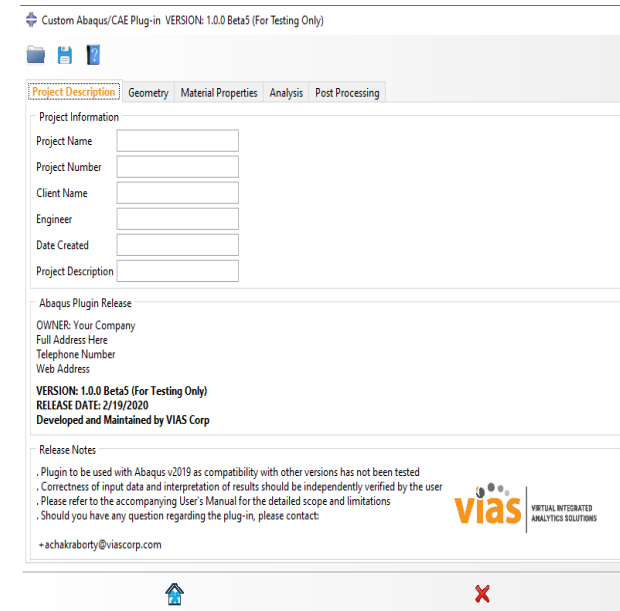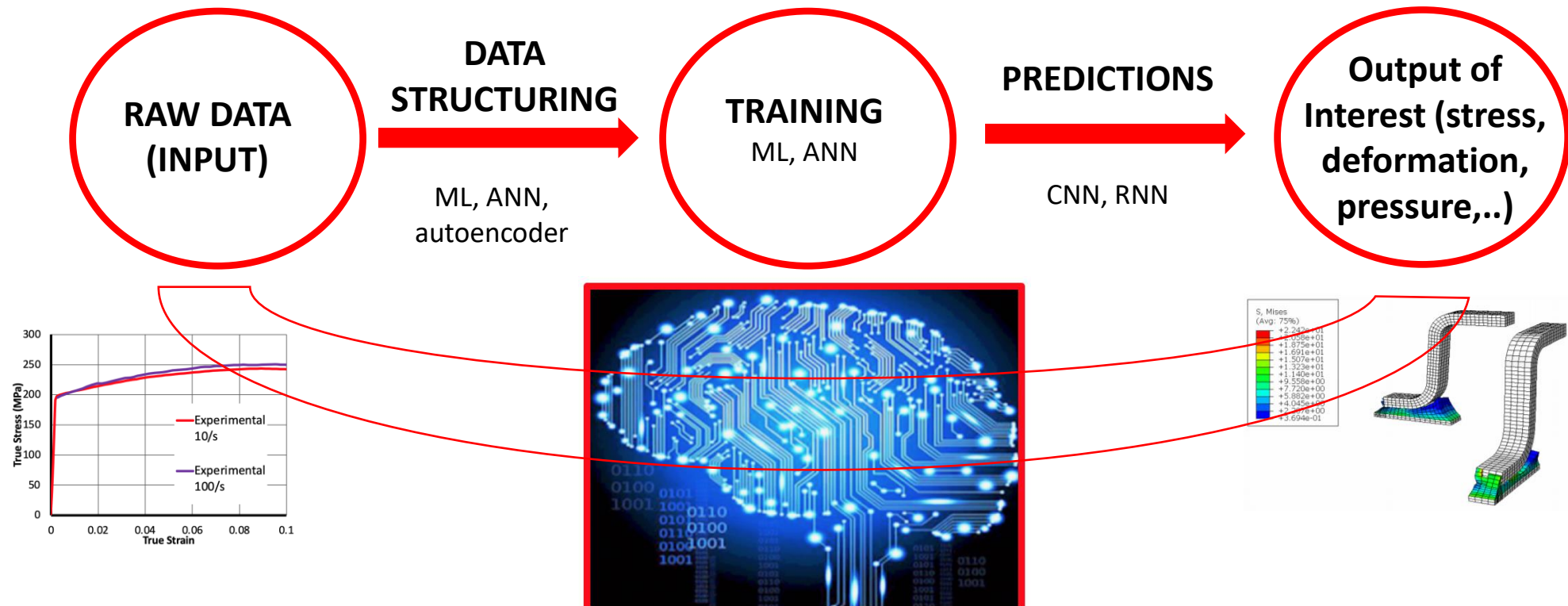
# Web-Based Workflow Automation

- The creation of customized **workflow with multiple-software applications** (Abaqus, Excel, Matlab, etc.) in a **controlled and collaborative environment**.
- The example below shows an automated workflow prepared in the Process Composer in 3DEXPERIENCE environment.
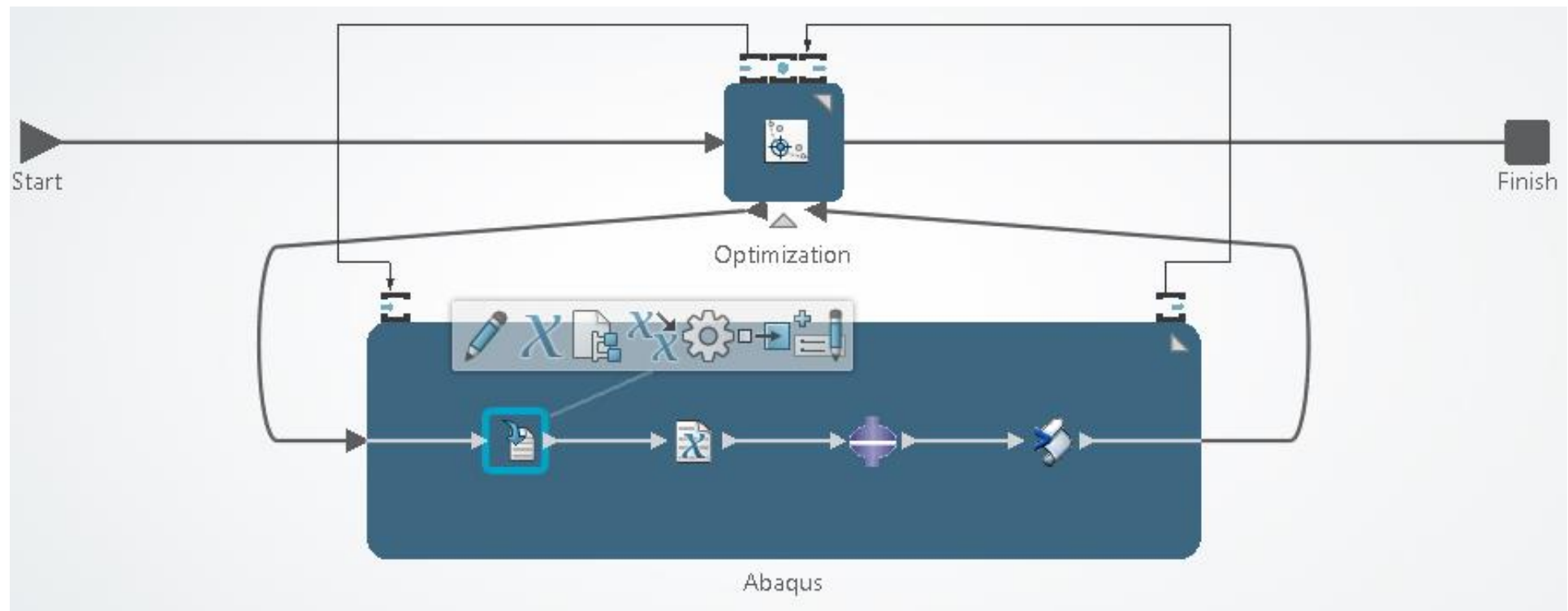
# Training Engagement

# Our Training Service

- Vias3D is a Dassault Systèmes Certification Training Center and a Certified Education Partner.

- Vias3D offers:

  - In center and onsite training classes

  - Effective virtual class delivery

  - Cloud based training courses are based on Vias3D infrastructure

  - User assessments and feedback to direct learning

  - Blended learning options to fit any organization

  - Corporate Leaning Programs
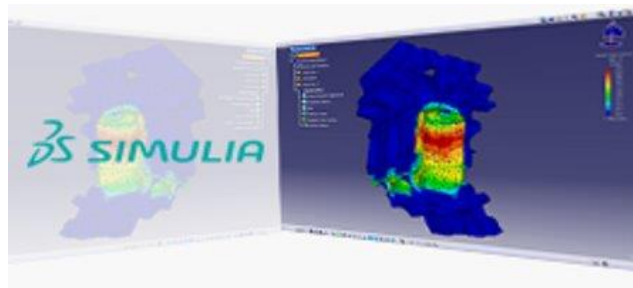
# Our Training Expertise

- Vias3D have Dassault Systèmes' certified instructors who are also experts in various industry applications providing training for broad range of topics in software solutions and applications.

  - **Introductory** – Getting started with the basic software features, meshing, solving linear problems, output visualization, post-processing, etc. Topics cover solutions like Abaqus, fe-safe, Isight, TOSCA, XFlow, CATIA, Delmia, Enovia, 3DEXPERIENCE.

  - **Expert-Level** – This level features nonlinear problems involving material and geometric nonlinearity, contact and convergence, fracture & damage mechanics, scripting & GUI, CATIA V5 Product and Part Design, etc.

  - **Industry Specific** – Contents are designed for particular industries focusing on problems pertinent to respective industrial applications, i.e., Oil and Gas, Marine & Offshore, Structural, Aerospace, Hi-Tech, Life Science, Consumer Packaged Goods, etc. Also, courses like FEA for fitness-for-service analysis, FEA for Offshore are offered.

  - **Customized** – Course content are modular and can be a combination of basic to advanced based on client-specific requirement. Typically designed in discussion with our client needs and contains customized examples.

# Why VIAS?

- Prompt and complete technical solutions
- Experts with knowledge of industry applications and software solutions
- Rich  technical consulting experience & Software Agnostic
- Knowledge transfer through training services
- Adherence to strict quality control (ISO 9001: 2015 Compliant)
- Flexible pricing / startup discounts
- One Stop Shop – CAD / FEA / CFD / EMAG / GUI / Root-Cause / Optimization

vias3D

# Thank You