Simulation for Fusion 360

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Evolution of Mechanical Engineering

- Engineers
  - Practical Inventions
  - Helpful and Functional

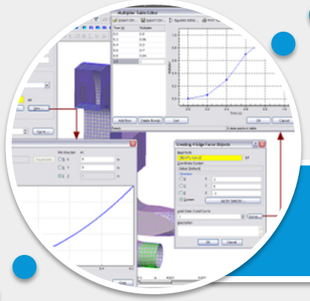
Trial-Error

Empirical

- Knowledge was captured and shared

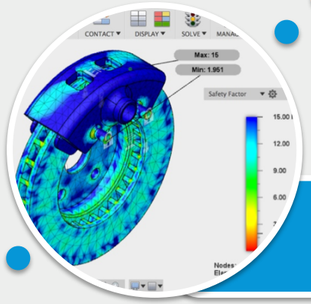
Science Based

- Physics and Mathematics
- Formulas that Human Can Calculate



Simulation (FEA)

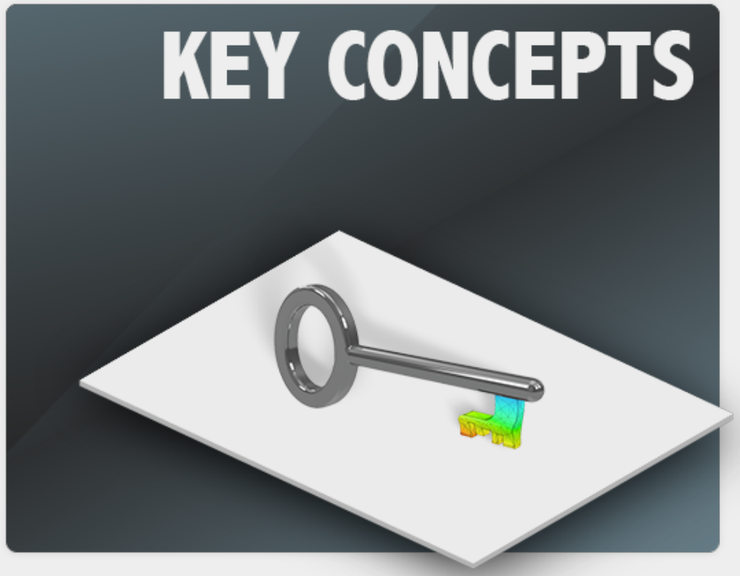
- Computer Powered
- Complex, Special training
- Traditionally about $30.000

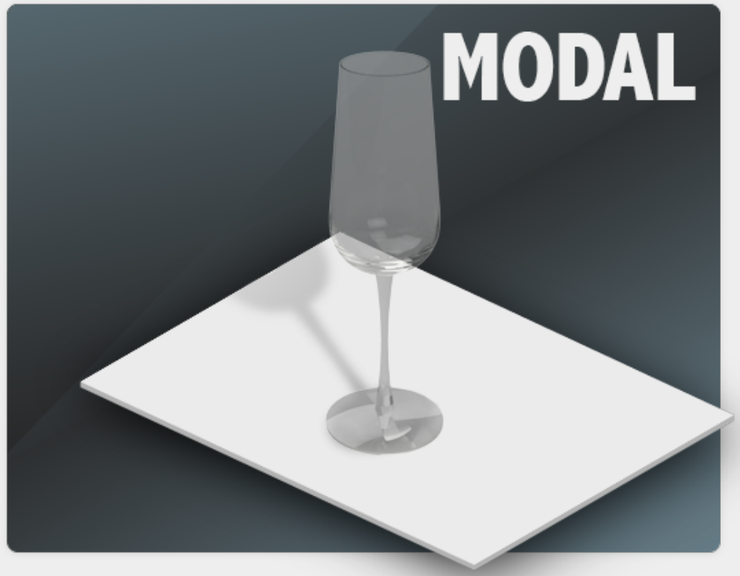


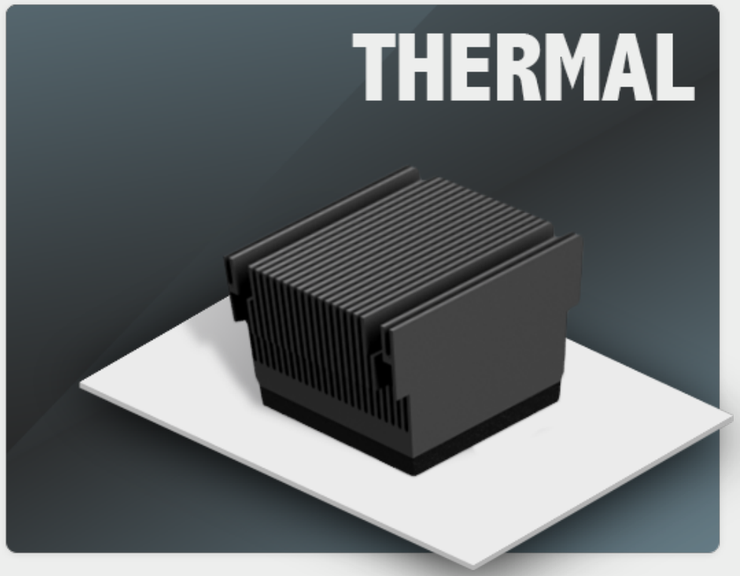
Fusion Simulation

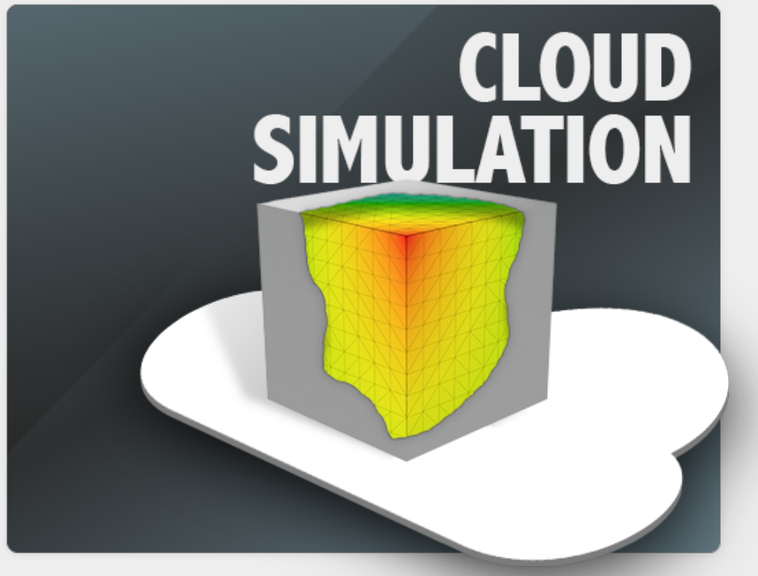
- Easy to Use
- Instant Results, Accessible
- $300: 100 times less expensive

Learning objectives

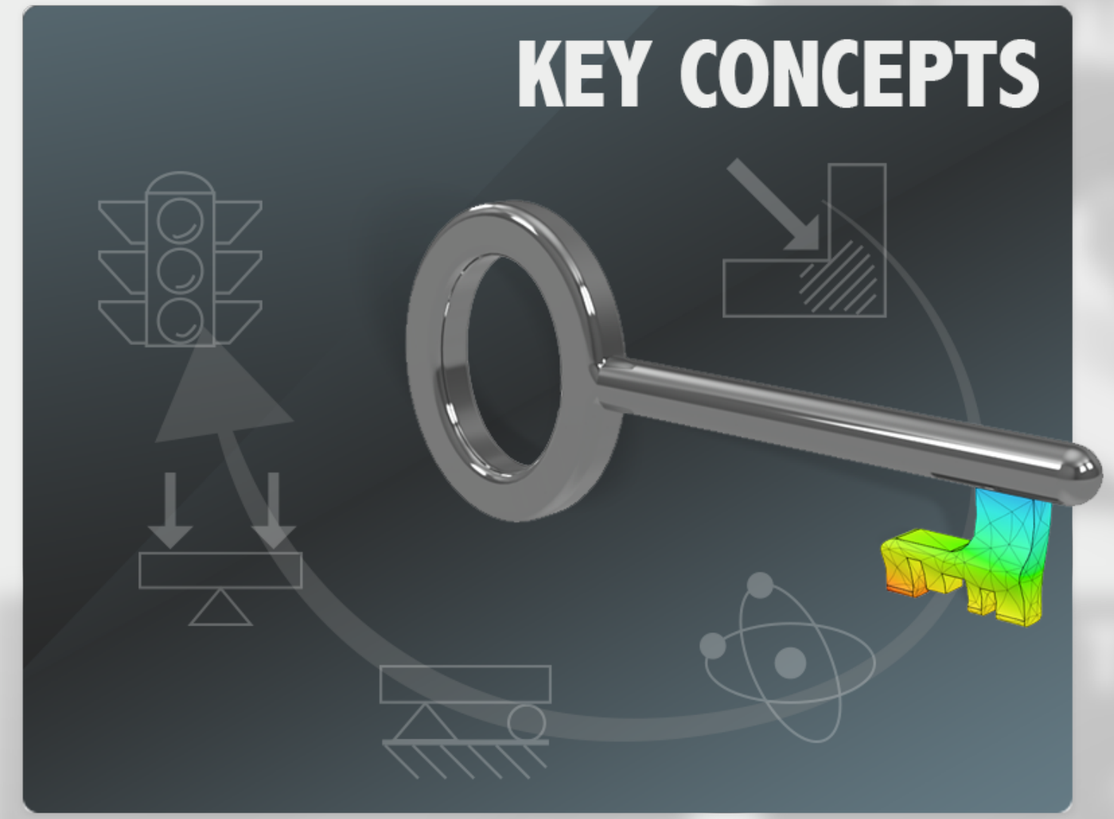








Learning objectives



Simulation for Fusion 360

Our Mission:

- To simulate behavior of design in various scenarios
- To be an alternative to experimental testing – Digital Prototyping
- To guide Engineers and Designers to the right design decisions
- To be part of Fusion 360 rich data collaboration expierience

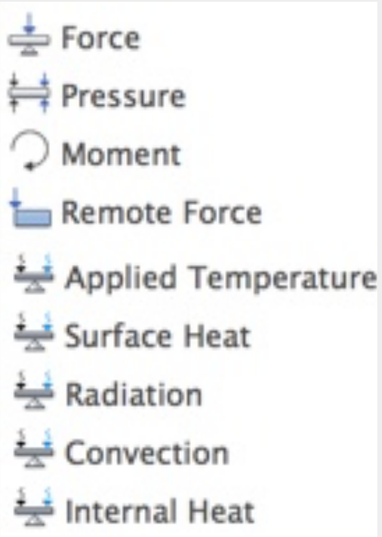
Key Concepts:

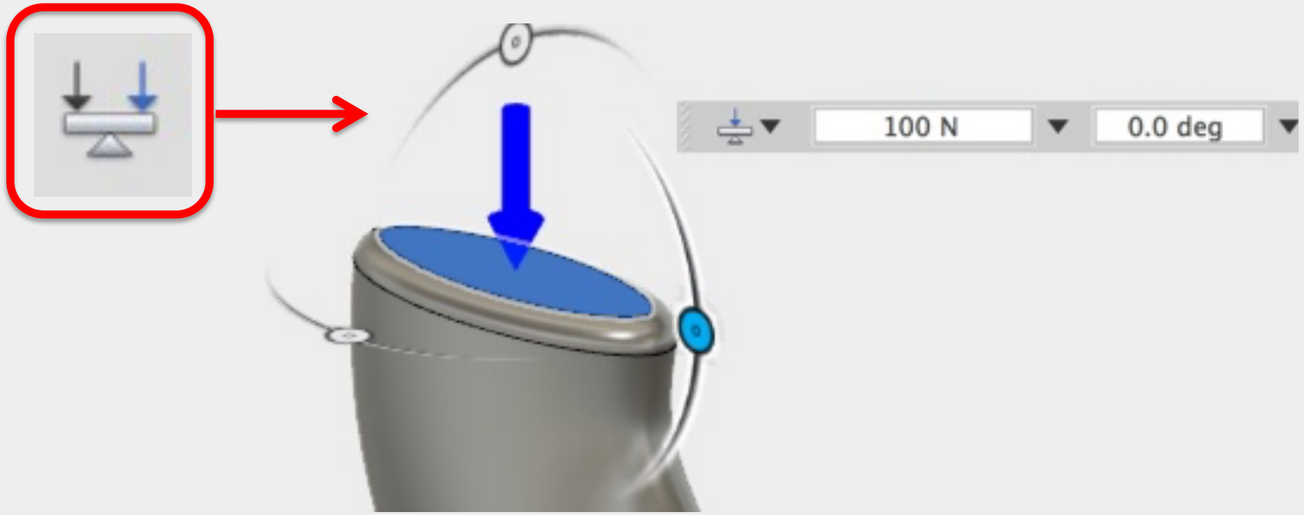
- Loads
- Constraints
- Contacts
- Studies
- Results

} Simulation Step-by-Step

Concept of Loads

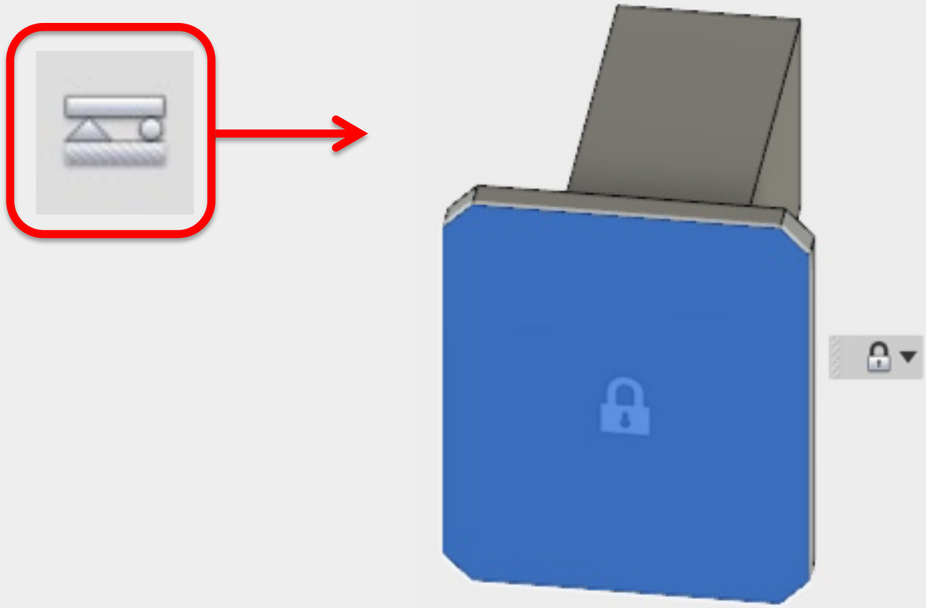
- Loads define forces, moments etc. applied to your design
- Loads are causing stresses and deformation of your design
- Multiple types of Loads
- Gravity





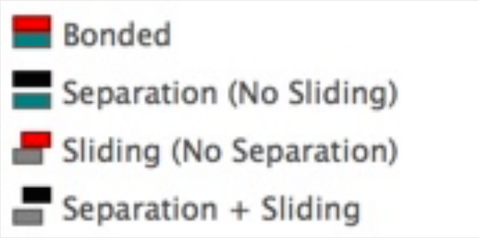
Concept of Constraints

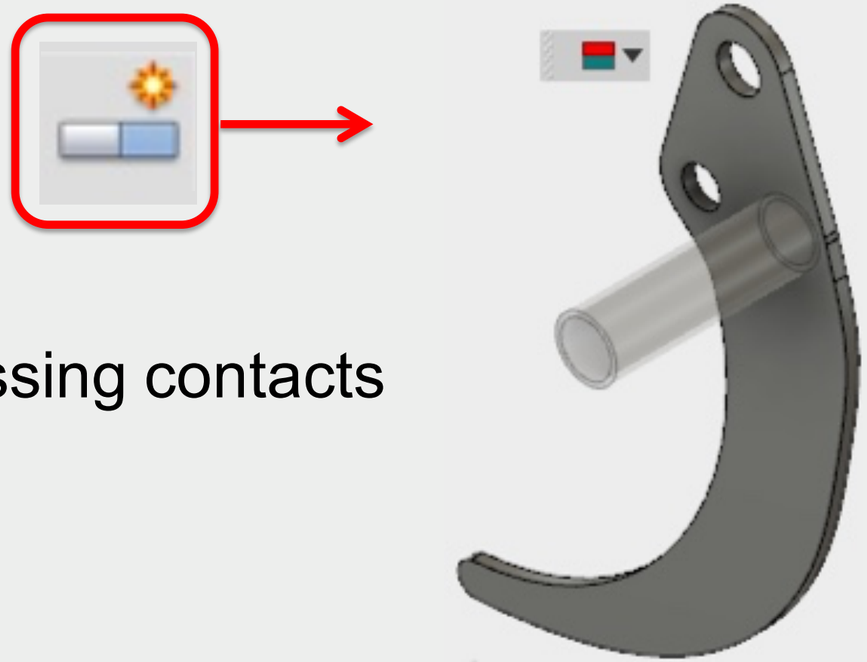
- Constraints limit displacement of your design
- Constraints describe connections of your design to the rest of the world
- Constraints balance Loads
- Multiple types of Constraints



Concept of Contacts

- Contacts (also called Joints) define connection between components
- Contacts describes how components interact with each other
- Multiple types of Contacts

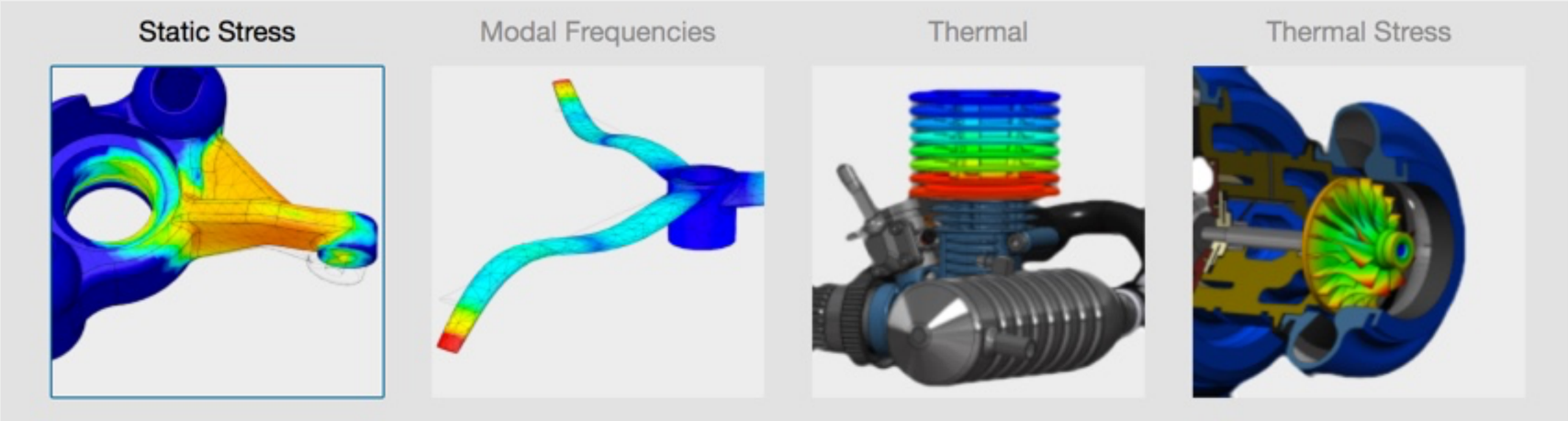


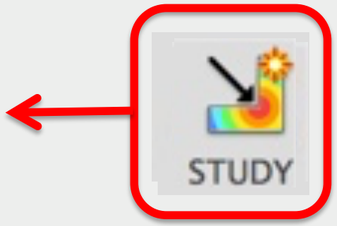


- Automatic Contacts generation
- Degrees of Freedom analysis helps with missing contacts

Concept of Studies

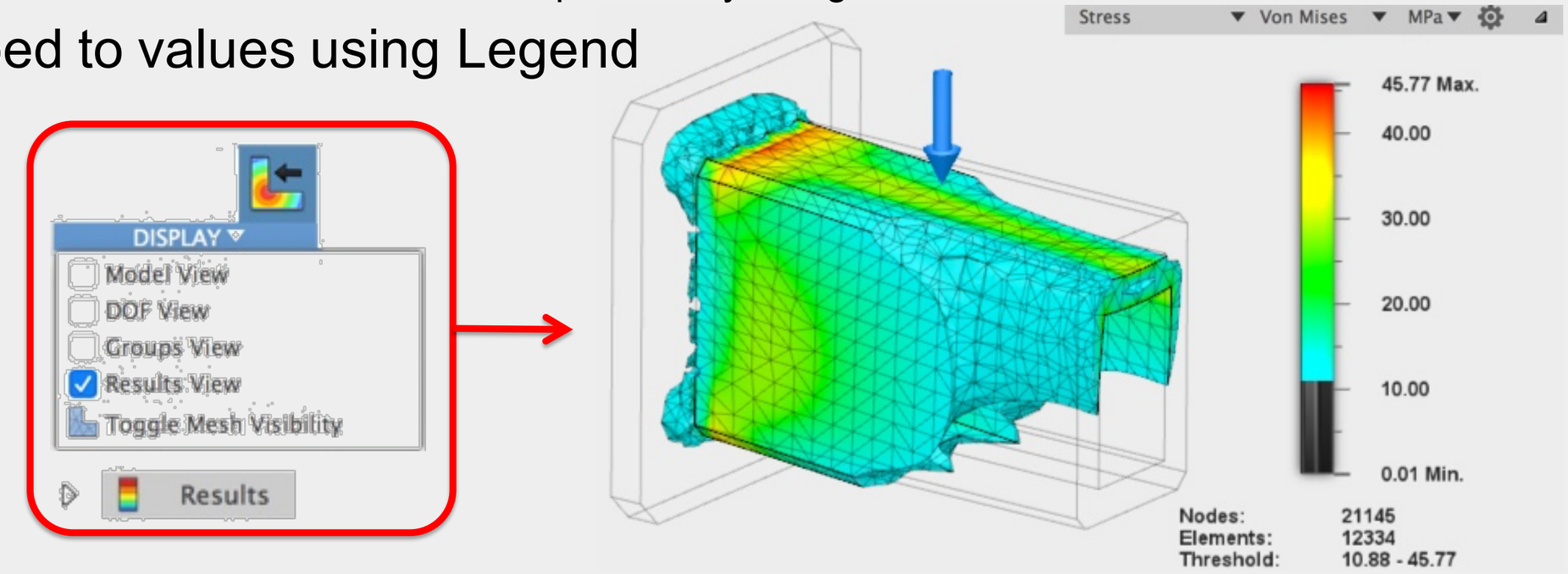
- Study contains definition of simulation and results
- Studies allows you to do multiple analysis on one design
- Multiple types of Studies



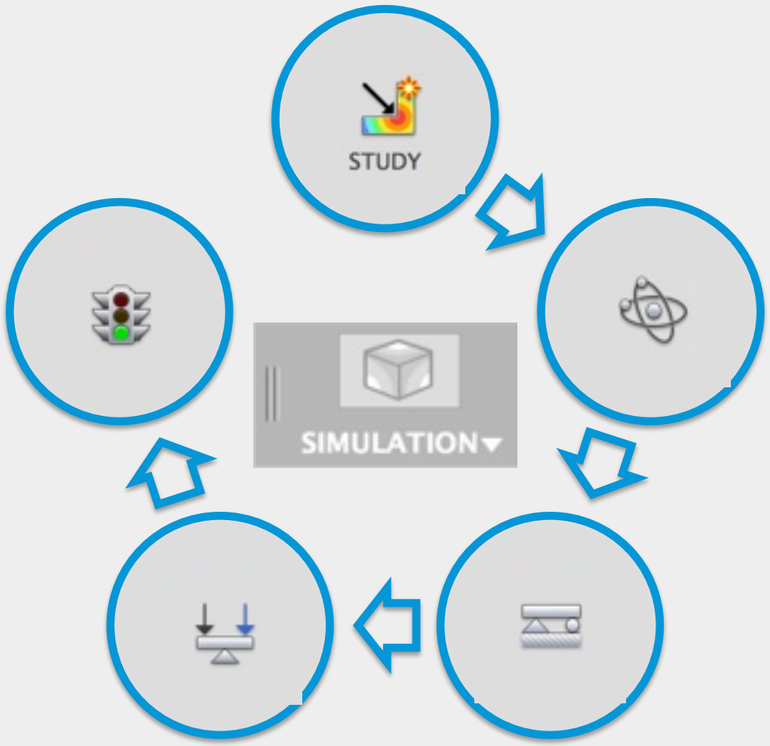


Concept of Results

- Results (also called Post-Processing) allow you to explore calculated stress, strain and deformation and make decision about your design
- In Results you find answers to your questions:
  - What is the stress in my design? What is the deformation of my design?
  - Would it break? Where can I remove material to optimize my design?
- Colors are mapped to values using Legend



Simulation Step-By-Step



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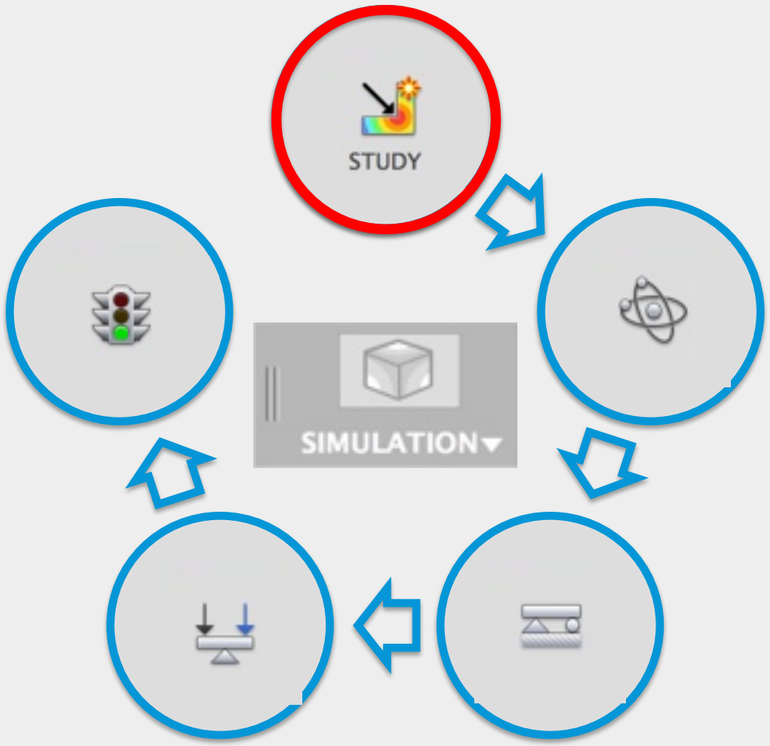

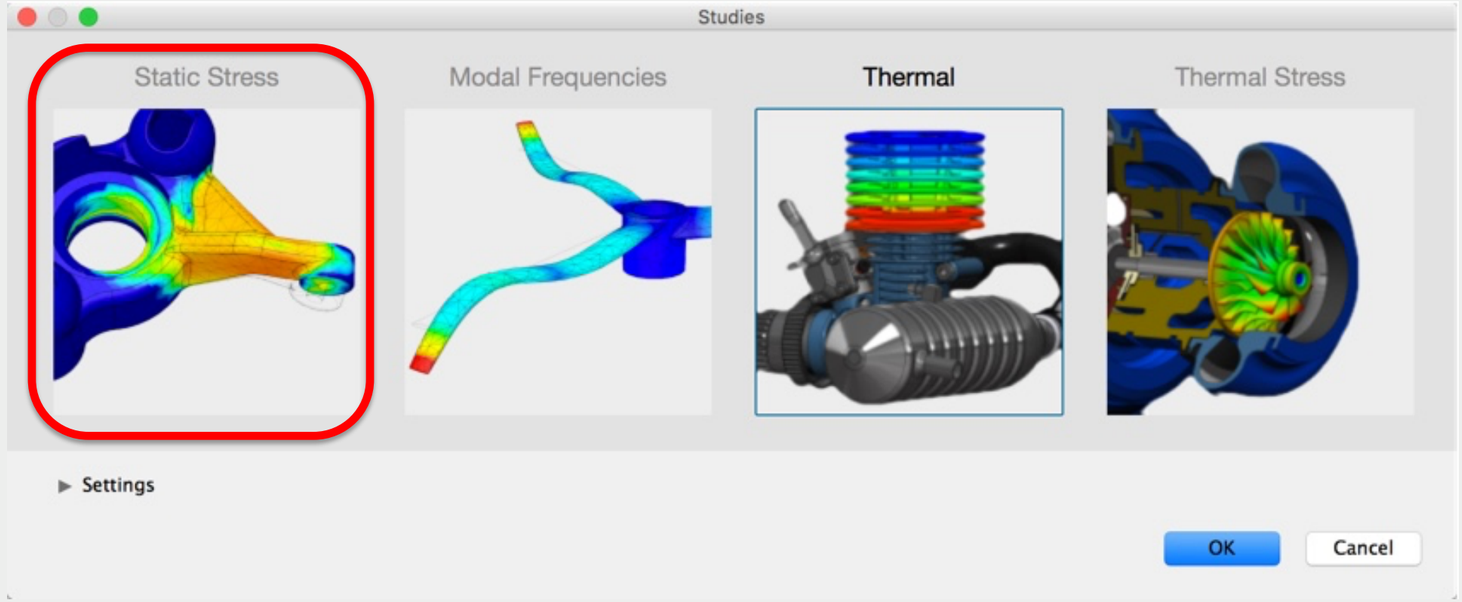

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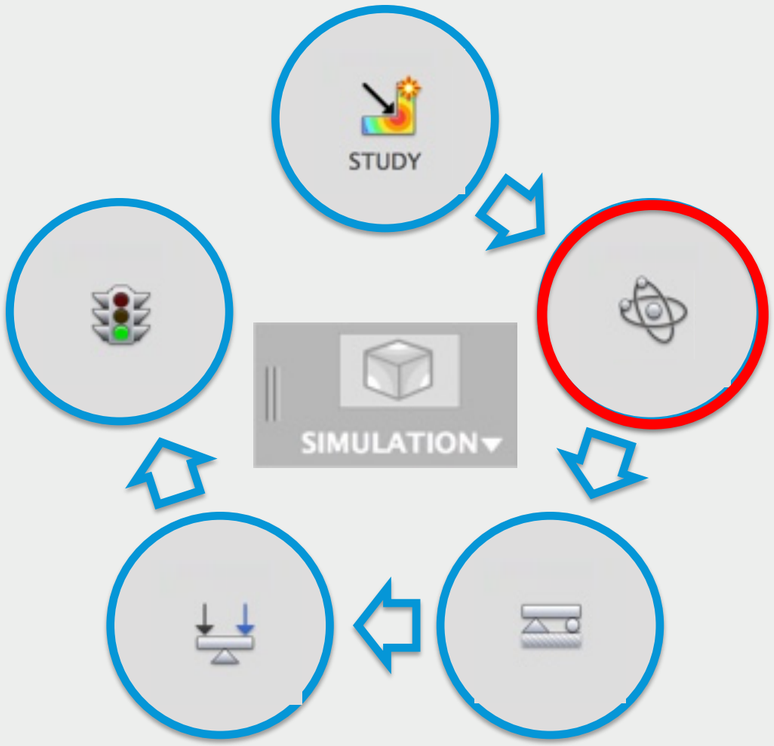

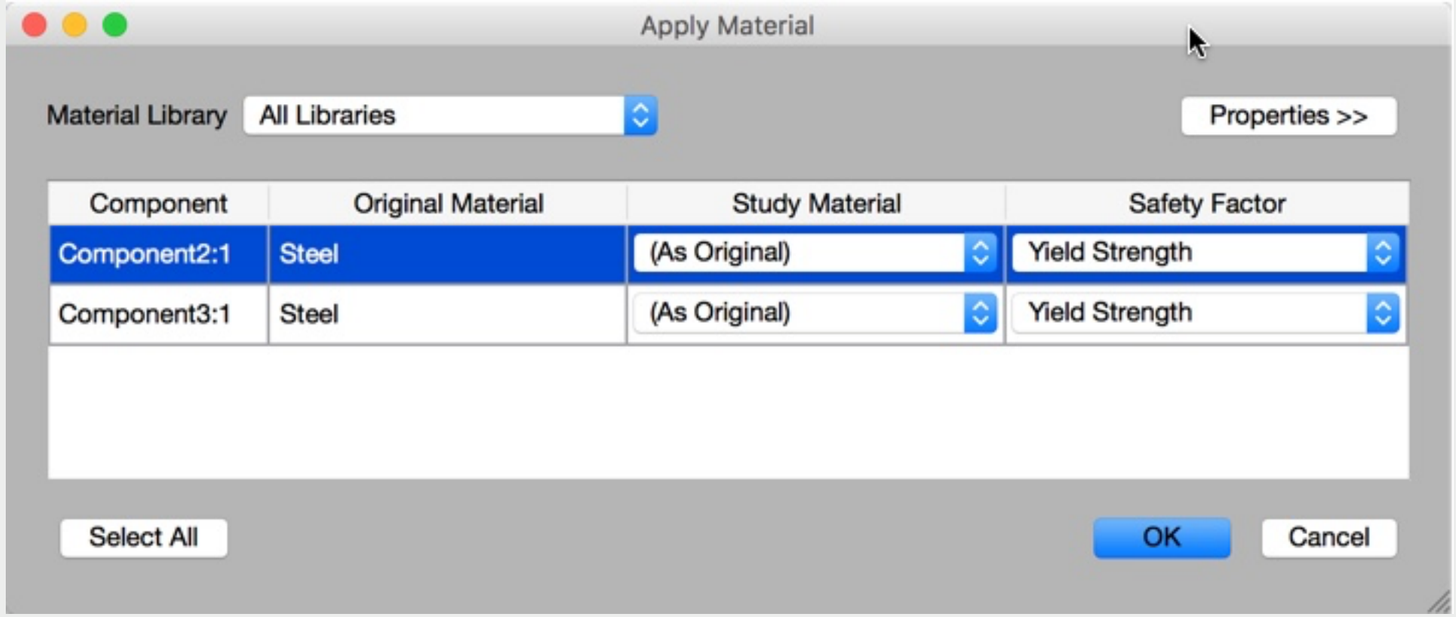

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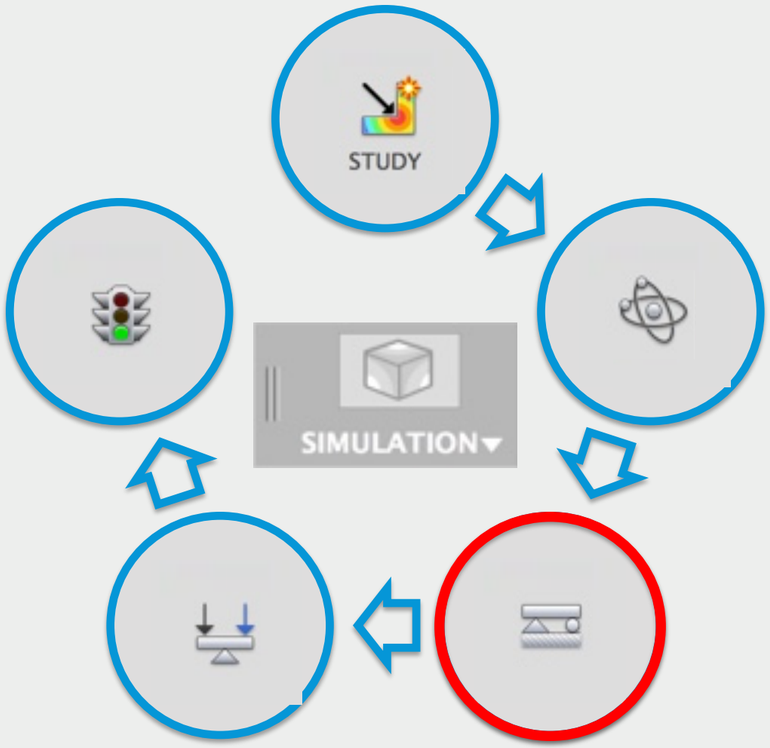

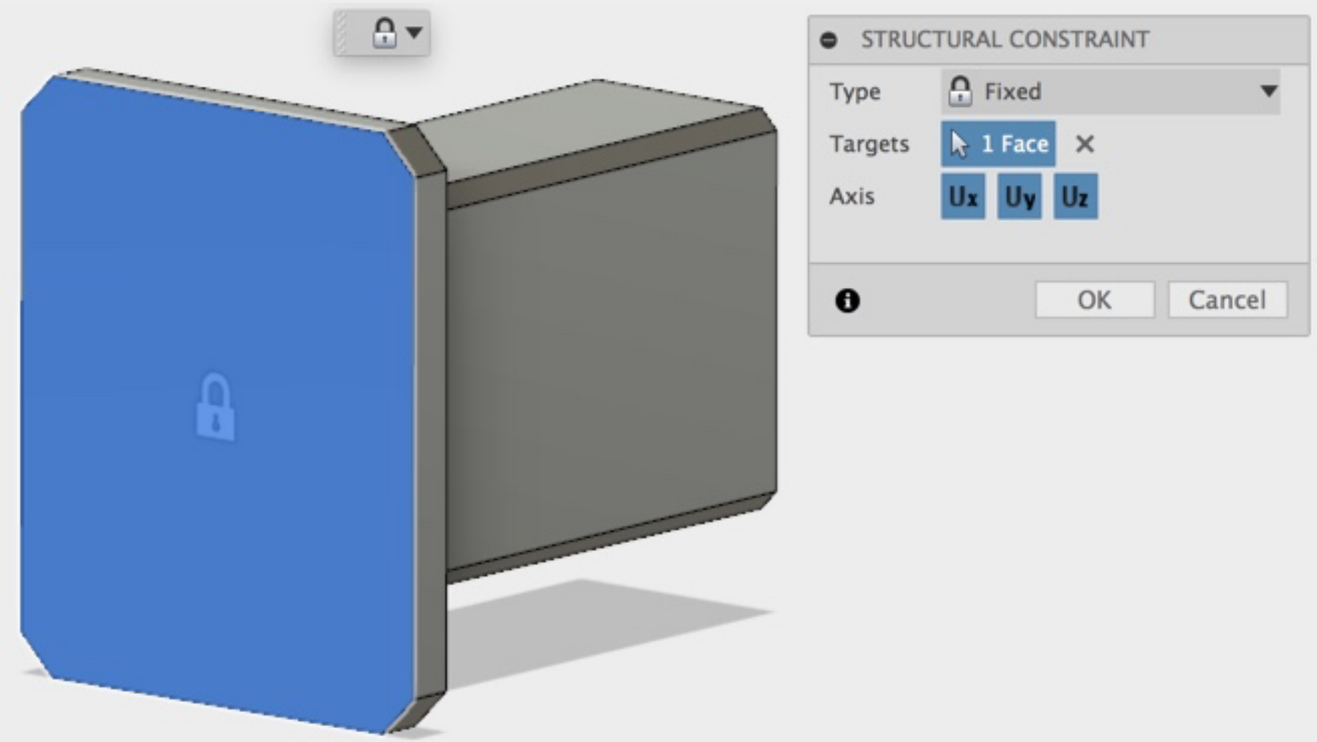

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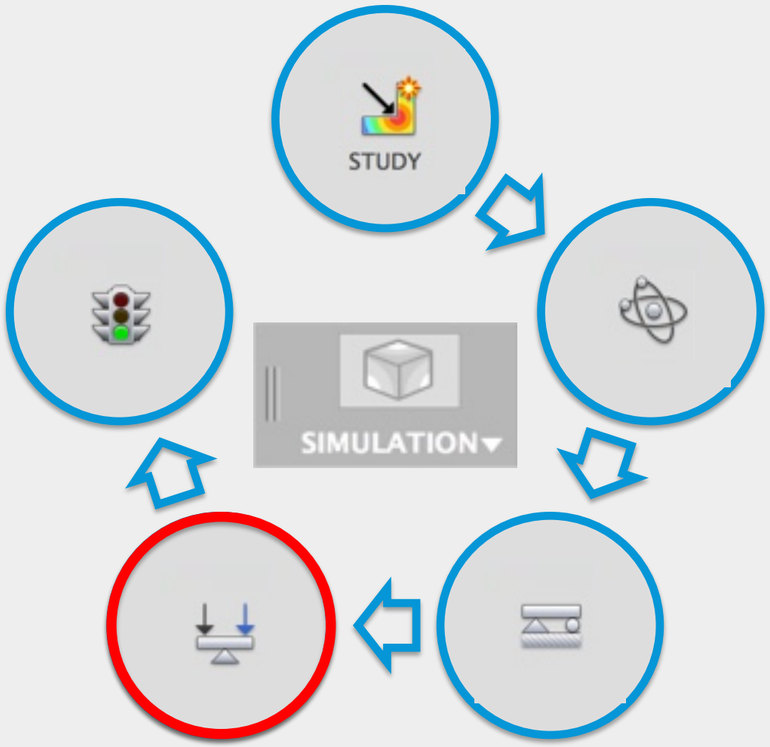
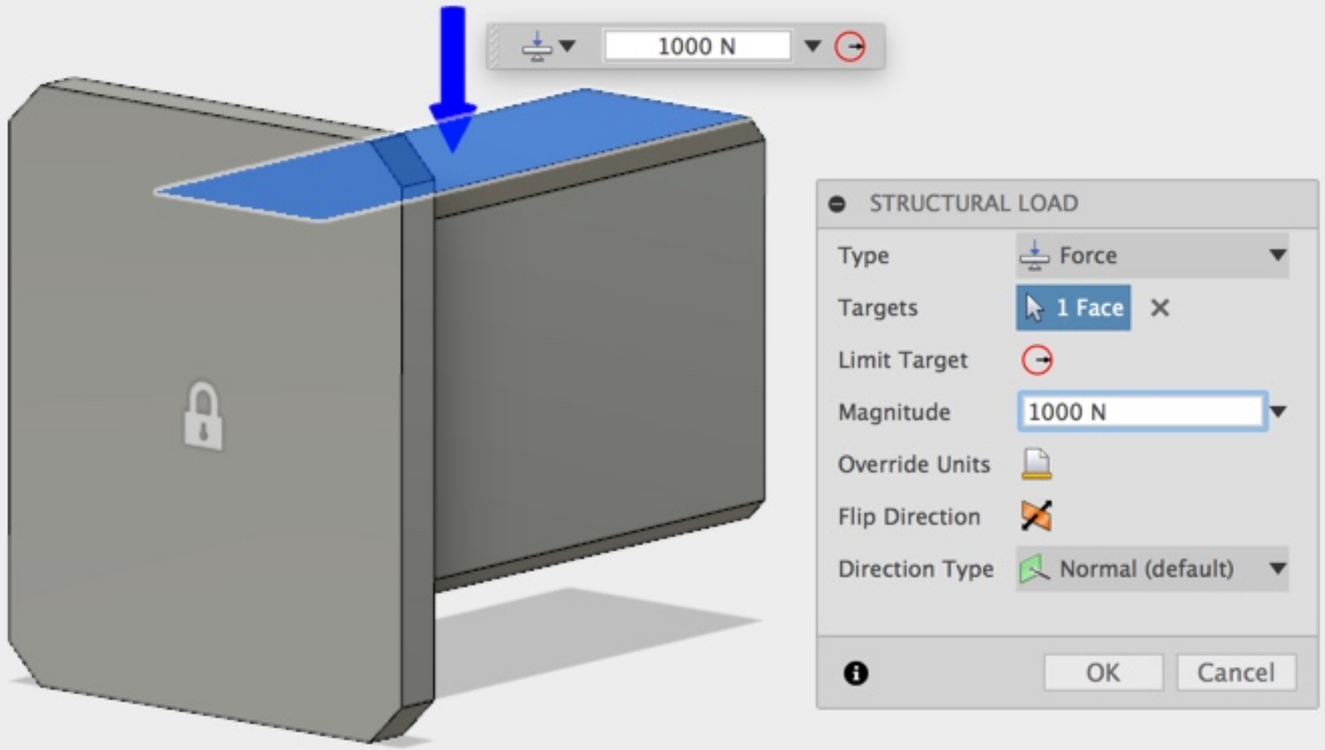
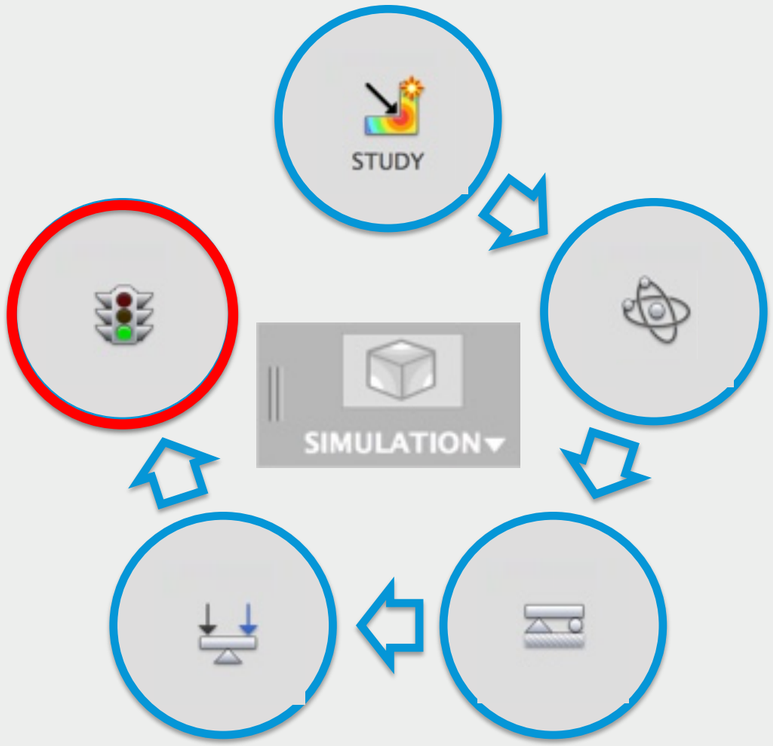
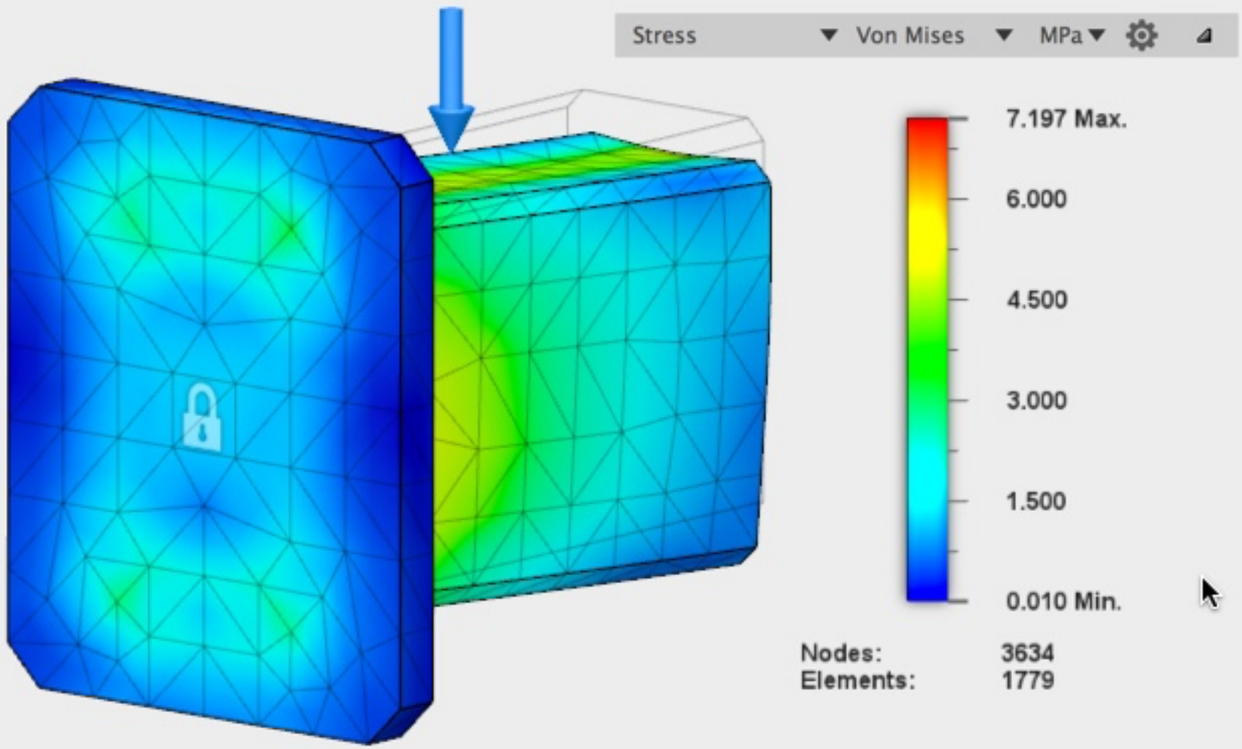




Simple Simulation Step-By-Step

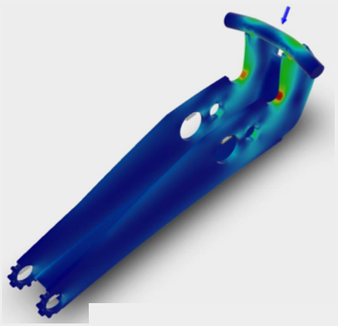


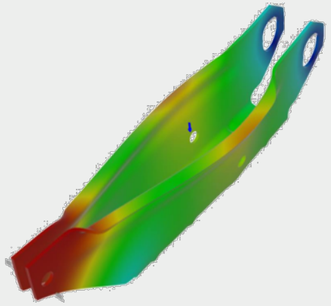


Learning objectives

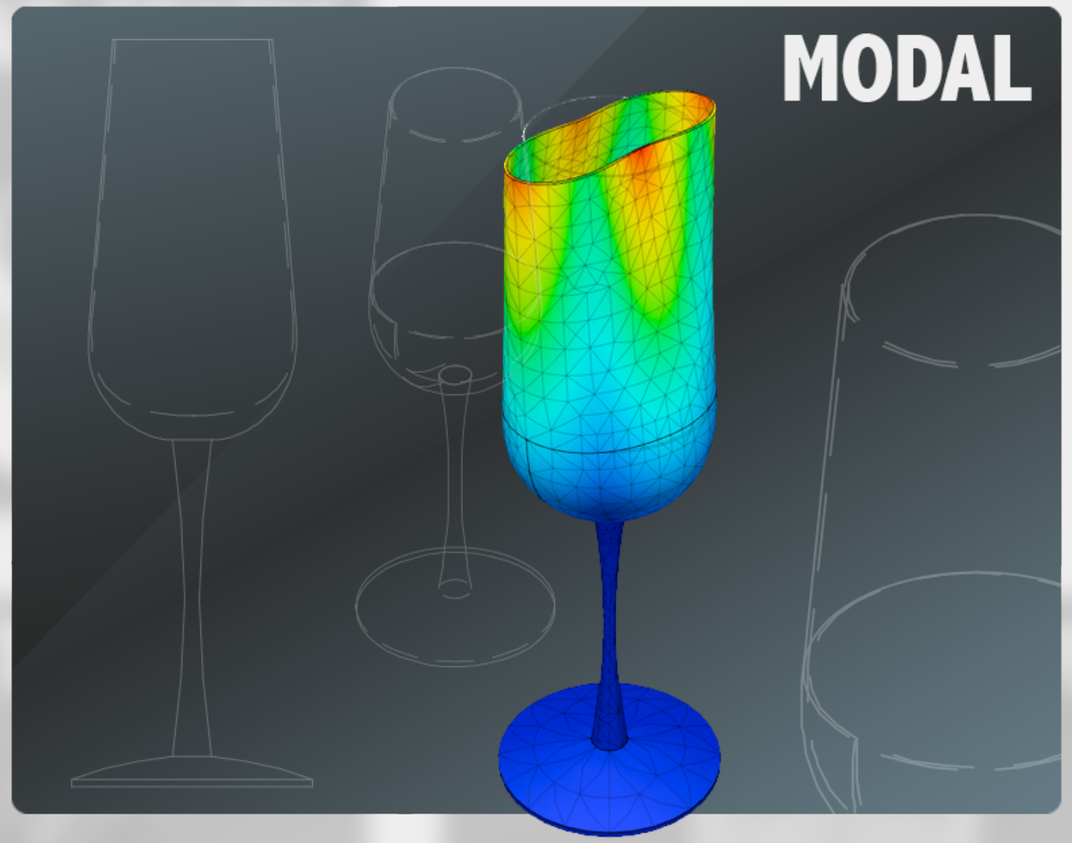
Linear Statis Stress

- Calculate displacements, stresses, strains and reaction forces caused by applied loads
- Assumptions:
  - Small deformations (deflections & rotations)
  - Linear material behavior
- Most commonly used simulation ~80%
- Example:
  - Jack
  - Verification





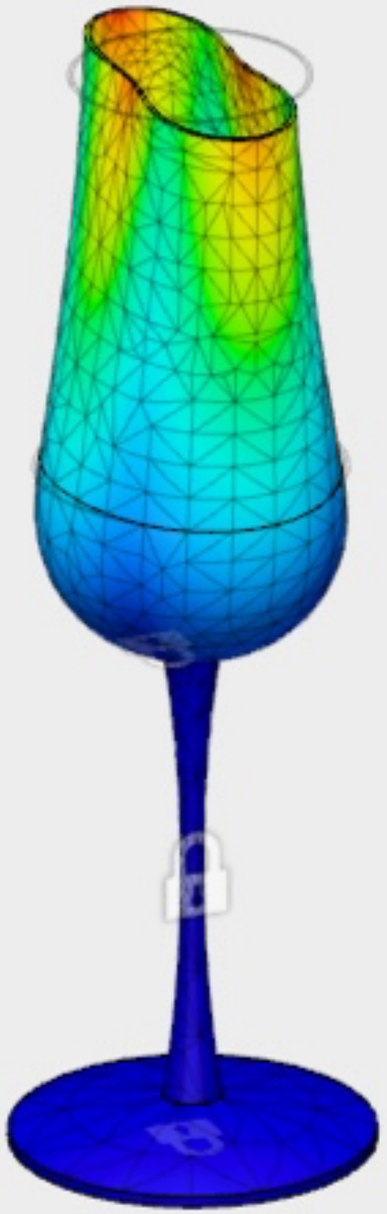
Learning objectives



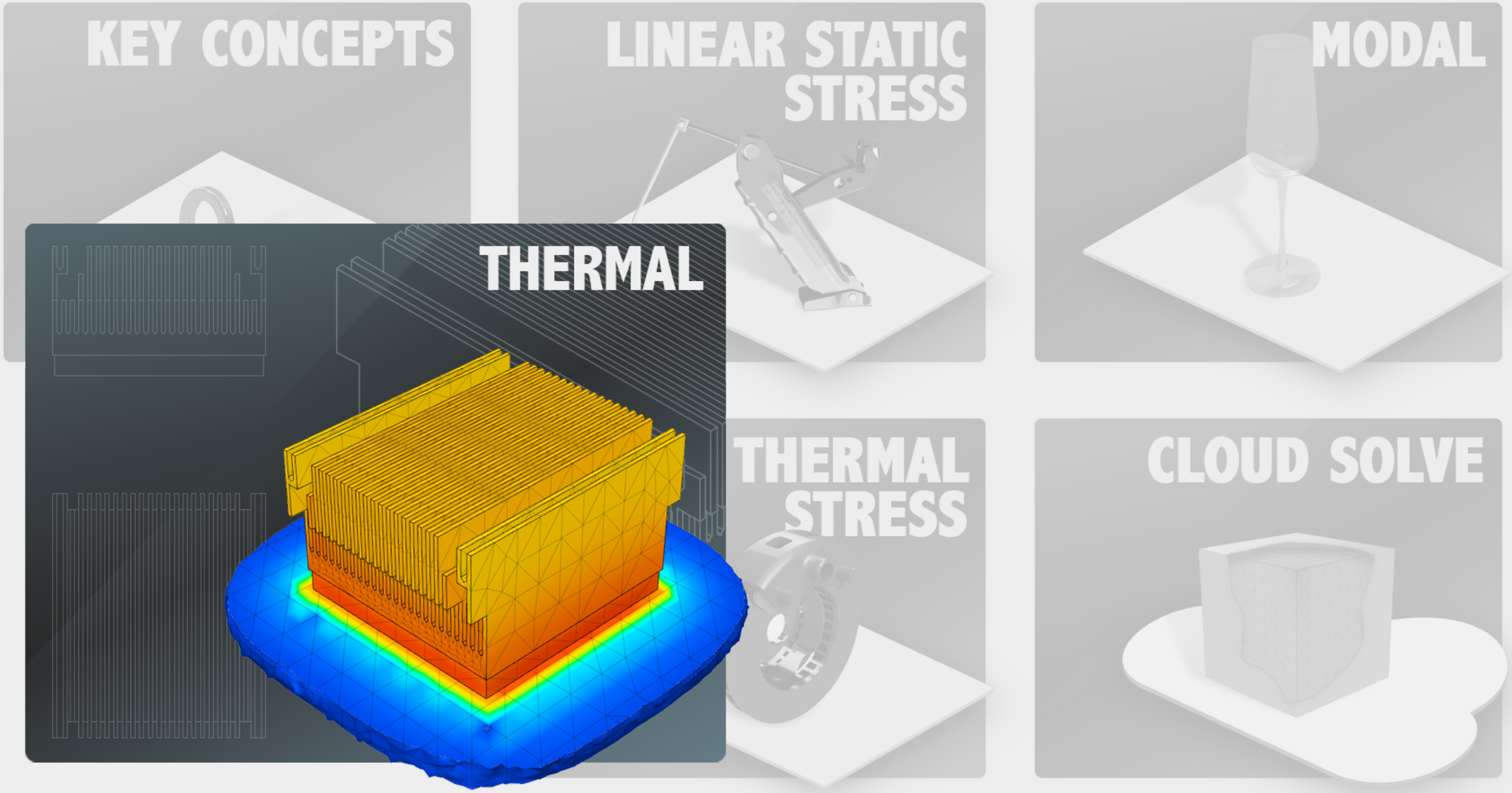
Modal

- Modal Analysis finds natural frequencies for your design
- These are frequencies that should be avoided

- Example:
  - Glass
  - What frequency would break it?
  - What are the shapes?



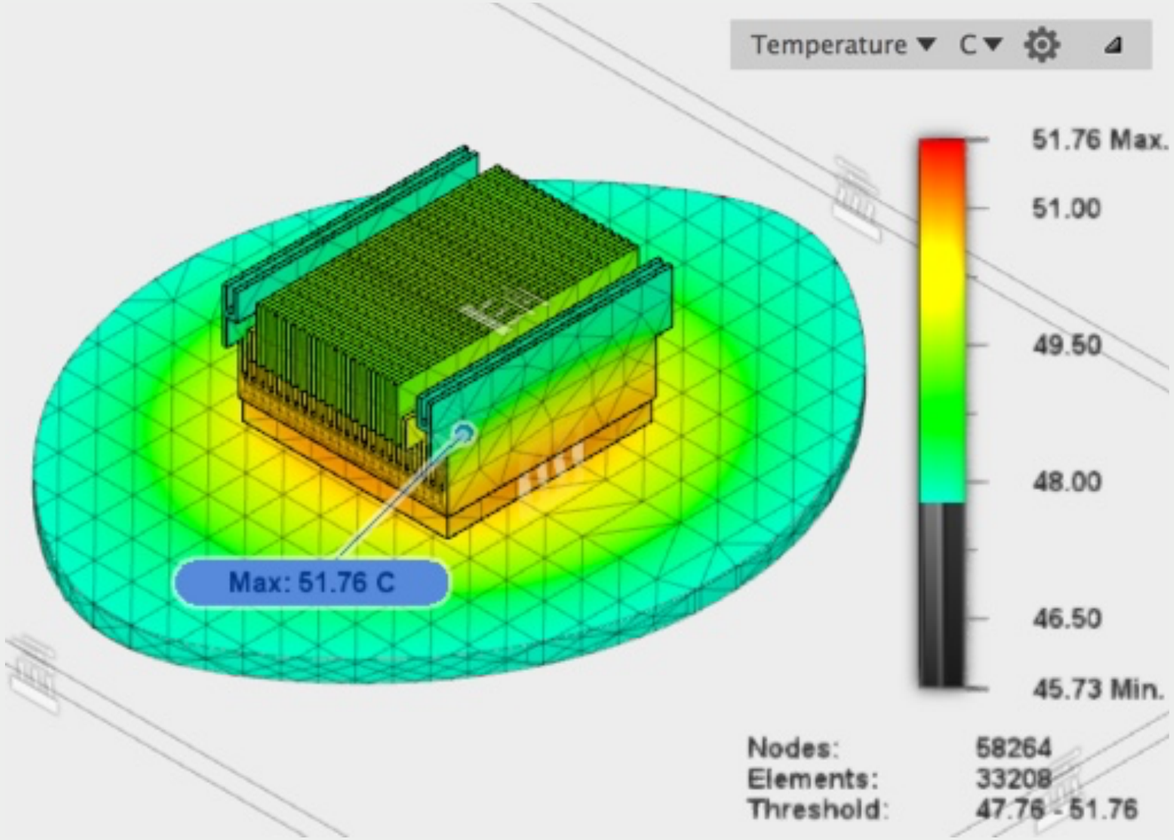
Learning objectives



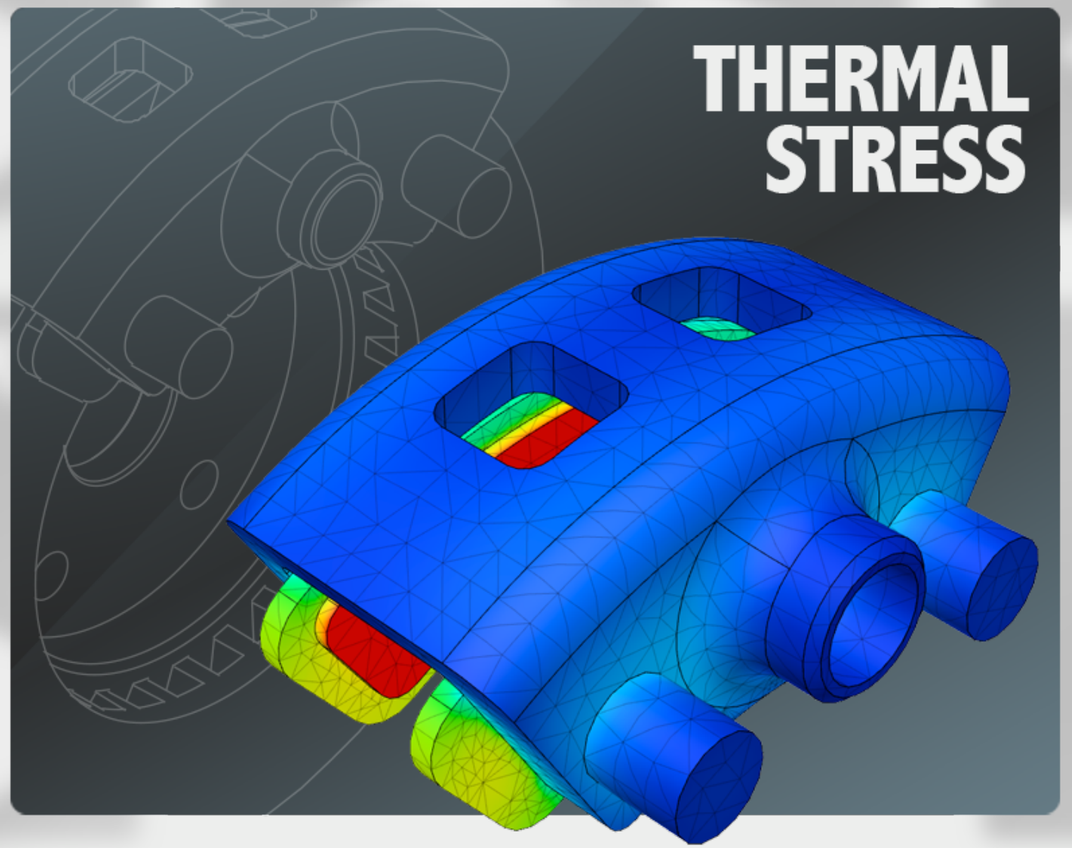
Thermal

- Analyze temperature distribution in your design caused by heat input and output
- Stabilized heat flux

- Example:
  - Passive CPU cooler
  - CPU input is 39 W
  - Max allowed temperature is 50°C
  - Fix a problem



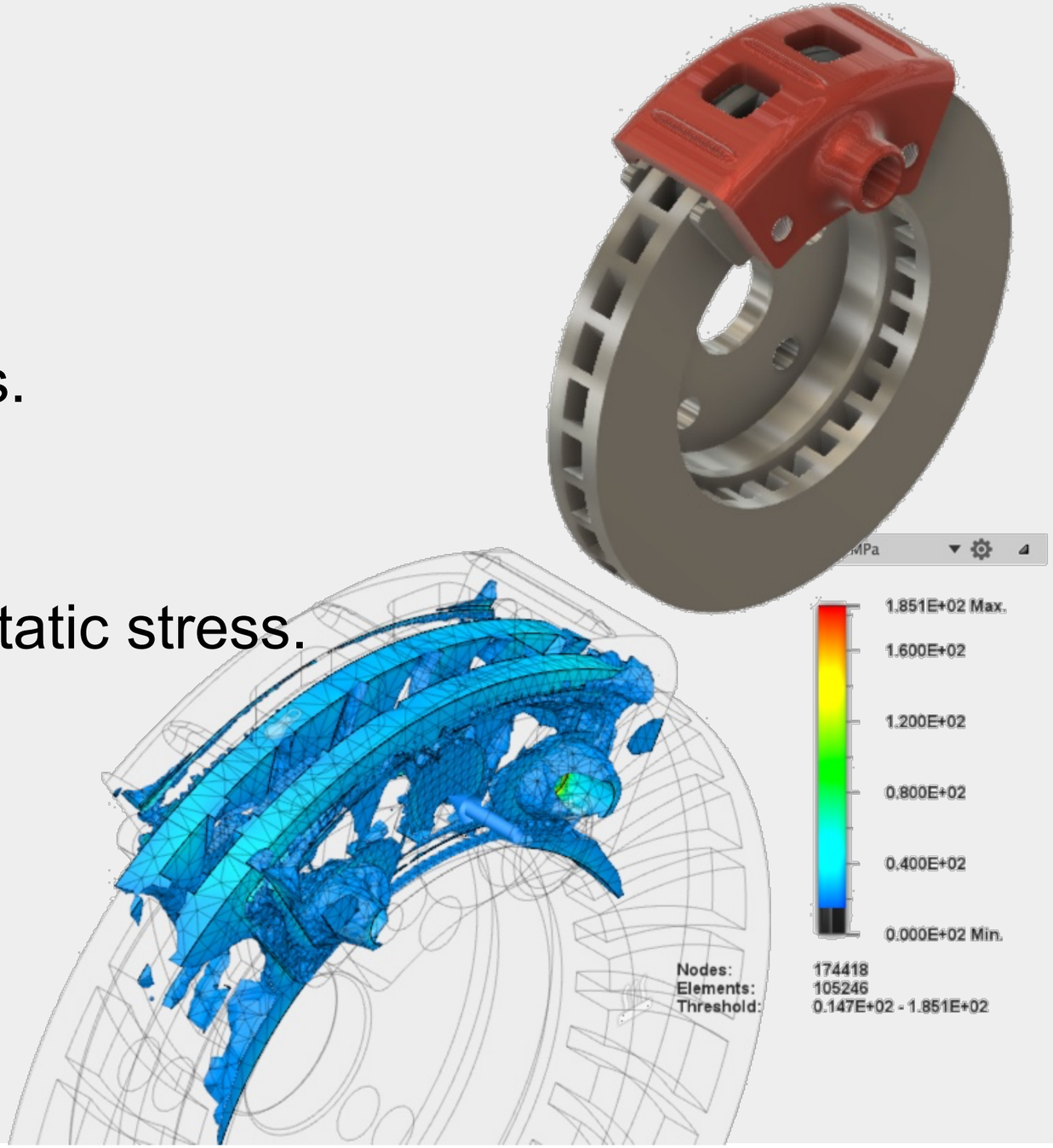
Learning objectives



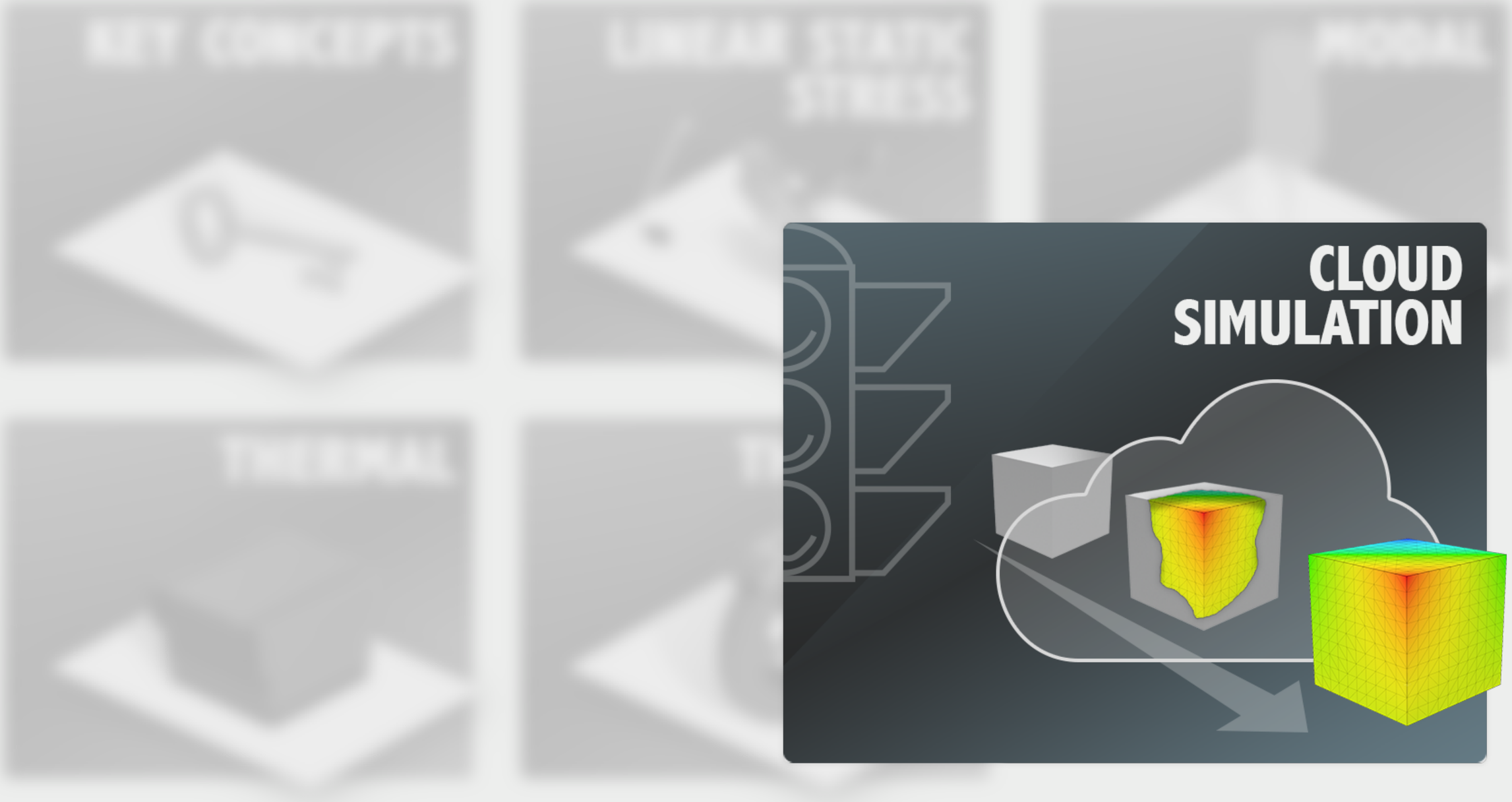
Thermal Stress

- Two steps analysis
  1. Calculate the thermal analysis.
     - Heat causes deformation.
     - Deformation causes stress.
  2. Combine thermal loads with static stress.

- Example:
  - Analyze a brake system
  - Optimize the design



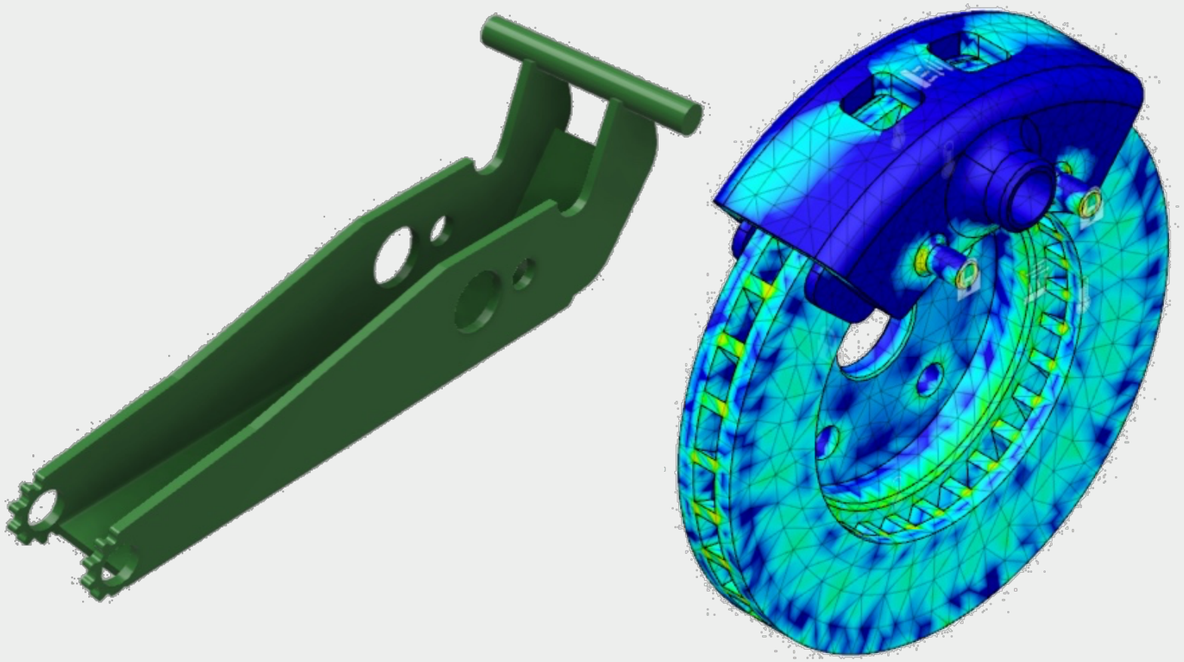
Learning objectives



Cloud Simulation

Scenario 1:

- Average part or a small assembly
- Focus on one study at a time
- For up to 100.000 elements in mesh



Local Solve:

Average computer: 8GB of memory and one 2.4 GHz CPU

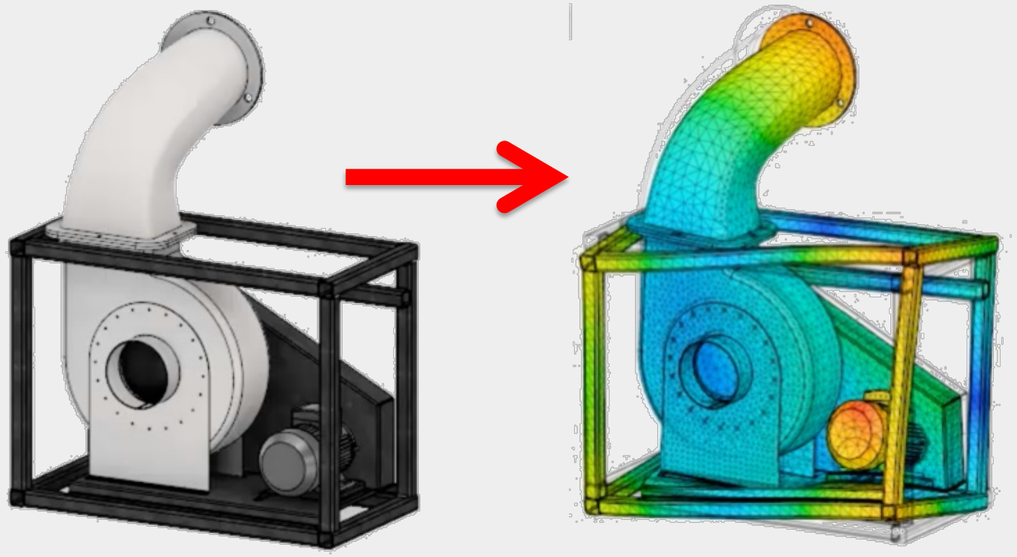
- Solve takes just seconds, max. minutes
- Very fast and responsive
- Our Solver is optimized for LSS

Cloud Simulation:

Cloud Worker: 64 GB of memory and multiple 2.5 GHz CPUs

- Similar time experience
- Richer Collaboration and Data Sharing

Cloud Simulation



Scenario 2:

- Larger assembly with more complex parts
- Focus on one study at a time

Local Solve:

Average computer: 8GB of memory and one 2.4 GHz CPU

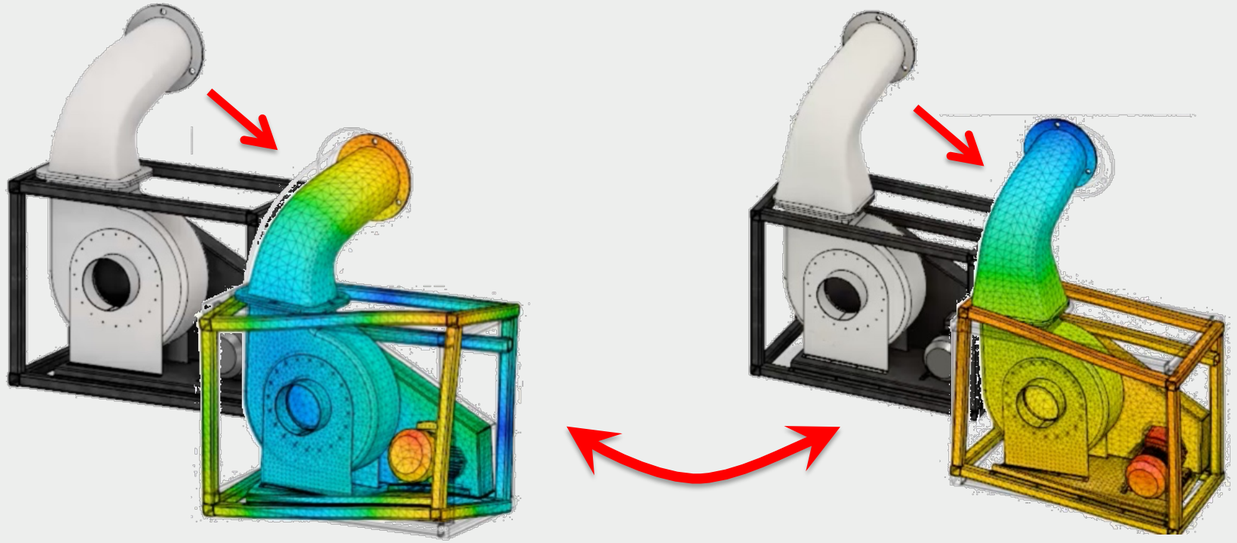
- It takes more than 4 hours
- Fusion is frozen with modal dialog
- Entire computer is pretty slow and non-responsive

Cloud Simulation:

Cloud Worker: 64 GB of memory and multiple 2.5 GHz CPUs

- Solve takes 1 hour: Saving 3 hours
- Fusion is not impacted – cloud calculation: Saving 4 hours
- Computer performance is not impacted

Cloud Simulation



Scenario 3:

- The same design
- What-if scenarios: 2 variants

Local Solve:

Average computer: 8GB of memory and one 2.4 GHz CPU

- One variant takes more than 4 hours
- Sequential solve of 2 variants: 8 hours
- Fusion is frozen with modal dialog
- Entire computer is pretty slow and non-responsive

Cloud Simulation:

Cloud Worker: 64 GB of memory and multiple 2.5 GHz CPUs

- Parallel calculations takes 1 hour: Saving 7 hours
- Fusion is not impacted –cloud calculation: Saving 8 hours
- Computer performance is not impacted

Questions?

CREDITS

LINEAR STATIC STRESS AND MODAL DEMO SET

Roman Vesely
Jan Priban

THERMAL STRESS DEMO SET

Pavel Holecek
Jan Vonasek

CLOUD SIMULATION VIDEOS

Pavel Pokorny

THERMAL DEMO SET

Josef Kucera

LEARNING OBJECTIVES GRAPHICS

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