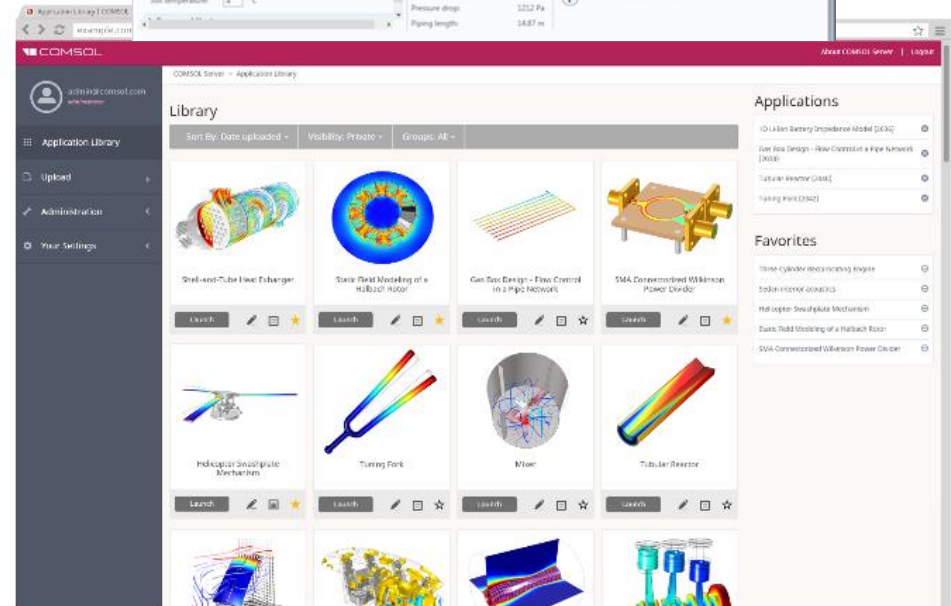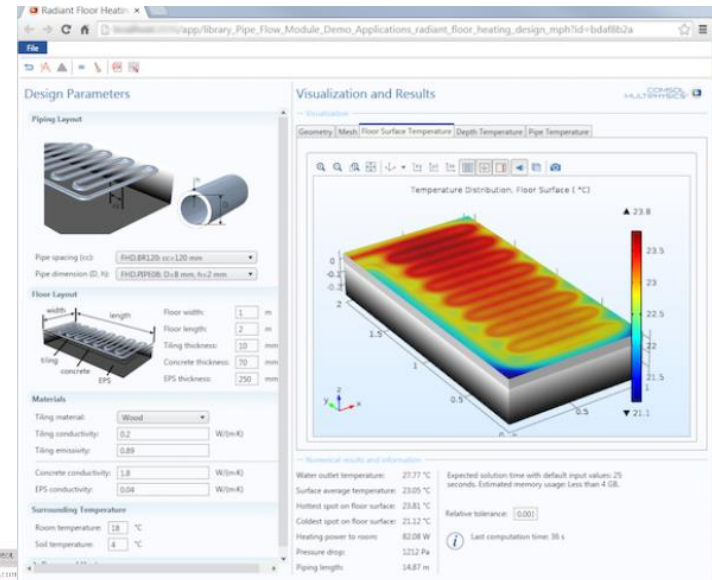# Multiphysics Simulation Applications

Jeff Crompton and Kyle Koppenhoefer
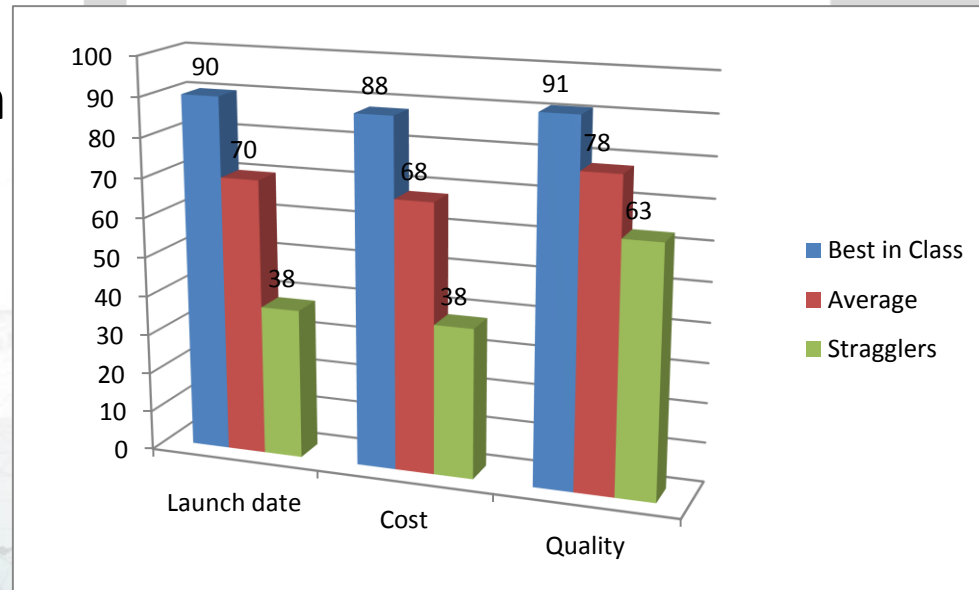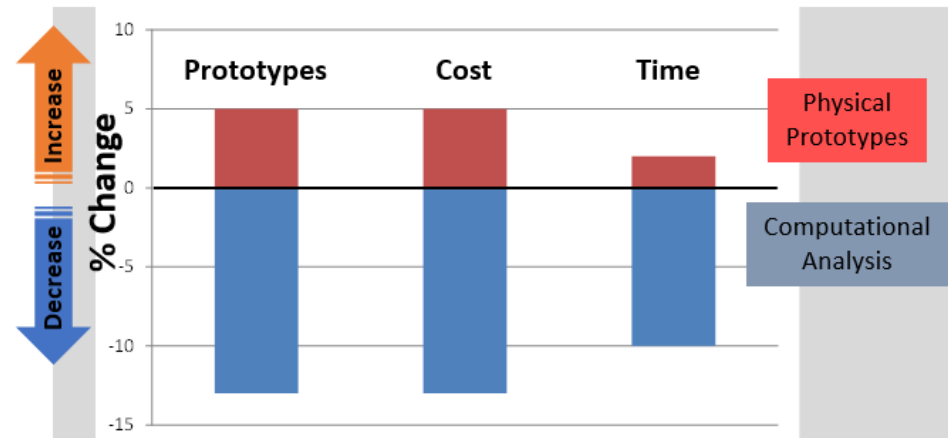
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Simulation Apps

- **Simplified interface to control Multiphysics analysis**

  - **Non-expert use**

  - **Increased sharing**

  - **Archiving**

  - **Teaching**

  - **Legacy links**

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Why Simulation Apps? - #1

- ## Simulation provides:
  - ### Enhanced technology development
  - ### Improved corporate performance
  - ### Market differentiation

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Why Simulation Apps? - #2

- **Extend use of computational analysis**
- **750K CAE users : 80M Scientists/Engineers**
- **Replace hand calculations by predictive physics**
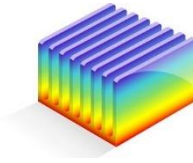- **Simplified interfaces to control complex analyses**

Corporate

CMCSIM
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3DADDSIM
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General

HEATSINKSIM
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QUENCHSIM
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MieSIM
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App example #1

- **Heatsink design**

- **Conduction, Convection, Radiation**

- **Optimization for specific applications**

- **Evaluation of complex design**

- **Parametric sweeps**

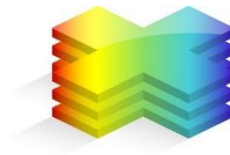- **Automated optimization**

- *Large number of analyses*
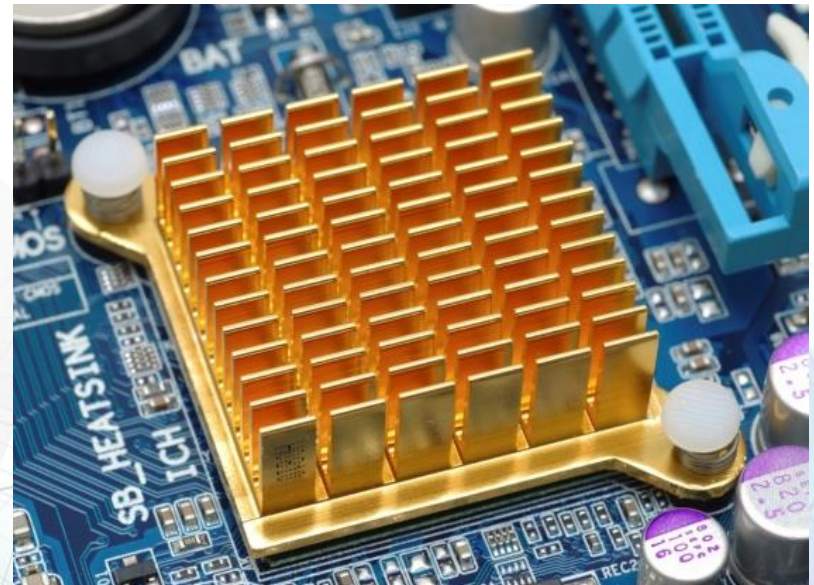
App example #1

- **Number of parametric analyses**

- **Individual problem size**

- **Optimize distribution of analyses over extended number of nodes**
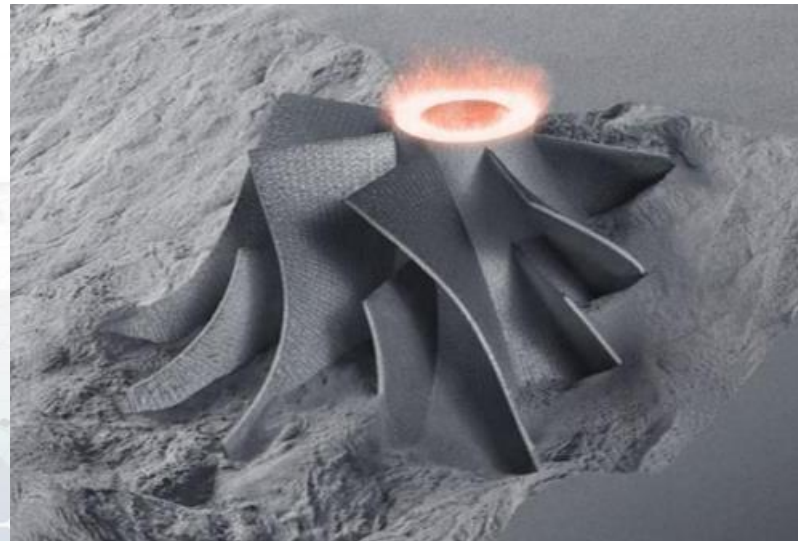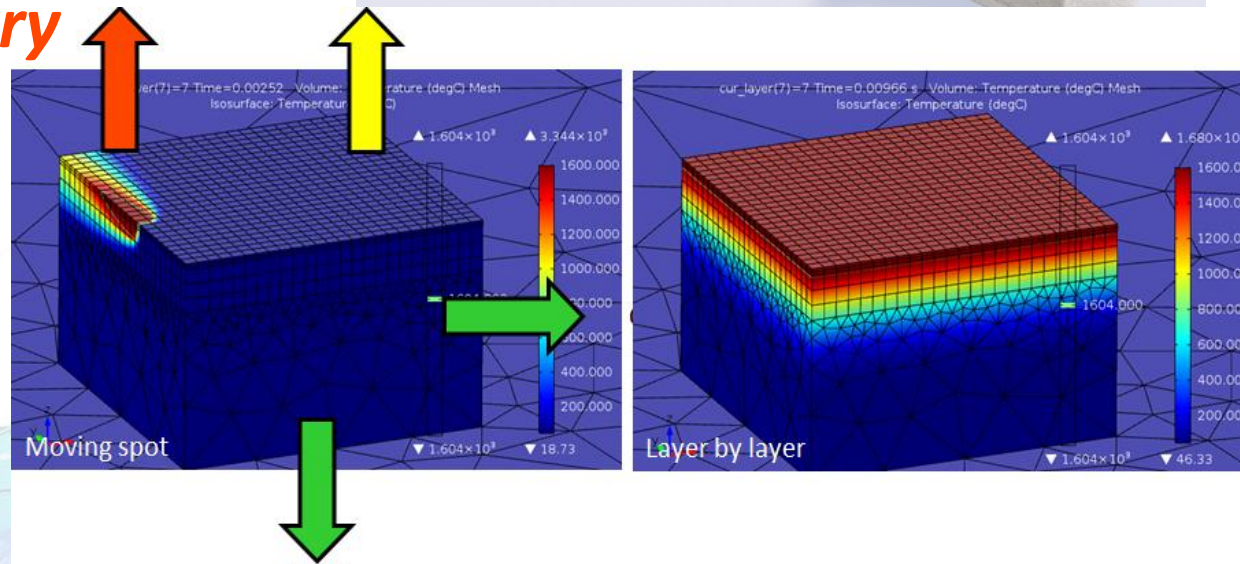
- *Distributed memory*
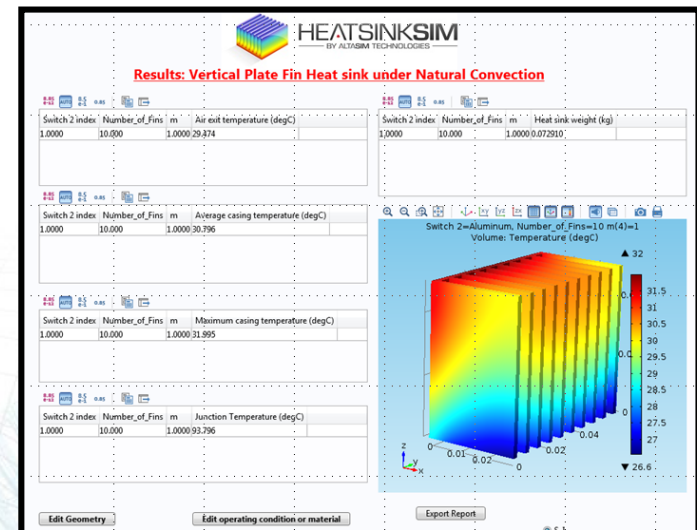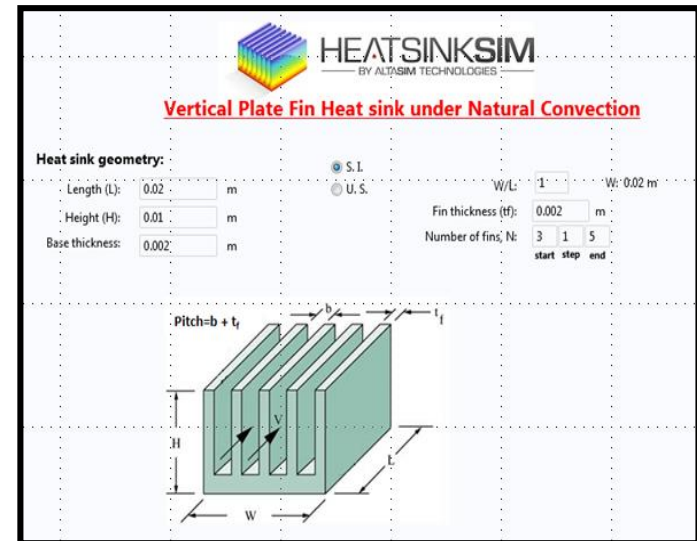
App example #2

- **PBF Additive manufacturing technology**
- **Multiphysics: Heat transfer, Fluid flow, Phase change**
- **Multiscale: cm to μm**
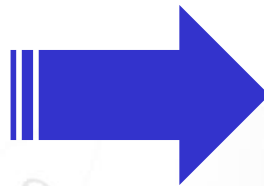- **Transient: Heat source, T dependent properties**

- ***Large problem sizes***

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App example #2

- **Establish problem size**
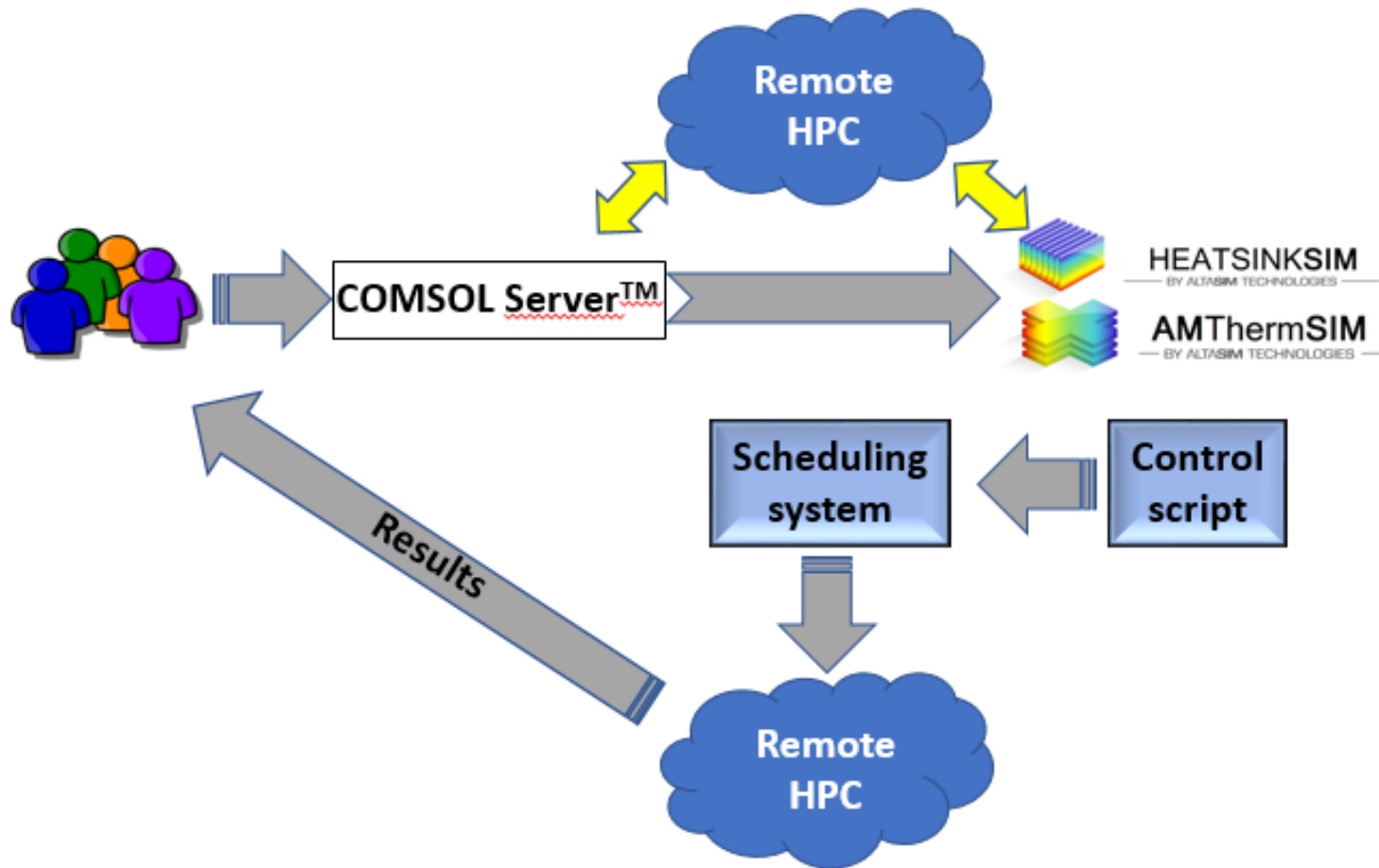- **Split into multiple interlinked analysis steps**
- *Shared memory distribution*

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App deployment

- **COMSOL Server/Client**

- **Remote HPC/Cluster deployment**

- **HPC system "Scheduler"**

- **Resource allocation:**
  - **# nodes**
  - **RAM**
  - **Availability**

Representative "Control" Algorithm

"Smart" App

Summary

- **Successful App functionality can rapidly increase**

- **Associated increase in computational resoruces needed to provide solution in realistic time**

- **Automated App use on HPC/Cluster can be integrated**

- **Routine use of complex Apps**

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