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Wind Turbines Workshop

www.feacomp.com

Outline

1. Simcenter STAR-CCM+ Positioning Presentation
2. Wind Turbine - Computational Fluid Dynamics Simulation
3. Wind Turbine - Fluid Structure Interaction Simulation

1. Simcenter STAR-CCM+ Positioning Presentation

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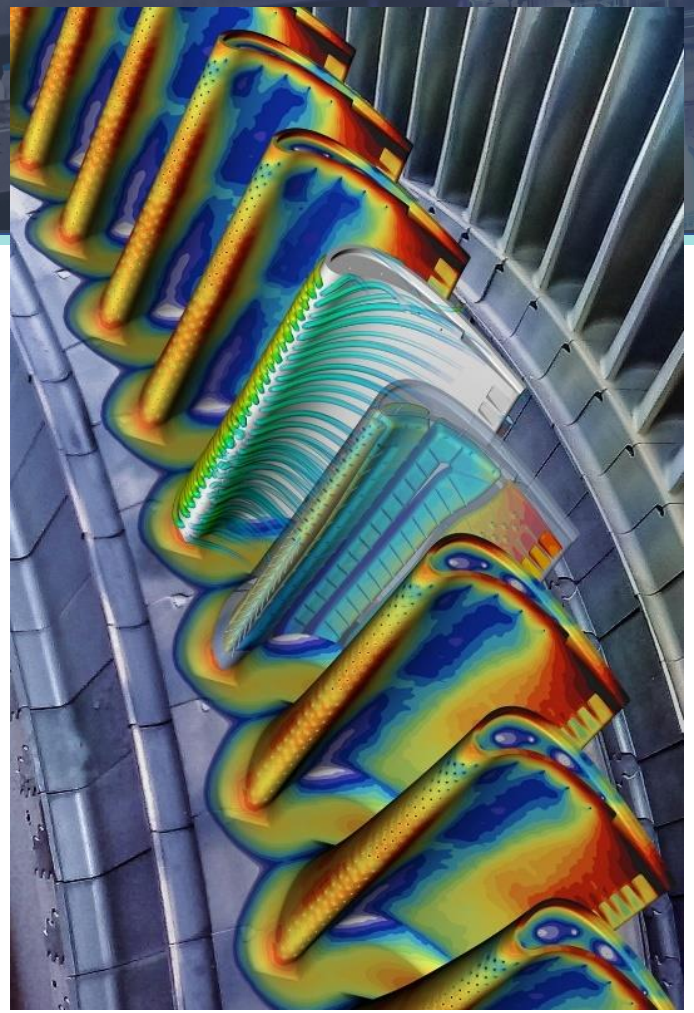
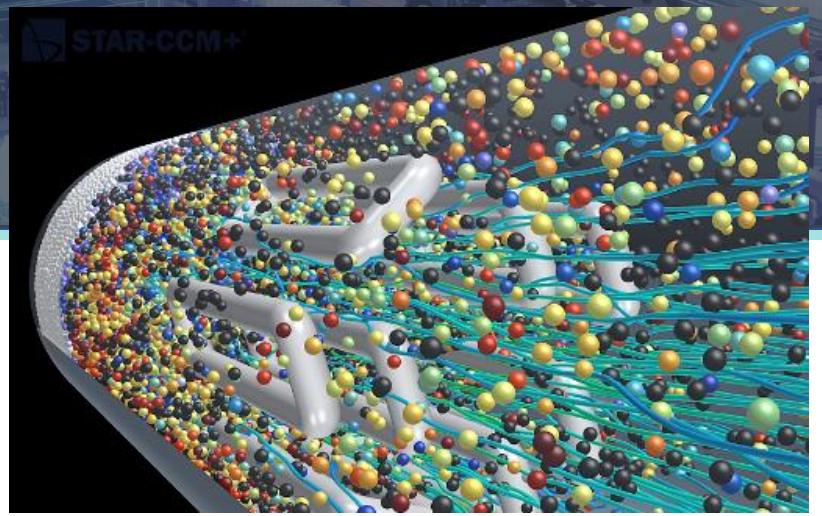
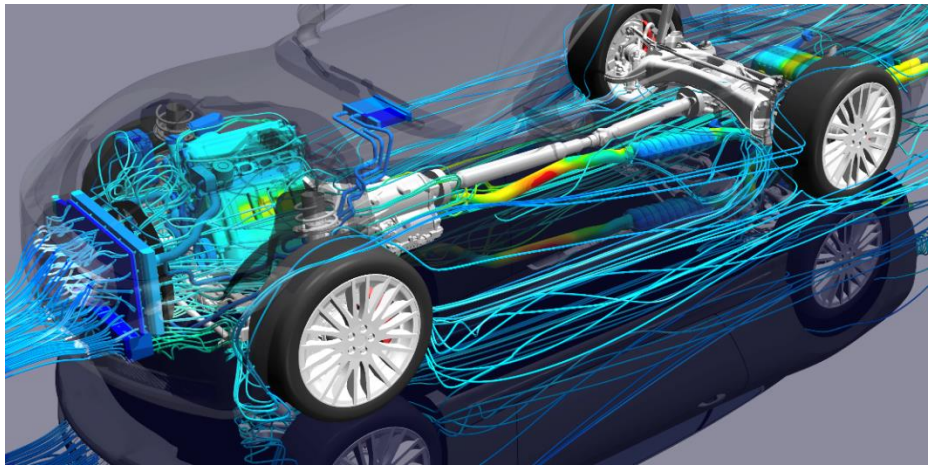
Simcenter STAR-CCM+
An integrated multiphysics solution for CFD engineers







Workshop 1: Numerical simulations for Wind Turbine Engineering Problems

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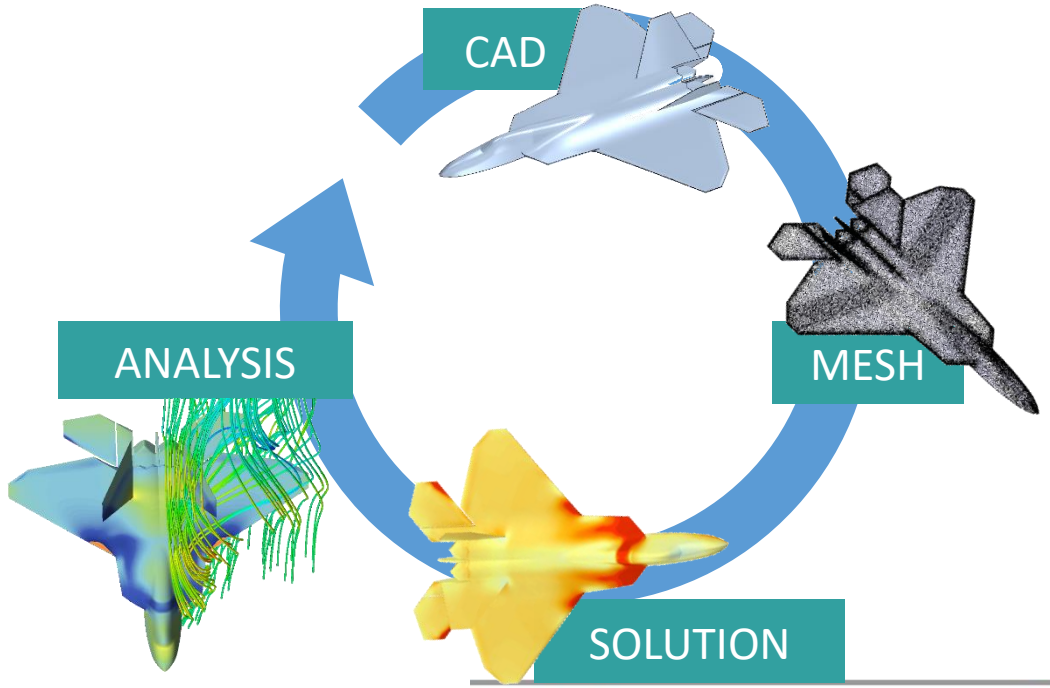
KIT Karlsruhe Institute of Technology
UNIVERSITY OF PATRAS

Simcenter STAR-CCM+

Workflow Automation

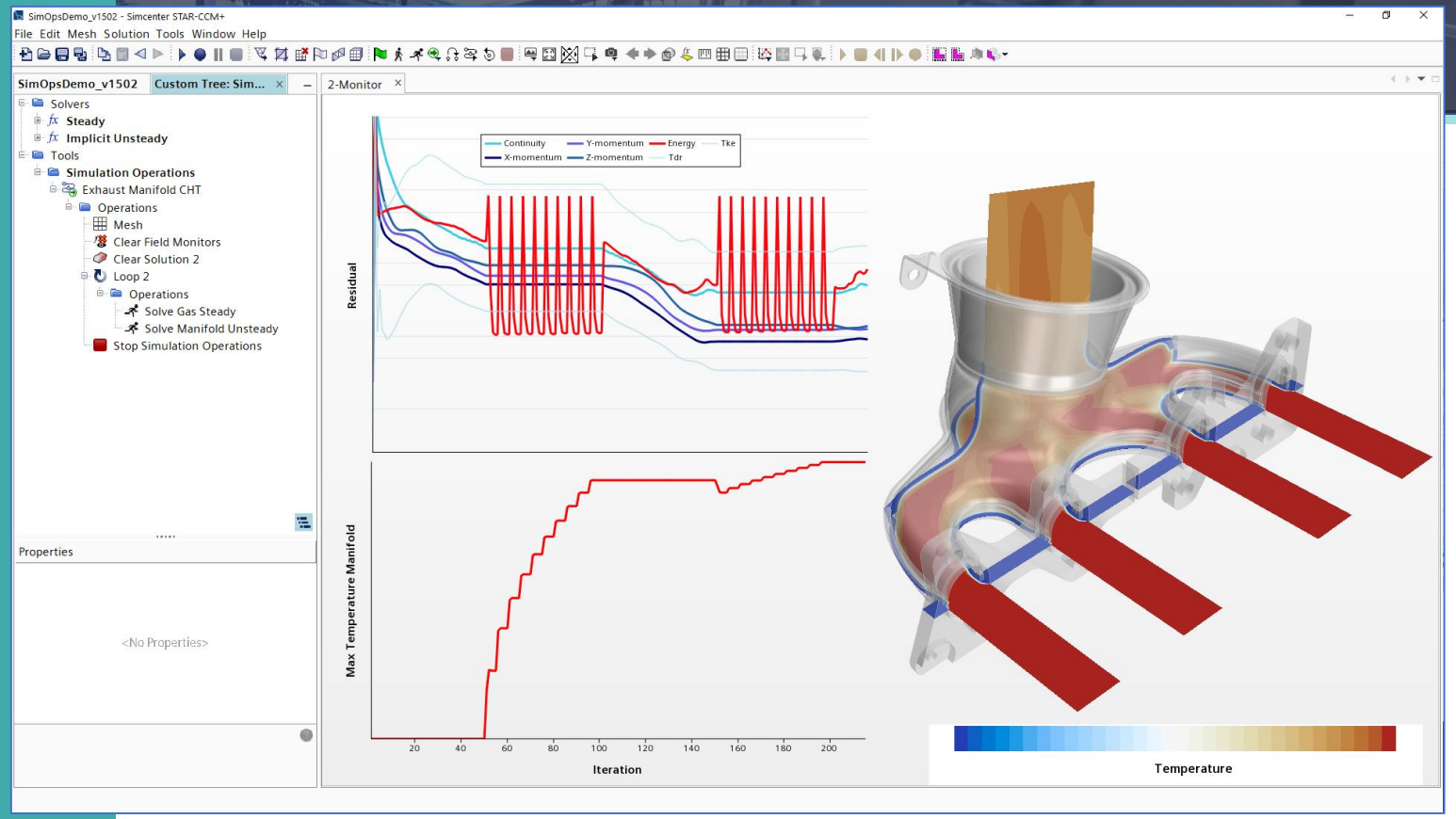
- Integrated CAD-to-solution in a single platform
- Single user interface and simulation file
- Robust & re-playable workflow enabling exploration

Reduce engineering time by 90%



Increasing simulation throughput with end-to-end automation

- Parametrisation of complete simulation process
- Logic based workflows to minimise user interaction
- Automated execution with simulation driver and macros

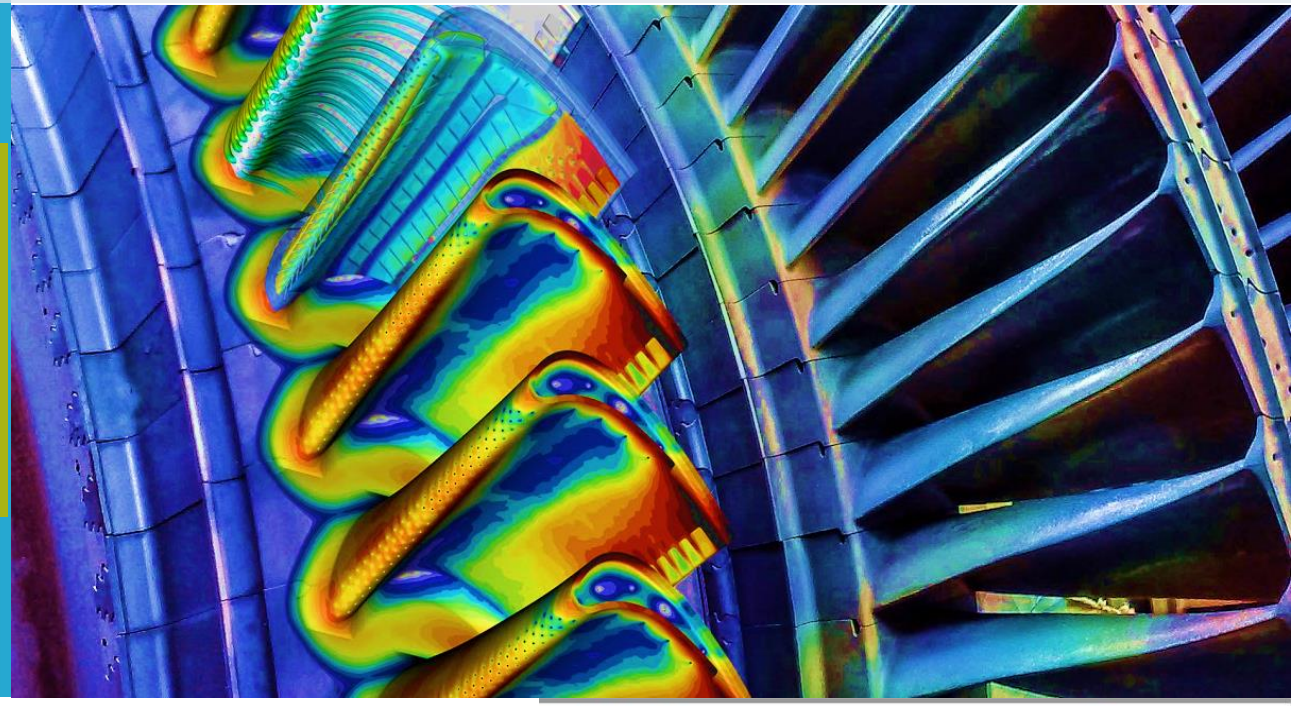


Simcenter STAR-CCM+

Integrated Multiphysics

- Built on the backbone of industry-leading CFD
- Broad range of validated physics models
- Multiple physics & motion in one simulation

Simulate reality no matter how complex the physics



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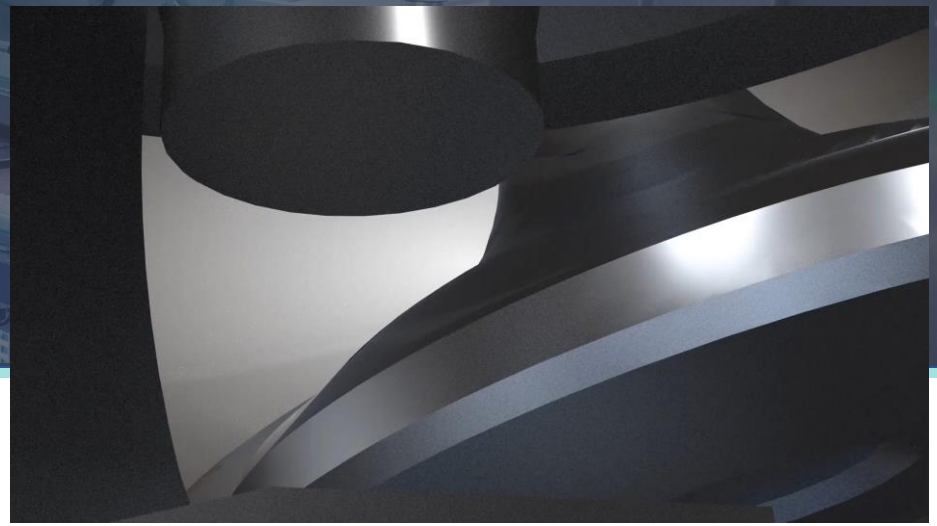
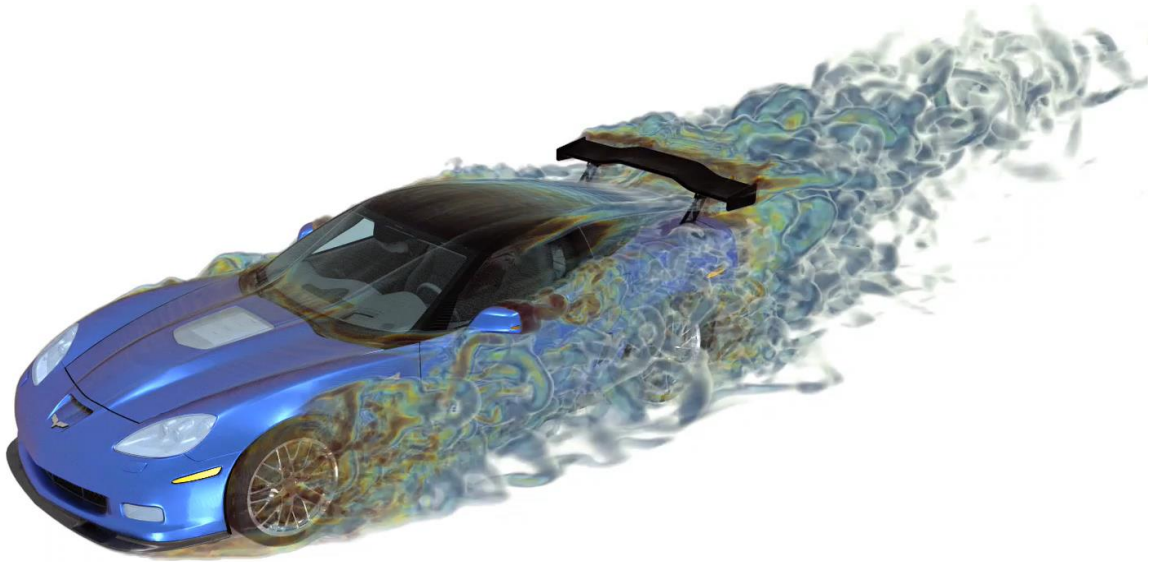
- Fluid dynamics
- Heat transfer
- Reacting flow
- Multiphase flow
- Particle flow
- Aero-acoustics
- Electro-magnetics
- Rheology
- Solid mechanics





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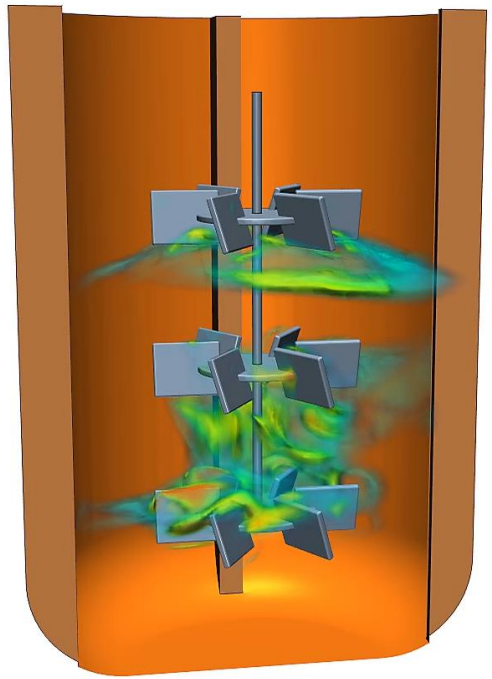
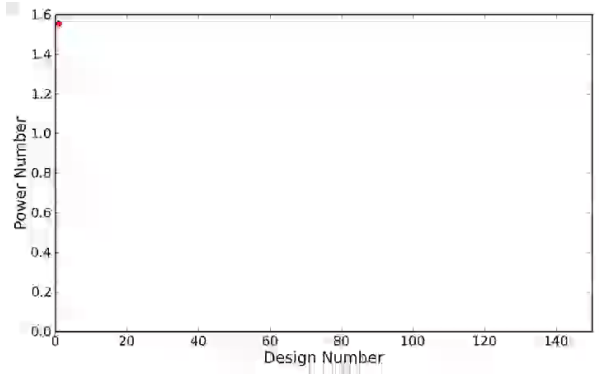
Simcenter STAR-CCM+

Design Exploration

- Built-in design exploration and optimization
- Intelligent approach with multiple search strategies
- No tuning of parameters or expertise required

Save $$$ by analyzing 1000s of design trade-offs

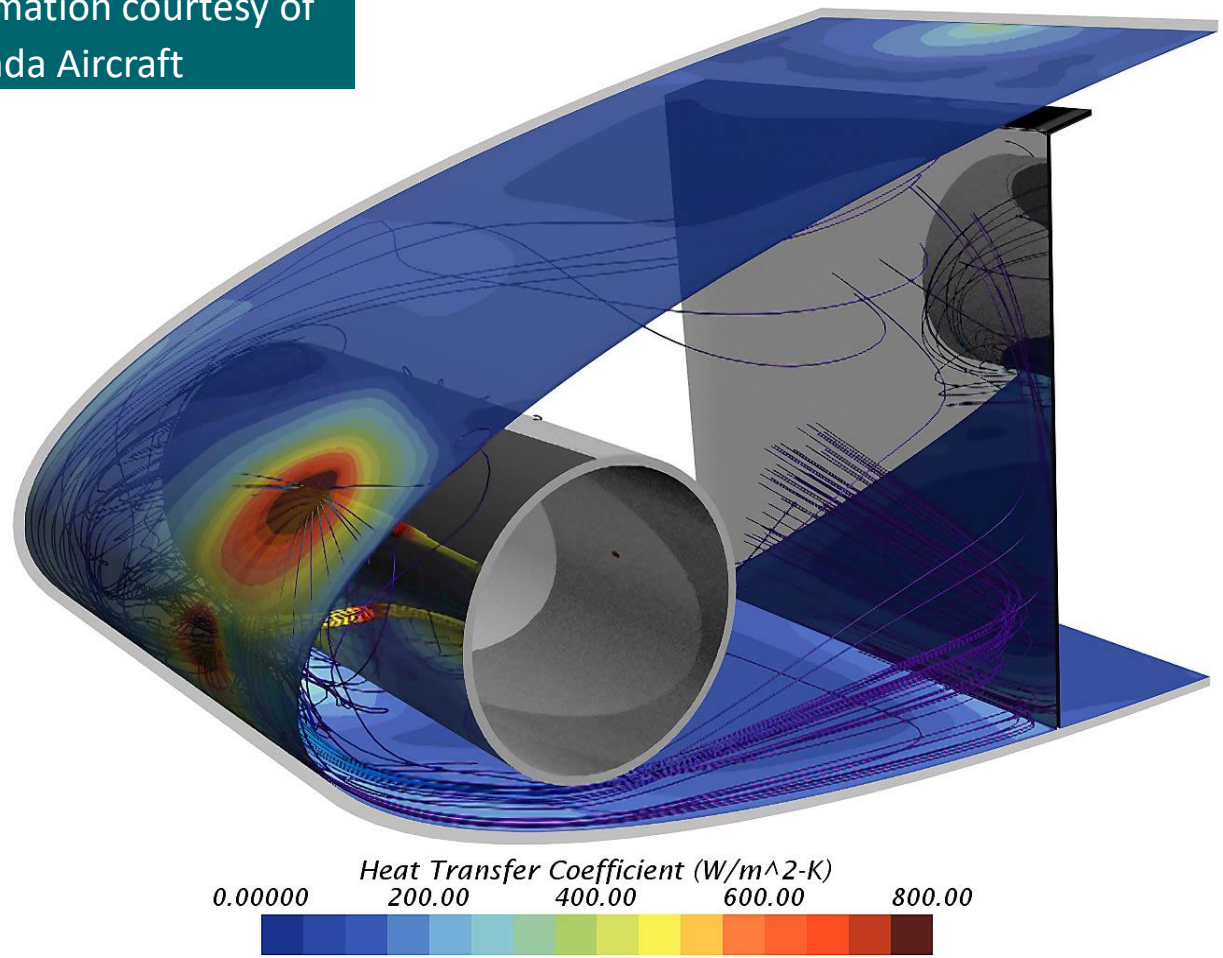




Improved product performance through exploration

- Fully integrated, easy to use, toolset for design exploration
- State of the art intelligent search for optimisation
- Powerful analysis capabilities to visualize correlations and investigate trade-offs

Animation courtesy of Honda Aircraft

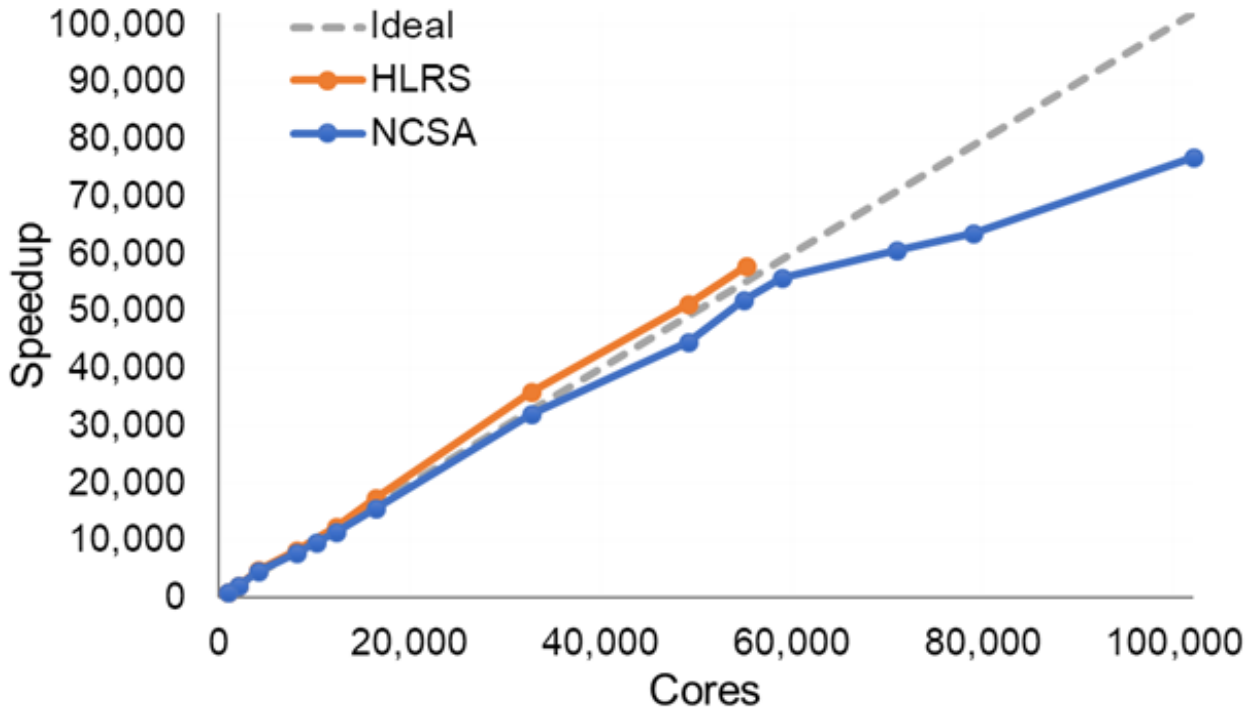


Simcenter STAR-CCM+

Faster Turnaround

- Parallelized across the complete simulation pipeline: pre-processing, solution and post-processing
- Solvers that scale to 100,000 cores
- Powerful, integrated, data analysis toolset

Use all your available compute resources to get results faster



Driving down solution time with effective use of hardware

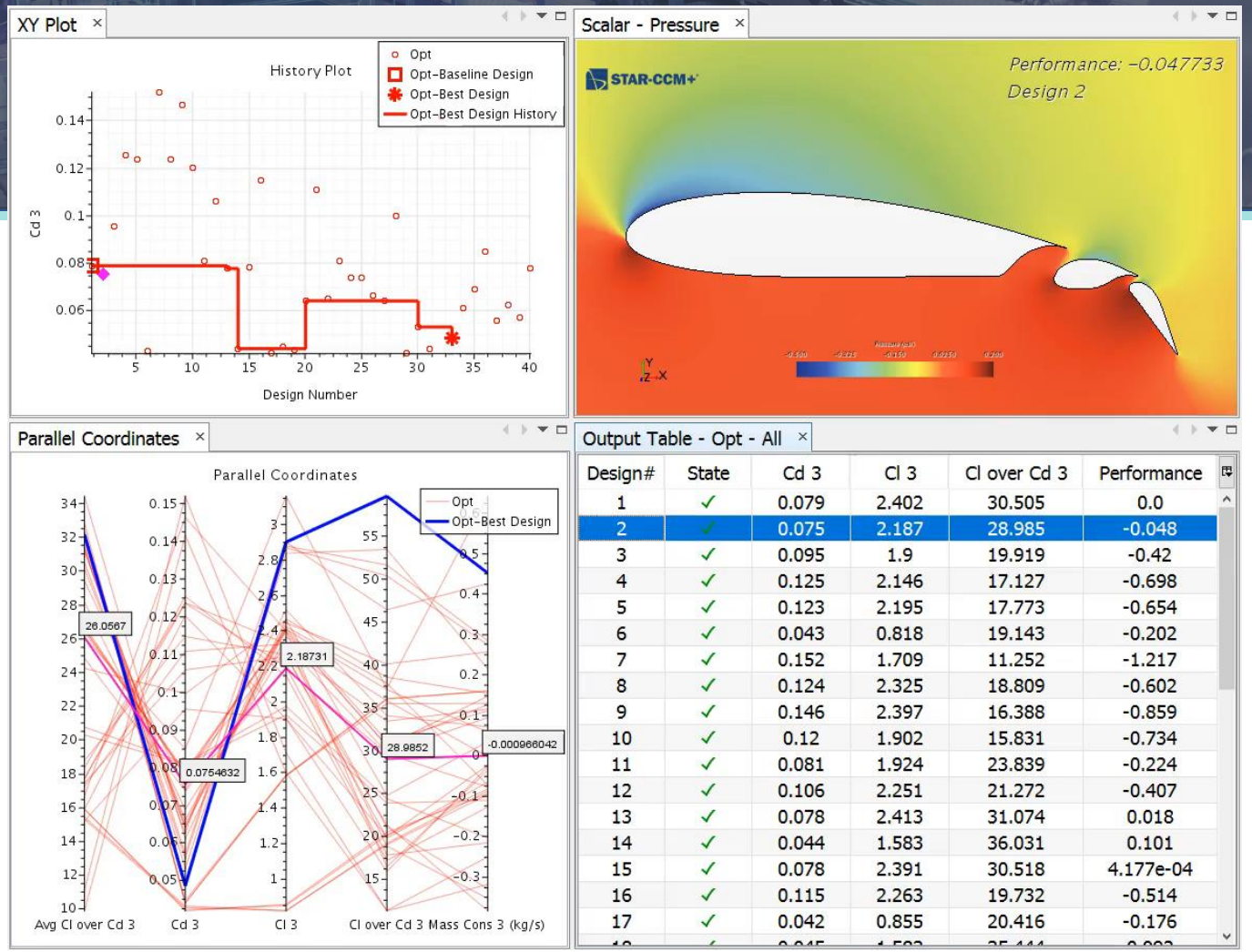
- Client-server approach for flexible deployment
- Parallel pipeline from mesh through to solution
- Solvers optimised to scale linearly beyond 100k cores

2.Wind Turbine - Computational Fluid Dynamics Simulation (Steady state)

Hand Calculations

@ Blade Tip: $V = \omega * r = 2{,}22\ rad/s * 44{,}2\ m = 98{,}12\ m/s$

Design Exploration



Design#	State	Cd 3	Cl 3	Cl over Cd 3	Performance
1	✓	0.079	2.402	30.505	0.0
2	✓	0.075	2.187	28.985	-0.048
3	✓	0.095	1.9	19.919	-0.42
4	✓	0.125	2.146	17.127	-0.698
5	✓	0.123	2.195	17.773	-0.654
6	✓	0.043	0.818	19.143	-0.202
7	✓	0.152	1.709	11.252	-1.217
8	✓	0.124	2.325	18.809	-0.602
9	✓	0.146	2.397	16.388	-0.859
10	✓	0.12	1.902	15.831	-0.734
11	✓	0.081	1.924	23.839	-0.224
12	✓	0.106	2.251	21.272	-0.407
13	✓	0.078	2.413	31.074	0.018
14	✓	0.044	1.583	36.031	0.101
15	✓	0.078	2.391	30.518	4.177e-04
16	✓	0.115	2.263	19.732	-0.514
17	✓	0.042	0.855	20.416	-0.176

2.Wind Turbine - Computational Fluid Dynamics Simulation (Transient)