QUANSCIENT
WEBINAR

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2nd May, 2024

# Accelerating R&D with cloud-powered multiphysics simulations

Comprehensive overview of Quanscient Allsolve with step-by-step live demonstrations.

## Overview

In this webinar, we covered how a cloud-based simulation platform can accelerate R&D in high-technology products through faster runtimes, higher accuracy, and higher throughput. Specifically, we introduced Quanscient Allsolve as a comprehensive simulation solution and covered the main benefits from both the technical and business perspectives, highlighting the practically unlimited computational power and ease of setting up simulations through live demonstrations.

## Speakers

### Dr. Abhishek Deshmukh

*Team Lead - Application Engineering*

Abhishek has more than nine years of experience in computational fluid dynamics (CFD) research and software development, especially for applications in high-speed compressible flows, turbulence, multiphase flows, and combustion.

### Jukka Knuutinen

*Head of Marketing*

Jukka has a background as a digital marketer specializing in lead acquisition through automated marketing funnels and captivating content creation — paid and organic.

# The problem with existing solutions

[Full introduction to Quanscient Allsolve on YouTube]

**78%**

Of engineers **need to reduce complexity** of their simulations due to lack of computational capacity.

**96%**

Of engineering decision makers say **reducing time, risk & cost** is the most valuable in their R&D.

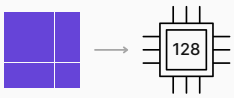
**81%**

Of engineering decision makers say **flexible software licensing** is important to increase simulation capabilities.

https://www.ansys.com/resource-center/white-paper/study-hpc-cloud-computing-engineering-simulation

# How Quanscient Allsolve tackles these challenges

Quanscient Allsolve is the only tool built from the ground up to take full advantage of cloud scaling in multiphysics simulations.




CURRENT STANDARD:

### Single CPU: multithreading

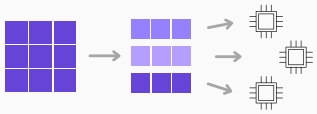
*Max speedup 4-8x*

- Use one CPU with many cores.
- Everyone does this, including us.

**Bottlenecks:**

- Memory bandwidth
- Algorithmic inefficiency

Mainly on-prem solutions.



CURRENT STATE-OF-THE-ART:

### Multi-CPU: Direct solver

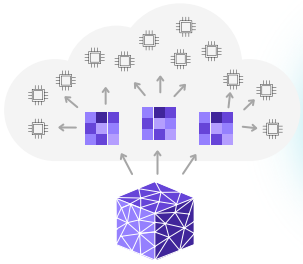
*Speedup 8-32x*

- Split the matrix into several CPUs.
- Can still multithread for each peace of the matrix.
- Many competitors do this, including us

**Bottlenecks:**

- Algorithmic complexity: scaling is limited.
- Efficiency problems.

Competitor multiphysics cloud solutions.



**The magic happens here:** We distribute the mesh and end up with multiple matrices

### Unlimited CPUs: Iterative solver

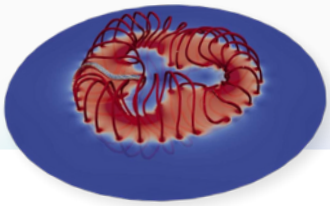
*Speedup +100x*

- Optimized Schwartz DDM solution: split the mesh into multiple pieces instead of the matrix.
- Only we do it efficiently for multiphysics. Competition would need to rewrite their solvers from scratch AND implement the cloud infrastructure around that.
- Thousands of CPUs.
- Additional speedups for running as many simulations as you want in parallel.

### The practically unlimited amount of computational resources combined with the efficient scaling enable

- **Faster and more accurate simulations:** Increased accuracy with runtime decreased from days to coffee breaks
- **More experiments, less prototypes:** Optimization tasks, Monte Carlo simulations, parametric sweeps, etc.

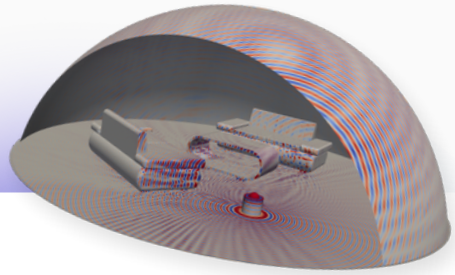
# Previous benchmark results



**Nuclear fusion stellarator simulation**

3D Magnetics

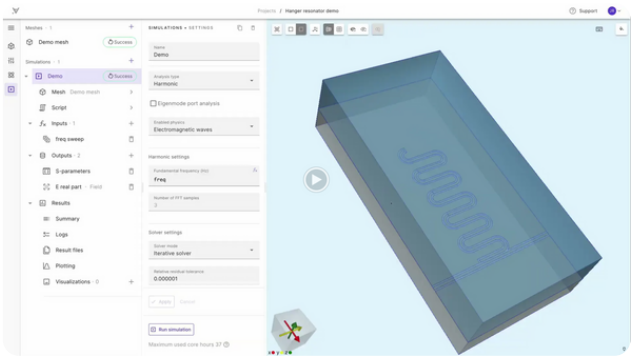
**317M unknowns** solved on
**500 cores** in **15 min**



**Large scale acoustic frequency analysis**

**360M unknowns** solved on
**1000 cores** in **20 min**

5 kHz acoustic waves in 90m^3 of air.



**Frequency sweep of a hanger resonator**

**29.1M unknowns** sweep in
**27 seconds**

Watch the 90-second video

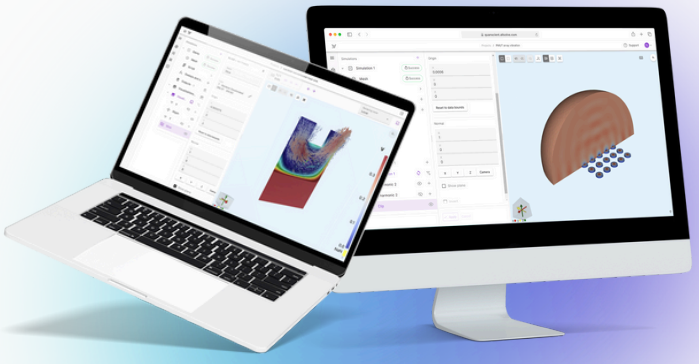
# Other benefits of Quanscient Allsolve

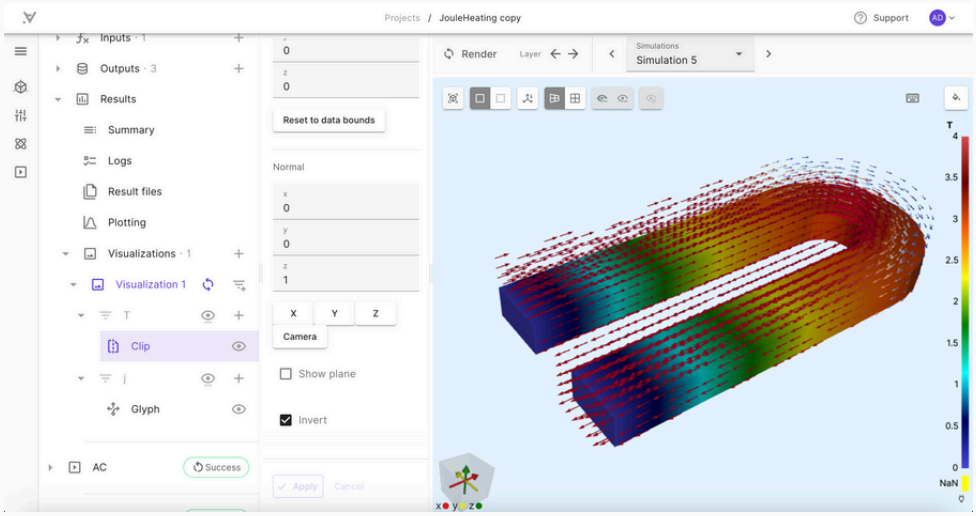
**No user limits**
Unlimited number of users with every plan. No hardware requirements. Real-time collaboration easy as sharing a link.

**Python scripting interface**
Automatically generated Python scripts defining the entire simulation. Extensive multiphysics script libraries.

**Usage-based pricing**
Cost-efficient pricing for organizations of all sizes. Quota only spent when simulations running.

**Support and materials**
Support directly from our experts one click away. Tutorial videos; user guides; documentation.






[Full Joule heating demonstration on YouTube](#)

# Step-by-step live demonstration of Joule heating

**Dr. Deshmukh** demonstrated the ease of setting up simulations in the GUI, complete with multiphysics coupling, analysis types, visualization, and data analysis, and the ability to effortlessly run simulations in parallel.

**Key benefits demonstrated:**

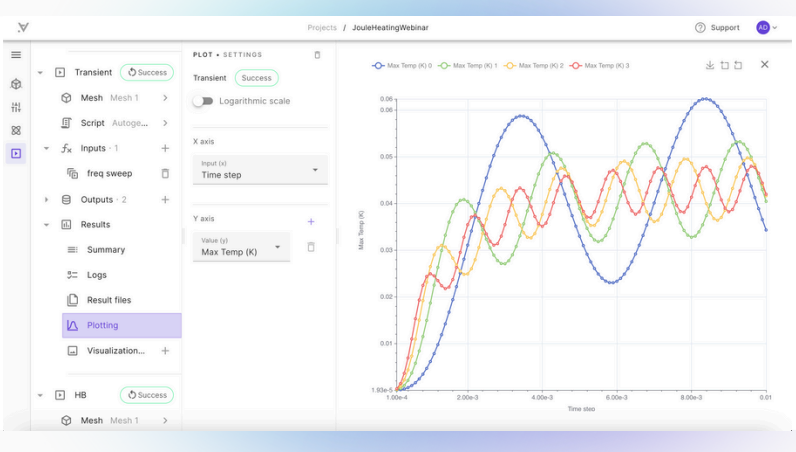
- **Ease of use:** Intuitive and fast setup in the GUI
- **Parallel simulations:** The steady-state case with constant DC was shown with parametric sweeps for several values of current flowing through the heating element
- **The harmonic balance method:** The transient simulation approach was compared with the harmonic balance method and the benefits of the harmonic balance approach were demonstrated

**Process:**

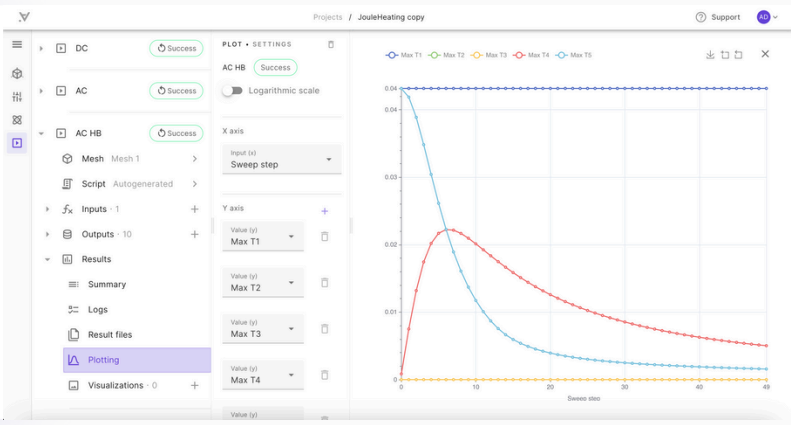
1. Walking through the problem setup in the GUI
2. Live execution of steady-state (DC), transient (AC), and harmonic balance simulations (AC harmonic) of heating of a conductor due to current flowing through it
3. Parametric sweeps with respect to current and frequencies

**Results:**

- Joule heating $\propto I^2$
- Contour plot: DC 5 ampere flowing through the copper element
- Line plots 1: AC 1 ampere transient with fundamental frequencies f0 = [100, 200, 300, 400] Hz
- Line plots 2: AC 1 ampere harmonic balance with 50 fundamental frequencies f0 = [1,...,400] Hz




*Results from transient analysis*




*Results with harmonic balance*

# Key takeaways

Quanscient Allsolve is a cloud-based multiphysics simulation software.

Through our proprietary algorithms and the implementation of DDM, our customers are able to take **full advantage** of cloud scaling in multiphysics simulations

→ Simulations run at a volume infeasible with current tools allowing larger throughput, more design of experiments, and faster optimization of design

**The end result:** More reliable designs decreasing time, money, and risk in high-technology R&D

# Interested in Quanscient Allsolve?

If you're considering whether Quanscient Allsolve could be a beneficial addition to your workflow, we invite you to schedule a complimentary 30-minute consultation with us. This no-obligation call is an excellent opportunity to discuss your specific needs and see how Allsolve can be tailored to meet them.

Book your session now

Not ready for a call just yet but still curious? Fill out this form to describe your use case. Our technical team will review your information and respond within one business day.

kiutra

Compared to other solutions, Allsolve is way easier to implement in the company and in the team as it requires no hardware and software setup. Everyone can access the same data and simulate at the same time, not requiring any local resources in the company.

**Klaus Eibensteiner**
*Cryogenic Engineer*
*kiutra*

skyTran

Simulation time from 3 weeks to 8 hours, with accuracy refined from 10% to 3% of experimental data.

**Iana Volvach, PhD**
*Electromagnetic FEA Engineer*
*skyTran*

Massachusetts Institute of Technology

With Quanscient Allsolve, I am able to run complex simulations in under a day, which would otherwise take a week to finish.

**Nicolo Riva, PhD**
*PostDoc MIT at PSFC*