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Quanscient Webinar 29th Oct 2024 | Executive Summary

Automated workflows in multiphysics simulations with Quanscient API

Learn how integration and automation will enable the new way of design and validation

Contents

Overview

This webinar explored the challenges and solutions in automating multiphysics simulations using the Quanscient API. Attendees learned how to integrate simulations with their design workflows, automate repetitive tasks, and leverage the power of cloud computing for increased efficiency. The webinar also demonstrated the API's capabilities in solving complex problems, such as finding material properties through an inverse problem-solving approach.

Asser Lähdemäki, Chief Product Officer & Co-Founder at Quanscient, presented the key functionalities and benefits of the API, highlighting its ease of use, flexibility, and potential to transform design processes. The webinar also featured a live demonstration of the API in action and a roadmap of its future development.

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About the speakers

Asser Lähdemäki

Chief Product Officer,
Co-Founder

Asser is a life-long software enthusiast with unchallenged intuition for software architecture. Previously, he has been working as an entrepreneur and as a researcher in a world-renowned Computational Electromagnetics group.

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.

Introduction to Quanscient Allsolve
A cloud-based multiphysics simulation software

FULL 5-MINUTE SECTION ON YOUTUBE

Through cloud computing and the advanced numerical techniques such as the Domain Decomposition Method (DDM), Quanscient Allsolve enables

Speed: Reducing runtime from weeks to hours, and days to minutes

Flexibility: Python scripting interface enabling customization, unlimited number of users with every plan with the hardware and all features included, and a usage-based pricing structure

Scalability: Thousands of simulations in parallel with zero added computational time enabling optimization studies, parameter sweeps, and manufacture-aware design

Automation: Programmatic control of simulations, proprietary design workflows, removing lengthy manual setups and repetitive tasks

Overall, Quanscient Allsolve enables increased simulation throughput and more reliable designs through the ability to run more simulations faster with more accurate results.

Introduction to Quanscient API

Quanscient API is an Application Programming Interface (API) that provides programmatic access to Quanscient Allsolve's simulation capabilities, enabling automation and integration with external workflows and applications.

FULL 12-MINUTE SECTION ON YOUTUBE

Challenges with existing design workflows

Licensing inflexibility

Traditional software licensing models often require separate licenses or modules for multiphysics simulations, leading to increased costs and limited flexibility. This inflexibility can hinder scalability, especially for complex problems that demand significant computational resources.

Limited interfacing

Certain programming interfaces utilize Java, which may present compatibility challenges in environments where Java is not readily available. While Python interfaces are increasingly prevalent, their quality and usability can be inconsistent.

Furthermore, some software requires separate licenses for interfacing, and reliance on custom text-file-based communication between software remains common, potentially introducing inefficiencies and errors.

Local hardware

Traditional simulation software often relies on local hardware, presenting limitations in terms of scalability and cost-effectiveness. Expanding computational resources can be expensive and challenging to manage, while reducing resources may lead to underutilization of existing infrastructure.

What is different about Quanscient API?

Simple licensing model

Our pricing model is based on the availability of computational resources and their actual usage, ensuring cost-effectiveness and scalability. Every plan includes all features, modules, physics, and an unlimited number of users.

Single modern API and SDK

The Quanscient API utilizes the same underlying structure as the graphical user interface, facilitating a seamless transition between interactive and programmatic simulation control.

This HTTP-based API provides comprehensive control over projects and simulations, and its OpenAPI definition enables client generation in various programming languages.

For enhanced usability and convenience, a Python SDK package offers a collection of classes and methods tailored to the public API.

Automatic high-performance computing without worrying about hardware

Using the Quanscient API, you can run hundreds of simulations easily and concurrently, without preparing any hardware or worrying about handling any infrastructure setup.

Users can readily specify the desired computational resources within their scripts, enabling efficient parallel execution of hundreds of simulations.

Introduction to Quanscient API
Use cases for the Quanscient API

FULL 4-MINUTE SECTION ON YOUTUBE

Implement FEA plugin into existing software

The Quanscient API enables the development of custom Finite Element Analysis (FEA) plugins for integration with existing software environments. This allows engineers to conduct simulations directly within their preferred CAD or PCB design software, streamlining the design process and facilitating rapid iteration.

Digital twins

The Quanscient API enables the creation of digital twins for complex systems, facilitating advanced simulations and analyses. For instance, in building automation, a digital twin can be used to optimize control strategies by incorporating real-time data such as outside and inside temperatures and radiator or cooler power. This allows for accurate prediction of the building's 3D temperature field, leading to improved energy efficiency and occupant comfort.

Power users who simply like to script

The Quanscient API caters to advanced users who prefer programmatic control over their simulations. It provides the flexibility to implement complex parameter sweeps, custom optimization algorithms, and user-defined formulations, empowering engineers to explore a broader range of simulation possibilities.

Training simulation AI models

The Quanscient API facilitates the generation of comprehensive datasets for training AI models, particularly Physics-Informed Neural Networks (PINNs). By enabling efficient simulation across a wide range of control and measurement parameters, the API enables users to create robust training datasets for developing AI models capable of rapid and accurate predictions.

Automated pipelines

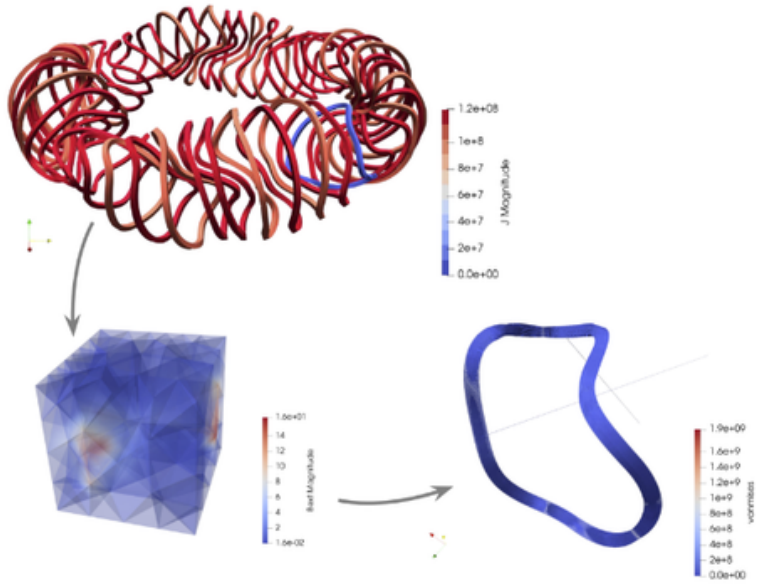
The Quanscient API enables the creation of automated simulation pipelines, facilitating efficient testing and validation of design iterations without manual intervention or repetitive setup procedures.

Simulation Data Management system integration

The Quanscient API facilitates seamless integration with Simulation Data Management (SDM) systems, enabling automated storage and management of simulation results and design versions. This streamlines data organization, enhances traceability, and promotes efficient collaboration within engineering teams.

Customer use case
Proxima Fusion & Atled Engineering

FULL 2-MINUTE SECTION ON YOUTUBE



About the use case

Proxima Fusion, a company developing stellarator-based fusion reactors, utilizes the Quanscient API to streamline the design and analysis of superconducting coils.

It is extremely important to prepare for a so-called quench, where the superconductor due to various reasons loses its superconductivity. If not handled well, it can lead to burned coils or even explosions.

In addition to the quench, an important aspect is preparing for the mechanical stress that the strong magnetic fields inflict on the coil structure.

A lot of variations of coil designs need to be considered. Thus, they wanted an automated pipeline to do basic checks after any design changes.

With Quanscient API, Atled Engineering together with Proxima Fusion created automated simulation workflows

This workflow involves preparing a mesh with appropriate tagging information, which is then passed to the API.

The API subsequently estimates the required Degrees of Freedom, configures the necessary computational resources (node count and type), and executes a preliminary simulation to determine the background field.

A full-fidelity coil analysis is then performed using a refined mesh and the previously obtained background field.

Finally, the API facilitates the export of relevant results, including field maps and mechanical data.

Live demo
Finding mechanical material properties

FULL 20-MINUTE SECTION ON YOUTUBE

The live demonstration showcased the Quanscient API's ability to solve complex engineering challenges through an inverse problem-solving approach. The specific problem involved determining the mechanical properties of a printed circuit board (PCB) and its mounted components to accurately simulate mechanical stress under various conditions.

This task presents a common dilemma in numerical analysis:

- Modeling the system in detail with all its anisotropic properties can become computationally expensive and complex to set up
- Simplifying the system by modeling it as a single anisotropic material might not accurately capture its true behavior

1. Measurement data: Experimental data on the resonant frequencies of the PCB from Lee et al. [1] was used as a reference

2. Inverse problem formulation: The goal was to find the material properties that, when used in the simulation, would produce eigenfrequencies matching the measured resonant frequencies

3. Optimization approach: An optimization algorithm was employed to solve this inverse problem

4. Objective function: The objective function ran simulations with different material property candidates and calculated residual by comparing the simulated eigenfrequencies with the measured values.

This iterative process continued until the optimization algorithm converged on a set of material properties that accurately reproduced the PCB's dynamic behavior in the simulation.

[1] Finite element model verification for packaged printed circuit board by experimental modal analysis
https://www.sciencedirect.com/science/article/abs/pii/S0026271408002965

The current roadmap of API development

FULL 3-MINUTE SECTION ON YOUTUBE

2024 Q3

Released alpha version, with the basic functionality of running simulations.

2024 Q4

Working on beta version.

More functionality for managing projects, simulations and checking quota.

Better API key management with organization level keys

Application API keys for production deployments (not associated with one human user).

2025 Q1-Q2

Released alpha version, with the basic functionality of running simulations.

2025 Q3 ⟶

Improved integration to different data stores to reduce moving data around.

Webhooks for receiving simulation status, quota and other events.

We are already piloting the API with several customers

Now is a great time to start using the API and give us feedback on the features that you need.

The longer term roadmap is not set in stone, we can make changes based on demand

Conclusion and key takeaways

FULL 2-MINUTE SECTION ON YOUTUBE

- Quanscient Allsolve, a cloud-based multiphysics simulation software, enables increased simulation throughput and more reliable designs through the ability to run more simulations faster with more accurate results
- The Quanscient API enables automation and integration of simulations within design workflows, reducing manual effort, accelerating design cycles, and allowing for more thorough exploration of design option
- The API supports a wide range of functionalities, from simple parameter sweeps to complex optimization algorithms and inverse problem solving

Next steps

If you are interested in exploring the capabilities of Quanscient Allsolve and the Quanscient API, we encourage you to schedule a consultation with our CRO, Mr. Nikola Strah.

During this meeting, you will:

- Learn how Quanscient Allsolve can address your specific simulation needs
- Learn how to integrate Quanscient Allsolve with your existing workflows
- Discover the platform's problem-solving capabilities and explore new possibilities for your use cases

Schedule a 30-minute introductory call now.

Book your session now!

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quanscient.com


info@quanscient.com


linkedin.com/company/quanscient