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Automated workflows in multiphysics simulations with **Quanscient API**

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Webinar agenda

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1

Introduction (3 min)

Jukka Knuutinen
Head of Marketing, Quanscient

- → Welcoming words
- → Motivation for the webinar
- → Introduction to Quanscient Allsolve

2

Challenges with existing design workflows and introduction to Quanscient API (10 min)

Asser Lähdemäki
Chief Product Officer, Quanscient

- → Overview of common problems with current design workflows
- → Introduction to the Quanscient API and its capabilities
- → Overview of the different ways to utilize the Quanscient API
- → Real-world customer use case

3

Live demo **Finding unknown material properties based on measurement data** (20 min)

Asser Lähdemäki

- → Live demonstration of an inverse problem solution using the Quanscient API
- → Demonstration of the key benefits of the API: ease of use, programmatic control, and integration

Webinar agenda

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4

Roadmap of API development
(5 min)

Asser Lähdemäki

- → Roadmap of upcoming features and functionalities
- → How we involve customer feedback in the development process

5

Q&A (10 min)

All speakers

- → Live discussion and answers to your questions

6

Conclusion and key takeaways
(5 min)

Asser Lähdemäki

- → Live demonstration of an inverse problem solution using the Quanscient API
- → Demonstration of the key benefits of the API: ease of use, programmatic control, and integration

Introduction to Quanscient Allsolve
4 key benefits

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Speed

- → Runtime from weeks to hours and days to minutes
- → Next-to-unlimited computing capacity and RAM
- → Speedups enabled by our proprietary algorithms

Scalability

- → Thousands of simulations in parallel with zero added computational time
- → Optimization studies, parameter sweeps, manufacture-aware design
- → Increased product reliability, faster iterations and eventually faster product-to-market

Flexibility

- → No hardware investments
- → All physics and features are also included in every plan
- → Unlimited number of users with every plan
- → Sharing a project as easy as sharing a link
- → Automatically generated Python script
- → Usage-based pricing

Automation

- → The focus of this webinar →

Introduction to Quanscient API

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Asser Lähdemäki
Chief Product Officer,
Co-Founder

Introduction to Quanscient API
Challenges with existing design workflows

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Licensing inflexibility

If you want to grasp multiphysics aspects of your design, **you need many different licenses** or modules.

Inflexibility in terms of where the license can be used and distributed.

For problems that need scaling, the amount of licenses needed grows very fast.

Limited interfacing

Some existing programming interfaces use for example Java, which is not an available choice in many environments.

There is increasing amount of Python interfaces available, but the clarity and usability of these greatly varies.

In some cases you need a separate license to interface with different software.

In many cases it is still common to rely on custom interfacing with text files to communicate between different software.

Local hardware

Most of the existing solutions are limited by the local hardware that you can provide and protect. It is costly to scale up and down.

Introduction to Quanscient API

What is different about Quanscient API?

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Simple licensing model

You get all multiphysics you need with a single price.

You pay for:

→ Availability of hardware

→ Smaller amount for hardware usage

Single modern API and SDK

Simulations defined via the same API as in the GUI product – easy to switch from a full GUI simulation to running via the API

HTTP based public API to control the projects and the simulations in them

→ OpenAPI definition available for generating client in any supported language

SDK package in Python for convenience classes and methods for 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.

You can just choose the amount of hardware (node count and type) you want to run with in your script.

Use cases for the Quanscient API

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Implement FEA plugin into existing software

Do your design and definitions in your CAD or PCB software, and perform simulations on the design as you go.

Digital twins

For example: Optimized control for building automation; feed outside and inside temperatures, radiator or cooler power in, get prediction of building temperature field out in full 3D precision.

Power users who simply like to script

Complex sweeps, optimization algorithms, custom formulations etc.

Training simulation AI models

Feed in your model, all of your control and measurement parameter space.

Easily simulate all cases and train a PINN AI model for quick predictions for your device.

Automated pipelines

Test every iteration of your design without extra steps or redoing setup.

Simulation Data Management system integration

Automate storing your results and design versions.

Customer use case
Proxima Fusion & Atled Engineering

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About the use case

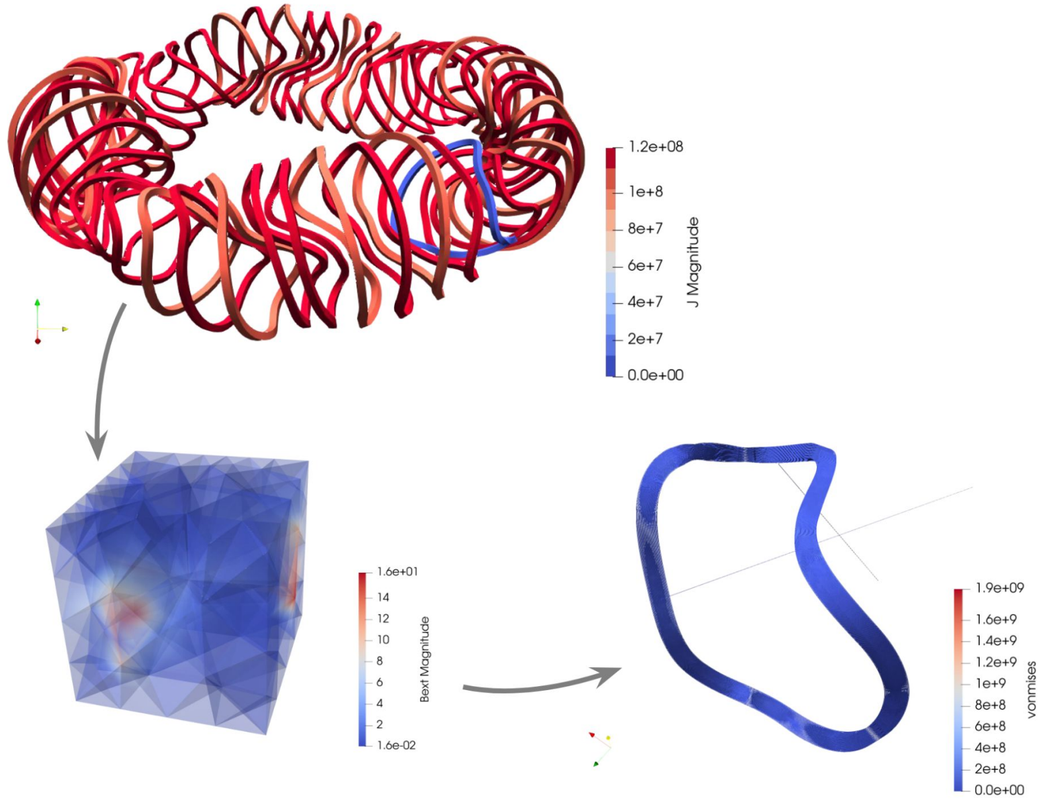
At **Proxima Fusion**, they are designing stellarator style fusion reactors.

The electromagnets to create the magnetic containment for the plasma are built with 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, can lead to burned coils or even explosion.

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.



Customer use case
Proxima Fusion & Atled Engineering

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

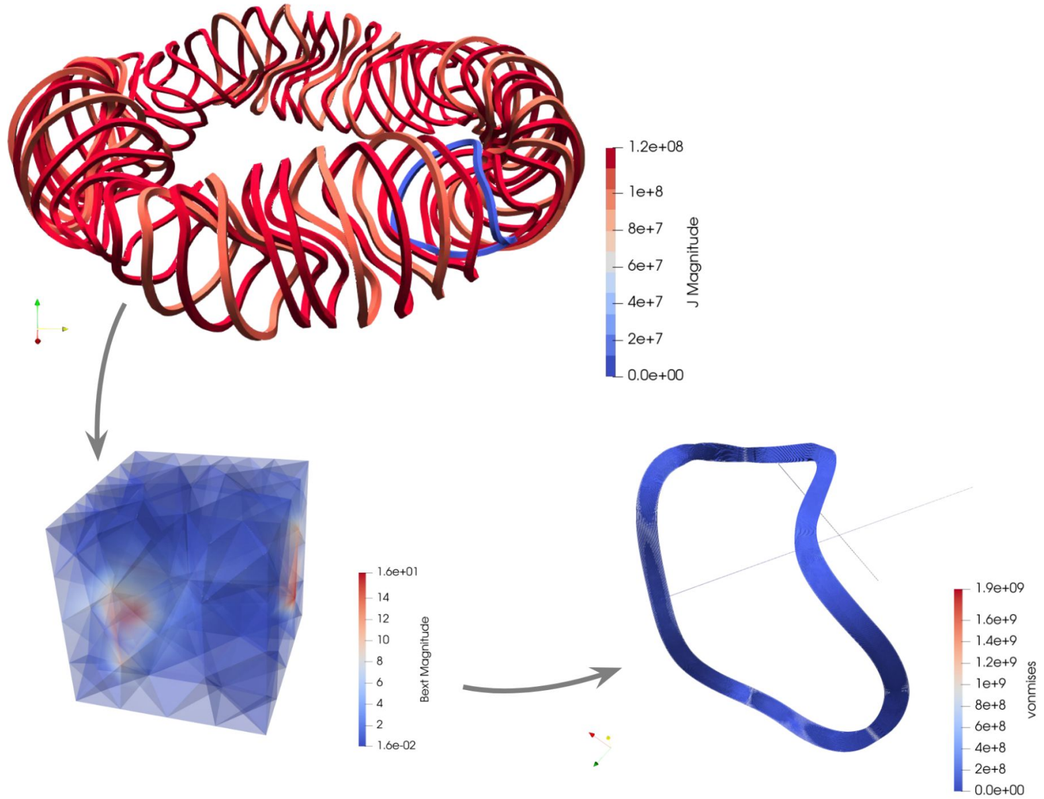
→ Preparing mesh with proper tagging and tag information.

→ Then, passing those inputs via the API, do the following:

- Estimate the number of Degrees of Freedom
- Configure the needed amount of RAM (node count & node type)
- Run simple simulation to get the background field

→ Run a Full Fidelity Coil analysis with finer mesh with the background field from the previous simulation

→ Export the results: field maps, mechanical data, etc...



Live demo
Finding mechanical material properties

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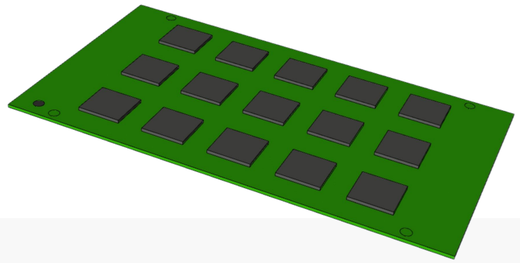

Problem Definition

In many cases, a system consisting of multiple anisotropic materials can pose some challenges in the numerical analysis.

→ The simple brute force approach that considers the detailed model with all the anisotropic properties for different materials can quickly grow in complexity and be hard to set up.

→ As an alternative, one can choose to model everything as single anisotropic material, which captures the behavior as a whole.

Approach

To calculate the single material properties, we need some measurement data that describes the behavior of the device.

→ Then we can formulate finding the properties as an Inverse problem, as we want to find the input (material properties) that produces the measured output

To solve the inverse problem, we use optimization. The objective function will run the simulation with current parameter candidates, and residual will be calculated from the simulated response versus the measured response.

Particular example

We want to know the mechanical properties of certain PCB and chip packages mounted to it, to simulate mechanical stress in various situations.

We will use the measurements of resonant frequencies for the PCB from Lee et al. [1] as a reference, and try to optimize the material properties to match the eigenfrequencies.

[1] Finite element model verification for packaged printed circuit board by experimental modal analysis

https://www.sciencedirect.com/science/article/abs/pii/S0026271408002965

Introduction to Quanscient API

The current roadmap of API development

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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

Planned first stable public release.

Public repository with the OpenAPI definition and Python SDK.

Meshing capability via the API with coordinate based picking
Improved capacity to run large amount of simulations in parallel.

2025 Q3 →

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

Webhooks for receiving simulation status, quota and other events.

Introduction to Quanscient API

The current roadmap of API development

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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

Get in touch
Schedule a personal demo

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Schedule a 30-minute meeting, and we'll:

- → Assess the compatibility of Quanscient Allsolve with your use case and existing workflows
- → Discover how Quanscient Allsolve could enhance your current simulation workflow and open up new possibilities
- → Evaluate the cost-effectiveness for your use case

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Thank you for your participation!

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You'll receive the event recording and executive summary PDF within a few business days.

In the meantime, we want to invite you to get in touch with us!

Scan the QR-code and schedule a 30-minute introductory call with us to discuss

- → Specific challenges you'd like to solve
- → Particular aspects you're interested in exploring
- → Specific goals related to your work

Finally, join our active community of close to 6000 simulation experts by following us on LinkedIn!

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