



Fidelity Fine Turbo Accelerates Turbomachinery Designs

Turbomachinery CFD for fast and accurate simulation of rotating machinery

Cadence[®] Fidelity FineTurbo is a computational fluid dynamics vertical specifically designed for engineers to optimize the power and efficiency of turbomachinery designs quickly and accurately. Its computational engine combines high-fidelity meshing with advanced numerics, automated design of experiments, and a sophisticated machine learning-driven optimization engine to enable designers to push the performance of rotating machinery to its absolute limits without sacrificing efficiency and staying within design parameters.

Fidelity Fine Turbo solves the aerodynamics of turbomachinery by relying on high-fidelity meshes and a fully structured solver. Its proprietary meshing technology can mesh both axial and radial machinery while properly handling gaps above and behind the blades. This software has proven capability and reliability for designing compressors, turbochargers, and gas turbines, and its unique NLH technology delivers blade-passing frequency analysis with best-in-class accuracy and speed.

The software contains a complete toolchain for end-to-end turbomachinery CFD, with meshing, solving, postprocessing, and optimization applications all designed and refined over the years specifically for this application.

Benefits

DATASHEET

 \blacktriangleright Fast, accurate CFD analysis for steady and unsteady flows

► Improve product power and efficiency via automated DoE ad optimization

Scriptable for bulk analysis and large-scale computations



Fig 1: Streamlines in a modernized compressor design



Fig 2: Mach number contours on a compressor stage

Features

High-quality meshing

The speed and accuracy of a CFD solution depend highly on the mesh. The proprietary Autogrid meshing technology in Fidelity Fine Turbo is a high-quality structured mesh generator specifically for turbomachinery, with a variety of features specifically developed for this application.

Fast, powerful solver

Fidelity Fine Turbo's coupled, density-based, structured solver delivers solutions in a fraction of the time segregated and unstructured solvers do. For unsteady analysis, its unique nonlinear harmonic method delivers solutions orders of magnitude faster than traditional time-stepping methods and can capture multiple modes accurately. It's so fast that many users get results on a workstation at speeds other solvers only achieve on HPC systems, and for the really big jobs, the solver is fully parallelized and ready for HPC computation.

Automation

Fidelity Fine Turbo uses a variety of automation technologies to accelerate the workflow. Several features in the Autogrid mesher automate the generation of high-quality meshes, and the companion Fidelity Fine Design3D tool can fully automate the exploration of a design space. And, of course, the entire workflow can be captured in scripts, allowing batch processing of designs in bulk.

Optimization

Fidelity Fine Turbo's companion optimization tool, Fine Design3D, is built around sophisticated AI/ML technology that has been refined and developed around turbomachinery applications. Self-organizing maps empower the designer to ensure the optimum exists in the proposed design space, and the multi-target, constrained optimization engine finds the target quickly without the need for user intervention.



Cadence's Turbomachinery CFD solutions are widely used by Kawasaki Heavy Industries to support the design and development of various products such as gas turbines, jet engine compressors, and steam turbines for power generation... Cadence software automatically generates highquality meshes and provides high-speed throughput flow computation, thanks to Cadence's innovative technologies, such as the CPU Booster and Non-Linear Harmonics, significantly reducing the design cycle time and cost.

Yusuke SAKAI, Senior Manager, Engine Technology Development Department, Aero Engine Business Division, Kawasaki Heavy Industries, Ltd.



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Fidelity Fine Open Accelerates Multiphysics Simulation

Integrated multiphysics software for complex designs

Cadence[®] Fidelity Fine Open is a general computational fluid dynamics application that extends the capabilities first introduced with Fidelity Fine Turbo to multiphysics simulations on unstructured domains. Its computational engine combines high-fidelity, automated meshing with advanced numerics and a variety of sophisticated physics models, enabling engineers to harness the power of CFD to deliver better performance from their designs.

A coupled, density-based solver at the heart of Fidelity Fine Open delivers fast convergence for high-Mach and low-compressibility flows without sacrificing accuracy.

While it's already an intrinsically fast solver, running it on the high-quality meshes generated by our hexdominant meshing technology delivers solutions even faster, whether on workstations, on-premises HPC systems, or in the cloud.

In addition to the density-based flow solver, Fidelity Fine Open features several other physics models that can be coupled to the flow. Solid modeling for CHT, a variety of radiation models, porous media, and a wide variety of chemistry models are available. Combined with our unique nonlinear harmonic method for rotating machinery, Fidelity Fine Open is an ideal tool for designing and simulating gas turbine engines and other complex devices.

Benefits

DATASHEET

Fast, accurate CFD for compressible and incompressible flows

- ^D Nonlinear harmonic method for rotating machinery
- Full-featured multiphysics
- ^D Full range of fidelity, from RANS to LES



Fig 1: Full gas turbine engine simulation in Fidelity Fine Open



Fig 2: Supersonic airframe simulation

Features

Automatic, high-quality meshing

The speed and accuracy of a CFD solution depend highly on the mesh. The proprietary meshing technology in Fidelity Fine Open is a fully parallel high-quality unstructured mesh generator with an integrated surface healing preprocessor.

Integration

Fidelity Fine Open is a true multiphysics simulation package capable of combing physics such as flow, radiation, combustion, and conductive heat transfer in a single simulation. Fine Open brings the simulation and investigation of complex designs within reach.

Fast, powerful solver

Fidelity Fine Open's coupled, density-based, unstructured solver delivers solutions in a fraction of the time segregated solvers do. For unsteady analysis of rotating machinery, its unique nonlinear harmonic method delivers solutions orders of magnitude faster than traditional timestepping methods and can capture multiple models accurately. For more general problems, URANS, DES, and LES are fully supported. And, of course, the solver is fully parallelized and ready for HPC computation.

Automation

Whether it's bringing your preprocessing down from weeks to hours, exploring a design space in Fine Design 3D, or just scripting your jobs for bulk processing, Fidelity Fine Open has a variety of ways to automate and accelerate your work.

Optimization

Fidelity Fin Open's companion optimization tool, Fine Design3D, is built around sophisticated AI/ML technology that can optimize any appropriately parametrized problem. Self-organizing maps empower the designer to ensure the optimum exists in the proposed design space, and the target quickly without the need for user intervention.





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