Shorter design iterations accelerate the optimization of a STÖBER gearbox.

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Structural analysis up to 100× faster

RISTRA —
Rapid Interactive
STRuctural Analysis

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RISTRA accelerates the simulation of a rim designed by RONAL GROUP by a factor of 93.

RISTRA (Rapid Interactive STRuctural Analysis) is a software for high-performance structural analysis based on the finite element method (FEM). Our specialized algorithms and data structures are optimized for massively parallel execution to leverage the high performance and energy efficiency of graphics processing units (GPUs). RISTRA accelerates structural analysis simulations by a factor of up to 100 compared to commercially available software without loss of quality. For example, the simulation of a wheel rim designed by RONAL GROUP was accelerated by a factor of 93. With sufficient GPU memory, RISTRA can solve problems with more than 10 million degrees of freedom.

We achieve this significant acceleration with our novel, massively parallel solver for linear systems of equations arising in structural analysis simulations, as well as GPU acceleration of all steps in the FEM, including matrix assembly. This minimizes expensive data transfers between GPU and main memory.

In addition to their high performance, GPUs use less energy per operation compared to conventional CPU systems. RISTRA is the first finite element software that also runs on GPU-accelerated edge devices, enabling fast simulations on the shop floor and the energy consumption is further reduced by a factor of 5, due to the energy-optimized hardware architecture of these edge devices.
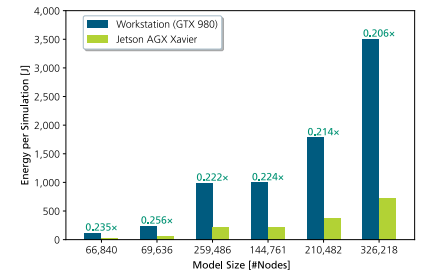
Applications

RISTRA accelerates computations and reduces energy consumption in a variety of scenarios such as structural analysis of single parts or automated shape and topology optimization. Therefore, RISTRA accelerates product development by shorter design iterations, as for example the optimization of a STÖBER gearbox. In addition, computation times for shape or topology-optimized geometry are reduced significantly — all with reduced energy consumption.

RISTRA can be used as stand-alone software, integrated into third-party software, or adapted to customer-specific needs to optimize engineering workflows. Moreover, simulation software vendors can make use of RISTRA software components, such as the high-performance solver for linear systems, to accelerate the runtime behavior of their own products.

Features
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- Linear, static structural analysis (small deformations)
- Linear isotropic and anisotropic materials
- Nonlinear structural analysis (large deformations, selected nonlinear materials)
- Simulation with tetrahedral meshes
  - TET4, TET10, TET20 (linear, quadratic, and cubic shape functions)
- Energy-efficient computation on GPUs
- Runs on energy-optimized, GPU-accelerated edge devices