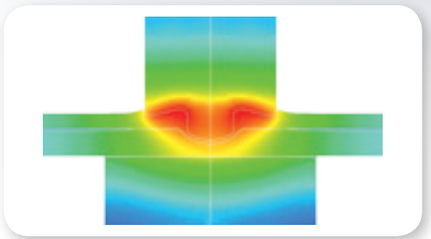
Morfeo v1.1 features

- Staggered Thermo-Mechanical Coupling (displacement)
- Staggered Thermo-Fluid Coupling (velocity/pressure)
- Thermo-Mechanico-Metallurgical coupling
- X-FEM Technology
- Level set Technology
- Eulerian, Updated Langrangian and ALE
- Stationary and Transient Thermal Analysis
- Constant, Cyclic and Periodic Dirichlet Boundary Conditions
- Elasto-Visco-Plastic Behavior
- Remeshing and Automatic Mesh Adaptation
- Adaptive Time Stepping
- Mechanical, Frictional and Thermal Contact between Deformable bodies
- Parallel Non-linear Solver (unlimited number of processors)
- User-friendly Interface (GUI) for pre- and post-processing
- Connected to SAMCEF, ABAQUS and FORGE
- Import/Export from/to Various pre-/post- Processing Tools (e.g. Catia v5)



Morfeo Supported platforms

- Windows 32 bits (sequential version)
  - > 2000
  - > XP
  - > Vista
- Linux 32 bits (sequential and parallel versions):
  - > Suse 10.2
  - > Suse 10.3
  - > Debian
- Linux 64 bits (sequential and parallel versions):
  - > Suse 10.2
  - > Suse 10.3
  - > Debian
  - > Red Hat 4.4

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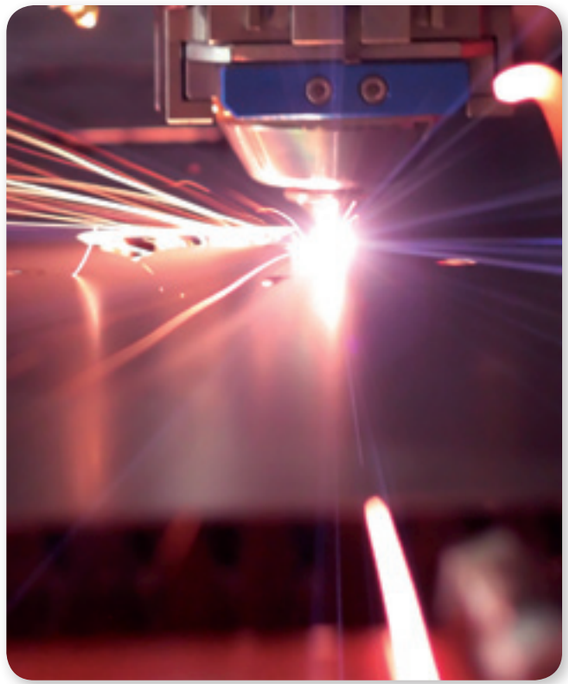


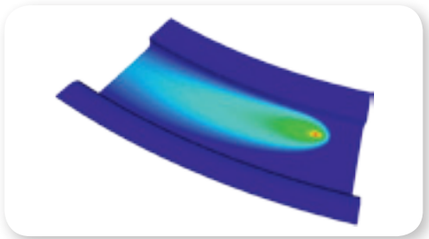
Morfeo

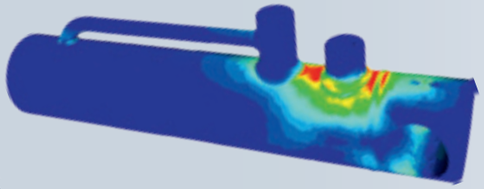
A new generation manufacturing software

Driving innovation in manufacturing

Simulation today is an essential component of the design cycle, increasing company profits by significantly reducing time to market. Modelling the manufacturing processes allows designers to reduce tedious manual tuning as well as waste of material and to optimize the resulting manufactured part in terms of mechanical properties, residual stresses and final deformations.

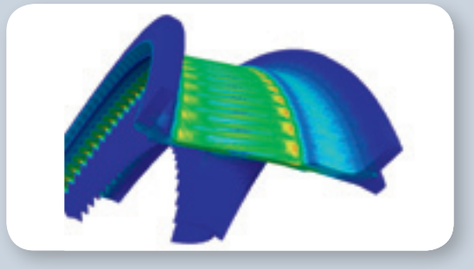
Cenaero integrates this approach in today's product development environment by marketing its new generation manufacturing software, **Morfeo** (**M**anufacturing **OR**iented **F**inite **E**lement t**O**ol). This innovative software is becoming the new reference in unified simulation for applications ranging from transformation and assembly processes to in-service structural response. **Morfeo** is based on the most modern programming technologies and is particularly designed to handle large and complex mechanical components within a realistic industrial environment.





Cutting edge tool for welding simulations

To reduce aircraft acquisition and lifecycle costs, manufacturers are constantly considering new materials and advanced processing technologies. Although the skin and stiffener components of metallic aircraft primary structures are riveted together, advanced fabrication processes such as welding have potential for significantly lower assembly times, resulting in lower manufacturing costs and higher productivity. However, before these processes can be applied commercially, many issues need to be addressed. Methods for strength analysis must be developed as well as manufacturing process parameter optimization for reliable welds with minimum distortion and residual stresses. Morfeo/welding is thus the right solution for the welding industry!



Morfeo/welding proposes a transient numerical model for a large scope of welding processes. The modelling of the thermo-mechanical problem allows the user to predict the level of residual stresses and distortions at the end of the process. The use of Morfeo/welding enables the optimization of the welding process by modifying the clamping system and/or the welding sequence in order to improve the design without having to perform expensive experimental work.

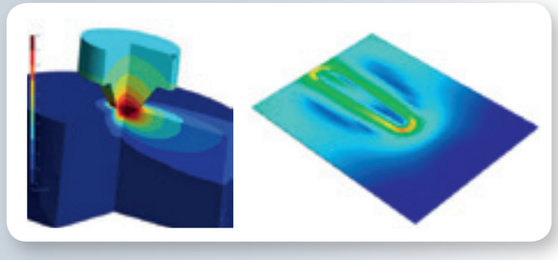
Moreover, the welding trajectory is defined directly from a CAD geometry. Therefore, complex and multiple welding paths can easily be processed.

The parallel version of Morfeo may be used to reduce the computation time.

Morfeo/welding also models the Friction Stir Welding (FSW) process. A local thermo-fluid model and a scale thermo-mechanical model are available. The local scale thermo-fluid FE model is available to predict temperature cycles and strain-rates around a FSW tool. Both, conventional and bobbin tools can be modelled.

Steady state and transient thermo-fluid models are available, thus allowing the flow and temperature fields around tools with complex geometry to be easily modeled. This model has the major advantage to avoid requiring the heat input to be measured in FSW experiments. The model is also available to simulate the Friction Stir Spot Welding (FSSW) process.

The output data from the thermo-fluid model may be used as input data to metallurgy models to predict for example the hardness distribution across a weld. The viscous dissipation calculated in the thermo-fluid model can be used as a heat source in a global thermo-mechanical simulation to determine the stresses in a FSW component (plug-in option).



Morfeo/welding features

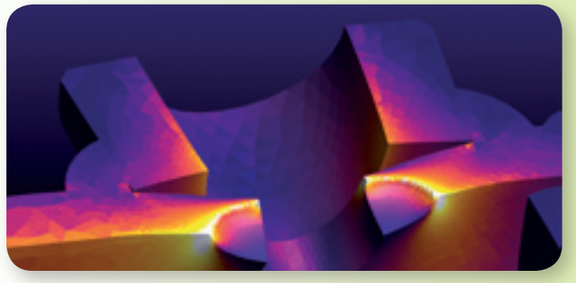
> Solid state welding (IFW, DFW, FSW, FSSW)
> Fusion welding (TIG, EBW, LBW)
> Staggered thermo-mechanical coupling
> Thermo-fluid coupling
> Complex workpieces and welding paths

Digital machining with ease and accuracy

An original algorithmic strategy makes Morfeo/machining particularly efficient for the simulation of multi-pass machining simulations. Relaxation of stresses generated during upstream processes is often the most critical distortion source during the machining process. In order to predict them accurately, it is crucial to take into account the whole sequence of passes. Therefore, the level-set (signed distance) is used to represent each path so that the workpiece can be meshed totally independently of the different cutting surfaces. This offers a strong advantage over the classical finite element approach which would require heavy remeshing operations after each machining step. This method guarantees that cuttings paths are defined in an initial undeformed configuration while a deformed workpiece is considered for the next machining pass. A coupling with effects occurring locally to the tool tip such as cutting forces is also proposed. Such a multiscale coupling enables dealing with complex three-dimensional workpieces in an industrial environment.

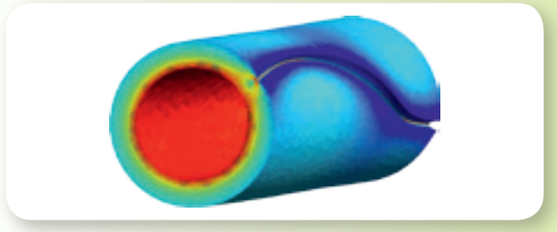
Morfeo/machining features

> Cutting paths represented by level-sets;
> Complete decoupling between cutting paths and workpiece mesh;
> Cutting paths always defined in an initial undeformed configuration while workpiece deformations are taken into account during the process;
> Parallelization of level-set computation and FE problem resolution;
> Dedicated to multi-pass machining on complex industrial workpieces.



Structural integrity analysis

Morfeo/crack is the first commercial software able to perform fully automated industrial three-dimensional fatigue crack propagation in complex assemblies with the eXtended Finite Element Method (XFEM). Cracks are easily introduced in complex models via level set functions. Accurate stress intensity factors are readily computed and used to assess the structural integrity of the parts. Adequate level set update functions and propagation laws are then used to freely propagate cracks in the mesh, with automatic handling of the topological changes. No or minor manual interventions are needed with Morfeo/crack, thereby helping engineers making crucial decisions during design phases or during investigation of critical in-service failure. Coupled with all the other features of Morfeo, the Crack module also plays a key role in the analysis of manufacturing defects.



Morfeo/Crack features

> Computation of Stress Intensity Factors
> Thermal, mechanical loading
> Extended set of boundary conditions available
> Automated 3D crack propagation
> Automatic handling of topological changes of the crack front
> Simultaneous handling of multiple cracks
> Mesh refinement in the vicinity of the crack
> Chaining with manufacturing processes
> Proper management of residual stress fields