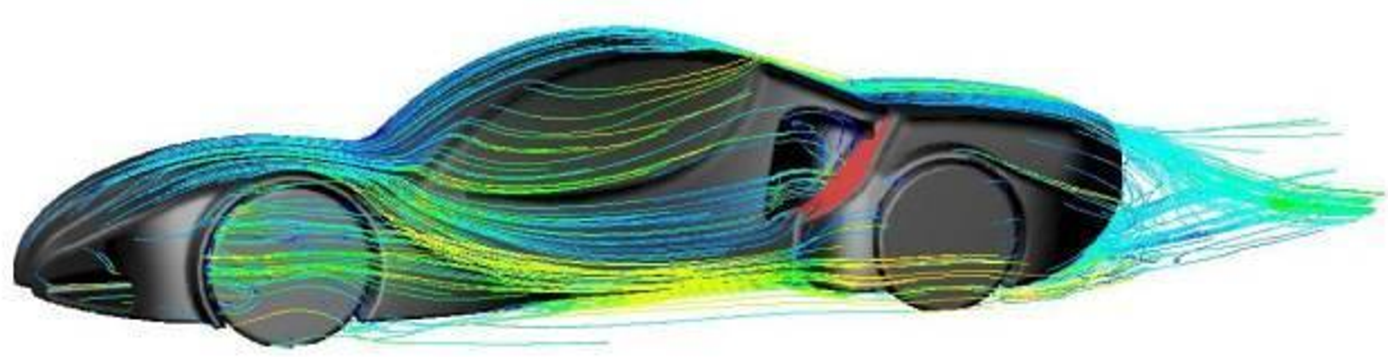
FEA | CFD | MBD | METAL FORMING SIMULATION

Optimize product development.

Simulation for informed decisions on components and manufacturing processes.



CFD | External vehicle aerodynamics

Over 6,200

CAE/CAD projects

As of 2025

Shorter development cycles

Evaluate design variants virtually at an early stage.

Lower material consumption

Optimize material distribution.

Optimize components and processes

Understand loading and material flow.

Reduce development costs

Support decisions with simulation.

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CAE expertise for parts and processes.

Material modeling, simulation, optimization and CAD/CAE project management.

FEA: Structural analysis, materials and contact

Static and dynamic finite element analysis (FEA) of metallic and nonmetallic materials, including plastics and elastomers. Three-dimensional contact problems and time-dependent loads.

Material models: Neo-Hookean, Mooney-Rivlin and Ogden.

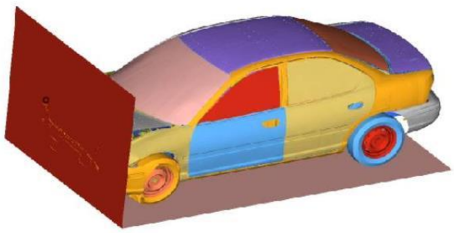
Applications: Engine and body components, seats and seat adjusters; flexible coupling discs, shift mechanism mounts, door seals, fan shrouds, folding seats, structural members and loudspeaker enclosures.

Flexible coupling disc | FEA

Dynamics, MBD and crash

Natural frequency and forced vibration analyses; multibody dynamics (MBD) simulations. Crash simulations with nonlinear material models, including compressible foams.

Applications: Pendulum and corner-pendulum impacts, full-overlap and AZT barrier tests (40 % offset); models for side impact and high-speed crashes against deformable barriers.



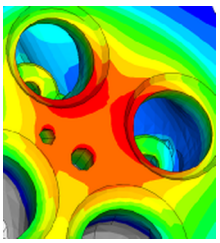
US NCAP crash simulation

Thermal analysis and fluid flow

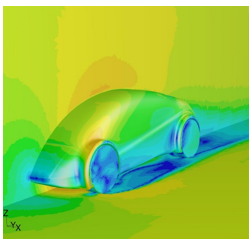
Thermal analysis: Steady-state and transient temperature fields with heat transfer and temperature-dependent material properties. Temperature field mapping and thermomechanical coupling.

CFD: Simulation of steady and unsteady, laminar and turbulent, incompressible and compressible flows, including fluid-structure interaction.

Applications: Engine components and external vehicle aerodynamics.



Cylinder head | Temperature distribution



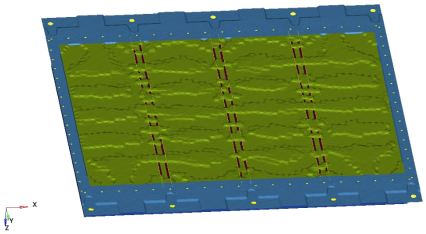
Electric vehicle | Velocity field

Topology, topography and structural optimization

Topology optimization of metallic and nonmetallic components, topography optimization (bead optimization) and optimization of fiber-reinforced composite structures with manufacturing constraints and multiple optimization objectives.

Applications: Topology optimization of an internal combustion engine main bearing cap; bearing supports, mold holders and flanged joints.

Topology optimization | A-pillar



Topography optimization | Battery housing

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Improve metal forming through simulation.

AFDEX extends MORPHOTEC's broad CAE expertise to material flow, tool geometry and forming process analysis. MORPHOTEC provides AFDEX simulation services, software sales and training.

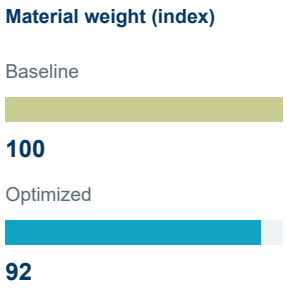
SIMULATION-BASED CASE STUDIES

8 %

less material required

Ball screw nut [1]

In a published AFDEX case study on cold forming a ball screw nut, the knockout (KO) pin geometry was optimized. Material weight fell by 8 % and forming force by 5 % compared with the baseline. The minimum geometry required for subsequent machining was maintained.

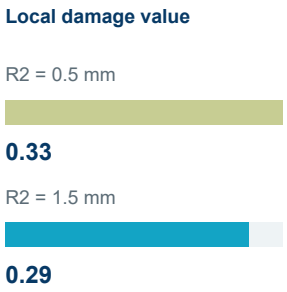


12 %

lower local forming damage

Tool radius R2 [2]

The MORPHOTEC study compares R2 = 0.5 to 1.5 mm under identical process conditions. The local normalized Cockcroft-Latham damage value fell from 0.33 to 0.29. This comparative assessment is not an absolute prediction of fracture or service life.

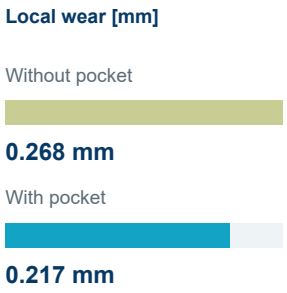


23 %

higher local punch wear without the pocket

Relief pocket in the die [3]

At forming stage U3, calculated local wear after 10,000 strokes was 0.268 mm without the pocket and 0.217 mm with the optimized relief pocket. Relative to the optimized variant, wear without the pocket is around 23 % higher. The punch remained unchanged.



The results apply to the models and boundary conditions investigated. They indicate simulation-based optimization potential and do not constitute general guarantees of savings or tool life.

[1] MORPHOTEC | AFDEX, 7 Sep 2026; Lee et al. 2019; MFRC Newsletter Q1/2020.
[2] MORPHOTEC, Tool radius | Local damage, 22 Sep 2026.
[3] MORPHOTEC, Relief pocket | Punch wear, openPR, 19 Oct 2026.

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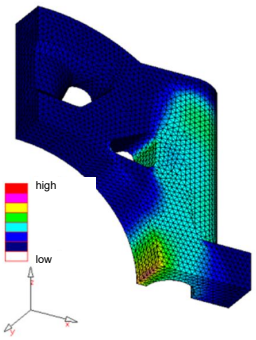
Engineering expertise. Industrial experience.

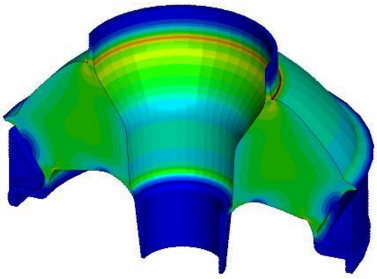
MORPHOTEC was founded in 1995 by Dr.-Ing. Stefan Henschen as a spin-off from the teaching and research unit for Mathematical Models in Materials Science at RWTH Aachen University, headed by Prof. Dr.-Ing. Josef Betten.

Dr. Henschen earned his doctorate at RWTH Aachen University in 2001 with a thesis on "Topology optimization using cellular automata". MORPHOTEC combines scientifically grounded simulation methods with many years of experience in industrial product and process development.

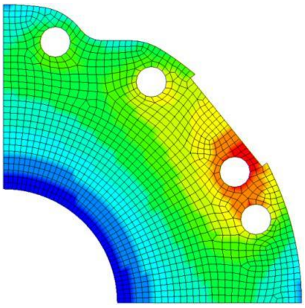
SELECTED CAE PROJECTS



Main bearing cap | Topology optimization



Hydraulic mount | FEA



Blow molding simulation

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Which development challenge can we help you solve?

Talk to us about your component, manufacturing process and technical objectives.