

PERMAS

Contact Analysis

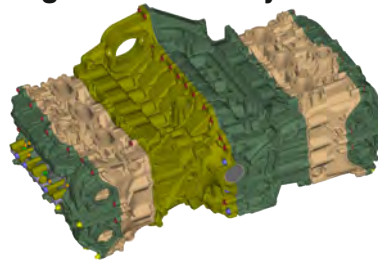
Comprehensive advanced contact capabilities for large models



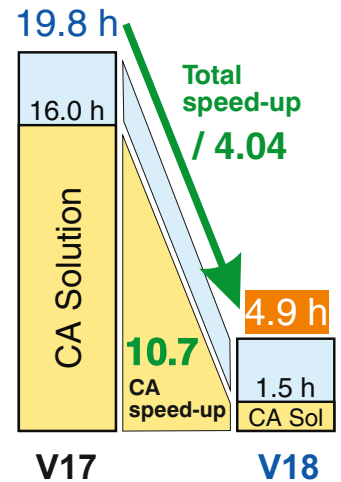
Drastically reduce the computation time for contact analysis.

PERMAS provides an alternative contact algorithm, full parallelization, GPU support, and contact multi-grid solution technique for high performance. Up to 40 times faster than other solvers.

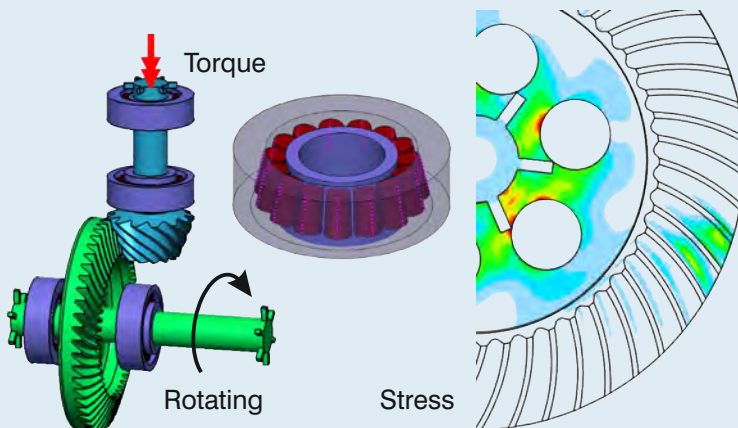
Large Contact Analysis



Model:
 19 Million nodes,
 13 Million elements,
56 Million DOF,
 145,000 contacts,
 gasket, bolt pret.,
 two temp. states,
37 timesteps



Contact with Gears and Roller Bearings

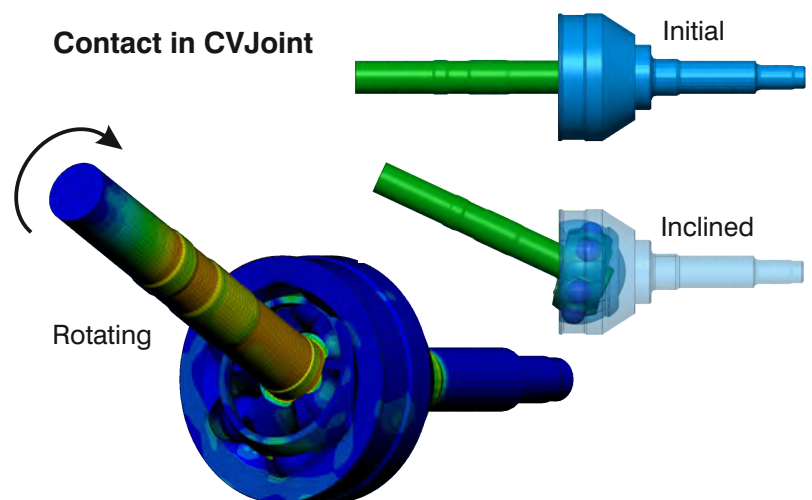


Avoid generating unwanted penetrating contact surfaces.

PERMAS does not use penalty methods. It uses a Lagrange multiplier method for high accuracy of contact results without penetrations.

Easily get all parts in contact at the beginning of an analysis.

PERMAS can handle all starting configurations efficiently and accurately, even with open gaps or pretension load cases.



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Contact Analysis

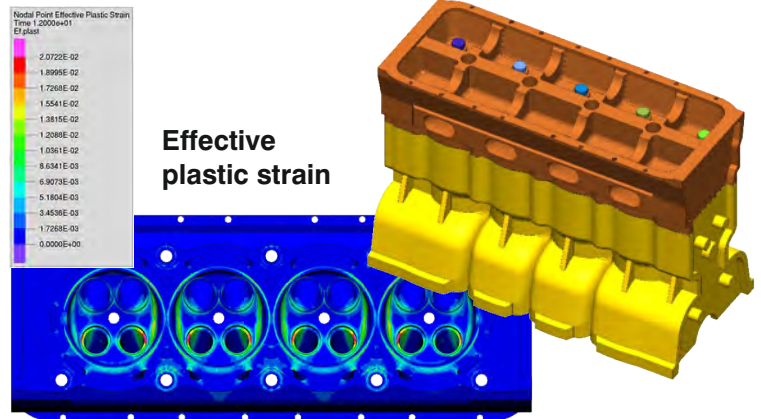
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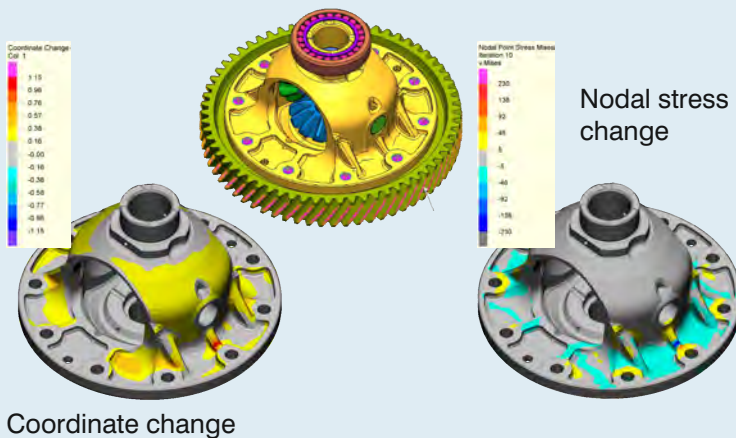
Account for plasticity and large rotations impact on contact.

PERMAS can use nonlinearities together with contact. The fast contact analysis significantly reduces the total computation time.

Engine with Elastic-Plastic Cylinder Head



Freeform optimization of differential housing



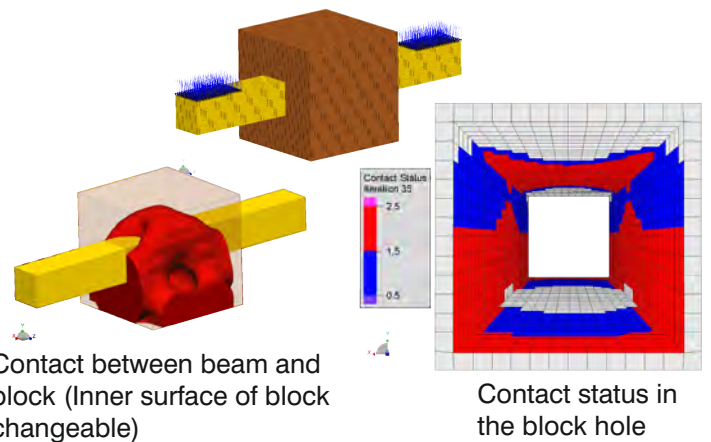
Leverage contact and optimization.

PERMAS has integrated optimization capabilities for multiple forms of optimization models with contact (like topology optimization, shape optimization).

Perform frequency response analysis after a contact analysis.

PERMAS provides a linearization of the contact analysis result to support a subsequent linear dynamic analysis. A simultaneous optimization of contact and frequency response is also supported.

Topology Optimization with Contact



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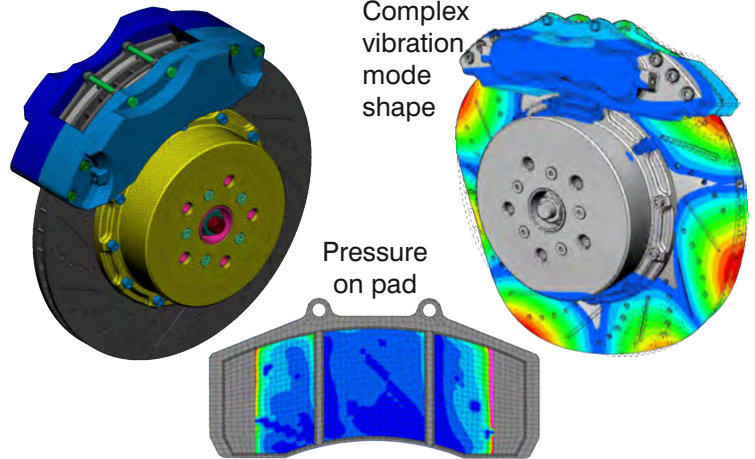
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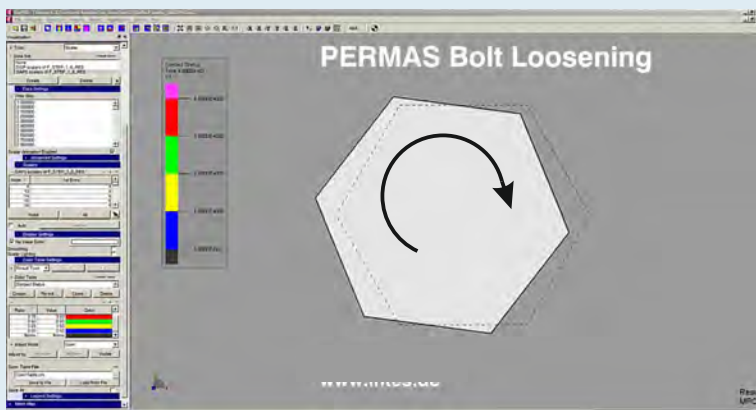
Easily evaluate the effect of friction.

PERMAS can do very fast contact analysis with and without friction to compare the resulting impact of friction.

Brake Squeal Analysis



Bolt Loosening



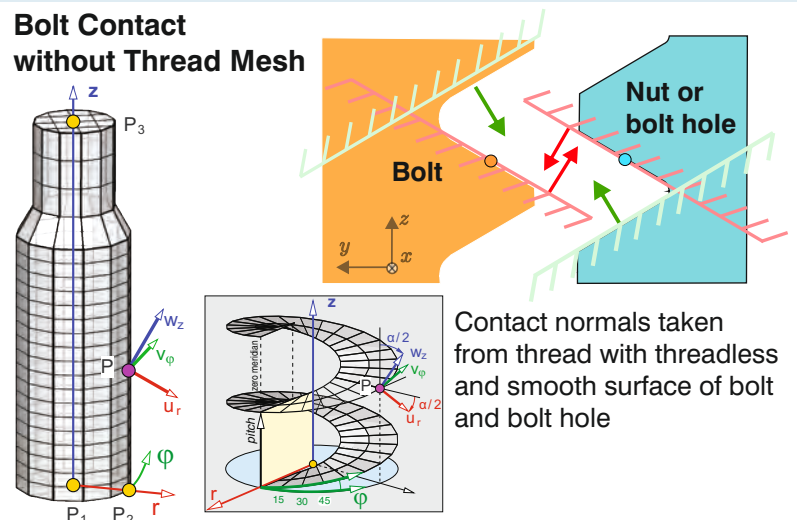
Analyze contact with or without friction.

In many cases, friction can be neglected. PERMAS can use normal contact degrees of freedom only, which is the fastest way to do a contact analysis, ideal for lubricated models.

Leverage advanced bolt modeling for contact.

PERMAS uses contact with 3D models of bolt shaft, head (and nut) to get accurate results using thread helix without meshing.

Bolt Contact without Thread Mesh



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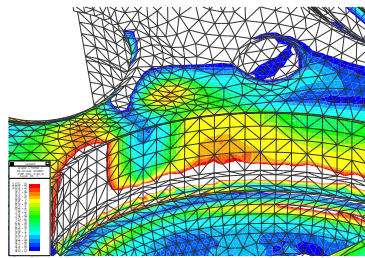
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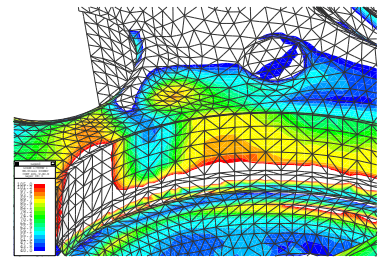
Obtain good stresses from contact analysis with tetrahedron elements.

PERMAS can obtain good stress results with quadratic (not linear) tetrahedron elements when linear hexahedron elements are not possible.

Preserve Result Quality with Reduced No. of Contacts

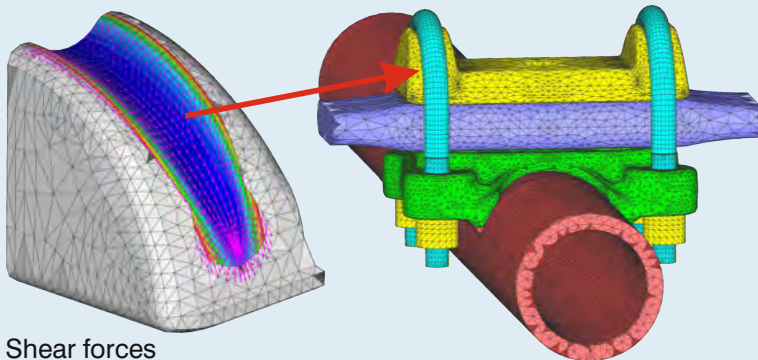


Fully quadratic contact and stress evaluation



Linearized contact and stress evaluation

Shear by Friction



Shear forces in bracket

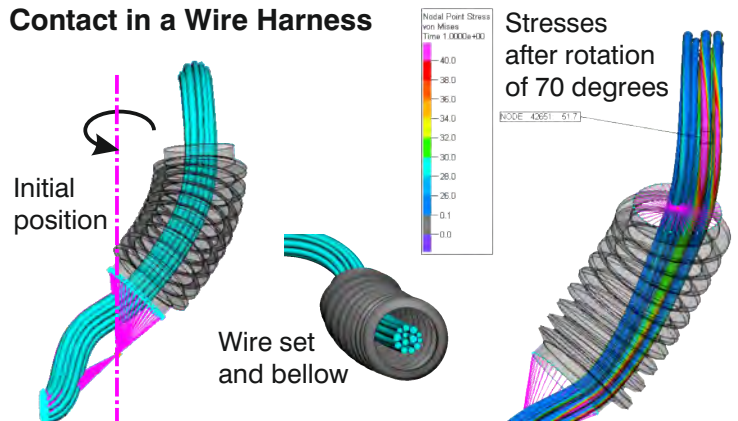
Detect and suppress initial penetrations of contact surfaces.

PERMAS does not modify node coordinates, instead its contact analysis handles the initial gap width without any required penetration.

Get a smoothly curved contact surface automatically.

PERMAS uses smoothed contact surfaces based on unmodified node coordinates.

Contact in a Wire Harness



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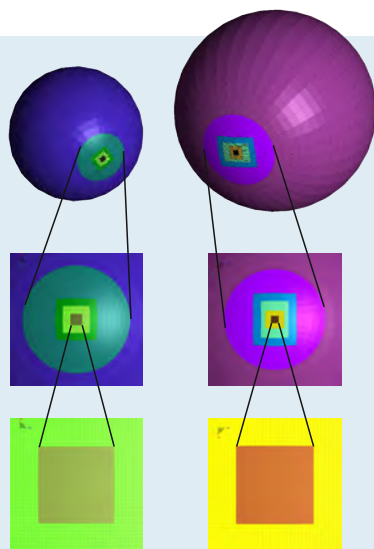
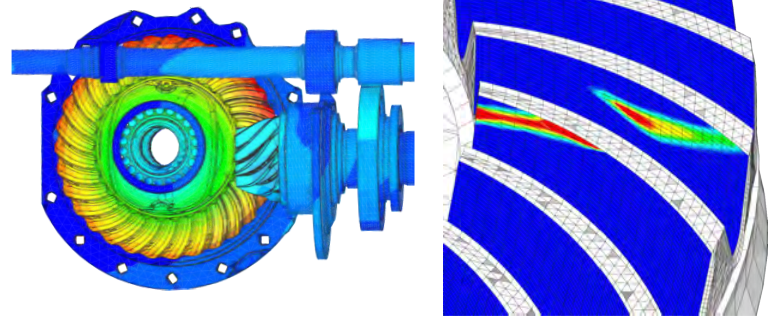
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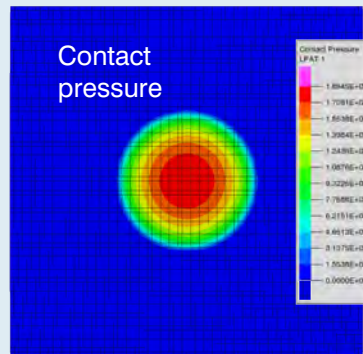
Get a smooth contact pressure result.

PERMAS provides a smooth geometry-based contact pressure computation using contact forces.

Contact Pressure



Sphere-to-Sphere Contact



Hertz: $p_0 = 1865.40$ MPa
 Permas: $p_0 = 1864.52$ MPa
 $\Delta = 0.05\%$

Refine your contact models for high quality results.

PERMAS is highly efficient for very large models. The contact algorithm used provides efficient results for refined contacts.

Leverage additional speed-up for contact analysis of variants.

PERMAS uses the resulting contact status for a first model variant as starting point for a second model variant. Run time is significantly reduced (extremely important for optimization).

Model Variants

