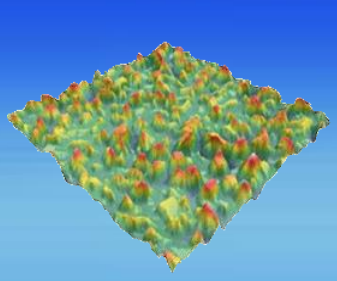
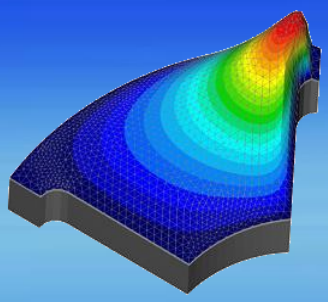




Highlights:

Two levels of journal bearing oil film models:
1) Mobility
2) FE HD with cavitation
- 2D or 3D with tilt

Journal orbit, MOFT, flow, journal bearings

Contact EHD modeling in valvetrains, roller bearings, etc…

Piston skirt and guide oil film hydrodynamics, secondary motions

Piston ring oil films, friction, effects of oil starvation, bore distortion

Thrust bearings in crankshafts and turbochargers

Turbocharger "double-bush" bearings

Roller bearing EHD contacts and friction

Detailed reporting of engine friction components

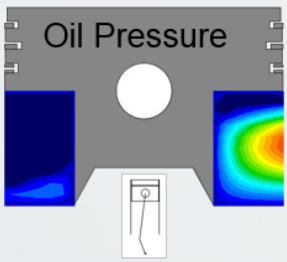
Friction and Tribology

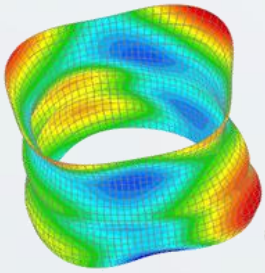
Predictive friction of engine and mechanical systems

Predictive models of friction losses in engines and other systems can be constructed in GT-SUITE, to assess impact of operating conditions and design parameters on friction and seek low friction designs. This functionality uses the validated fundamental tribological elements of GT-SUITE, including oil film hydrodynamics and EHD contact models, a statistical asperity contact model, and also on the ability to take temperature, pressure and shear rate dependence of lubricant viscosity, as well as geometrical details, into account. Application of these elements enable GT-SUITE to model, at each friction interface, the share of load carried hydrodynamically vs. by contact, which is essential to accurate prediction of friction. In addition to friction, models predict secondary motions (orbits, film thicknesses), oil flow, wear load, contact deformations, Hertz stress and temperature rise.

Piston Skirt and Piston Rings

Piston skirt dynamics are based on a finite element representation of the skirt oil film, taking into account tilt and eccentricity as well as hydrodynamics and asperity contact. Piston ring dynamics are based on strong physics accounting for ring-bore conformability, oil starvation, ring tension and asperity contact.

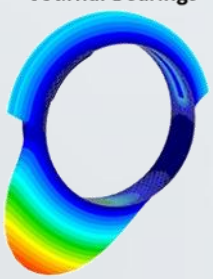




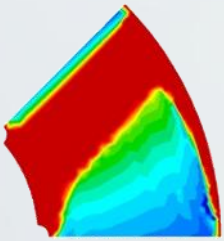
Journal, Thrust and Roller Bearings

GT-SUITE offers best in class bearing modeling options, ranging from the fast running mobility method journal bearing suited perfectly for system level simulations to finite-element meshed journal bearings including the effects of cavitation, elasticity, and 3D journal tilt. Additionally, there are dedicated models for thrust bearings and roller (ball/needle) type bearings.

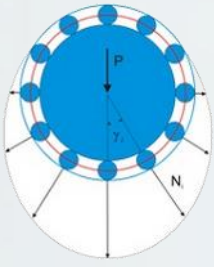
Journal Bearings



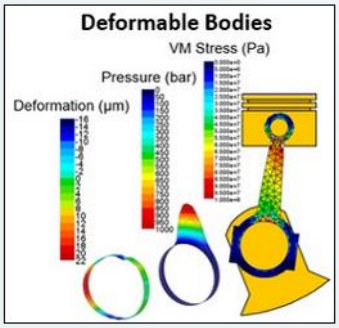
Thrust Bearings



Roller Bearings



Deformable Bodies



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Advanced Features and Applications:

Fully integrated with MBD models of cranktrains, valvetrains, etc…

Fully integrated with lubrication system models

Automatic extraction of surface roughness from profilometer data

Piston bore distortion profile input

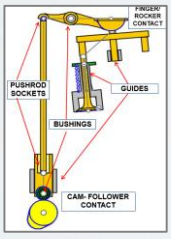
Deformed bearing clearance shape from "crush" during installation

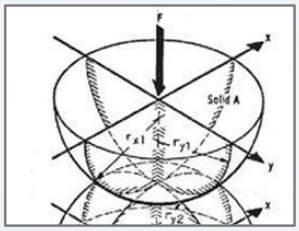
Root cause investigation of wear and seizure issues

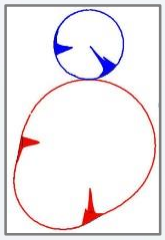
Fast simulation times suitable for multi-variable DoEs

General EHD Contact Models

A general EHD Hertz contact solution is applied for formal MBD contacts. This allows for accurate friction predictions at the various contact interfaces in a valvetrain system for example, including at the cam-follower interface to predict cam wear load, as well as at pushrod and valve guides and sockets and rocker bushings.

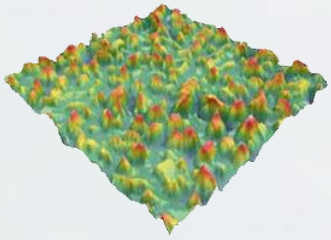


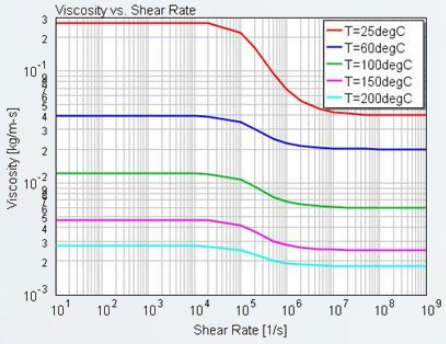




Effects of Surface Roughness and Oil Characteristics

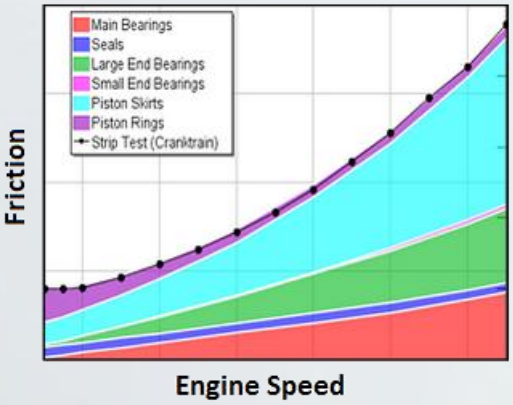
Surface roughness and oil properties have a strong influence on friction behavior. A built in asperity contact model is applied to all friction interfaces including bearings, skirt, ring and general EHD contacts. Experimental profilometer data can be used as input. Furthermore, oil viscosity can be a function not only on temperature and film pressure, but also on shear rate to account for the shear thinning behavior of oils.

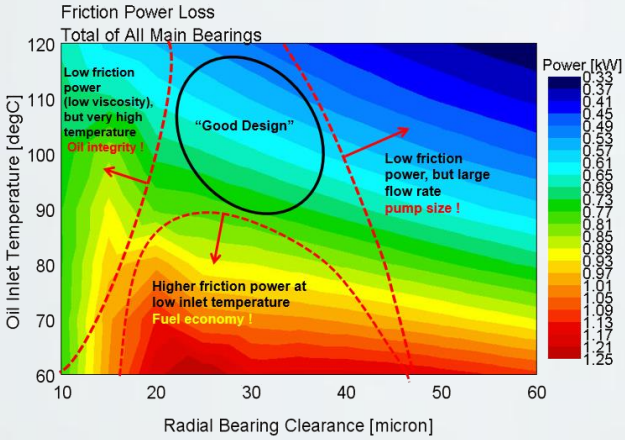




Virtual Engine Stripdown Friction and Finding the Optimal Design

GT-SUITE can reproduce engine stripdown test measurements accurately, by modeling the major friction consumers in the engine including main bearings, con rod bearings, seals, piston skirts and piston rings. Many of the geometrical and oil properties inputs can be parameterized, allowing for designs of bearings, skirts and rings to be optimized to minimize friction and maximize performance. GT-SUITE offers a built-in design of experiments (DoE) interface allowing many parameters and cases to be run.





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