

Gear Contact Pressure Analysis under Shaft Misalignment

Semi-analytical investigation of spur and helical gear contact

Research by Stelian Cazan and co-authors • Adapted from a research presentation

Why shaft misalignment matters

Shaft deflection and assembly errors can alter the separation between mating tooth flanks.

The resulting nonuniform load distribution may create localized contact pressure peaks.

Understanding these effects helps engineers evaluate gearbox reliability.

Engineering questions addressed

- 01 How does gear tooth geometry affect the contact zone?
- 02 How does shaft misalignment change pressure distribution?
- 03 Where do localized pressure concentrations appear?
- 04 Can a semi-analytical model support efficient engineering assessment?

Why a non-Hertzian approach?

Classical Hertzian solutions are useful reference models, but idealized assumptions may not represent finite contact geometry and edge effects adequately.

A discretized, non-Hertzian contact formulation allows pressure to vary over the modeled contact region.

Model suitability depends on geometry, boundary conditions and assumptions.

Numerical workflow

Gear geometry and operating inputs



Local separation field between mating flanks



Discretized elastic contact problem

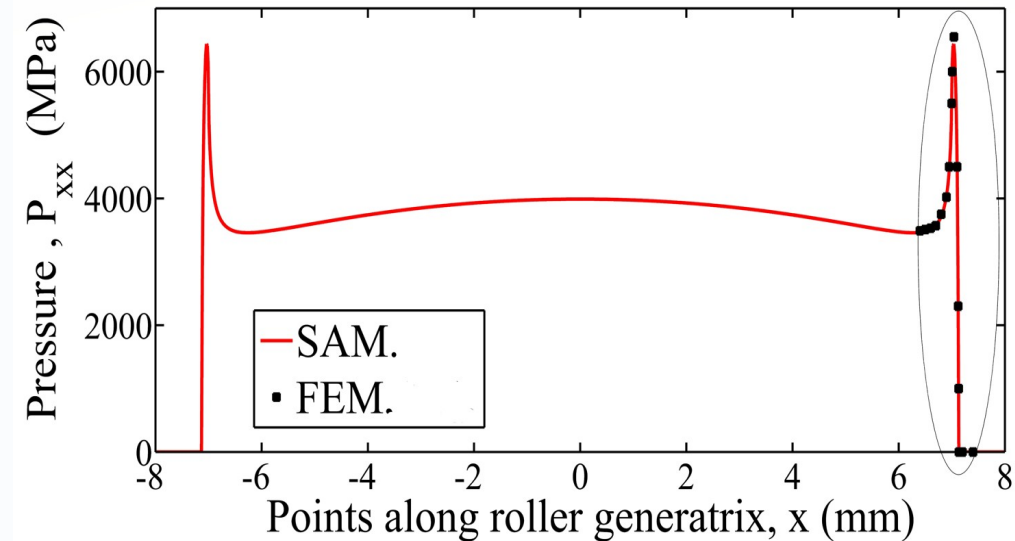


Contact pressure distribution and engineering interpretation

Validation against reference contact cases

The source presentation documents reference checks involving sphere–sphere, roller-bearing and cylinder–cylinder contact configurations.

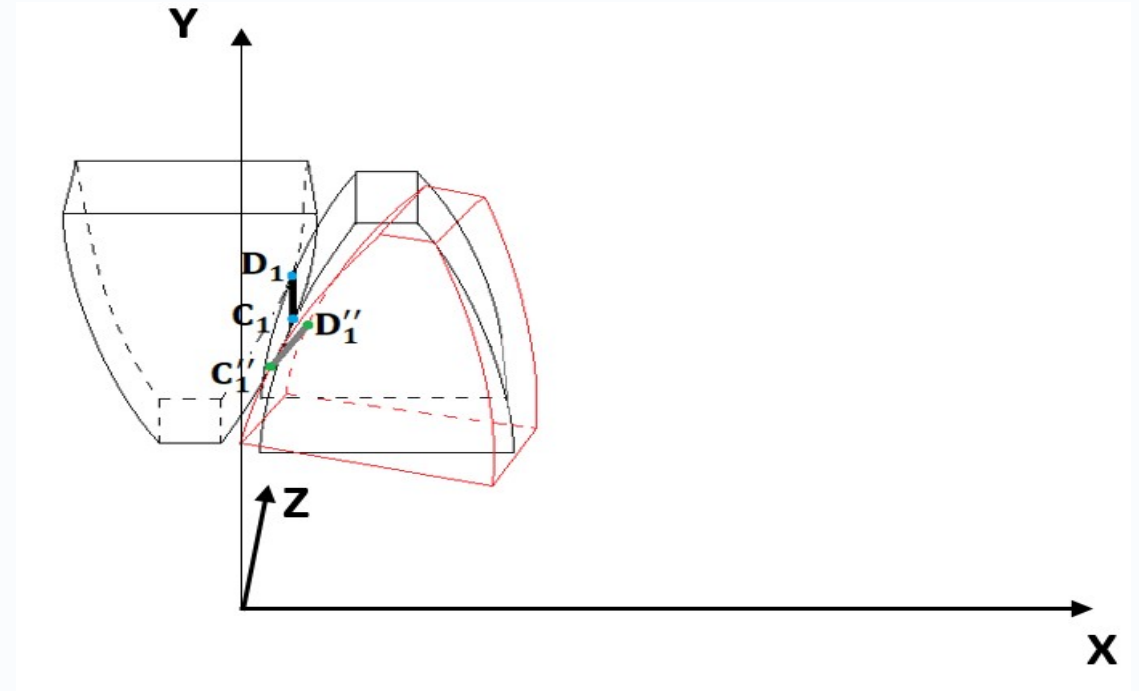
These examples support the numerical approach; the public deck does not establish a universal accuracy guarantee.



Modeling shaft deflection and misalignment

The tooth-flank separation field is updated to account for geometric changes associated with shaft misalignment.

The modified separation field feeds the contact calculation.



Illustrative helical gear case

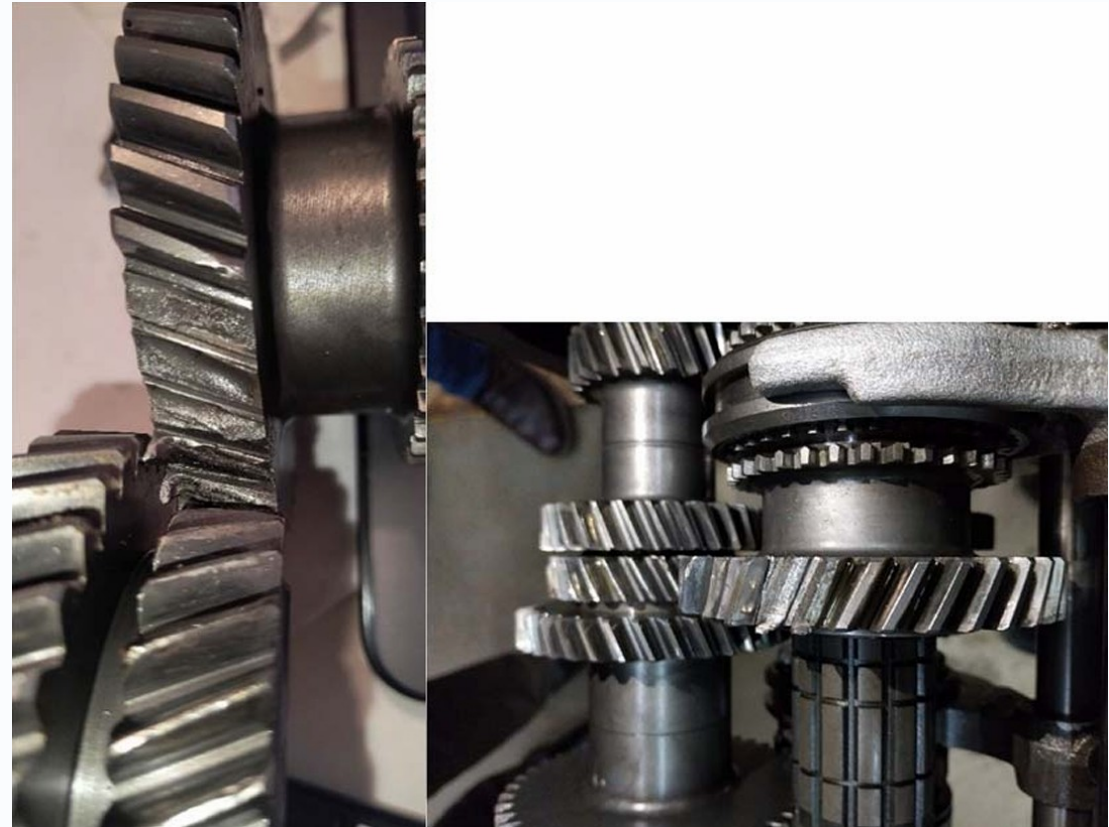
Input conditions reported in the research slides:

- Normal force: 6,600 N
- Tooth counts: 37 / 27
- Module: 4 mm
- Face width: 16.7 mm
- Offset misalignment: 2 mm
- Young's modulus: 210,000 MPa

Localized contact pressure peak

The original research presentation reports a maximum contact pressure of 3,500 MPa for the illustrated misaligned helical gear case.

This is a case-specific numerical result—not a general value or a failure threshold.



Engineering implications

- Shaft alignment can strongly influence where tooth contact loads concentrate.
- Pressure maps help identify potentially critical contact regions.
- Simulation results should be interpreted together with operating loads, material data and actual geometry.
- Case-specific analysis can support design review, troubleshooting and microgeometry decisions.

Discuss a gear-contact problem

S&S GEARCORE provides independent numerical assessment of spur and helical gear contact, load distribution and misalignment effects.

For a scoped engineering assessment, share the gear geometry, operating conditions and observed issue.

contact@ssgearcore.com • ssgearcore.com

Technical research adaptation. Numerical findings are illustrative and subject to model assumptions.

Tractor transmission: two loading scenarios

Separate numerical scenarios; figures to be inserted from the original solver outputs.

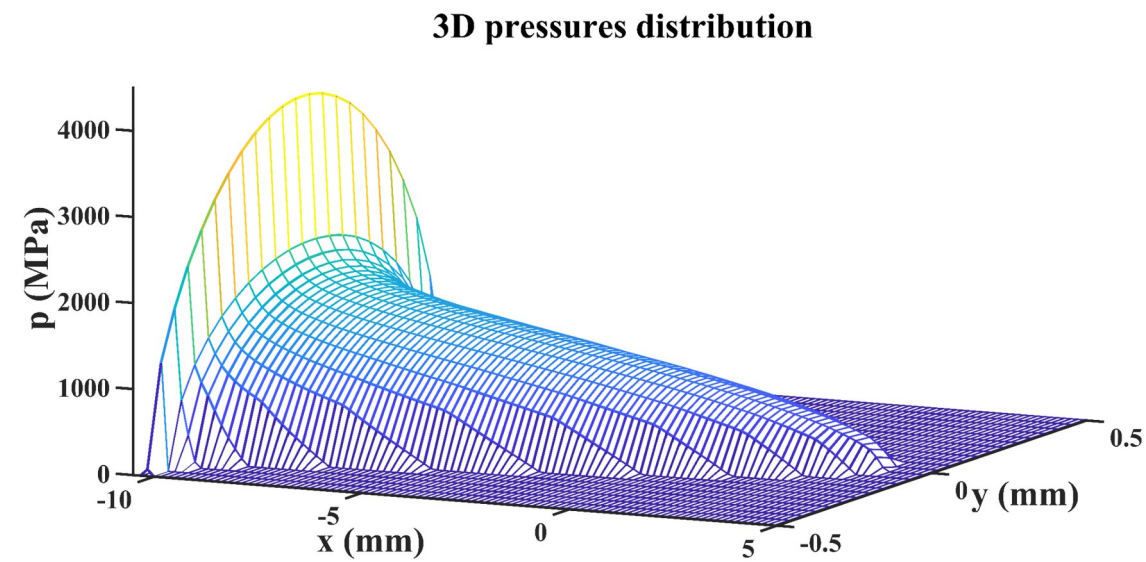
Scenario A	Shaft misalignment: 0.1°
Scenario B	Misalignment: 0.1° + axial mounting offset: 1 mm
Normal load	6,600 N
Gear geometry	37/27 teeth · module 4 mm · helix angle 15°
Face width	16.7 mm

Illustrative study parameters — verify against original model before publication.

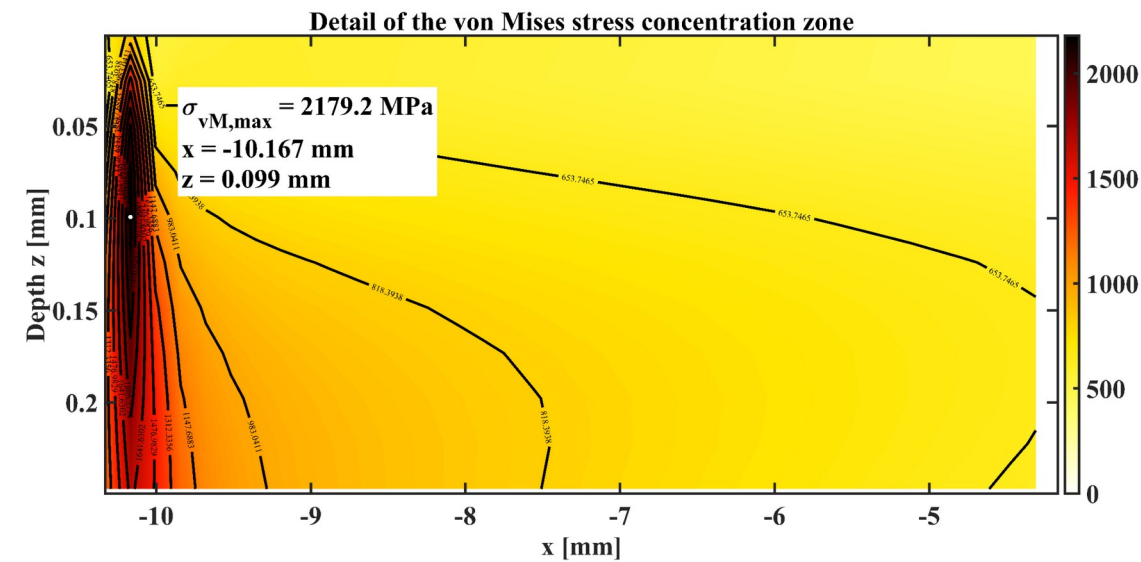
Scenario A | contact pressure and subsurface stress

Misalignment: 0.1°

3D CONTACT PRESSURE DISTRIBUTION



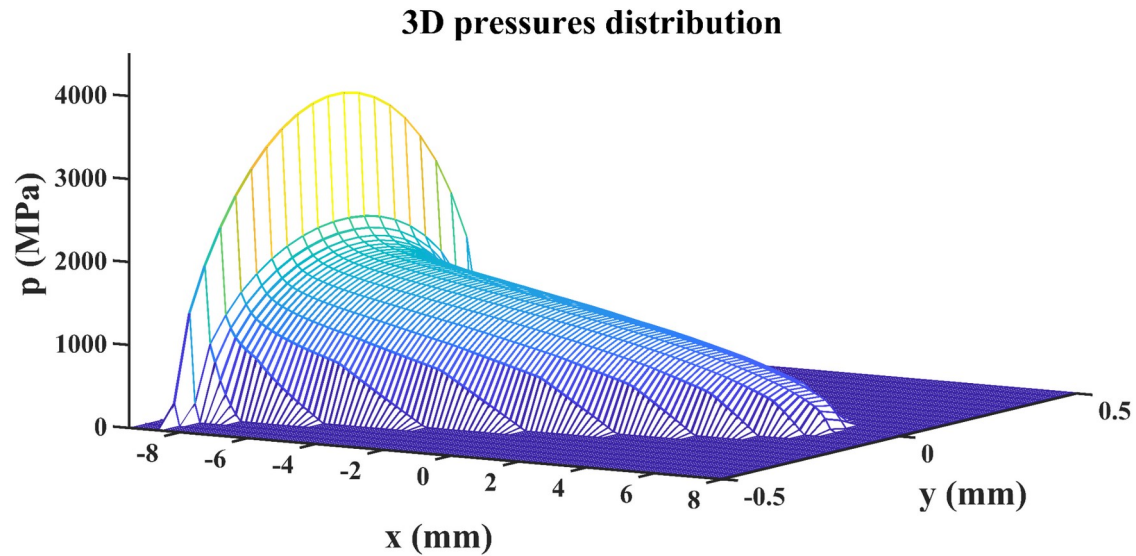
VON MISES STRESS DISTRIBUTION



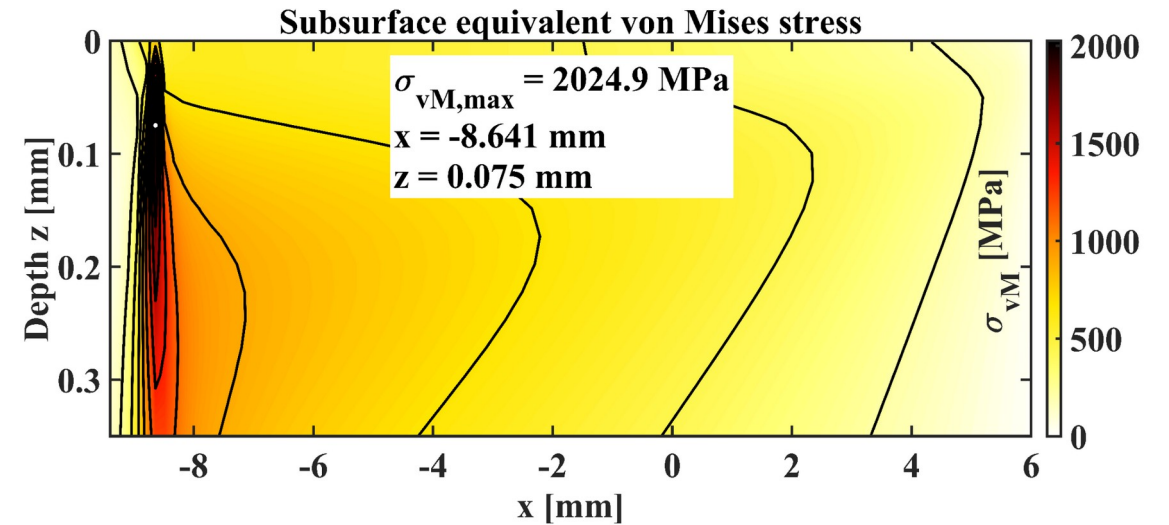
Scenario B | misalignment + axial offset

Misalignment: 0.1° | Axial offset: 1 mm

3D CONTACT PRESSURE DISTRIBUTION



VON MISES STRESS DISTRIBUTION



From numerical evidence to engineering decisions

How this study can support gearbox investigation and redesign.

Diagnose

Identify contact localization and edge loading

Compare

Evaluate separate versus combined assembly errors

Assess

Examine pressure and subsurface stress distributions

Optimize

Explore alignment and microgeometry modifications