1. [Optimization and Statistical Analysis of Stress Parameters in Helical Gears Using Taguchi Method and ANOVA]

Patil, Prashant J. (1); Jadhav, Mahesh R. (1); Mulik, Pramod V. (1); Lingaraju, S.V. (1); Joshi, Krishnakumar D. (1)
Source: *Journal of The Institution of Engineers (India): Series C*, v 107, n 1, p 287-297, February 2026; **ISSN:** 22500545, **E-ISSN:** 22500553; **DOI:** 10.1007/s40032-025-01283-9; **Publisher:** Springer
Author affiliation: (1) Department of Mechanical Engineering, Tatyasaheb Kore Institute of Engineering and Technology Warananagar, Warana University, Kolhapur, India
Abstract: Helical gears are essential in mechanical systems, requiring precise assessment of bending stresses under dynamic conditions for reliable design. The demand for compact, high-performance, and quieter gearboxes presents challenges in stress analysis, requiring more accurate predictive methods beyond conventional approaches. This study examines the influence of the module on bending stresses in helical gear pairs using experimental, theoretical, and finite element analysis (FEA) approaches. The photostress technique was employed to measure bending stresses, while dynamic loads were calculated using the velocity factor method and Spott's equation. Finite element analysis modeled and simulated gear dynamics using a commercial solver. Comparative analyses identified discrepancies between theoretical, experimental, and FEA results, quantifying error percentages. Findings reveal notable variations between methods, necessitating a correction factor to improve the accuracy of theoretical predictions. The proposed correction factor aligns estimates from the velocity factor method and Spott's equation with experimental and FEA results, enhancing reliability. This research offers a framework for optimizing gear design, reducing material usage and costs without compromising strength and performance, with applications across automotive, aerospace, and industrial sectors. © The Institution of Engineers (India) 2025. (28 refs)
Main heading: Dynamic analysis
Controlled terms: Dynamic loads - Dynamics - Helical gears - Industrial research - Machine design - Stress analysis - Taguchi methods
Uncontrolled terms: Bending stress - Contact Stress - Correction factors - Dynamics analysis - Factor methods - Finite element analyse - LS-DYNA - Photostress analyze - True stress - Velocity factor
Classification Code: 214.1.1 Stress and Strain - 215.1.2 Mechanical Properties Testing Methods - 408 Structural Design - 601 Mechanical Design - 601.2 Machine Components - 901.3 Engineering Research - 904 Design - 912.1 Industrial Engineering - 913.3 Quality Assurance and Control - 1202.2 Mathematical Statistics - 1301.1.1 Mechanics - 1301.7 Statistical and Nonlinear Physics
Database: Compendex
Data Provider: Engineering Village

2. [Modeling and Contact Stress Analysis of Crossed-Axes Helical Gear System] (*Open Access*)

Kadhim, Mohammed Abdulaal (1); Abdullah, Mohammad Qasim (1)
Source: *International Journal of Automotive and Mechanical Engineering*, v 22, n 2, p 12443-12467, June 1, 2025; **ISSN:** 22298649, **E-ISSN:** 21801606; **DOI:** 10.15282/ijame.22.2.2025.15.0952; **Publisher:** Universiti Malaysia Pahang
Author affiliation: (1) Mechanical Engineering Department, College of Engineering, University of Baghdad, Iraq
Abstract: Crossed helical gears are susceptible to pitting damage resulting from contact stress, primarily due to the theoretical point of contact between the gears. The contact point transforms into an ellipse due to the deformation of the elastic material under varying loading conditions. The overheating between the tooth profiles during the engagement process contributes to the proliferation of pits, deteriorating the tooth surface and causing premature tooth failure. This study investigates the influence of two modifications: the tip relief design and the compound profile design, which combines involute and epicycloid profiles. A shaping process generates both standard and modified helical gears. The results indicate that increasing the amount of misalignment with a smaller harmonic waveform reduces the transmission error. The involute-epicycloid profile reduces the sliding velocity with the most significant improvement of approximately 16%. A decrease in the angle of pressure and an increase in the helix angle of 1.5 and 1.7, respectively, enhance the total contact ratio. The maximum contact stress observed for the modified involute-epicycloid surface decreased by 6%, 6%, and 2%, while the tooth root stress reduced by 6%, 8%, and 12% for the three positions, respectively. Meanwhile, the maximum contact stress for tip relief modification decreased by 2%, 6%, and -6%, whereas the tooth root stress reduced by 2%, 7%, and -1% for the three positions, respectively. Consequently, the modified crossed helical gear drive demonstrates superior performance compared to the standard gear drive for a given helix angle. Furthermore, the stress concentration factor decreased through the use of the modified helical teeth by about 2% and 6%. ©2025 The Author(s). Published by Universiti Malaysia Pahang Al-Sultan Abdullah Publishing. This is an open access article under the CC BY-NC 4.0 International license (41 refs)
Main heading: Helical gears
Controlled terms: End effectors - Gear teeth - Stress analysis - Stress concentration - Stress relief
Uncontrolled terms: Contact Stress - Contact stress analysis - Crossed axes - Crossed helical gears - Crossed-axis helical gear - Epicycloid - Gear drives - Helix angles - Tip relief - Tooth root stress
Classification Code: 214.1.1 Stress and Strain - 601.2 Machine Components - 731.5 Robotics

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Open Access type(s): All Open Access, Gold
Database: Compendex
Data Provider: Engineering Village

3. [Classroom Stress Indicator Analysis Using Principal Component Analysis in Cognitive Load Evaluation]()

Madhavan, Smitha Poovathinkal (1)
Source: *2025 International Conference on Intelligent Innovations in Engineering and Technology, ICIIET 2025*, 2025, *2025 International Conference on Intelligent Innovations in Engineering and Technology, ICIIET 2025*; **ISBN-13:** 9798331591038; **DOI:** 10.1109/ICIIET65921.2025.11377844; **Conference:** 2025 International Conference on Intelligent Innovations in Engineering and Technology, ICIIET 2025, December 4, 2025 - December 6, 2025; **Publisher:** Institute of Electrical and Electronics Engineers Inc.
Author affiliation: (1) School of Nursing, Lincoln University College, Selangor, Petaling Jaya, Malaysia
Abstract: Classroom stress significantly impacts students' cognitive performance and learning outcomes, making its assessment crucial for optimizing educational environments. Traditional methods of stress evaluation often rely on self-reported surveys or simple observational techniques, which may be subjective, time-consuming, and unable to capture real-time physiological responses. To address these limitations, this study proposes a novel framework, Identifying Peak Stress Periods using Principal Component Analysis (IPSP-PCA), which analyzes physiological data such as heart rate, skin conductance, and pupil dilation collected during classroom activities. IPSP-PCA reduces data dimensionality, identifies the principal components that correspond to stress variations, and detects peak stress periods in students effectively. The proposed method enables continuous, objective monitoring of cognitive load and stress levels without interrupting classroom interactions. Application of IPSP-PCA in classroom scenarios demonstrates its ability to pinpoint moments of high cognitive strain, providing actionable insights for educators to modify teaching strategies and support student well-being. Findings indicate that IPSP-PCA achieves higher accuracy and reliability in detecting stress patterns compared to conventional methods, highlighting its potential as a practical tool for real-time classroom stress monitoring. © 2025 IEEE. (21 refs)
Main heading: Principal component analysis
Controlled terms: Education computing - Gears - Physiological models - Psychophysiology - Students - Teaching
Uncontrolled terms: Classroom stress - Cognitive loads - Peak stress - Peak stress detection - Physiological monitoring - Principal-component analysis - Real- time - Stress detection - Stress indicators - Student performance
Classification Code: 101.1 Biomedical Engineering - 101.5 Ergonomics and Human Factors Engineering - 601.2 Machine Components - 602 Mechanical Drives and Transmissions - 901.2 Education - 1101.2 Machine Learning
Database: Compendex
Data Provider: Engineering Village

4. [Consideration of Materials Used in Trochoidal Gear Reducer Based on Stress Analysis of Internal Components Aimed at Weight Reduction]()

Satake, Hironori (1); Takesue, Naoyuki (1)
Source: *2026 IEEE/SICE International Symposium on System Integration, SII 2026*, p 1653-1658, 2026, *2026 IEEE/SICE International Symposium on System Integration, SII 2026*; **ISBN-13:** 9781665457842; **DOI:** 10.1109/SII64115.2026.11404664; **Conference:** 2026 IEEE/SICE International Symposium on System Integration, SII 2026, January 11, 2026 - January 14, 2026; **Sponsor:** Applied Science and Artificial Intelligence Institute; Hitachi; OMRON SINIC X Corporation; Unitree Robotics; Universal Robots; **Publisher:** Institute of Electrical and Electronics Engineers Inc.
Author affiliation: (1) Tokyo Metropolitan University, Hino, Tokyo, Japan
Abstract: In recent years, the demand for industrial robots has been increasing year by year and is expected to continue to grow in the future. On the other hand, efforts toward the Sustainable Development Goals (SDGs) and carbon neutrality are spreading worldwide. This paper aims to develop a lightweight reduction gear for energy-saving robots. To reduce the weight of robots, it is necessary to replace conventional metal materials with new lightweight materials. However, weight reduction generally reduces rigidity, which tends to lower the high-speed and high-precision performance required of industrial robots.The authors have studied the possibility of replacing metal parts with machined CFRP, POM, and 3D printer resin parts, and have examined the adaptability of these parts. In the previous report, we experimentally compared the weight, no-load running torque, torque-torsional characteristic, and dynamic torque transfer efficiency of 20 combinations of metal and resin reduction gears. In this report, we focus on the yield strength of materials and analyze the load distribution, stress of reduction gear components, taking into account the effects of assembly and fabrication errors. We then calculate and

compare the output torque per volume and weight of four types of reduction gears using metal and resin combinations. Under the condition of designing within the elastic range of the materials, it was demonstrated that using resin gears could increase the maximum output while saving space and reducing weight. Additionally, the validity of the theoretical values was verified by comparing them with FEM analysis results. © 2026 IEEE. (15 refs)
Main heading: Torque
Controlled terms: Energy conservation - Gear manufacture - Gears - Intelligent robots - Reduction - Stress analysis
Uncontrolled terms: Carbon neutralities - Conventional metals - Energy savings - Energy-savings - Gear reducers - Metals materials - Reduction gear - Stresses analysis - Trochoidal gears - Weight reduction
Classification Code: 101.6.1 Robotic Assistants - 214.1.1 Stress and Strain - 601.2 Machine Components - 602 Mechanical Drives and Transmissions - 731.6 Robot Applications - 802.2 Chemical Reactions - 1009.1 Energy Conservation - 1301.1.2 Physical Properties of Gases, Liquids and Solids
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Database: Compendex
Data Provider: Engineering Village

5. Generation and Stress Analysis of Helical Gear Tooth Combining Involute with Epicycloidal and Hypocycloidal Profiles (*Open Access*)

Kadhim, Mohammed Abdulaal (1); Abdulah, Mohammad Qasim (1)
Source: *International Journal of Automotive and Mechanical Engineering*, v 22, n 1, p 12016-12034, 2025; **ISSN:** 22298649, **E-ISSN:** 21801606; **DOI:** 10.15282/IJAME.22.1.2025.6.0923; **Publisher:** Universiti Malaysia Pahang
Author affiliation: (1) Mechanical Engineering Department, College of Engineering, University of Baghdad, Iraq
Abstract: This paper examines the helical gear that combines the involute with epicycloidal-hypocycloidal profiles. The tooth profile was produced through the shaper-cutting process, which was conducted using an appropriate rack cutter with a Cartesian coordinate system. A computer program was developed using Microsoft Visual Basic and subsequently integrated into SolidWorks using the application programming interface. This numerical investigation aims to analyze the impact of tool parameters on the produced gear tooth profile, with the goal of enhancing the dynamic performance and deformation resistance of the proposed helical gear model. Additionally, this study assesses the effect of teeth thickness on the helical gear model. The results indicate a highly accurate approximation of the involute, cycloidal, and modified gear tooth profiles, which were programmed according to the module, teeth number, and rolling angle. The use of a combination of curves (epicycloidal, involute, and hypocycloidal) in a single tooth resulted in a larger contact area, thereby improving the ability of the gears to withstand greater pressures and extending their lifespan. The modified non-parallel helical gear drive outperformed other non-parallel helical gear drives. The best enhancements in maximum contact stress and teeth bending stress achieved approximately 33.169% and 26.08% compared to the standard involute profile and about 17.69% and 0.67% when compared to the cycloidal profile. © 2025 The Author(s). Published by Universiti Malaysia Pahang Al-Sultan Abdullah Publishing. This is an open access article under the CC BY-NC 4.0 International license (31 refs)
Main heading: Helical gears
Controlled terms: Epicyclic gears - Gear cutting - Gear teeth - Stress analysis
Uncontrolled terms: Cycloidal - Epicycloidal - Gear drives - Gear models - Generating process - Helical gear teeth - Hypocycloidal - Involute - Stresses analysis - Tooth profile
Classification Code: 214.1.1 Stress and Strain - 601.2 Machine Components - 604.1 Metal Cutting
Open Access type(s): All Open Access, Gold
Database: Compendex
Data Provider: Engineering Village

6. Parametric Study of Addendum Modification on Helical Gear Tooth Root Stress using Finite Element Analysis (*Open Access*)

Achari, Akkasaligara Sathyanarayana (1, 2); Daivagna, Umesh M. (2); Basavaraj, Yadavalli (2); Banakar, Prashanth (1); Paradeshi, Lokesh B. (3)
Source: *International Journal of Vehicle Structures and Systems*, v 17, n 5, p 867-875, December 28, 2025; **ISSN:** 09753060, **E-ISSN:** 09753540; **DOI:** 10.4273/ijvss.17.5.22; **Publisher:** Carbon Magics Ltd
Author affiliation: (1) Dept. of Mech. Engg., Jain College of Engg. & Tech., Visvesvaraya Tech. University, Karnataka, Belagavi, India (2) Dept. of Mech. Engg., Ballari Inst. of Tech. & Mgmnt., Visvesvaraya Tech. University, Karnataka, Belagavi, India (3) Dept. of Mech. Engg., R.V. Inst. of Tech. & Mgmnt., Visvesvaraya Tech. University, Karnataka, Belagavi, India

Abstract: This study employs two-dimensional finite element analysis (FEA) to investigate the stresses at various points of helical gear teeth, including Von-Mises stress, principal stresses, maximum shear stress and normal stress calculations of external cylindrical gears with parallel axes. Initially, single involute symmetric helical gear tooth profiles with increasing positive addendum modification were modelled in Solid Edge ST5. The gear tooth geometry files were then imported to ANSYS 19 platform for static structural analysis. Three paths and six locations were identified for plane stress analysis. Path-1 was created on the clearance circle, path-2 on the pitch circle and path-3 on the addendum circle of the gear. The finite element model in ANSYS 19 was subjected to boundary conditions and results were obtained on the different paths and locations. The impact of addendum modification coefficient (AMC) on the tooth root, pitch point and tooth tip of an external cylindrical gear with parallel axes was explored and all stress components of addendum-modified gears were compared to a standard helical gear. The findings indicate that Von-Mises stress, principal stresses and shear stresses decrease with an increase in addendum modification on path-1, while they increase with an increase in addendum modification on path-2 and path-3. The study also highlights the importance of selecting an appropriate AMC to balance the strength of helical gear teeth with a smaller number of teeth. © 2025. Carbon Magics Ltd. (24 refs)
Main heading: Helical gears
Controlled terms: Computational methods - Gear teeth - Geometry - Shear flow - Shear stress - Stress analysis
Uncontrolled terms: Addendum modification coefficient - Finite element analyse - Form factors - Gear design - Helical gear design - Helical gear teeth - Modification coefficient - Tooth form factor - Tooth thickness - VonMises stress
Classification Code: 214.1.1 Stress and Strain - 301.1.5 Flow of Fluid-Like Materials - 601.2 Machine Components - 1201.5 Computational Mathematics - 1201.14 Geometry and Topology
Open Access type(s): All Open Access, Hybrid Gold
Database: Compendex
Data Provider: Engineering Village

7. Optimizing Structural Steel Spur Gear Design for Reduced Stress Concentrations in Industry 4.0 Using Finite Element Analysis

Agrawal, Anant Prakash (1); Ali, Shahazad (1); Tripathi, Naveen Mani (2); Kumar, Rajeev (1); Srivastava, Pulkit (1)
Source: *Recent Patents on Mechanical Engineering*, v 18, n 4, p 371-378, 2025; **ISSN:** 22127976, **E-ISSN:** 1874477X; **DOI:** 10.2174/0122127976309163240620080241; **Publisher:** Bentham Science Publishers
Author affiliation: (1) Department of Mechanical Engineering, Noida Institute of Engineering and Technology, UP, Greater Noida; 201306, India (2) Department of Mechanical Engineering, Assam Energy Institute, Centre of Rajiv Gandhi Institute of Petroleum Technology, Sivasagar, Jais; 785697, India
Abstract: The advent of Industry 4.0 has highlighted the importance of spur gears in power transmission across the automotive, aerospace, and marine industries. However, these gears are susceptible to failure due to bending and contact stresses from fatigue. Designing an involute gear profile presents challenges, particularly in managing tooth root stresses and avoiding interference. This study tackles these issues through comprehensive stress analysis, using modeling and FEM assessment. The focus is on evaluating bending stresses at critical locations and identifying strategies to reduce stress concentrations at the gear tooth root. By enhancing gear robustness, this research could contribute to potential patents in gear technology. Background: Spur gears are crucial for power transmission but often fail due to fatigue-induced stresses and design challenges at the tooth root. Objective: This study aims to address spur gear design challenges through comprehensive stress analysis, using modeling and FEM to assess bending stresses and explore strategies to reduce stress concentrations at the tooth root. Methods: The research uses SolidWorks and ANSYS for FEM analysis, focusing on bending stresses and exploring modifications in gear design using various materials for optimization. Results: The analysis shows strategic modifications to the gear's fillet radius and addendum can reduce stress at the tooth root by 38.26%, with stainless steel being the optimal material for enhanced gear strength. Conclusion: The study emphasizes strategic adjustments in fillet radius and addendum to reduce stress in spur gears, highlighting stainless steel's superior performance for optimized design and enhanced strength. © 2025 Bentham Science Publishers (29 refs)
Main heading: Shape optimization
Controlled terms: Electric power transmission - Fatigue of materials - Gear teeth - Power transmission - Stainless steel - Strategic materials
Uncontrolled terms: Bending stress - Design challenges - Fillet radius - Finite element analyse - Gear design - Power-transmission - Shape-optimization - Stresses analysis - Structural steels - Tooth root
Classification Code: 202.5.3 Steel - 214 Materials Science - 214.1.1 Stress and Strain - 601.2 Machine Components - 602.2 Mechanical Transmissions - 706.1.1 Electric Power Transmission - 1201.7 Optimization Techniques
Database: Compendex
Data Provider: Engineering Village

8. Investigation of dynamic stress similarity in gear transmission system considering geometric distortion: Theoretical analysis and experimental prediction

Zhang, Chunpeng (1); Wei, Jing (2); Wang, Guoying (1); Gao, Wen (1)
Source: *Mechanism and Machine Theory*, v 216, November 15, 2025; **ISSN:** 0094114X; **DOI:** 10.1016/j.mechmachtheory.2025.106225; **Article number:** 106225; **Publisher:** Elsevier Ltd
Author affiliation: (1) School of Machinery and Automation, Weifang University, Weifang; 261061, China (2) State Key Laboratory of Mechanical Transmission for Advanced Equipment, Chongqing University, Chongqing; 400044, China
Abstract: Dynamic stress serves as a critical parameter in characterizing the performance of gear transmission systems (GTS) and predicting gear life. For large GTS, the long processing cycle and high processing cost of experimental parts make it difficult to implement experiments. Thus, the development of a scaled model for dynamic stress testing becomes imperative. Through the integration of equation analysis and dynamic stress calculation methodologies, the similarity relationship of dynamic stress has been established. Based on the calculation results of GTS dynamic model and finite element model, it is found that the tooth root dynamic stress (TRDS) curve and meshing stress distribution of the scaled model are similar to those of the prototype. A method to adjust the amplitude and speed of the resonant point is proposed by analyzing the sensitivity of GTS resonance parameters to geometric distortion. The dynamic stress resonance characteristics of the prototype can be accurately predicted by applying the distortion model. Additionally, the similarity analysis method has been implemented to predict the TRDS curve in a parallel gear within a specific 2 MW wind turbine gearbox. © 2025 Elsevier Ltd (54 refs)
Main heading: Forecasting
Controlled terms: Gear trains - Gear transmissions - Gears - Power transmission - Transmissions
Uncontrolled terms: Dynamic stress - Gear transmission system - Geometric distortion - Large gear - Performance - Resonance parameters - Root dynamics - Scale-model - Scaled modeling - Tooth root
Classification Code: 601.2 Machine Components - 602 Mechanical Drives and Transmissions - 602.2 Mechanical Transmissions - 661 Automotive Engines and Related Equipment - 662.3 Automobile Components and Materials - 1201.14 Geometry and Topology - 1202 Statistical Methods
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Database: Compendex
Data Provider: Engineering Village

9. Maximum stress and shared load distribution analysis on the profile of spur corrected gear pairs in contact

Belarhzal, Samya (1); Boudi, El Mostapha (1)
Source: *2025 11th International Conference on Optimization and Applications, ICOA 2025 - Proceedings*, 2025, *2025 11th International Conference on Optimization and Applications, ICOA 2025 - Proceedings*; **ISBN-13:** 9798331599577; **DOI:** 10.1109/ICOA66896.2025.11236905; **Conference:** 11th International Conference on Optimization and Applications, ICOA 2025, October 16, 2025 - October 17, 2025; **Publisher:** Institute of Electrical and Electronics Engineers Inc.
Author affiliation: (1) Mohammadia School of Engineers, Mechanical Department, Rabat, Morocco
Abstract: Increasing the durability and fatigue resistance of gears is a crucial objective for researchers. For this reason, the modification of the tooth profile is introduced as a new parameter to analyze its effect on the distribution of the shared load on the profile of the pairs of teeth in contact, then the stress generated. This study was carried out using a pair of cylindrical gears based on a circular involute, with standard and corrected straight teeth by different values of profile shift factor x1 and x2. Same value for modulus, number of teeth, width, and pressure angle. Gear 1 (pinion) is considered the driving gear. The results showed an improvement in load distribution and an attenuation of the stress generated, according to the analytical model used. © 2025 IEEE. (11 refs)
Main heading: Spur gears
Controlled terms: Contacts (fluid mechanics) - Electric power plant loads - Gear teeth
Uncontrolled terms: Contact pitch - Contact ratio - Contact Stress - Distribution analysis - Gear pairs - Load distributions - Load shard distribution - Maximum stress - Profile shift factor - Shift factors
Classification Code: 301.1 Fluid Flow - 601.2 Machine Components - 706.1.2 Electric Power Distribution
Database: Compendex
Data Provider: Engineering Village

10. Analysis of the contact stress of beveloid gears with straight teeth and parallel axes (*Open Access*)

Sciarra, Giuseppe (1); Mottola, Giovanni (2); Pleguezuelos, Miguel (3); Sánchez, Miryam B. (3); Carricato, Marco (1); Pedrero, José I. (3)
Source: *Mechanism and Machine Theory*, v 214, October 15, 2025; **ISSN:** 0094114X; **DOI:** 10.1016/j.mechmachtheory.2025.106156; **Article number:** 106156; **Publisher:** Elsevier Ltd
Author affiliation: (1) University of Bologna, Department of Industrial Engineering, Viale del Risorgimento 2, Bologna, 40136, Italy (2) University of Messina, Department of Engineering, Contrada di Dio, Messina, Sant'Agata; 98166, Italy (3) UNED, Departamento de Mecánica, Juan del Rosal 12, Madrid, 28040, Spain
Abstract: Beveloid gears are spur or helical gears whose outside radius, root radius and shift coefficient vary linearly along the face width, but with constant module and base radius. Accordingly, the gear outer surface is not a cylinder, but a cone. Beveloid gears mounted with parallel axes and opposite cone angles are interesting because they allow backlash control. In this case, the transverse sections have the profile of a spur gear, but with different outside radii, root radii and shift coefficients in each section. Accordingly, the inner and outer contact points and the transverse contact ratio are different, and an axial contact ratio can be defined. This paper studies the contact stress of beveloid gears with straight teeth and parallel axes, based on the analysis of contact segments along the meshing cycle, and the variation of the tooth-pair mesh stiffness and load-sharing ratio along the instantaneous contact lines. The analysis is based on minimum elastic potential energy and considers teeth undercutting and pointing. Results are validated through finite-element analysis of a sample gear pair. The analytical method presented in this work is computationally efficient and can be used as a calculation step within an optimization algorithm. © 2025 The Author(s) (33 refs)
Main heading: Stiffness
Controlled terms: Bevel gears - End effectors - Gear teeth - Helical gears - Molecular physics - Potential energy - Spur gears
Uncontrolled terms: Beveloid gears - Cone angle - Contact ratio - Contact Stress - Face-width - Load sharing - Meshing stiffness - Outer surface - Parallel axis - Shift coefficients
Classification Code: 214 Materials Science - 601.2 Machine Components - 731.5 Robotics - 1301.1.1 Mechanics - 1301.1.3 Atomic and Molecular Physics
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Open Access type(s): All Open Access, Green
Database: Compendex
Data Provider: Engineering Village

11. Stress analysis and frictional behavior of helical power core components in marine dynamic cables under axial tension and bending loads

Huang, Gongsai (1, 2); Guo, Chongchong (1, 2); Li, Hongjiang (1, 2); Wu, Wenhua (1, 2, 3)
Source: *Marine Structures*, v 103, August 15, 2025; **ISSN:** 09518339; **DOI:** 10.1016/j.marstruc.2025.103854; **Article number:** 103854; **Publisher:** Elsevier Ltd
Author affiliation: (1) Department of Engineering Mechanics, School of Mechanics and Aerospace Engineering, Dalian University of Technology, Liaoning, Dalian; 116023, China (2) State Key Laboratory of Structural Analysis, Optimization and CAE Software for Industrial Equipment, Dalian University of Technology, Liaoning, Dalian; 116023, China (3) Ningbo Institute of Dalian University of Technology, Ningbo; 315000, China
Abstract: As the development of offshore wind energy continues increasing, the utilization of dynamic cables becomes crucial. Helical power core components are essential functional elements in marine dynamic cables, and understanding the mechanical behavior of these spiral structures under complex external loads has garnered significant attention. This study introduces a comprehensive stress analysis model for helical power core components in dynamic cables subjected to axial tension and bending loads. Unlike previous simplified models, the proposed approach fully accounts for the double-helix structure in the conductor configuration. By introducing Darboux vectors, which encompass two curvatures and one twist, the mechanical response models for both single-helix and double-helix conductor wires under combined tension and bending loads are developed. The study further delves into the interactions between local frictional contact and the geometric characteristics of the helical structure, leading to the formulation of analytical models for contact stresses in helical components. Additionally, a multi-layer pressure transmission model for the helical power core is proposed based on the force action-reaction principle. To account for frictional forces, Coulomb's friction law is integrated into the model,

and an iterative solution procedure is provided to obtain friction-slip results. The theoretical model is verified using finite element (FE) simulations and existing experimental data, specifically applied to a high-voltage direct current (HVDC) cable. The results demonstrate the accuracy of the model in predicting cross-sectional stresses under nonlinear combined tension and bending moments. This work offers valuable technical support for the analysis and design of marine dynamic cables under complex loading conditions, contributing to the optimization of their mechanical performance. © 2025 (80 refs)
Main heading: Stress-strain curves
Controlled terms: Bending moments - Helical gears - HVDC power transmission - Stick-slip - Stiction
Uncontrolled terms: Double helix structure - Friction-slip behavior - Frictional contact - Helical power core - Marine dynamic cable - Multi-layer pressure transmission - Multi-layers - Power - Pressure transmission - Slip behavior
Classification Code: 214.1.1 Stress and Strain - 408.1 Structural Members and Shapes - 601 Mechanical Design - 601.2 Machine Components - 606 Lubrication and Tribology - 706.1.1 Electric Power Transmission - 1301.1.1 Mechanics
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Data Provider: Engineering Village

12. Analysis of residual stress in helical gear teeth involute profile and helix in hobbing, shaving, carbonitriding, quenching and tempering processes

de Sousa Neves, Carlos Alberto (1, 2); Carneiro, José Rubens Gonçalves (1); da Silva, Gilmar Cordeiro (1); Martins, Paulo Sérgio (1, 2); Ba, Elhadji Cheikh Talibouya (3, 4); Firpe, Pedro Miraglia (5); Silva José, Anderson (2, 4); da Silva Braga, Leandro (2, 4); Miranda, Daniel Moreira (2, 4)
Source: *Forschung im Ingenieurwesen/Engineering Research*, v 89, n 1, December 2025; **ISSN:** 00157899, **E-ISSN:** 14340860; **DOI:** 10.1007/s10010-025-00932-w; **Article number:** 165; **Publisher:** Springer Vieweg
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Abstract: Low-alloy steels have become a mainstay in critical components like gears and shafts, due their cost-effectiveness and desirable mechanical properties. However, their inherent limitations highlight the need for innovative solutions to enhance their mechanical properties, particularly for applications demanding exceptional performance and durability. In all manufacturing processes, there are active forces to make the desired transformation of a given material, generating friction and, consequently, heat, to provide the formation, or not, of a chip. When these forces cease to act on the material, that is, when it remains at rest, residual stress is generated due to the efforts that led to the change in its structure (crystalline lattice). Stresses have a major effect on the physical, mechanical and chemical properties of the surface layer. Therefore, an appropriate residual stress can be obtained by selecting appropriate process parameters. Several studies have investigated the effect of machining processes separately on residual stress behavior. Based on this, this study aims to contribute to the advancement of research in gear manufacturing by presenting an investigation conducted in the automotive industry, in which residual stress was evaluated sequentially as a function of each stage of the manufacturing process—hobbing#→ shaving#→ carbonitriding—in manual transmission reduction gears manufactured from low-carbon manganese steel. It was demonstrated that different types of residual stresses are intrinsic to certain stages of the manufacturing process and that their transformations are interdependent, almost like a "memory" accumulated in each constructive phase of the component. © Der/die Autor(en), exklusiv lizenziert an Springer-Verlag GmbH Deutschland, ein Teil von Springer Nature 2025. (32 refs)
Main heading: Automotive industry
Controlled terms: Cost effectiveness - Durability - Gear manufacture - Gear teeth - Helical gears - Industrial research - Low carbon steel - Residual stresses - Steel research
Uncontrolled terms: Critical component - Helical gear teeth - Hobbing process - Low-alloy steel - Manufacturing process - Mechanical - Property - Quenching and tempering - Quenching process - Tempering process
Classification Code: 202.5.3 Steel - 214 Materials Science - 214.1 Mechanical Properties of Materials - 214.1.1 Stress and Strain - 601.2 Machine Components - 662.1 Automobiles - 901.3 Engineering Research - 911.2 Industrial Economics - 912.1 Industrial Engineering

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Database: Compendex
Data Provider: Engineering Village

13. STUDY OF THE STRESS STATE FOR GEARS USED IN TRANSMISSIONS FOR POWER PLANTS

Bucur, Mihai (1); Cananau, Sorin (2); Mirica, Radu (2); Chiujdea, Cosmina (2)
Source: *UPB Scientific Bulletin, Series D: Mechanical Engineering*, v 88, n 1, p 192-200, 2026; **ISSN:** 14542358, **E-ISSN:** 22863699; **Publisher:** Politechnica University of Bucharest
Author affiliation: (1) Dept. of Naval department, INCDTM Comoti, India (2) National University of Science and Technology POLITEHNICA Bucharest, Bucharest, Romania
Abstract: This article presents a direct experimental methodology for mapping the stress distribution at the tooth root of helical gears. The work focuses on two fundamental aspects: (1) evaluating and determining the stress distribution at the tooth base through advanced experimental methods, such as strain gauge measurements and photoelastic analysis, under various loading and operating conditions; and (2) investigating the influence of specific factors in helical gears, such as misalignments and geometric modifications, on the stress profile at the root fillet. The experimental system was created and tested within in-depth studies conducted by the authors, to provide a solid database for validating numerical simulations and improving design processes. © 2026, Politechnica University of Bucharest. All rights reserved. (10 refs)
Main heading: Stress concentration
Controlled terms: Electric power transmission - Gear teeth - Gear transmissions - Helical gears - Strain gages - Stress analysis
Uncontrolled terms: Experimental methodology - Experimental methods - Loading condition - Photo-elastic analysis - Power - Root stress - Strain gage measurements - Stress state - Stresses distribution - Tooth root
Classification Code: 214.1.1 Stress and Strain - 601.2 Machine Components - 602.2 Mechanical Transmissions - 662.3 Automobile Components and Materials - 706.1.1 Electric Power Transmission - 942.1.6 Mechanical and Miscellaneous Measuring Instruments
Database: Compendex
Data Provider: Engineering Village

14. Interfacial stress distribution prediction for coating/substrate systems in coating reinforced cylindrical gears

Luo, Cong (1, 2); Chen, Siyu (1, 2); Yu, Long (1, 2); Lu, Xiaohan (1, 2)
Source: *Acta Mechanica Sinica/Lixue Xuebao*, v 42, n 9, September 2026; **ISSN:** 05677718, **E-ISSN:** 16143116; **DOI:** 10.1007/s10409-025-25597-x; **Article number:** 425597; **Publisher:** Springer Verlag
Author affiliation: (1) College of Electromechanical Engineering, Central South University, Changsha; 410083, China (2) National Key Laboratory of Extreme Service Performance Precision Manufacturing, Central South University, Changsha; 410083, China
Abstract: The normal stress magnitude, stress gradient, and tangential stress at the coating-substrate interface of gear systems are key metrics for assessing interfacial bonding strength. Because the reinforced coating is extremely thin and the interfacial stress field is highly complex, conventional numerical methods often exhibit poor convergence and low computational efficiency when analyzing discontinuous interfacial fields. To address these limitations, this study develops a novel, accurate, and efficient calculation method based on interfacial and contact mechanics. An interfacial mechanics analysis model under concentrated contact loading is established to predict the interfacial stress distribution in coating-reinforced gear systems. By varying coating thickness and the elastic modulus ratio between coating and substrate, we systematically investigate the distribution patterns and evolution of interfacial stresses under concentrated loading and elucidate how these parameters influence the interfacial stress field. Finally, detailed numerical experiments based on the full field analytical solution are presented and compared with finite element simulations to verify the accuracy and effectiveness of the proposed method. This study provides a necessary theoretical basis for the detailed design, strength testing, and reliability evaluation of gear coating structures in practical engineering applications and holds significant importance. (Figure presented.) © The Chinese Society of Theoretical and Applied Mechanics and Springer-Verlag GmbH Germany, part of Springer Nature 2026. (49 refs)
Main heading: Stress concentration
Controlled terms: Coatings - Computation theory - Computational efficiency - Gears - Interfaces (materials) - Numerical methods - Reinforcement - Stress analysis - Substrates

Uncontrolled terms: Coating-substrate systems - Computational modelling - Cylindrical gear - Diamond like carbon coatings - Gear system - Interfacial mechanics - Interfacial stress - Normal stress - Stress field - Stresses distribution
Classification Code: 208.2 Coating Materials - 214 Materials Science - 214.1.1 Stress and Strain - 601.2 Machine Components - 602 Mechanical Drives and Transmissions - 714.2 Semiconductor Devices and Integrated Circuits - 941.5 Mechanical Variables Measurements - 1102.1 Computer Theory, Includes Computational Logic, Automata Theory, Switching Theory, Programming Theory - 1201.9 Numerical Methods
Funding text: This work was supported by the National Natural Science Foundation of China (Grant No. 12372213), and the Natural Science Foundation of Hunan Province (Grant No. 2023JJ40702).
Database: Compendex
Data Provider: Engineering Village

15. Analysis of spur gears drilled with radial holes on teeth surface for effective weight reduction

Sutar, Sanjay S. (1); Kumar, G. C. Mohan (1); Doddamani, Mrityunjay (2)
Source: *Journal of the Brazilian Society of Mechanical Sciences and Engineering*, v 47, n 1, January 2025; **ISSN:** 16785878, **E-ISSN:** 18063691; **DOI:** 10.1007/s40430-024-05321-y; **Article number:** 22; **Publisher:** Springer Science and Business Media Deutschland GmbH
Author affiliation: (1) Polymer Composites Laboratory, Department of Mechanical Engineering, National Institute of Technology Karnataka, Surathkal, Mangalore; 575025, India (2) School of Mechanical and Materials Engineering, Indian Institute of Technology Mandi, Himachal Pradesh, Mandi; 175075, India
Abstract: Optimizing the geometry for efficient material utilization and gear weight reduction involves strategically removing material from gear teeth. This present study examines the stresses induced in the gears featuring radial holes within the gear tooth focused on lightening the weight of conventional gears. Radial holes are introduced at varying depths from the top of the gear tooth. The analysis uses ANSYS to assess the stresses in a conventional gear tooth and also the tooth with radial holes. Examining stress magnitudes near the gear root under similar loading and boundary conditions is critical and interesting. A complementary photoelastic approach is implemented, and stress distribution in these gears is confirmed to ensure the findings of finite element analysis. This approach retains the stress distribution while achieving a notable 6.7% reduction in volume compared to a conventional AGMA spur gear. Moreover, these radial holes are envisaged to contribute to adequate gear lubrication and cooling through fluid motion. © The Author(s), under exclusive licence to The Brazilian Society of Mechanical Sciences and Engineering 2024. (36 refs)
Main heading: Spur gears
Controlled terms: Gear teeth - Stress analysis - Stress concentration
Uncontrolled terms: Element method - Experimental stress analysis - Material utilization - Radial depth - Radial holes - Root region - Stresses distribution - Teeth surface - Weight lightening - Weight reduction
Classification Code: 214.1.1 Stress and Strain - 601.2 Machine Components
Database: Compendex
Data Provider: Engineering Village

16. Thermo-mechanical coupling modeling of residual stress in internal gear power honing

Yuan, Bin (1); Xu, Zixiang (1); Han, Jiang (2); Ding, Wei (1); Zhang, Runmei (1); Tian, Xiaoqing (2); Xia, Lian (2)
Source: *Journal of the Brazilian Society of Mechanical Sciences and Engineering*, v 48, n 3, March 2026; **ISSN:** 16785878, **E-ISSN:** 18063691; **DOI:** 10.1007/s40430-025-06177-6; **Article number:** 215; **Publisher:** Springer Science and Business Media Deutschland GmbH
Author affiliation: (1) Key Laboratory of Intelligent Manufacturing of Construction Machinery, Anhui Jianzhu University, Hefei; 230601, China (2) School of Mechanical Engineering, Hefei University of Technology, Hefei; 230009, China
Abstract: Power honing of internal gears is a key finishing process for high-performance transmission gears, and accurate control of residual stresses on the tooth surface is of great significance to ensure the strength and durability of the gears and to realize low-noise meshing. Based on the theory of misaligned spatial conjugate internal meshing, this study establishes a thermo-mechanical coupling model for the formation process of residual stress in power honed internal gears, derives a model for the relative velocity field of abrasive particles and honing force in the contact zone of gear honing, and successfully predicts the distribution of residual stress on the tooth surface through thermo-mechanical coupling stress analysis. The innovation of the model lies in the establishment of a thermo-mechanical coupling model based on physical principles, which directly correlates the contact kinematics with the machining force. In this paper, the framework system of mechanical force and thermal load is constructed, and an experimentally verified comprehensive prediction method of tooth residual stress is established. Taking the carburized quenched 20CrMnTi gears as a representative case, the residual stresses on the tooth surface are measured by power honing test, and the prediction results coincide with the measured values and the spatial distribution trend under different axial intersection angles, which verifies the reliability and applicability of the

model. This study provides operable guidance for the selection of honing process for transmission system gears, which helps to ensure that the gears are in a favorable residual compressive stress state. (22 refs)
Main heading: Residual stresses
Controlled terms: Compressive stress - Electric power transmission - Gears - Honing - Honing machines - Reliability theory - Spatial distribution - Stress analysis - Transmissions
Uncontrolled terms: Coupling models - Finishing process - Internal gear - Performance - Power - Power honing - Teeth surface - Thermo - mechanical couplings - Thermo-mechanical coupling model - Transmission gear
Classification Code: 208 Coatings, Surfaces, Finishes, Films and Deposition - 214.1.1 Stress and Strain - 601.2 Machine Components - 602 Mechanical Drives and Transmissions - 602.2 Mechanical Transmissions - 603 Machine Tools - 706.1.1 Electric Power Transmission - 942.2.3 Abrasive Devices and Processes - 1201 Mathematics - 1202.2 Mathematical Statistics
Funding Details: Number: JZ202391,JZ202364, Acronym: AHJZU, Sponsor: Anhui Jianzhu University; Number: 300102252507, Acronym: -, Sponsor: -; Number: 52275483, Acronym: NNSF, Sponsor: National Natural Science Foundation of China; Number: IMCM2023KF02, Acronym: -, Sponsor: -; Number: SGCZXZD2101, Acronym: -, Sponsor: -;
Funding text: The authors would like to thank the Anhui Jianzhu University Project(JZ202364), the Anhui Jianzhu University Project(JZ202391), National Natural Science Foundation of China (52275483), the Open Fund of Key Laboratory of Intelligent Manufacturing of Construction Machinery (IMCM2023KF02), the Open Fund of the Key Laboratory of Highway Construction Machinery of Shaanxi Province (300102252507), the Open Fund of the Center for Simulation Design and Modern Manufacturing Engineering Technology Research of Anhui Province (SGCZXZD2101) for supporting this research under Grant.
Database: Compendex
Data Provider: Engineering Village

17. A digital Twin–Driven performance correlation analysis method for wind turbine gearbox journal bearings

Ma, Jinhui (1, 2, 3); Yang, Xingkai (1, 2, 3); Hu, Xulong (1, 2, 3); Pan, Zhongfeng (1); Zhang, Kai (1, 2, 3); Zhang, Yabin (1, 2, 4); Feng, Kai (1, 2, 3)
Source: *Mechanical Systems and Signal Processing*, v 244, January 15, 2026; **ISSN:** 08883270, **E-ISSN:** 10961216; **DOI:** 10.1016/j.ymssp.2025.113777; **Article number:** 113777; **Publisher:** Academic Press
Author affiliation: (1) College of Mechanical and Vehicle Engineering, Hunan University, Changsha; 410082, China (2) Hunan Provincial Key Laboratory of Critical Components for Frontier Equipment, Hunan University, Changsha; 410082, China (3) Mechanical Industry Engineering Research Center for Extreme Bearings and Equipment, Hunan University, Changsha; 410082, China (4) Hunan SUND Technological Corporation, Xiangtan; 411102, China
Abstract: The higher-power demand of wind turbines limits the application of rolling bearings in gearboxes, making journal bearings a viable alternative. However, under low-speed and heavy-load conditions, planet gear journal bearings (PGJBs) are prone to performance degradation, such as the occurrence of wear and the transition of lubrication regimes. Performance of PGJBs is related to bearing design, manufacturing, and operating condition parameters, but how these parameters correlate to bearing performance remain unknown. To address this issue, a digital twin (DT)-driven performance correlation analysis method is proposed. First, a DT model of a PGJB is constructed by integrating a laser cladding (LC) module, a mixed elastohydrodynamic lubrication module, and a wear module. The DT model is experimentally calibrated with a dataset of a full-scale PGJB test rig. Subsequently, a refined XGBoost-SHAP approach is proposed to capture the nonlinear relationships between design, manufacturing, operating condition parameters and PGJB performance indicators and quantifies global and individual importance. Results show that PGJB design parameters play a dominant role in determining bearing lubrication and wear performance, followed by operating condition parameters and then manufacturing parameters. The most influential parameters are aspect ratio, LC layer thickness, and rotational speed. Besides, how these most influential parameters affect the oil film thickness, oil film pressure, maximum elastic deformation, and wear depth are revealed via detailed parametric analysis. This study provides theoretical guidance for the design and manufacturing of high-performance PGJBs in wind turbine gearboxes. (61 refs)
Main heading: Aspect ratio
Controlled terms: Correlation methods - Digital twin - Elastohydrodynamic lubrication - Elastohydrodynamics - Gear manufacture - Gears - Lubricating oils - Wear of materials - Wind turbines
Uncontrolled terms: Condition parameters - Correlation analysis - Digital twin model - Operating condition - Parametric analysis - Performance correlation - Performance correlation analyze - Planet gear journal bearing - Planet gears - Xgboost-SHAP approach
Classification Code: 214 Materials Science - 301.1.1 Liquid Dynamics - 601.2 Machine Components - 602 Mechanical Drives and Transmissions - 606.1 Lubricants - 606.2 Lubrication - 1008.5 Wind Power and Wind Power Generation - 1106.5 Computer Applications - 1202.2 Mathematical Statistics
Funding Details: Number: -, Acronym: -, Sponsor: Natural Science Foundation of Hunan Province; Number: 52505181, Acronym: NNSF, Sponsor: National Natural Science Foundation of China;

Funding text: This work was financially supported by the National Natural Science Foundation of China (Grant No. 52505181) and the Hunan Provincial Natural Science Foundation of China
Database: Compendex
Data Provider: Engineering Village

18. Impact of Gear Ratios on Drive Cycle Efficiency and Thermal Performance in Lightweight EVS

Yenipınar, Burak (1); Ocak, Cemil (2); Dalcali, Adem (3)
Source: *International Journal of Numerical Modelling: Electronic Networks, Devices and Fields*, v 39, n 1, January/February 2026; **ISSN:** 08943370, **E-ISSN:** 10991204; **DOI:** 10.1002/jnm.70149; **Article number:** e70149; **Publisher:** John Wiley and Sons Ltd
Author affiliation: (1) Electrical and Electronics Engineering, Ostim Technical University, Ankara, Turkey (2) Electrical and Electronics Engineering, Gazi University, Ankara, Turkey (3) Electrical and Electronics Engineering, Bandırma Onyedi Eylül University, Bandırma, Balıkesir, Turkey
Abstract: This study investigates the performance and thermal behavior of induction motors used in electric vehicles under different gear ratios. In line with increasing energy efficiency requirements, the dynamic characteristics of the motor during the WLTP Class 1 driving cycle have been analyzed in detail. A four-pole, squirrel-cage induction motor with a rated power of 5 kW was designed, and its electromagnetic performance and loss components have been calculated using ANSYS Motor-CAD software. Thermal analysis revealed that, under S2-60-min duty cycle, the stator winding temperature reached approximately 155°C, and under prolonged operation, the temperature approached insulation limits. In simulations where 10 consecutive WLTP Class 1 cycles have been applied, temperature rise trends and energy consumption data have been evaluated over a total operating period of 2.84 h. To examine the effect of gear ratio on performance, various ratios between 5 and 15 have been tested, and the motor's torque, speed, efficiency, and regenerative energy recovery characteristics have been compared. The results showed that selecting a gear ratio of 7 provided the most favorable operating conditions, with an average efficiency of 88.88%, cycle-averaged instantaneous efficiency of 68.44%, and 60.17 Wh of regenerative energy recovery. Furthermore, it has been determined that high-ratio operating scenarios led to a rapid increase in thermal load, necessitating additional cooling measures. © 2026 John Wiley & Sons Ltd. (37 refs)
Main heading: Induction motors
Controlled terms: Electric vehicles - Energy efficiency - Energy utilization - Gears - Thermal insulation - Thermoanalysis - Traction motors
Uncontrolled terms: Class 1 - Drive cycles - Driving cycle - Energy recovery - Gear ratios - Inductions motors - Performance - Regenerative energy - Thermal - WLTP driving cycle
Classification Code: 217.3.2 Heat Insulating Materials - 601.2 Machine Components - 602 Mechanical Drives and Transmissions - 662.1 Automobiles - 705.3 Electric Motors - 705.3.1 AC and DC Motors - 801.3 Physical Chemistry - 1009 Energy Management - 1009.2 Energy Consumption - 1501.1.1 Sustainable Transport
Funding text: The authors have nothing to report.
Database: Compendex
Data Provider: Engineering Village

19. Enhancing agricultural sprayer gearbox efficiency and lifecycle through dual spiral spring and hydraulic damper integration: comparative study with conventional systems

Patil, Avinash A. (1); Sulakhe, Vishal Narayanrao (1); Kaware, Kiran (1); Wankhede, Pankaj (2)
Source: *Physica Scripta*, v 100, n 6, June 1, 2025; **ISSN:** 00318949, **E-ISSN:** 14024896; **DOI:** 10.1088/1402-4896/add584; **Article number:** 066102; **Publisher:** Institute of Physics
Author affiliation: (1) Mechanical Engineering Department, School of Engineering and Technology, Sandip University, MS, Nashik, India (2) Department of Mechanical Engineering, S. B. Jain Institute of Technology, Management and Research, MS, Nagpur, India
Abstract: Torsional vibrations in agricultural sprayer gearboxes remain a critical challenge, leading to mechanical wear, reduced operational efficiency, and frequent failures. This study proposes an innovative dual spiral spring and rotary hydraulic damper system to address these issues. The system was designed to absorb torsional forces efficiently while dissipating vibration energy, significantly improving the performance and lifecycle of gearbox components. The proposed system was analyzed using a finite element approach in Ansys Workbench, focusing on stress distribution, deformation, and fatigue life under dynamic loading conditions. Comparative analysis with conventional damping systems revealed a 35% increase in fatigue life, a 28% reduction in deformation, and a 20% improvement in operational efficiency. The integration of advanced damping mechanisms presents a cost-effective and reliable solution for mitigating torsional vibrations in agricultural machinery, ensuring enhanced durability and performance. The presented results are derived through finite element simulations, with planned experimental validation and prototyping forming part of the future work. © 2025 IOP Publishing Ltd. All rights, including for text and data mining, AI training, and similar technologies, are reserved. (25 refs)

Main heading: Machine vibrations
Controlled terms: Aerodynamic loads - Agricultural implements - Gears - Harvesters - Milking machines - Springs (components) - Torsional stress - Vibration analysis
Uncontrolled terms: Comparatives studies - Dual spiral spring - Dual-spiral - Gearbox efficiency - Hydraulic damper - Operational efficiencies - Performance - Pesticide sprayer - Torsional vibration - Vibration-damping
Classification Code: 214.1.1 Stress and Strain - 601.2 Machine Components - 601.3 Mechanisms - 602 Mechanical Drives and Transmissions - 651 Aerodynamics - 821.2 Agricultural Machinery and Equipment - 941.5 Mechanical Variables Measurements
Database: Compendex
Data Provider: Engineering Village

20. Experimental performance comparison of triangle and spur gear hydraulic pumps energy consumption efficiency standpoint

Yazar, Mehmet (1)
Source: *Sadhana - Academy Proceedings in Engineering Sciences*, v 50, n 4, December 2025; **ISSN:** 02562499, **E-ISSN:** 09737677; **DOI:** 10.1007/s12046-025-02966-w; **Article number:** 287; **Publisher:** Springer
Author affiliation: (1) Department of Mechanical Program, Çanakkale Onsekiz Mart University, Çanakkale; 17020, Turkey
Abstract: This study aimed to experimentally compare the energy consumption performances of widely used hydraulic spur gear pumps and lesser-known triangular gear pumps. Flow rate, pressure, temperature, and energy consumption are key performance indicators for evaluating the operational efficiency of gear pumps. The effect of pump drive shaft speed and pump type (spur and triangular) on these output variables and energy consumption performance was examined, and regression analysis was performed. For this purpose, both pumps were tested under identical conditions using hydraulic oil (SAE 10W) as the working fluid, with drive shaft speeds ranging from 100 to 1600 rpm. Measurements were taken at 100 rpm intervals for fifteen minutes and repeated four times. The system included an energy analyser, pressure sensors, flow meters, and temperature sensors to record real-time data during pump operation. The findings show that the triangle gear pump consumes an average of 1.86% less energy at all speeds, provides 7.11% higher flow rate, produces 161.39% higher pressure, and has 18.17% less temperature rise compared to the spur gear pump. In addition, it has been experimentally proven that the triangle pump consumes an average of 47% less energy when unit flow rate and unit pressure production are taken into consideration. Moreover, it was observed that the triangle gear pump exhibits 12.94% and 51.20% less temperature change during operation, depending on the unit flow rate and unit pressure, respectively. These experimental results, obtained under controlled laboratory conditions, suggest that triangular hydraulic gear pumps are a viable alternative to conventional spur gear pumps in industrial applications due to their lower energy consumption and improved flow and pressure characteristics. © Indian Academy of Sciences 2025. (33 refs)
Main heading: Energy utilization
Controlled terms: Energy efficiency - Flow rate - Fluids - Gear pumps - Regression analysis - Spur gears
Uncontrolled terms: Alternative pump design - Energy - Energy-consumption - Hydraulic gear pump - Hydraulic pump - Performance - Performance comparison - Pump design - Pump energies - Shaft speed
Classification Code: 301 Fluids - 301.1 Fluid Flow - 302.1 Thermodynamics - 601.2 Machine Components - 609.2 Pumps - 941.5 Mechanical Variables Measurements - 1009 Energy Management - 1009.2 Energy Consumption - 1202.2 Mathematical Statistics
Funding text: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.
Database: Compendex
Data Provider: Engineering Village

21. Study on grinding residual stress and parameter optimization of spiral bevel gears

Zhang, Fengshou (1); Chang, Jibao (1)
Source: *International Journal of Advanced Manufacturing Technology*, v 143, n 5-6, p 2375-2389, March 2026; **ISSN:** 02683768, **E-ISSN:** 14333015; **DOI:** 10.1007/s00170-025-17285-x; **Publisher:** Springer Science and Business Media Deutschland GmbH
Author affiliation: (1) Henan University of Science and Technology School of Mechatronics Engineering, Luoyang; 471000, China
Abstract: This study comprehensively investigates the grinding process of spiral bevel gears and establishes a stochastic multi-grain finite element model using ABAQUS. A single-factor simulation approach is employed to systematically examine the depth-dependent distribution of residual stresses within the subsurface following grinding. Based on these results, a predictive model for residual stress is developed using a three-factor, four-level orthogonal experimental design. Grinding parameters are subsequently optimized through Grey Relational Analysis (GRA) and Particle Swarm Optimization (PSO), with a comparative evaluation of both methods conducted via the entropy weight approach. Key findings indicate that

the machined tooth flanks exhibit a residual compressive stress state, with the maximum compressive stress located in the near-subsurface region. This stress gradually transitions to residual tensile stress with increasing depth, eventually approaching zero. Among the grinding parameters, depth of cut exerts the most pronounced influence on residual stress magnitude, followed by grinding speed, whereas feed rate has a comparatively minor effect. The GRA-based optimization scheme achieves superior solution quality compared with the PSO approach. Experimental validation demonstrates strong agreement between measured and simulated residual stress profiles, with overall discrepancies below 16%, thereby confirming the reliability of both the multi-grain simulation model and the predictive framework. These findings provide a robust theoretical foundation for optimizing the grinding process in spiral bevel gear manufacturing. © The Author(s), under exclusive licence to Springer-Verlag London Ltd., part of Springer Nature 2025. (22 refs)
Main heading: Bevel gears
Controlled terms: Compressive stress - Grinding (machining) - Particle swarm optimization (PSO) - Stochastic models - Stochastic systems
Uncontrolled terms: Finite element modelling (FEM) - Grey relational analysis - Grinding parameters - Grinding process - Grinding residual stress - Multi-Grain - Parameter optimization - Parametric optimization - Spiral bevel gears - Stochastics
Classification Code: 214.1.1 Stress and Strain - 601.2 Machine Components - 604.2 Machining Operations - 1106 Computer Software, Data Handling and Applications - 1201.7 Optimization Techniques - 1202.1 Probability Theory
Funding Details: Number: HT-J2019-VII-0017-0159, Acronym: -, Sponsor: National Science and Technology Major Project; Number: -, Acronym: -, Sponsor: National Science and Technology Major Project; Number: 52175049, Acronym: NNSFC, Sponsor: National Natural Science Foundation of China; Number: -, Acronym: NNSFC, Sponsor: National Natural Science Foundation of China;
Funding text: This work was completed with the support of the National Science and Technology Major Projects (HT-J2019-VII-0017-0159) and the National Natural Science Foundation of China (52175049).
Database: Compendex
Data Provider: Engineering Village

22. [Instantaneous efficiency modeling and analysis of 2 K-H reducers for rehabilitation robots]

Zou, Shuaidong (1); Yan, Wenjie (2); Xu, Huachao (1); He, Xiaohui (1); Zhao, Yun (1)
Source: *Journal of the Brazilian Society of Mechanical Sciences and Engineering*, v 48, n 4, March 2026; **ISSN:** 16785878, **E-ISSN:** 18063691; **DOI:** [10.1007/s40430-025-06235-z]; **Article number:** 274; **Publisher:** Springer Science and Business Media Deutschland GmbH
Author affiliation: (1) College of Smart Health, Chongqing Polytechnic University of Electronic Technology, Chongqing; 401331, China (2) The State Key Laboratory of Mechanical Transmission for Advanced Equipment, Chongqing University, Chongqing; 400044, China
Abstract: The performance of rehabilitation robotic joints, particularly their motion smoothness and control precision, is critically dependent on the instantaneous efficiency of their reducers. Conventional analyses, often relying on time-averaged efficiency and constant friction models, fail to capture the dynamic fluctuations that induce output torque ripple. This paper presents a comprehensive framework for the high-fidelity prediction of the instantaneous efficiency of a 2 K-H planetary reducer. The primary contributions of this work are threefold: First, a time-varying friction model based on the Schlenk equation is developed at the component level, accounting for real-time variations in load, speed, and contact geometry. Second, a hierarchical "component-system-machine" methodology is established, systematically integrating the dual-stage gear meshing losses with the often-neglected frictional loss from the eccentric carrier bearing. Third, a thorough parametric analysis is conducted to identify critical design parameters. Numerical simulations demonstrate that the carrier bearing loss can reduce the overall efficiency by 2–3% points, a factor critical for accurate performance evaluation. The analysis further reveals that gear surface roughness is the most influential parameter, followed by operating speed and input torque. The established framework provides a robust and accurate tool for the design and optimization of high-performance, low-fluctuation reducers for next-generation rehabilitation robotics. © The Author(s), under exclusive licence to The Brazilian Society of Mechanical Sciences and Engineering 2025. (31 refs)
Main heading: Surface roughness
Controlled terms: Building components - Efficiency - Friction - Gears - Robotics - Tribology
Uncontrolled terms: 2k-H planetary reducer - Efficiency analysis - Efficiency models - Friction modeling - Instantaneous efficiencies - Modelling and analysis - Performance - Powerloss - Rehabilitation robot - Rehabilitation robotics
Classification Code: 208 Coatings, Surfaces, Finishes, Films and Deposition - 408.1 Structural Members and Shapes - 601.2 Machine Components - 602 Mechanical Drives and Transmissions - 606 Lubrication and Tribology - 731.5 Robotics - 913.1 Production Engineering - 1301.1.1 Mechanics
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Database: Compendex
Data Provider: Engineering Village

23. Analysis of Thrust Force and Losses Based on the Position and Horizontal and Vertical Length of the Ferromagnetic Pole Piece in a Linear MG

Ha, Tae-Yun (2); Kim, Yong-Jae (3); Park, Eui-Jong (1)
Source: *Journal of Electrical Engineering and Technology*, v 21, n 2, p 1611-1618, March 2026; **ISSN:** 19750102, **E-ISSN:** 20937423; **DOI:** 10.1007/s42835-025-02554-2; **Publisher:** Korean Institute of Electrical Engineers
Author affiliation: (1) Faculty of Smart Vehicle System Engineering, Chosun University, Gwangju, Korea, Republic of (2) Department of Aerospace Engineering, Chosun University, Gwangju, Korea, Republic of (3) Department of Electrical Engineering, Chosun University, Gwangju, Korea, Republic of
Abstract: In magnetic gears, the ferromagnetic pole piece is a key component that induces the flux-modulation effect and directly affects the performance of the magnetic gear (MG). In rotary machines, mutual interference between design parameters may occur. Therefore, in this study, for a linear magnetic gear, the effects of the initial position and the horizontal (X) and vertical (Y) dimensions of the ferromagnetic pole piece on thrust force, loss, and efficiency were analyzed using FEM. The optimized model was designed to maximize thrust force and efficiency, and its performance was compared with that of the initial model. As a result, the thrust force increased by 20.8%, the efficiency decreased by 0.3%, and the thrust-force ripple increased by 1%. These results confirm that adjusting the position of the ferromagnetic pole piece within the air gap, rather than adopting a 1:1 ratio for horizontal and vertical lengths, allows the thrust force performance to be maximized. © The Author(s) under exclusive licence to The Korean Institute of Electrical Engineers 2026. (16 refs)
Main heading: Ferromagnetism
Controlled terms: Efficiency - Gears - Poles
Uncontrolled terms: Ferromagnetic pole piece - Ferromagnetics - Horizontal - LMG - Magnetic gear - Performance - Polepieces - Position - Thrust forces - Vertical
Classification Code: 408.1 Structural Members and Shapes - 482 Mineralogy - 601.2 Machine Components - 602 Mechanical Drives and Transmissions - 701.2 Magnetism: Basic Concepts and Phenomena - 708.4 Magnetic Materials - 913.1 Production Engineering
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Database: Compendex
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24. Digital twin surrogate modeling for real-time monitoring of gear transmissions using a dynamic graph attention network

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Abstract: Gear transmissions require real-time structural performance monitoring to ensure safe and reliable operation of advanced machinery. However, traditional methods that rely on offline finite-element analysis (FEA) fail to meet the demands of real-time condition monitoring. To overcome this limitation, this paper proposes a digital twin approach that employs a graph neural network-based surrogate model for the real-time structural stress monitoring of gear transmissions. First, a digital twin framework is established, representing the FEA mesh as a graph. Second, a novel surrogate model based on dynamic graph attention networks (DGATs) is constructed by integrating a multi-head graph attention network module within a gated recurrent unit, enabling a joint learning of spatiotemporal features at each update step. Finally, the trained DGAT surrogate model is deployed on an edge-AI-enabled device to evaluate its prediction accuracy and time efficiency. Experiments demonstrate that the proposed DGAT has higher accuracy than the other surrogate models, achieving 96.1% accuracy of the traditional offline FEM simulation. In addition, the proposed DGAT can reduce the inference time up to 1.1821

s, which speeds up the computational efficiency by three orders of magnitude compared with the FEM simulation. © 2026 Elsevier Ltd. (41 refs)
Main heading: Efficiency
Controlled terms: Condition monitoring - Digital twin - Fuel additives - Gear transmissions - Gears - Graph neural networks - Power transmission
Uncontrolled terms: Dynamic graph - Dynamic graph attention network - FEM simulations - Finite element analyse - Gear transmissions - Offline - Real time monitoring - Real- time - Structural performance - Surrogate modeling
Classification Code: 601.2 Machine Components - 602 Mechanical Drives and Transmissions - 602.2 Mechanical Transmissions - 662.3 Automobile Components and Materials - 803 Chemical Agents and Basic Industrial Chemicals - 913.1 Production Engineering - 913.5 Maintenance - 1101 Artificial Intelligence - 1106.5 Computer Applications
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25. Comparative Analysis of Carbon Fibre-Reinforced Nylon Composite Gear Performance: Numerical and Experimental Approaches

Pujari, Likhith (1); Khot, Mantesh Basappa (2)
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Abstract: The emergence of 3D printing technology has revolutionized the manufacturing sector, offering exceptional design flexibility and customization within the context of Industry 4.0. This study explores the application of 3D printing to create high-performance spur gears made from carbon fibre-reinforced nylon for robotic systems. Leveraging the capabilities of 3D printing, the research aimed to design, fabricate, and assess the performance of these gears. Gear designs were developed using Computer-Aided Design (CAD) software, fabricated through material extrusion 3D printing, and then subjected to mechanical testing to evaluate properties such as contact stress and bending strength. Finite Element Analysis (FEA) was employed to simulate and predict these mechanical properties, with results showing predicted contact stress and bending strength of 4.72 MPa and 261.96 MPa, respectively. Experimental results closely aligned with measured values for contact stress and bending strength of 4.50 MPa and 250.12 MPa, respectively. This study uniquely demonstrates that finite element predictions for CFR-nylon gears closely align with experimental results, with errors of less than 5%. The findings underscore the novelty of employing CFR-nylon in 3D-printed gear applications and highlight its potential for lightweight, high-performance use in robotic systems and additive manufacturing. © The Institution of Engineers (India) 2025. (20 refs)
Main heading: Bending strength
Controlled terms: Bridge decks - Carbon fibers - Computer aided design - End effectors - Gear manufacture - Mechanical testing - Rayon - Reinforcement - Spur gears
Uncontrolled terms: 3-D printing - 3D-printing - Carbon fiber reinforced - Contact Stress - Mechanical - Onyx - Performance - Property - Reinforced nylons - Robotic systems
Classification Code: 213.2 Synthetic Fibers - 214 Materials Science - 215.1 Testing of Mechanical Properties of Materials - 215.1.2 Mechanical Properties Testing Methods - 401.1 Bridges - 601.2 Machine Components - 731.5 Robotics - 804 Chemical Products - 904 Design - 941.5 Mechanical Variables Measurements
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