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Crosswind Stability Evaluation of High-Speed Train Using Different Wind Models

Mengge Yu, Rongchao Jiang, Qian Zhang and Jiye Zhang

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Review

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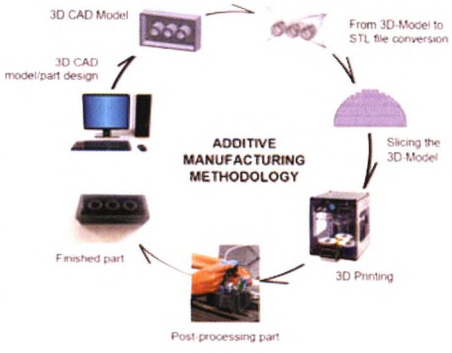
Design and Manufacturing Strategies for Fused Deposition Modelling in Additive Manufacturing: A Review.

Hugo I Medellin-Castillo • Jorge Zaragoza-Siqueiros

Abstract: Although several research works in the literature have focused on studying the capabilities of additive manufacturing (AM) systems, few works have addressed the development of Design for Additive Manufacturing (DfAM) knowledge, tools, rules, and methodologies, which has limited the penetration and impact of AM in industry. In this paper a comprehensive review of design and manufacturing strategies for Fused Deposition Modelling (FDM) is presented. Consequently, several DfAM strategies are proposed and analysed based on existing research works and the operation principles, materials, capabilities and limitations of the FDM process. These strategies have been divided into four main groups: geometry, quality, materials and sustainability. The implementation and practicality of the proposed DfAM is illustrated by three case studies. The new proposed DfAM strategies are intended to assist designers and manufacturers when making decisions to satisfy functional needs, while ensuring manufacturability in FDM systems. Moreover, many of these strategies can be applied or extended to other AM processes besides FDM.



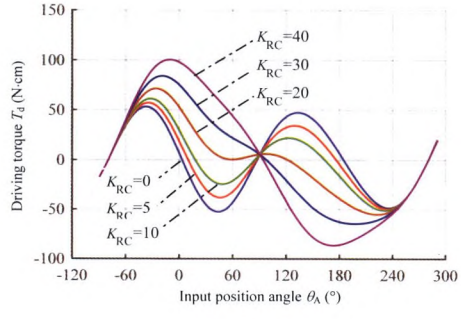
Mechanism and Robotics

(2019)32:54
DOI: 10.1186/s10033-019-0369-z

On Generating Expected Kinetostatic Nonlinear Stiffness Characteristics by the Kinematic Limb-Singularity of a Crank-Slider Linkage with Springs.

Baokun Li • Guangbo Hao

Abstract: Being different from avoidance of singularity of closed-loop linkages, this paper employs the kinematic singularity to construct compliant mechanisms with expected nonlinear stiffness characteristics to enrich the methods of compliant mechanisms synthesis. The theory for generating kinetostatic nonlinear stiffness characteristic by the kinematic limb-singularity of a crank-slider linkage is developed. Based on the principle of virtual work, the kinetostatic model of the crank-linkage with springs is established. The influences of spring stiffness on the toque-position angle relation are analyzed. It indicates that corresponding spring stiffness may generate one of four types of nonlinear stiffness characteristics including the bi-stable, local negative-stiffness, zero-stiffness or positive-stiffness when the mechanism works around the kinematic limb-singularity position. Thus the compliant mechanism with an expected stiffness characteristic can be constructed by employing the pseudo rigid-body model of the mechanism whose joints or links are replaced by corresponding flexures. Finally, a tri-symmetrical constant-torque compliant mechanism is fabricated, where the curve of torque-position angle is obtained by an experimental testing. The measurement indicates that the compliant mechanism can generate a nearly constant-torque zone.



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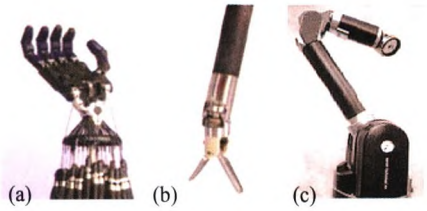
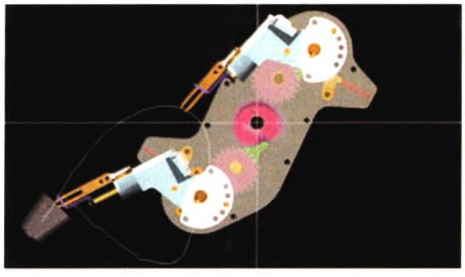


(2019)32:48
DOI: 10.1186/s10033-019-0362-6

Modified Pre-stretching Assembly Method for Cable-Driven Systems.

Guokai Zhang • Xuyang Ren • Jinhua Li • Kang Kong • Shuxin Wang • Jingchao Shen

Abstract: Soft cable-driven systems have been employed in many assembled mechanisms, such as industrial robots, parallel kinematic mechanism machines, medical devices, and humaniform hands. A pre-stretching process is necessary to guarantee the quality of cable-driven systems during the assembly process. However, the stress relaxation of cables becomes a critical concern during long-term operation. This study investigates the effects of non-uniform deformation and long-term stress relaxation of the driven cables owing to moving parts in the system. A simple closed-loop cable-driven system is built and an alternating load is applied to it to replicate the operation of transmission cables. Under different experimental conditions, the cable tension is recorded and the boundary data are selected to be curve-fitted. Based on the fitted results, a formula is presented to estimate the stress relaxation of cables to evaluate the assembly performance. Further experimental results show that the stress relaxation is mainly caused by cable creep and the assembly procedure. To remove the influence of the assembly procedure, a modified pre-stretching assembly method based on the stress relaxation theory is proposed and verification experiments are performed. Finally, the assembly performance is optimized using a cable-driven surgical robot as an example. This paper proposes a dual stretching method instead of the pre-stretching method to assemble the cable-driven system to improve its performance and prolong its service life.



(2019)32:49
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Design and Experimental Research on Seedling Pick-Up Mechanism of Planetary Gear Train with Combined Non-circular Gear Transmission.

Yaxin Yu • Jikun Liu • Bingliang Ye • Gaohong Yu • Xuejun Jin • Liang Sun • Junhua Tong

Abstract: Currently, transplanting mechanisms for dryland plug seedlings in China are mainly semiautomatic and have low efficiency. The rotary seedling pick-up mechanism with a planetary gear train for non-uniform intermittent transmission, and a concave and convex locking arc device, has a large rigid impact. To solve these problems, according to the design requirements for a dryland plug seedling transplanting mechanism, a rotary seedling pick-up mechanism of a planetary gear train with combined non-circular gear transmission of incomplete eccentric circular and non-circular gears was proposed. This has the characteristics of two-times greater fluctuation of the transmission ratio in a cycle, and can achieve a non-uniform continuous drive. Through analysis of the working principle of the seedling pick-up mechanism, its kinematics model was established. The human–computer interaction optimization method and self-developed computer-aided analysis and optimization software were used to obtain a set of parameters that satisfy the operation requirements of the seedling pick-up mechanism. According to the optimized parameters, the structure of the seedling pick-up mechanism was designed, a virtual prototype of the mechanism was created, and a physical prototype was manufactured. A virtual motion simulation of the mechanism was performed, high-speed photographic kinematics tests were conducted, and the kinematic properties of the physical prototype were investigated, whereby the correctness of the theoretical model and the optimized design of the mechanism were verified. Further, laboratory seedling pick-up tests were conducted. The success ratio of seedling pick-up was 93.8% when the seedling pick-up efficiency of the mechanism was 60 plants per minute per row, indicating that the mechanism has a high efficiency and success ratio for seedling pick-up and can be applied to a dryland plug seedling transplanter.

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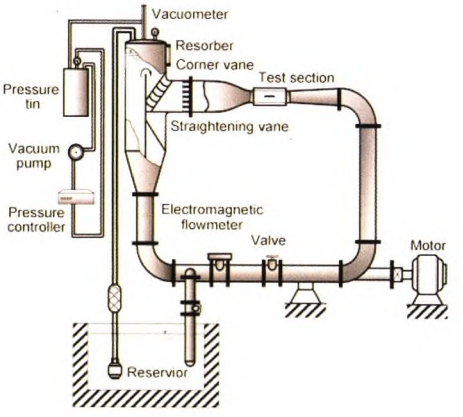
Experimental Study on Influences of Surface Materials on Cavitation Flow Around Hydrofoils. Jiafeng Hao • Mindi Zhang • Xu Huang

Abstract: In order to resist on the cavitation erosion, many researchers try to change the solidity and tenacity of the coatings, but ignore the influence of surface characteristics of materials on cavitation flow and the interaction with each other. In this paper, high speed visualization system is used to observe the cavitation flow patterns in different stage. After comparing the characteristics of cavitation flow around hydrofoils made of aluminum (Foil A), stainless steel (Foil B) and the hydrofoil painted with epoxy coating (Foil C), the study shows that material has a significant effect on the cavitation flow. Firstly, When the incipient cavitation occurs, cavitation number of Foil A is highest among three hydrofoils, generating horseshoe vortex randomly. For Foil B and Foil C, it shows in the form of free bubbles. When the sheet cavitation occurs, Foil A has the highest cavitation number and shortest period, which is contrary to Foil C. And cavity consists of lots of small finger-like cavities. For Foil B and Foil C, it both constitutes with many bubbles. Compared with the high-density and small-scale cavities over surface of Foil C, the cavity of Foil B has larger scale and less density, which causes a minimal scope of influence of the re-entrant jet and strong randomness. When the cloud cavitation occurs, Foil C has the lowest cavitation number and shortest period. Secondly, compared with aluminum, both of stainless steel and epoxy coating restrains the occurrence and development of cavitation, and stainless steel and epoxy coating performs better than aluminum. For inception and sheet cavitation, stainless steel performs better than epoxy coating and aluminum. For cloud cavitation, epoxy coating performs better than stainless steel and aluminum. The objective of this paper is applied experimental method to investigate the effect of surface materials on cavitation around Clark-Y hydrofoils.



Intelligent Manufacturing Technology

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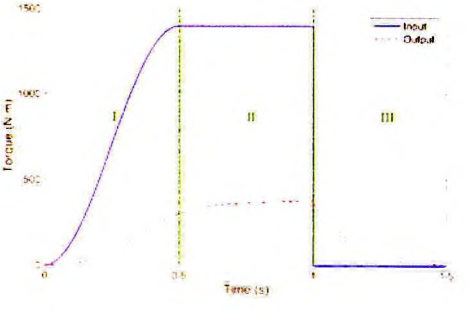
A Contact Force Model Considering Meshing and Collision States for Dynamic Analysis in Helical Gear System.
Dong Xiang • Yinhua Shen • Yaozhong Wei

Abstract: The current research on gear system dynamics mainly utilizes linear spring damping model to calculate the contact force between gears. However, this linear model cannot correctly describe the energy transfer process of collision that often occurs in gear system. Focus on the contact-impact events, this paper proposes an improved gear contact force model for dynamic analysis in helical gear transmission system. In this model, a new factor associated with hysteresis damping is developed for contact-impact state, whereas the traditional linear damping factor is utilized for normal meshing state. For determining the selection strategy of these two damping factors, the fundamental contact mechanics of contact-impact event affected by supporting forces are analyzed. During this analysis, an effect factor is proposed for evaluating the influence of supporting forces on collision. Meanwhile, a new restitution of coefficient is deduced for calculating hysteresis damping factor, which suitable for both separation and non-separation states at the end of collision. In addition, the time-varying meshing stiffness (TVMS) is obtained based on the potential energy approach and the slice theory. Finally, a dynamic analysis of a helical gear system is carried out to better understand the contact force model proposed in this paper. The analysis results show that the contribution of supporting forces to the dynamic response of contact-impact event within gear pair is important. The supporting forces and dissipative energy are the main reasons for gear system to enter a steady contact state from repeated contact-impact state. This research proposes an improved contact force model which distinguishes meshing and collision states in gear system.



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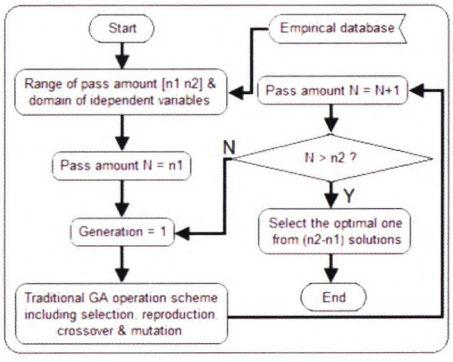

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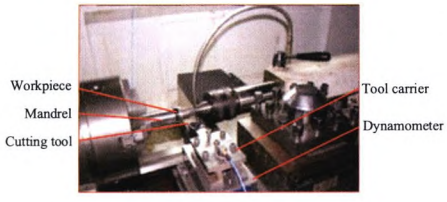
Towards Energy Efficient Shape Rolling: Roll Pass Optimal Design and Case Studies. Kan Huang • Bin Huang • Lei Fu • Kazem Abhary

Abstract: Shape rolling is widely employed in the production of long workpieces with appropriate cross-section profiles for other industrial applications. In the development of shape rolling systems, roll pass design (RPD) plays an essential role on the quality control of products, service life of rolls, productivity of rolling systems, as well as energy consumption of rolling operations. This study attempts to establish a generic strategy based on hybrid modeling and an improved genetic algorithm, to support the optimizations of RPD and shape rolling operations at a systematic perspective. Objectives include improving the quality and efficiency of RPD, reducing energy consumption of shape rolling, as well as releasing the demands on costly trails and expert knowledge in RPD. Hybrid modeling based on cross-disciplinary knowledge is developed to overcome the limitations of isolated single-disciplinary models. And conventional genetic algorithm is improved for the implementation of optimal design. Targeting to integrate empirical data and published reliable solutions into optimizations, a parameters estimation method is proposed to transfer the initially misaligned models into a uniform pattern. A tool based on the Matlab platform is developed to demonstrate the optimal design operations, with case studies involved to validate the proposed methodology.



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Experimental Study on Wear Characteristics of PCBN Tool with Variable Chamfered Edge. Tao Chen • Lixing Song • Suyan Li • Xianli Liu

Abstract: Owing to heavy dynamic and thermal loads, PCBN tools are seriously worn during hard cutting, which largely constrains the improvement of their machining performance. Therein, the chamfered structure of a cutting edge has a notable influence on the tool wear. Thus, a comparative study was carried out on the wear morphology and wear mechanism of PCBN tools with either a variable chamfered edge or an invariable chamfered edge. The results indicate that, for a PCBN tool with a variable chamfered edge, the rake wear area is far from the cutting edge and slowly extends toward it. A shallow large-area crater wear occurs on the rake face, and the flank wear area has a long triangular shape with a smaller wear area and width, and the cutting edge remains in a good state during the cutting process. In contrast, for a PCBN tool with an invariable chamfered edge, a deep small-area crater appears on the rake face, and the wear area is close to the cutting edge and quickly extends toward it. Thus, it is easy for chips to accumulate in the crater, resulting in large-area and high-speed wear on the flank face. In addition, the tool shows a weak wear resistance. In the initial wear stage, the rake wear mechanism of the two cutting tools is a mixture of abrasive, oxidation, and other types of wear, whereas their flank wear mechanism is dominated by abrasive wear. With an aggravation of the tool wear, the oxidation and diffusion wear mechanism are both increasingly strengthened. The rake wear of the cutter with a variable chamfered edge showed an obvious increase in the oxidation and diffusion wear, as did the flank wear of the cutter with an invariable chamfered edge. This study revealed the wear mechanism of the PCBN tool with a variable chamfered edge and provided theoretical and technological support for its popularization and application in the machining of high-hardness materials.

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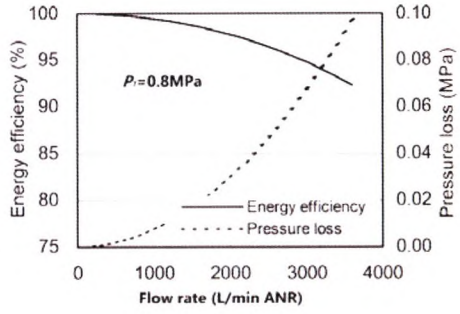
Methods to Evaluate and Measure Power of Pneumatic System and Their Applications. Yan Shi • Maolin Cai • Weiqing Xu • Yixuan Wang

Abstract: Pneumatic system has been widely used throughout industry, and it consumes more than billions kW·h of electricity one year all over the world. So as to improve the efficiency of pneumatic system, its power evaluation as well as measurement methods should be proposed, and their applicability should be validated. In this paper, firstly, power evaluation and measurement methods of pneumatic system were introduced for the first time. Secondly, based on the proposed methods, power distributions in pneumatic system was analyzed. Thirdly, through the analysis on pneumatic efficiencies of typical compressors and pneumatic components, the applicability of the proposed methods were validated. It can be concluded that, first of all, the proposed methods to evaluation and measurement the power of pneumatic system were efficient. Furthermore, the pneumatic power efficiencies of pneumatic system in the air production and cleaning procedure are respectively about 35%–75% and 85%–90%. Moreover, the pneumatic power efficiencies of pneumatic system in the transmission and consumption procedures are about 70%–85% and 10%–35%. And the total pneumatic power efficiency of pneumatic system is about 2%–20%, which varies largely with the system configuration. This paper provides a method to analyze and measure the power of pneumatic system, lay a foundation for the optimization and energy-saving design of pneumatic system.



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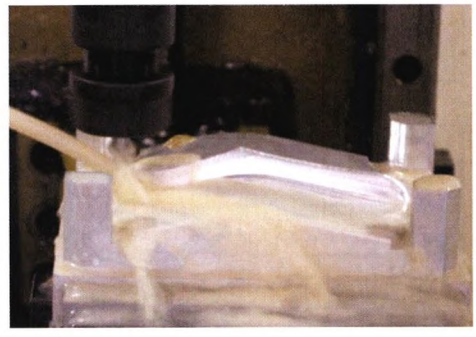
An Optimal Feed Interpolator Based on G^2 Continuous Bézier Curves for High-Speed Machining of Linear Tool Path.

Yongqiao Jin • Sheng Zhao • Yuhan Wang

Abstract: A numerical control (NC) tool path of digital CAD model is widely generated as a set of short line segments in machining. However, there are three shortcomings in the linear tool path, such as discontinuities of tangency and curvature, huge number of line segments, and short lengths of line segments. These disadvantages hinder the development of high speed machining. To smooth the linear tool path and improve machining efficiency of short line segments, this paper presents an optimal feed interpolator based on G^2 continuous Bézier curves for the linear tool path. First, the areas suitable for fitting are screened out based on the geometric characteristics of continuous short segments (CSSs). CSSs in every area are compressed and fitted into a G^2 Continuous Bézier curve by using the least square method. Then a series of cubic Bézier curves are generated. However, the junction between adjacent Bézier curves is only G^0 continuous. By adjusting the control points and inserting Bézier transition curves between adjacent Bézier curves, the G^2 continuous tool path is constructed. The fitting error is estimated by the second-order Taylor formula. Without iteration, the fitting algorithm can be implemented in real-time environment. Second, the optimal feed interpolator considering the comprehensive constraints (such as the chord error constraint, the maximum normal acceleration, servo capacity of each axis, etc.) is proposed. Simulation and experiment are conducted. The results shows that the proposed method can generate smooth path, decrease the amount of segments and reduce machining time for machining of linear tool path. The proposed research provides an effective method for high-speed machining of complex 2-D/3-D profiles described by short line segments.



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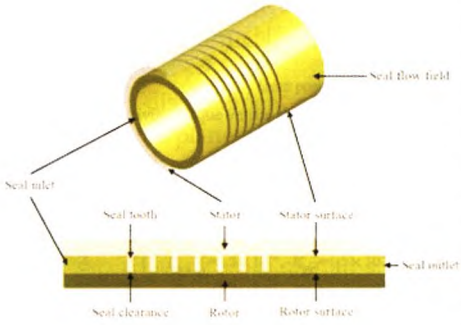

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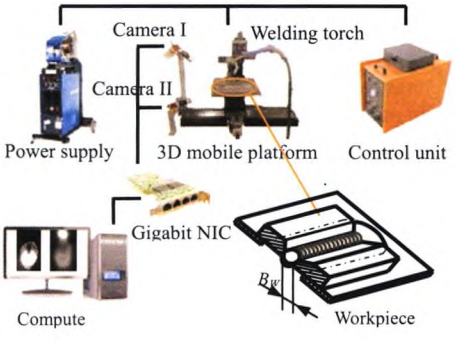
Effects of Four Types of Pre-swirls on the Leakage, Flow Field, and Fluid-Induced Force of the Rotary Straight-through Labyrinth Gas Seal.

Qingfeng Wang • Lidong He

Abstract: The labyrinth seal in turbomachinery is a key element that restricts leakage flow among rotor-stator clearances from high-pressure regions to low-pressure regions. The fluid-induced forces on the rotor from seals during machine operation must be accurately quantified to predict their dynamic behavior effectively. To understand the fluid-induced force characteristics of the labyrinth seal more fully, the effects of four types of pre-swirls on the leakage, flow field, and fluid-induced force of a rotary straight-through labyrinth gas seal (RSTLGS) were numerically investigated using the proposed steady computational fluid dynamics (CFD) method based on the three-dimensional models of the RSTLGS. The leakage, flow field, and fluid-induced force of the RSTLGS for six axial pre-swirl velocities, four radial pre-swirl angles, four circumferential positive pre-swirl angles, and four circumferential negative pre-swirl angles were computed under the same geometrical parameters and operational conditions. Mesh analysis ensures the accuracy of the present steady CFD method. The numerical results show that the four types of pre-swirls influence the leakage, flow field, and fluid-induced force of the RSTLGS. The axial pre-swirl velocity remarkably inhibits the fluid-induced force, and the circumferential positive pre-swirl angle and circumferential negative pre-swirl angle remarkably promote the fluid-induced force. The effects of the radial pre-swirl angle on the fluid-induced force are complicated, and the pressure forces and viscous forces show the maximum or minimum values at a specific radial pre-swirl angle. The pre-swirl has a negligible impact on the leakage. The four types of pre-swirls affect the leakage, flow field, and fluid-induced force of the RSTLGS to varying degrees. The pre-swirl is the influence factor affecting the leakage, flow field, and fluid-induced force of the RSTLGS. The conclusions will help to understand the fluid-induced force of labyrinth seals more fully, by providing helpful suggestions for engineering practices and a theoretical basis to analyze the fluid–structure interaction of the seal-rotor system in future research.



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Penetration Estimation of GMA Backing Welding Based on Weld Pool Geometry Parameters.

Junfen Huang • Long Xue • Jiqiang Huang • Yong Zou • Ke Ma

Abstract: Penetration estimation is a prerequisite of the automation of backing welding based on vision sensing technology. However, the arc interference in welding process leads to the difficulties of extracting the weld pool characteristic information, which brings great challenges to the penetration estimation. At present, most researches focus on the extraction of weld pool geometry parameters, and the visual sensing systems are complex in structure and complicated in the image processing algorithms. The research of penetration estimation based on weld pool geometry parameters is still in the exploratory stage. The purpose of this paper is to research the relationship between the weld pool geometry parameters and the penetration during backing welding and to estimate penetration using the weld pool geometry parameters. A passive vision sensing test system for gas metal arc (GMA) backing welding was established. An image processing algorithm was developed to extract the weld pool geometry parameters, namely, the area, maximum width and length, half-length, length-width ratio and advancing contact angle (simplified as AWP, MWWP, MLWP, HLWP, LWR and ACA, respectively). The corresponding relationships between the weld pool geometry parameters and the penetration state were explored by analysing their changes with the welding current and speed. The distribution of the weld pool geometry parameters corresponding to penetration was determined. When the AWP of the weld pool is within a certain range and the values of LWR and ACA are close to their maximum and minimum respectively, the penetration is in good condition. A mathematical model with the weld pool geometry parameters as independent variables and the back-bead width (the indicator of the penetration state) as a dependent variable was established based on multivariable linear regression analysis, and relevant statistical tests were carried out. Multivariable linear regression equations for the weld pool geometry parameters and the back-bead width were deduced according to the variations in the current and speed, and the equations can be used to estimate the penetration of backing welding. The study provides a solution to penetration estimation of GMA backing welding based on automatic vision sensing.

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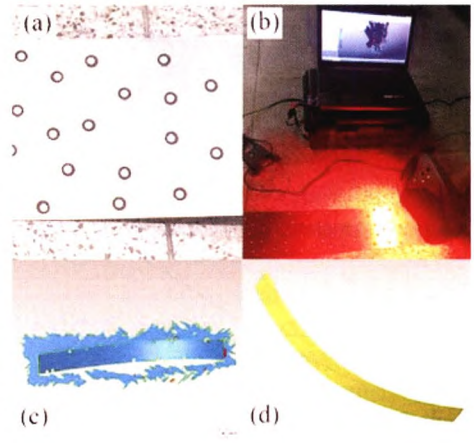
Model for the Whole Roller Leveling Process of Plates with Random Curvature Distribution Based on the Curvature Integration Method.

Ben Guan • Chao Zhang • Yong Zang • Yuan Wang

Abstract: A model based on the curvature integration method has been applied in an online plate leveling system. However, there are some shortcomings in the current leveling models. On the one hand, the models cannot deal with the leveling process of plates with a random curvature distribution. On the other hand, the current models are suitable only for stable leveling processes and ignore the biting in and tailing out stages. This study presents a new plate-leveling model based on the curvature integration method, which can describe the leveling process of plates with random curvature distribution. Further, the model is solved in two cases in order to take the biting in and tailing out stages into consideration. The proposed model is evaluated by comparing with a plate leveling experiment. Finally, the leveling process of a plate with a wave bent is studied using the proposed model. It is found that the contact angles vary greatly during the biting in and tailing out stages. However, they are relatively steady during the 5 roller leveling stage. In addition, the contact angle of roller No. 2 is the smallest, which is close to 0. Roller leveling can effectively eliminate bending in the plate, but there are regions in the head and tail of the plate, where roller leveling is not effective. The non-leveling region length is about 2 times that of the roller space. This study proposes a quasi-static plate-leveling model, which makes it possible to analyze the dynamic straightening process using a curvature integration method. It also makes it possible to analyze the straightening process of a plate with random curvature distribution.

Keywords: Leveling, Curvature integration method, Curvature, Contact angle, Deflection



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A New Method of Wind Turbine Bearing Fault Diagnosis Based on Multi-Masking Empirical Mode Decomposition and Fuzzy C-Means Clustering.

Yongtao Hu • Shuqing Zhang • Anqi Jiang • Liguo Zhang • Wanlu Jiang • Junfeng Li

Abstract: Based on Multi-Masking Empirical Mode Decomposition (MMEMD) and fuzzy c-means (FCM) clustering, a new method of wind turbine bearing fault diagnosis FCM-MMEMD is proposed, which can determine the fault accurately and timely. First, FCM clustering is employed to classify the data into different clusters, which helps to estimate whether there is a fault and how many fault types there are. If fault signals exist, the fault vibration signals are then demodulated and decomposed into different frequency bands by MMEMD in order to be analyzed further. In order to overcome the mode mixing defect of empirical mode decomposition (EMD), a novel method called MMEMD is proposed. It is an improvement to masking empirical mode decomposition (MEMD). By adding multi-masking signals to the signals to be decomposed in different levels, it can restrain low-frequency components from mixing in high-frequency components effectively in the sifting process and then suppress the mode mixing. It has the advantages of easy implementation and strong ability of suppressing modal mixing. The fault type is determined by Hilbert envelope finally. The results of simulation signal decomposition showed the high performance of MMEMD. Experiments of bearing fault diagnosis in wind turbine bearing fault diagnosis proved the validity and high accuracy of the new method.

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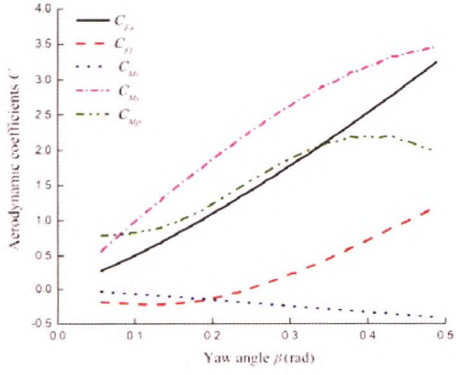
Advanced Transportation Equipment



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Crosswind Stability Evaluation of High-Speed Train Using Different Wind Models. Mengge Yu • Rongchao Jiang • Qian Zhang • Jiye Zhang

Abstract: Different wind models are being used for the operational safety evaluation of a high-speed train exposed to crosswinds. However, the methodology for simulating natural wind is of substantial importance in the wind–train system, and different simplified forms of natural wind result in different levels of accuracy. The purpose of the research in this paper is to investigate the effects of different wind models on the operational safety evaluation of high-speed trains. First, three wind models, namely, steady wind model, gust wind model, and turbulent wind model, are constructed. Following this, the algorithms for computing the aerodynamic loads using the wind models are described. A multi-body dynamic model of a vehicle is then set up using the commercial software "Simpack" for investigating the dynamic behavior of a railway vehicle exposed to wind loads. The rollover risks corresponding to each wind model are evaluated by applying the definition of characteristic wind curves (CWC). The results indicate that the CWC computed using the gust wind model is marginally higher than that computed using the turbulent wind model; the difference is less than 1%. With regard to the steady wind model, the assurance coefficient substantially affects the final CWC. A reasonable agreement of CWC between the steady wind model and turbulent wind model can be obtained by applying an "appropriate value" of the assurance coefficient. This study included a systematic analysis of the operational safety evaluation results using different wind models; the analysis can serve as a reference basis for different engineering accuracy requirements.

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Methodology to Evaluate Fatigue Damage of High-Speed Train Welded Bogie Frames Based on On-Track Dynamic Stress Test Data.
Guangxue Yang • Meng Wang • Qiang Li • Ran Ding

Abstract: The current method of estimating the fatigue life of railway structures is to calculating the equivalent stress amplitude based on the measured stress data. However, the random of the measured data is not considered. In this paper, a new method was established to compute the equivalent stress amplitude to evaluate the fatigue damage based on the measurable randomness, since the equivalent stress is the key parameter for assessment of structure fatigue life and load derivation. The equivalent stress amplitude of a high-speed train welded bogie frame was found to obey normal distribution under uniform operation route that verified by on-track dynamic stress data, and the proposed model is, in effect, an improved version of the mathematical model used to calculate the equivalent stress amplitude. The data of a long-term, on-track dynamic stress test program was analyzed to find that the normal distribution parameters of equivalent stress amplitude values differ across different operation route. Thus, the fatigue damage of the high-speed train welded bogie frame can be evaluated by the proposed method if the running schedule of the train is known a priori. The results also showed that the equivalent stress amplitude of the region connected to the power system is more random than in other regions of the bogie frame.

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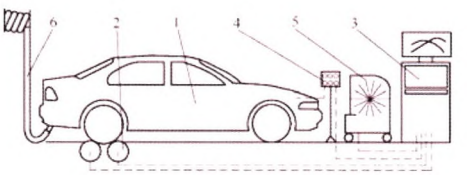
Coefficient of Engine Flexibility as a Basis for the Assessment of Vehicle Tractive Performance. Dariusz Szpica

Abstract: The paper attempts to analyze full load characteristics of over 500 combustion engines. Using statistical tools, the author determined the value of the coefficient of flexibility. Engine flexibility is the capability of the engine to adapt to varying loads. Importantly, in the investigations, the author took into account the parameters calculated in the course of the investigations on a chassis dynamometer, i.e., actual, not taken from technical specifications of brand new vehicles. Different stages of operating wear allow a better characterization of the population. Subsequent utilization of the results in tractive calculations is more reliable. The engines were divided into in six groups, depending on the type of fuel system: fuel injected gasoline and turbocharged gasoline, spark ignition LPG, naturally aspirated diesel and turbocharged diesel. However, engines running on alternative fuels are characterized with a greater flexibility than the fuel injected base engines. Conformity of flexibility of fuel injected and LPG IV generation engines have been observed, which confirms the appropriateness of engine adaptation to alternative fueling. Gasoline engine supercharging allowed a reduction of the maximum engine speed of the maximum torque, which extends the range of analyzable speeds for flexibility and consequently, the flexibility as such.



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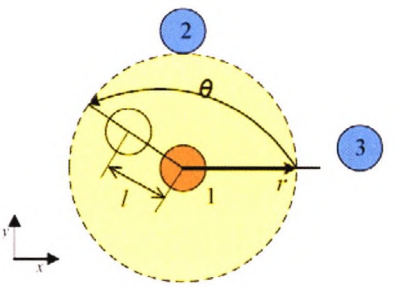
Micro Model of Carbon Fiber/Cyanate Ester Composites and Analysis of Machining Damage Mechanism.

Haitao Liu • Jie Lin • Yazhou Sun • Jinyang Zhang

Abstract: Machining damage occurs on the surface of carbon fiber reinforced polymer (CFRP) composites during processing. In the current simulation model of CFRP, the initial defects on the carbon fiber and the periodic random distribution of the reinforcement phase in the matrix are not considered in detail, which makes the characteristics of the cutting model significantly different from the actual processing conditions. In this paper, a novel three-phase model of carbon fiber/cyanate ester composites is proposed to simulate the machining damage of the composites. The periodic random distribution of the carbon fiber reinforced phase in the matrix was realized using a double perturbation algorithm. To achieve the stochastic distribution of the strength of a single carbon fiber, a novel method that combines the Weibull intensity distribution theory with the Monte Carlo method is presented. The mechanical properties of the cyanate matrix were characterized by fitting the stress-strain curves, and the cohesive zone model was employed to simulate the interface. Based on the model, the machining damage mechanism of the composites was revealed using finite element simulations and by conducting a theoretical analysis. Furthermore, the milling surfaces of the composites were observed using a scanning electron microscope, to verify the accuracy of the simulation results. In this study, the simulations and theoretical analysis of the carbon fiber/cyanate ester composite processing were carried out based on a novel three-phase model, which revealed the material failure and machining damage mechanism more accurately.



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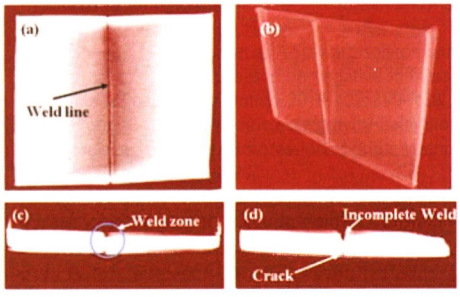

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Effect of Heat Sink and Cooling Mediums on Ferrite Austenite Ratio and Distortion in Laser Welding of Duplex Stainless Steel 2205.

P Dinesh Babu • P Gouthaman • P Marimuthu

Abstract: In order to control the ferrite and austenite percentage in duplex stainless steel welding, many researchers try to change the laser welding parameters and cooling medium, but ignore to study the influence of heat sink effect on weld strength. In this work, the effect of aluminium heat sink and varying cooling medium on the laser welding of duplex stainless steel (DSS) 2205 is studied. The 2 mm thick DSS sheets welded with pulsed Nd: YAG laser welding machine by varying the cooling medium (air and oil) and an aluminium plate used as a heat sink. The welded specimens tested for tensile strength, micro-hardness, distortion, microstructure and radiography analysis. The faster cooling rate in the oil quenching process enhances the ferrite percentage compared with air-cooled samples. But the faster cooling rate in oil quenching leads to more distortion and using aluminium as a heat sink influenced positively the distortion to a small extent. The lower cooling rate in air quenching leads to a higher tensile strength of the welded specimen. The objective of this work is to analyse experimentally the effect of cooling medium and heat sink in the mechanical and metallurgical properties of laser welded duplex stainless steel.

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