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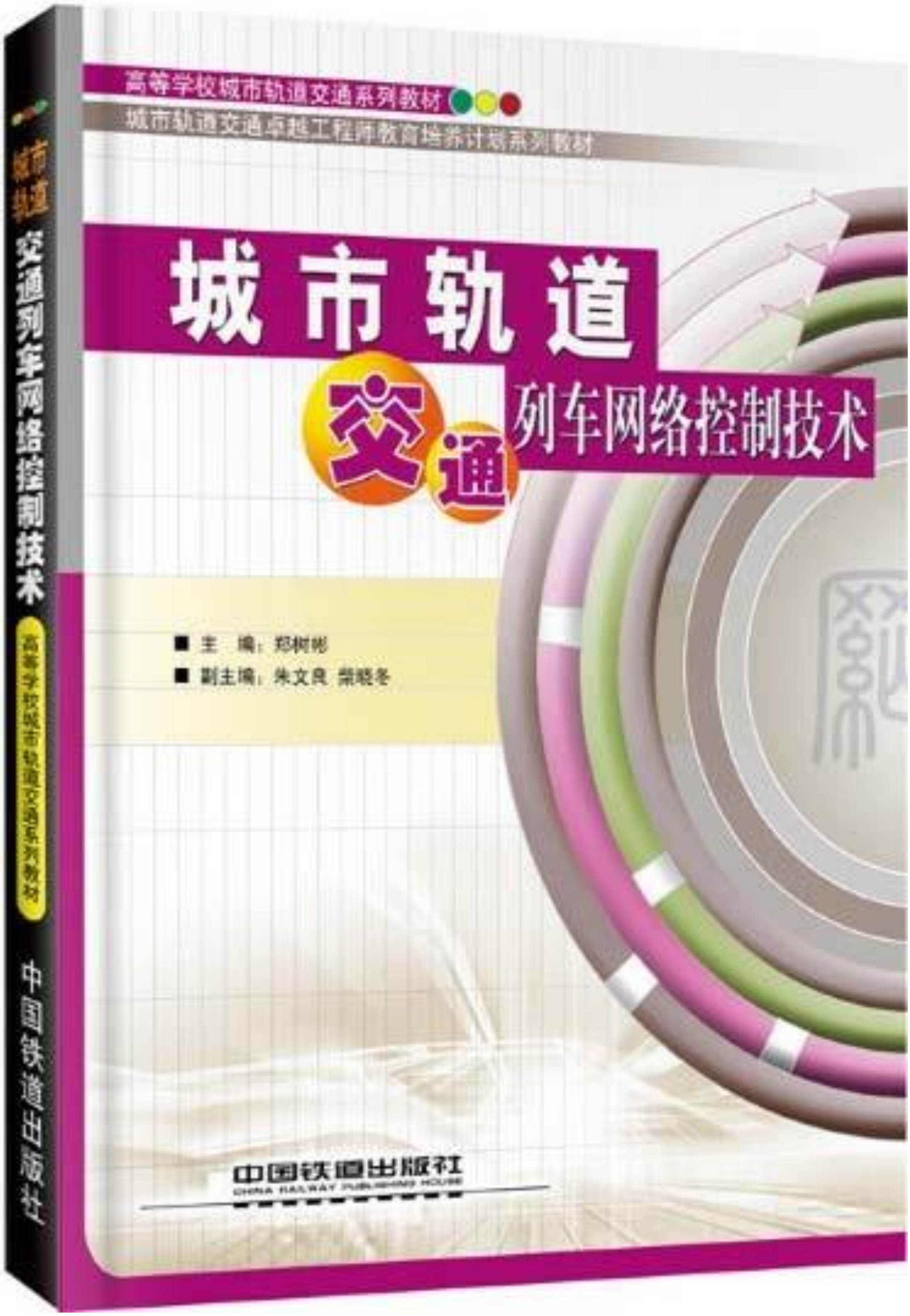

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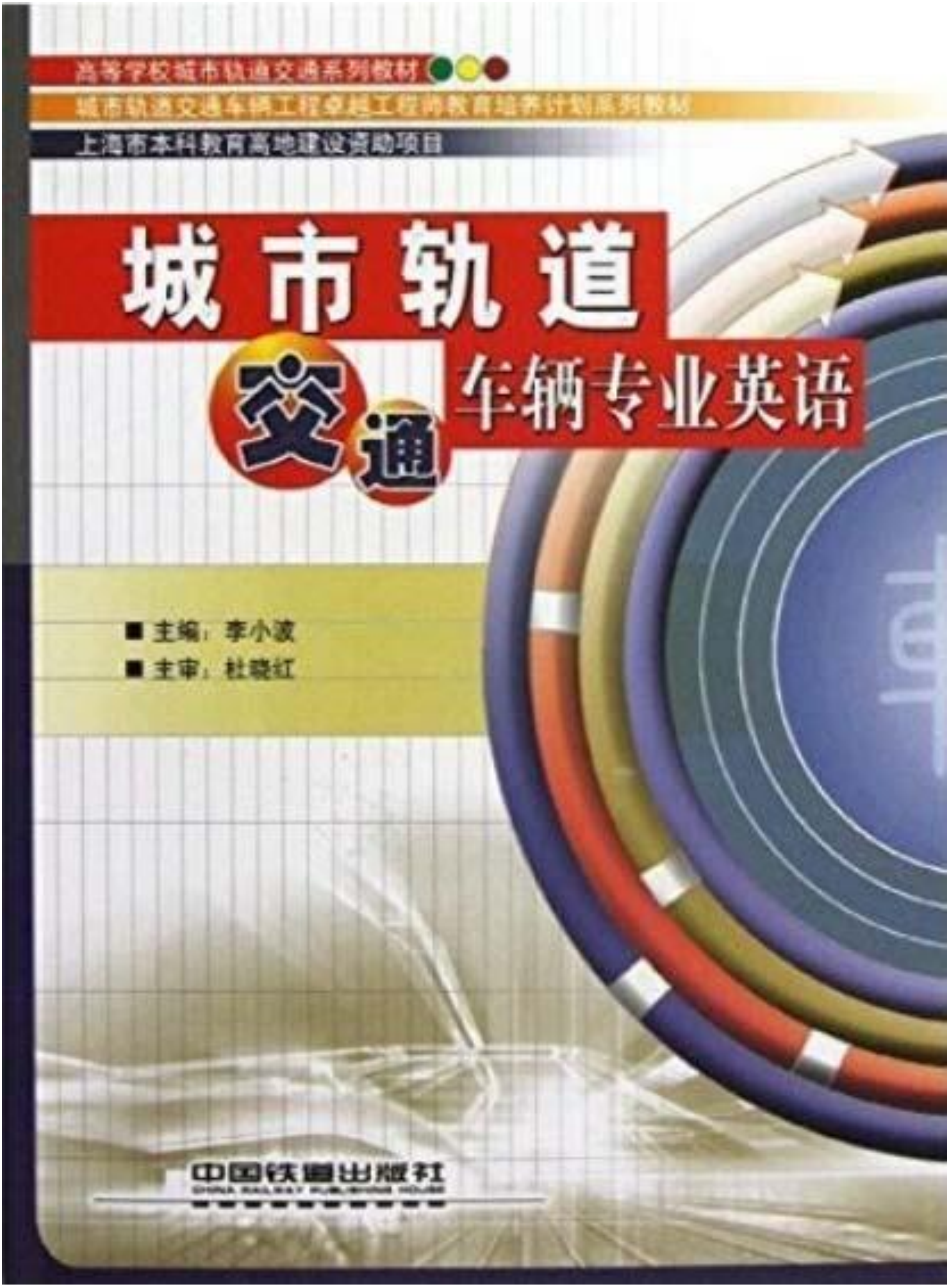

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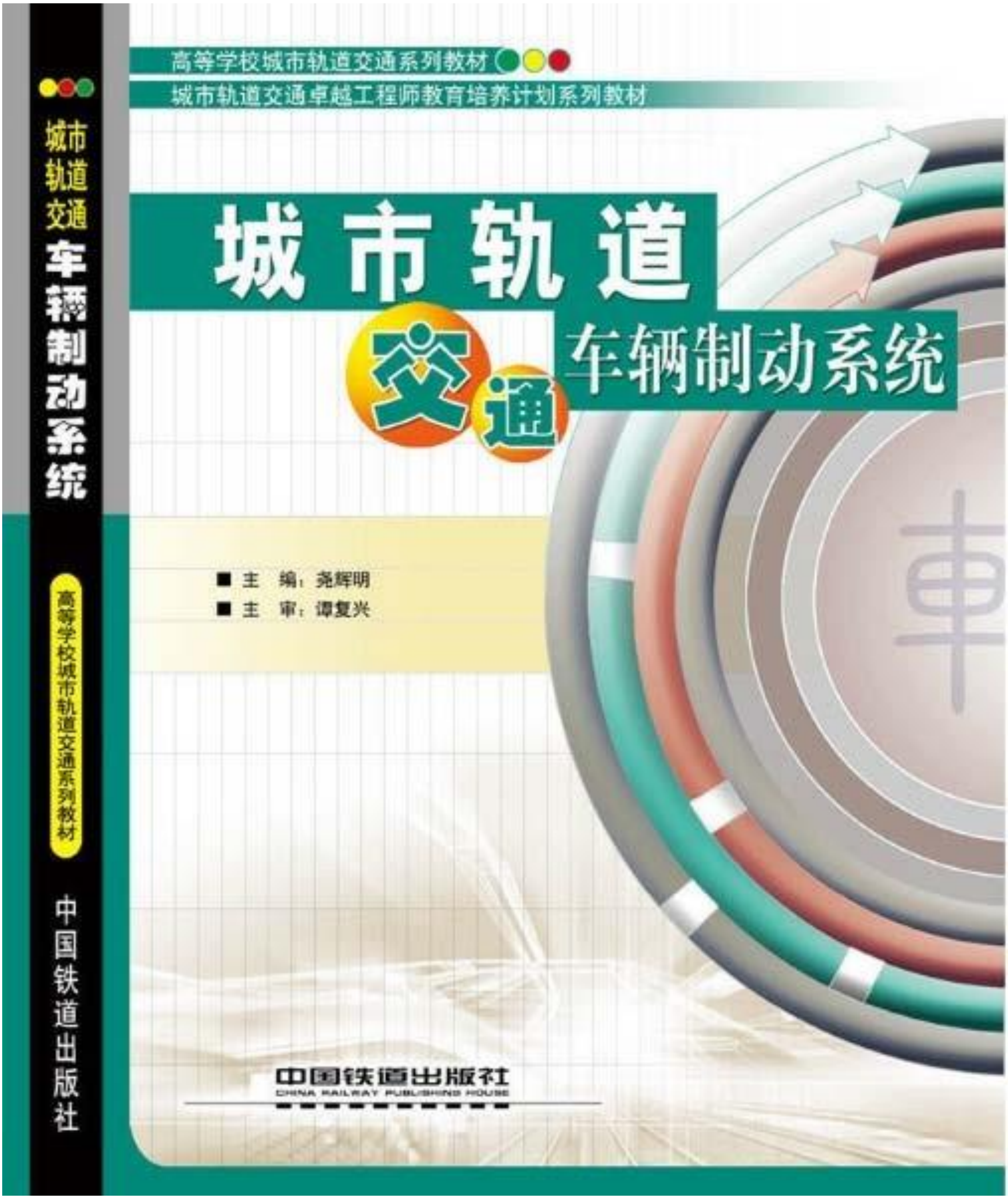

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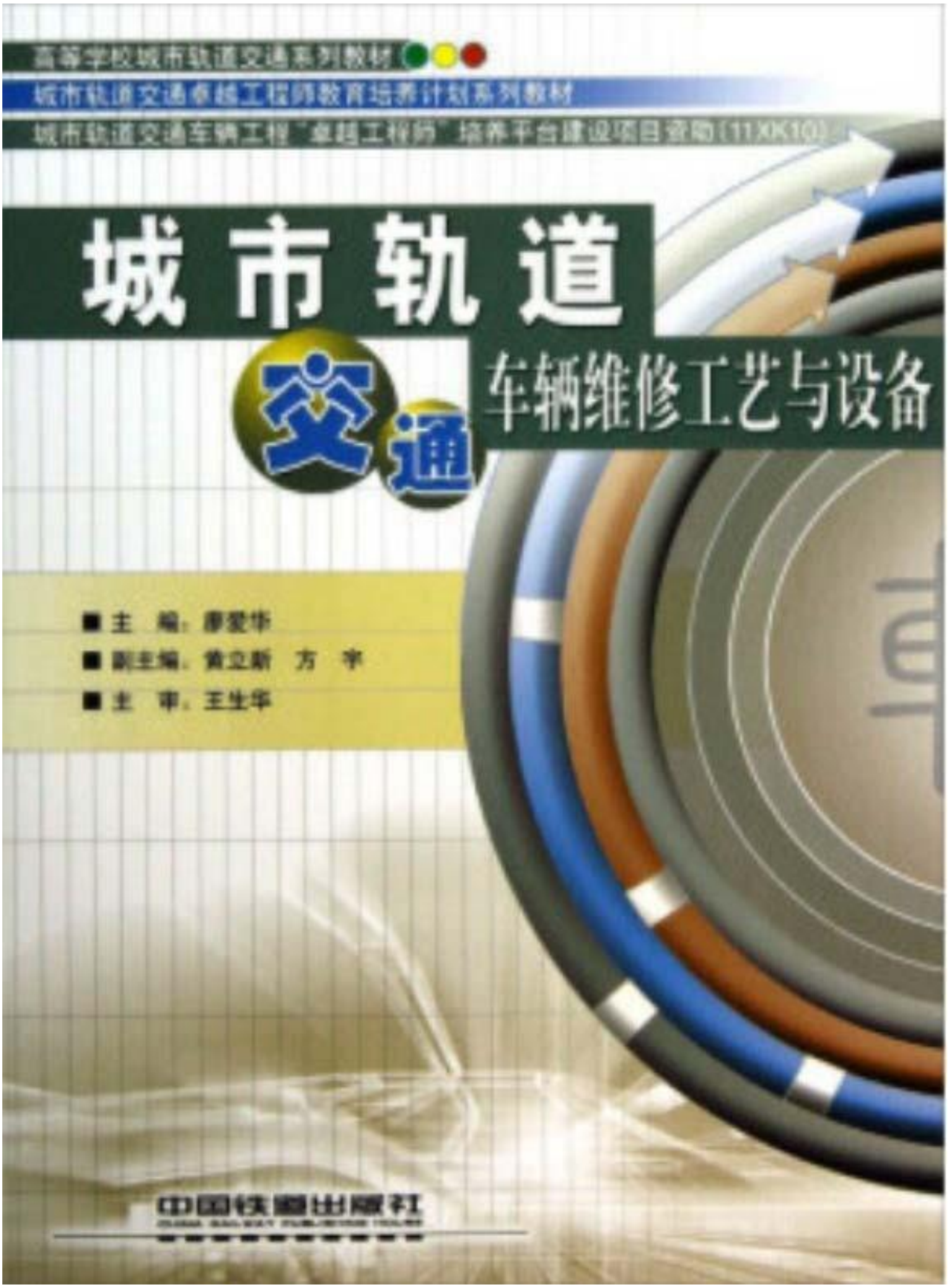

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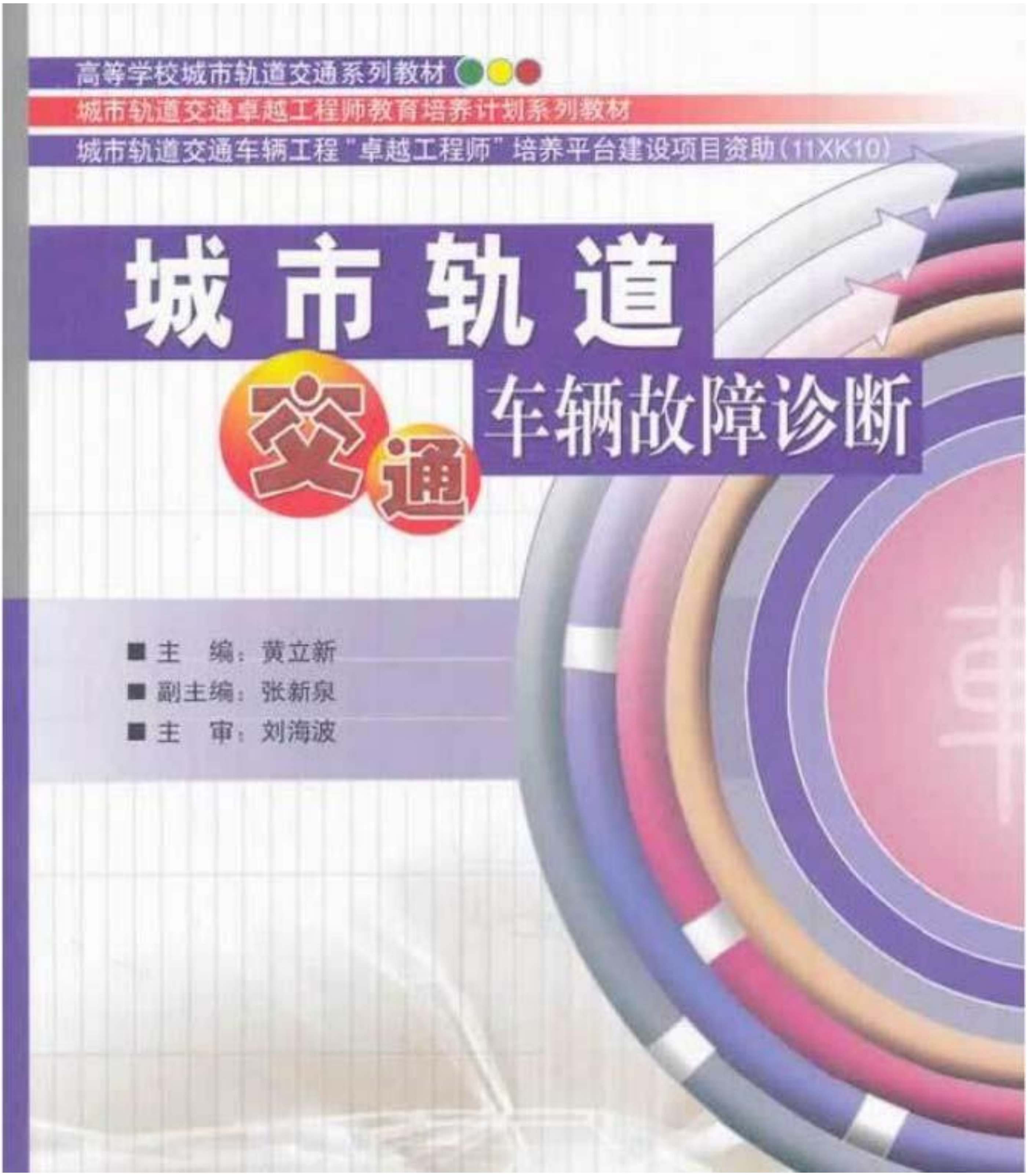

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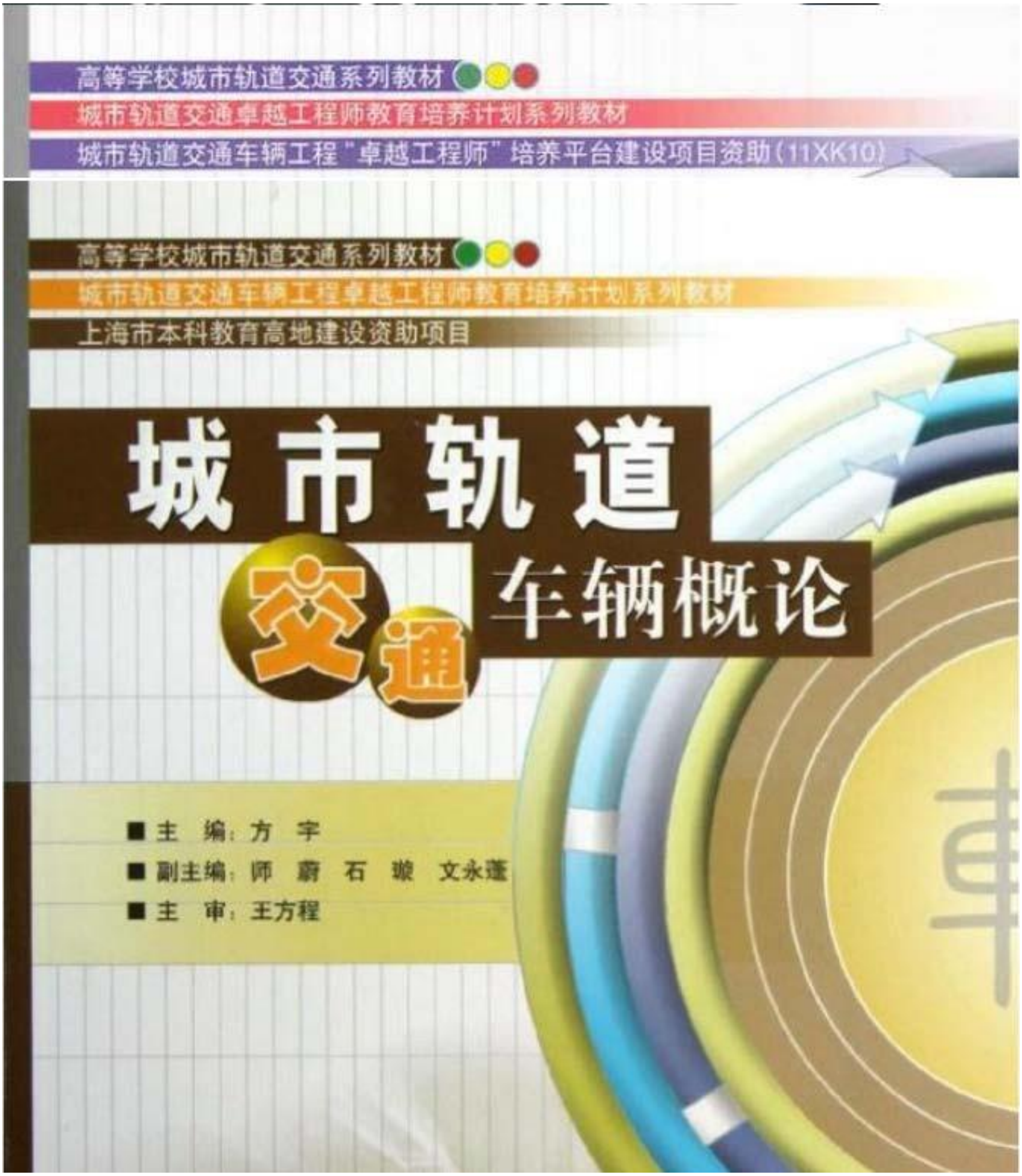

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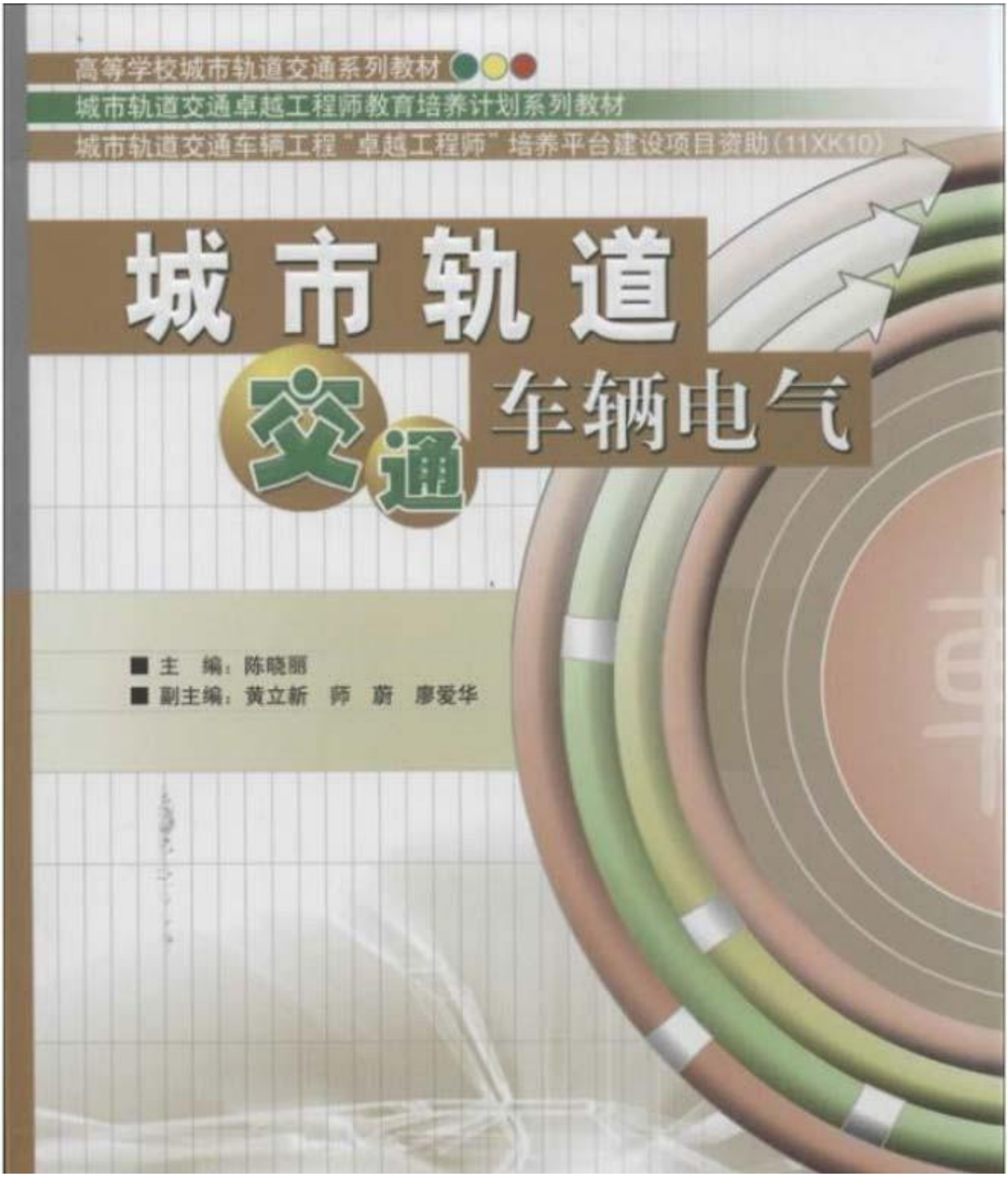

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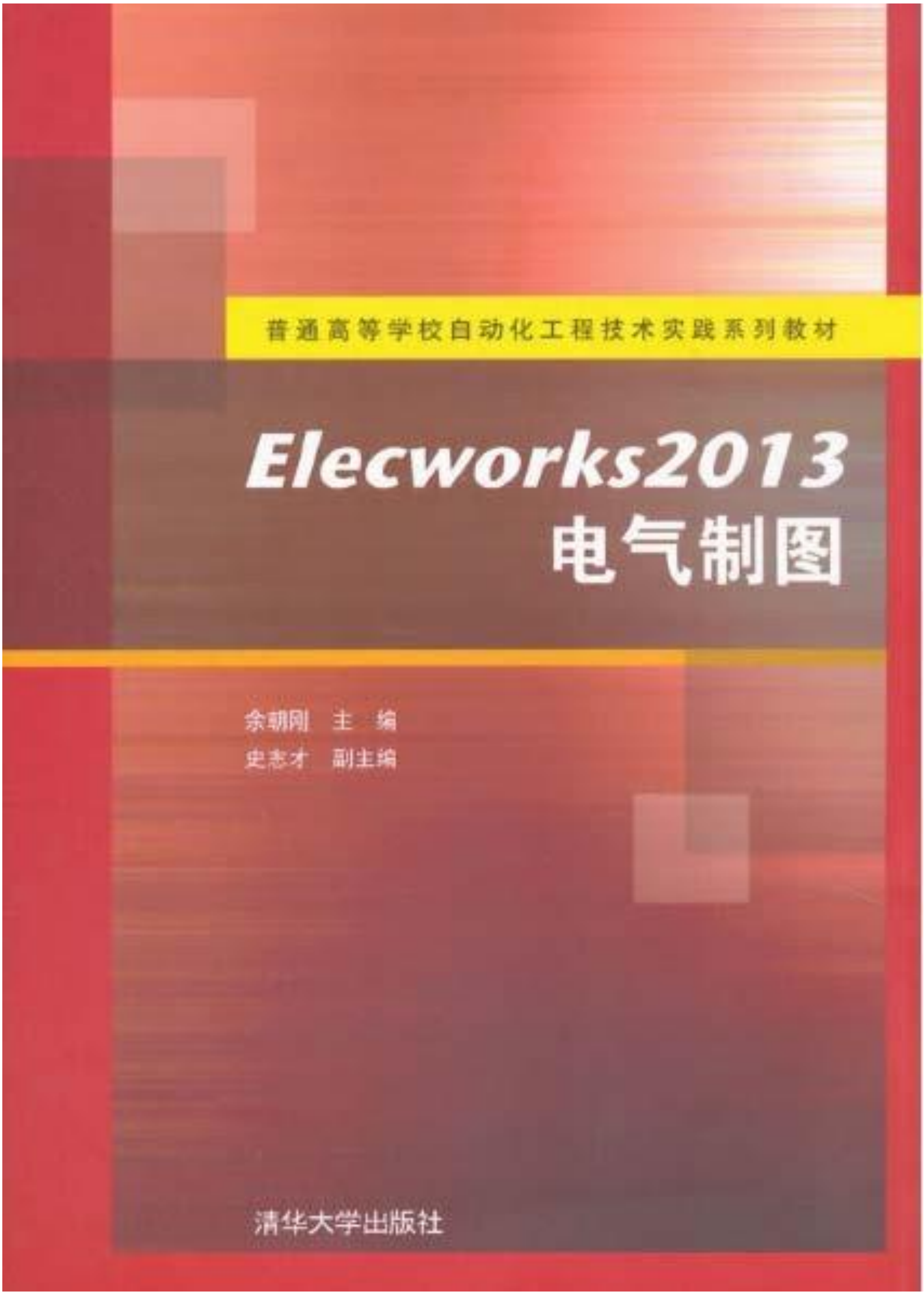

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Study on the vibration suppression of a flexible carbody for urban railway vehicles with a magnetorheological elastomer-based dynamic vibration absorber

Yongpeng Wen, Qian Sun, Yu Zou and Haoming You

Abstract

Magnetorheological elastomer is a new kind of intelligent material that mainly incorporates micron-sized ferromagnetic particles into a polymer. A dynamic vibration absorber that is based on the controllable shear modulus of magnetorheological elastomer is widely used in vibration systems. In the study, a flexible carbody model with a magnetorheological elastomer dynamic vibration absorber is established. A design method of a semiactive dynamic vibration absorber that is based on magnetorheological elastomer is introduced, and the operational principle of the semiactive dynamic vibration absorber is also discussed. To improve the vibration absorption performance of the magnetorheological elastomer dynamic vibration absorber, via multiple regression analysis, the optimal design frequency expressions for both the rigid vibration and the elastic vibration of the carbody are fitted. Parameter determination for the magnetorheological elastomer dynamic vibration absorber is investigated in detail. Then, the effects on the rigid vibration and the elastic vibration with the magnetorheological elastomer vibration absorber both with the passive vibration absorber and without a vibration absorber are analyzed. Finally, Sperling's riding index is used to evaluate the feasibility and the performance of the magnetorheological elastomer dynamic vibration absorber in a practical application. The results demonstrate that the vibration of the carbody can be effectively reduced by using the magnetorheological elastomer dynamic vibration absorber instead of the dynamic vibration absorber without the magnetorheological elastomer. The magnetorheological elastomer dynamic vibration absorber that is modified by the optimum frequency provides superior vibration reduction performance and improves the riding quality of the railway vehicle.

Keywords

Railway vehicle, magnetorheological elastomer, flexible carbody, dynamic vibration absorber, vibration suppression, riding quality

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Introduction

The rapid development of urban rail transit is an inevitable trend in the process of urban modernization. The comfort of urban railway vehicles has gradually become an important issue of public concern.[1] In the operation of urban railway vehicles, due to the short distance between stations, it is necessary for urban railway vehicles to start, accelerate, bend, and brake frequently, which affects the riding quality. In view of the changes in the working conditions of urban railway vehicles and the complicated vibration of the carbody, a dynamic vibration absorber (DVA), which is an effective technology for suppressing the vibration of the carbody, will directly influence the running stability of urban railway vehicles and the riding comfort of passengers.[2,3]

To improve the riding comfort of passengers, the vibration absorber technology has been widely used in the field of vibration and control of railway vehicles in recent years. Zhou et al. proposed the optimal frequency ratio and damping ratio for the design of the DVA of the carbody and determined the suppression effect of the passive DVA on the elastic vibration of the carbody via the fast algorithm of stationarity.[4–8]

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Research Article

A Novel Prediction Model for Car Body Vibration Acceleration Based on Correlation Analysis and Neural Networks

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This paper aims to create a prediction model for car body vibration acceleration that is reliable, effective, and close to real-world conditions. Therefore, a huge amount of data on railway parameters were collected by multiple sensors, and different correlation coefficients were selected to screen out the parameters closely correlated to car body vibration acceleration. Taking the selected parameters and previous car body vibration acceleration as the inputs, a prediction model for car body vibration acceleration was established based on several training algorithms and neural network structures. Then, the model was successfully applied to predict the car body vibration acceleration of test datasets on different segments of the same railway. The results show that the proposed method overcomes the complexity and uncertainty of the multiparameter coupling analysis in traditional theoretical models. The research findings boast a great potential for application.

1. Introduction

Passenger comfort is an important indicator of the operation quality of passenger trains. Previous studies [1, 2] have shown that passenger comfort can be estimated indirectly by parameters like vibration acceleration of the car body. Based on the estimated passenger comfort, it is possible to identify the warning signals or system statuses needed to ensure the smooth operation of the train.

Much research has been done to forecast the vibration acceleration of trains. For instance, Shafiullah et al. [3] predicted the forward and backward vertical acceleration conditions by popular regression algorithms. Zhai et al. [4] created a comprehensive train-track dynamics model to predict the ground vibrations of high-speed trains. Inspired by the dynamics model, Czop et al. [5] proposed a rail irregularity detection method based on the bearing box acceleration during train operation and successfully applied the method to recognize the rail regularities of a typical railway in Poland. Qian et al. [6] established a model to predict the vibration acceleration of high-speed trains based on nonlinear autoregressive neural network with exogenous inputs (NARX NN) and multibody dynamic model and proved the prediction accuracy of the model through experimental analysis.

In addition, some scholars have attempted to infer important parameters of railways from vibration acceleration of the car body. For example, Connolly et al. [7] assessed the effects of vibration acceleration on passenger comfort and track performance. Koo et al. [8] put forward theoretical derailment coefficients for single wheel pairs, considering the impacts from lateral vibration acceleration and gyroscopic factors as well as flange angle, friction coefficient, wheel unloading, wheel radius, gauge, and bearing position. Navik et al. [9] developed a new sensor system that captures the dynamic behaviour of high-speed rail with several sensors placed at an interval of 150m and predicted the maximum vertical displacement, train speed, dynamic behaviour, and quantification modal parameters with vibration acceleration time series.

In general, the previous research into vibration acceleration had concentrated on the traditional multibody dynamics modelling, and the research results were mainly derived through simulation. In actual operation, the train is faced with a complex environment and uncertain track conditions. Thus, there is always some gap between the simulated state

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Modeling and analysis of the electrical braking energy of urban railway vehicles

Jian Yang, Yue Hou, Ruigang Song and Tianchen Yuan

Abstract

In this paper, the energy distribution of electrical braking for an urban railway transportation system is studied. In order to calculate the percentage of regenerative and resistance braking energy, line 2 of the Shanghai Metro traction power network is modeled through an analysis approach. An effective method is proposed to establish the equivalent models for each part of the traction power network. The parameters and conditions are based on real parameters from the Shanghai Metro line 2. When the departure interval is 200 seconds, the regenerative braking energy accounts for 71.8% of the total electrical braking energy based on the simulation data and 69.3% of the total electrical braking energy based on the measured data. This paper can provide a theoretical basis for energy-saving evaluation of urban railway transportation systems.

Keywords

regenerative braking, resistance braking, traction power network, simulation, urban railway vehicle

1. Introduction

In recent years, energy has begun to play a more important role in the world. The rapid development of urban rail transit brings more demands for energy.[1] To improve operations and save energy, the modeling and simulation of urban railway network systems is important to the analysis of urban railway network systems.[2–7] In an urban railway network system, trains accelerate and brake frequently.[1] The main braking mode of urban railways is regenerative braking. However, the regenerative braking energy cannot be returned to the traction network, and it is wasted in the braking resistors. As a result, the kinetic energy of the train is turned into heat.[8,9] The electrical energy is wasted in the resistor in the form of heat, and the resulting increase in the temperature of the railway tunnels brings problems to train security. Therefore, it is important to study the energy distribution problem to improve the performance of the energy storage apparatus for electrical braking.[8] Some studies only focus on the running state of the train and the characteristics of the traction motor, without considering the total traction network.[10–14] Research has shown that it is necessary to establish the traction networks for further study.[8,15,16]

In this paper, the traction supply network, trains and substations are modeled using real data obtained from line 2 of the Shanghai Metro. The model shows the behavior of the traction network, train operation and braking performance of the train especially. The network model is simulated in the ''Numerical method'' section (3.2).

2. Model for traction power supply systems

The traction power supply system of urban rail transportation systems is composed of a traction substation and contact system, which provides electricity to trains. The traction substation is the core of the traction power supply system. The electrical energy is transmitted from the traction substation to the contact system and trains by the feeder circuit, and the energy is returned to the traction substation through the steel rails and loop current line. The traction power supply system consists of the contact system, loop line, steel rails and feeder circuit.[1] Figure 1 shows a schematic diagram of the traction power supply system.

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Sound field reconstruction with sparse sampling and the equivalent source method

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ABSTRACT

The equivalent source method is reformulated under the compressive sensing framework for tackling with the spatially extended sound source. The sound field to be reconstructed is first modeled using the equivalent source method according to the topology of sound source, and then the singular value decomposition is used to obtain a series of orthogonal basis of the sound field. Utilizing the sparse property of the basis and combining with the compressive sensing theory, the sound field is finally reconstructed from sparse sampling. Its performance is investigated by using simulations and an experiment, the results show that the sparsity of the solution is greatly enhanced by using the proposed method, and the sound field can be accurately reconstructed with sparse sampling.

1. Introduction

Nearfield acoustic holography (NAH) was first proposed in the 1980s, and one of the main advantages of NAH was that it broke through the restriction of the wavelength to the resolution of the holographic reconstructions [1]. In the original NAH, the pressure was uniformly sampled at the hologram, and the minimum resolution of the reconstructed sound field was equal to the interspacing between the spatial sampling points, according to the Nyquist theorem [2]. Thus theoretically, NAH possesses no intrinsic resolution limitation of sound field reconstruction as long as there are enough samplings. Nevertheless, an increase of the sampling leads to an increase of the sampling cost.

With the development of NAH, the methods applying to arbitrarily shaped sound source have emerged, such as the boundary element method [3], the Helmholtz least square method [4], the equivalent source method (ESM) [5–7], to name a few. These methods do not require measuring the pressure with a uniform measurement interspacing, and the random microphone array can also be adopted [8]. Traditionally, these methods solve the reconstruction problem in a least square sense, and the number of the sampling points should be no less than the unknowns. For example, the sampling points should be more than the equivalent sources in the ESM, and in the Helmholtz least square method the sampling points should be more than the spherical waves used for reconstruction. Efforts have been made to reduce the sampling points while keeping resolution unchanged. In a previous study, Leclère proposed a combined criterion for selecting the regularization parameter to solve the under-determined inverse problem [9].

Abbreviations: NAH, nearfield acoustic holography; ESM, equivalent source method; CS, compressive sensing.

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Robust neural tracking control for switched nonaffine stochastic nonlinear systems with unknown control directions and backlash-like hysteresis

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Abstract

This paper is concerned with the tracking control problem for a class of switched stochastic nonlinear systems in nonaffine form with both unknown control directions and unknown backlash-like hysteresis, and a novel neural tracking control scheme is proposed based on backstepping technique and Nussbaum function. Dynamic surface control (DSC) is adopted to overcome the problem of complexity explosion of the traditional backstepping design. High-order neural networks (HONNs) are utilized to approximate the lumped unknown nonlinear functions, and only one adaptive parameter needs to be updated. Stability analysis shows all closed-loop error signals are semi-globally uniformly ultimately bounded in the fourth-moment (or mean square), and the system tracking error is ensured to converge to a small neighborhood of zero. Finally, simulation results illustrate the effectiveness of the proposed scheme.

1. Introduction

During the past decades, because stochastic disturbance commonly exists in engineering practice, e.g., aircraft, biology, and many kinds of process control systems, stochastic nonlin-

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Quality Estimation System for Resistance Spot Welding of Stainless Steel

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Resistance spot welding (RSW), as one of the most widely used processes in sheet metal fabrication, is a complex electromechanical coupled nonlinear process, and weld quality is influenced by various process conditions, noise and errors. Therefore, inconsistent quality from weld to weld is a major problem for RSW process. However, so far there is no satisfactory non-destructive quality estimation method to evaluate the weld quality.

The objective of this study is to explore a quality estimation system for RSW. In order to build the quality estimation system, the relationship between various variables during RSW process and weld quality was studied by lots of experiments. Test results showed that the system built in this study could accurately estimate the weld quality and the maximum estimation error was only 5.6%.

KEY WORDS: resistance spot welding; weld quality estimation system; BP neural network.

1. Introduction

Resistance spot weld (RSW) has been an irreplaceable material joining process and has been widely used in many areas over the past decades, such as automotive, aerospace, railway car and electrical industries, due to its advantages of automation, high production efficiency and low cost. However, in the actual production, the fluctuation of weld quality is common even though using the same weld parameters. The main reason for the inconsistence is that the weld quality is influenced by the complex electromechanical coupled nonlinear process and various process conditions, noise and errors. In order to increase the reliability of each spot and to reduce the risk of part failure, a number of studies had been conducted in the past to perform destructive and nondestructive inspection of the welds.

In the previous studies, various electrical and mechanical variables, such as welding current, electrode voltage, dynamic resistance, and electrode displacement, have been researched to monitor and evaluate the quality of the RSW.[1–5] Dickinson *et al.*[6] observed the relationship between the dynamic resistance and the phenomena occurring during spot weld formation (surface breakdown, asperity collapse, heating of the work pieces, molten nugget formation, nugget growth, and mechanical collapse), based on the pattern changes of the dynamic resistance. Chien *et al.*[7] found force signal during welding process provided the most information on nugget formation. C.T. Ji[8] characterized dynamic electrode displacement and force during RSW of aluminum alloy sheet and discussed possible strategies for process monitoring and control.

Recently, the artificial intelligence (AI) technique has been applied in the area of welding control and quality estimation, including RSW. Dilthey[9] used a neural network to estimate the tensile shear strength of the welds. Cho and Rhee[10] developed a AI quality estimation system of RSW by using Hopfield neural network, and the dynamic resistance, which included the information of nugget information, was applied to the system. Podrzaj[11] used a LVQ (a linear vector quantization) neural network to detect the expulsion for different materials, and pointed that the electrode force signal was the most important indicator of the expulsion occurrence.

In this study, an AI weld quality estimation system for stainless steel was researched and established by using a BP neural network and various welding parameters and dynamic signals which provide important information of weld quality were applied to this system.

2. Experimental Procedures

The experiments were conducted on TDZ-3X100 three-phase secondary rectifying spot welder. Input voltage of the spot welder was 380±10%V and the frequency of input voltage was 50 Hz. The electrodes used in this study were radius tips with 100 mm radius and 20 mm end face diameter. The material for electrode was Cu–Cr alloy. **Figure 1**

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Research Article

A Novel Control Strategy on Multiple-Mode Application of Electric Vehicle in Distributed Photovoltaic Systems

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Considering the booming development of electric vehicle (EV), this article presents a novel control scheme analyzing EV multiple-mode application in a number of distributed photovoltaic (PV) systems, which rationalizes the energy flow among the energy system participants containing a power grid, a grid-connected PV system, power consumption devices, storage batteries, and EV. Based on the control scheme, the authors propose two day-ahead optimal control strategies with different objective functions: one is minimizing the daily electricity expense of an individual distributed PV system and the other is minimizing the daily total expense of distributed PV systems which EV can be connected to. The model has been verified by the actual data and forecast data, respectively. The results show under the individual objective, in the distributed PV system with EV, the electricity expense can obtain an annual reduction of 27.18%. Furthermore, in the distributed PV system with a storage battery as well as EV, the electricity expense can obtain an annual reduction from 30.67% to 81.49% with a storage battery capacity changing from 1 kWh to 20 kWh. Under the total objective, the total expense and even the individual expense have different degrees of reduction. However, the specific benefits should be rerationally distributed by balancing the interests of all the distributed PV systems. In addition, besides the application in the distributed PV systems, this model may have some potential on the development of a regional energy system.

1. Introduction

Due to electric vehicles (EVs) in the past several years showing an explosive development, researchers have found that these mobile distributed storage units have great potential in energy systems in future power grids, especially when coordinated with renewable energy. Therefore, the literature on the rational planning, optimal operation of EVs, and renewable energy sources has mushroomed these years. Wu et al. [1] briefly analyze the possible scenarios of using renewable energy to charge EVs. Chen and Duan [2] deal with the daily EV mileage uncertainty by Monte Carlo simulation and design an optimization and integration method of EV in microgrids with minimizing the total cost of electricity as the goal. ElNozahy et al. [3] also use Monte Carlo simulation to provide a probabilistic planning and scheduling method for an energy storage system integrating EVs and photovoltaic (PV) arrays in a distributed power grid. Guo et al. [4] discuss a two-stage renewable energy generation parking lot economy framework for EVs. The first stage processes uncertainty of renewable energy, and the second stage controls EV charging operation based on a predictive model. Considering the smart grid with EV and PV power generation in an islanding operation mode, Tang et al. [5] provide an online reinforcement learning method called object representation adaptive dynamic programming, which is for the adaptive islanding control unit in smart grids. Hashemi et al. [6] present a sensitivity analysis on feasibility of users supplying energy into power grids, to determine the minimum storage system capacity with different positions of low voltage power grid configuration. It prevents the overvoltage caused by PV high penetration, which presents a definition named residual power curve (RPC). Paterakis et al. [7] give a detailed family energy management system structure to determine the best home appliance scheduling strategy based on demand response on the following day when the price changes and

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Micromechanical Modeling for the Damage Accumulation and Adhesive Wear of Metallic Materials Containing Inclusions

Metallic materials usually contain some amounts of inclusions which are known to affect their mechanical properties since the bonding strength of the matrix–inclusion interface is relatively low, voids or cracks are thus easily formed under a tensile loading. However, under a contact loading, the effects of subsurface inclusions on the sliding wear of metallic materials are not thoroughly understood. In this work, a micromechanical model is proposed to study the shear fracture and wear of metallic materials containing random inclusions. With the model, crack branching and crack aggregation during contact loading are simulated, and the formation process of sheet-like wear particles is clarified. It is demonstrated that the subsurface micro-cracks, particularly those near inclusions, and their subsequent evolution play a major role in the adhesive wear. This investigation is helpful in understanding the adhesive mechanism of wear, and the proposed model could be a promising approach for the prediction of adhesive wear.
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Keywords: adhesive wear, shear fracture, inclusion, cohesive zone model, contact mechanics, surface fracture cracking, wear mechanisms

1 Introduction

The sliding contact between two solid objects causes friction and wear. The friction sometimes is harmful since it leads to the loss of the energy which converts into heat and noise, yet it is also needed sometimes because of its various advantages such as traction drive, stir welding, and braking. However, the wear does harms but no good. For example, in production, wear can cause damage to tools and equipment, and in human life, wear can cause diseases in teeth and joints. In reality, wear is also an extremely complex behavior of the contact system, which depends on the material properties, loading conditions, environmental factors, etc. In order to explain the wear phenomenon and predict the wear results, researchers all over the world in the past developed a large number of wear mechanisms and models, including adhesive wear, abrasive wear, corrosion wear, fatigue wear, fretting wear, and so on. Among them, the adhesive theory of wear is now widely accepted thanks to pioneer researcher Archard [1] who presented the wear equation $V = kLS/H$, where V is the volume of removed material, k is a wear coefficient, L is the normal load, S is the sliding distance, and H is the hardness of the softer material.

The mechanism of adhesive wear is somewhat similar to the adhesion theory of friction, in which the wear particles are thought to be pulled out from the softer material due to the strong adhesion between contacting surfaces [2]. However, it can be noticed that the adhesion properties are not directly accounted in the wear equation, and interestingly, the wear coefficient k in the Archard equation is interpreted as probability of the adhesion at asperity encounter being strong enough to pluck out a wear fragment [2]. Similar to the coefficient of friction (μ), the wear coefficient (k) is not a material parameter, but a system parameter whose value is rather difficult to obtain. For a long time, the tribology researchers have designed a large number of experiments to determine the wear coefficient. However, as pointed out by Finkin [3], the data produced by a laboratory test, which simply rubs substances together, are utterly useless unless the test conditions actually simulate the contact situation of the intended use.

Although the adhesive wear and the Archard equation have achieved a wide range of acceptance, they are not perfect. Suh [4] indicated that "the Archard's theory is weak in that : (a) It completely ignores the physics and physical metallurgy of metal deformation; (b) Many of the assumptions employed in the mathematical derivation are unreasonable and arbitrary; and (c) The theory does not provide any insight to the wear of metals under different sliding conditions." Thereupon, Suh proposed the delamination theory of wear [4], which is based on the behavior of dislocations at the surface, subsurface crack and void formation, and subsequent joining of cracks by shear deformation of the surface. And in their later works [5–9], Suh and his collaborators made many attempts to model and analyze the delamination process of contact material by implementing the methodology of fracture mechanics.

Basically, the delamination model can explain some wear phenomena. For example, it predicts that the shape of wear debris is likely to be thin flake-like sheets, which has been confirmed by some carefully prepared experiments [4,9]. However, the theoretical system of the delamination theory, developed till now, is still not complete, and thus, some limitations can be recognized. First, under the contact loading, the hydrostatic pressure below the contact surface has a significant effect on the nucleation and aggregation of voids. Therefore, the mechanism and exact location of the crack initiation in contact solids need to be clarified in detail. Second, in the presence of the voids and second-phase inclusions, the crack behavior is very intricate such that artificially define a propagation path is unreasonable. Finally, as pointed out by Alpas et al. [10] and Zhang and Alpas [11], the models based on elastic fracture mechanics, considering the effect of stress intensity factors at the tip of the crack as a driving force for its propagation, are actually not readily applicable to the wear of ductile materials.

Despite the shortcomings mentioned above, the works of Suh and his collaborators were still considered to be a great contribution to

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Fast Sparse Reconstruction of Sound Field Via Bayesian Compressive Sensing

To overcome the contradiction between the resolution and the measurement cost, various algorithms for reconstructing the sound field with sparse measurement have been developed. However, limited attention is paid to the computation efficiency. In this study, a fast sparse reconstruction method is proposed based on the Bayesian compressive sensing. First, the reconstruction problem is modeled by a sparse decomposition of the sound field via singular value decomposition. Then, the Bayesian compressive sensing is adapted to reconstruct the sound field with sparse measurement of sound pressure. Numerical results demonstrate that the proposed method is applicable to either the spatially sparse distributed sound sources or the spatially extended sound sources. And comparisons with other two sparse reconstruction methods show that the proposed one has the advantages in terms of reconstruction accuracy and computational efficiency. In addition, as it is developed in the framework of multitask compressive sensing, the method can use multiple snap shots to perform reconstruction, which greatly enhances the robustness to noise. The validity and the advantage of the proposed method are further proved by experimental results. [DOI: 10.1115/1.4043239]

Keywords: sound field reconstruction, nearfield acoustic holography, Bayesian compressive sensing, acoustic imaging

1 Introduction

The acoustic imaging technique [1–5] has found wide applications in many industries, and imaging the sound field with high spatial resolution has always been an interest. As one of the acoustic imaging techniques, the nearfield acoustic holography (NAH) [3–9] is attractive due to the advantage of high spatial resolution. However, the high resolution of NAH relies on intensive measurement and results in high measurement cost. To reduce the measurement cost, the interpolation techniques [10–13] and the combined regularization strategy [14] have been introduced.

Recently, Chardon et al. [15] provided a detailed discussion of the sparse property of the Fourier basis for reconstructing sound field and introduced the compressive sensing (CS) technique [16,17] into NAH to reduce the number of samplings. It was shown that the normal velocity of plates could be accurately reconstructed with high spatial resolution by using only a small number of samplings, as long as the normal velocity can be sparsely represented in a well-designed dictionary. To apply the sparse reconstruction to arbitrarily shaped sound sources, various methods were developed, such as the compressive equivalent source method (ESM) which was suitable for sparsely distributed sources [18,19], the acoustic radiation mode-based methods proposed by Bi et al. [20] and Hu et al. [21] for spatially extended sound sources, the fast wideband acoustical holography (WBH) proposed by Hald [22], the Bayesian methods using sparsity enforcing a priori [1,23], and some other methods [24–29]. The contradiction between the resolution and the measurement cost is greatly alleviated by using the sparse reconstruction methods. However, except the work by Hald [22], limited attention is paid to the computation efficiency in previous studies.

In the present paper, a fast sparse reconstruction method is proposed based on Bayesian compressive sensing (BCS). The method consists in a sparse decomposition of the sound field and solving the sparse solution. The sparse decomposition is implemented through the singular value decomposition (SVD), and different from the Bayesian methods previously mentioned [1,23], the sparse solution is solved based on sparse Bayesian learning [30], which relies on a parameterized prior that encourages sparse solution. The performance of the proposed method is evaluated numerically and experimentally, and comparisons are made with other two sparse reconstruction methods to demonstrate the advantage of the proposed method. Besides, the performance of using multiple snapshots is also investigated.

This paper is outlined as follows: A theoretical description is given in Sec. 2. In Sec. 3, numerical simulations are conducted to evaluate the proposed method by comparing to the WBH [22] and the compressed modal equivalent point source method (CMEPSM) [20]. The performance of the multiple snapshots is also shown. The proposed method is further validated by experimental results in Sec. 4, and the conclusion is drawn in Sec. 5.

2 Theoretical Background

2.1 Sound Field Reconstruction Model. The sound field reconstruction consists in measuring the sound pressure (or particle velocity) in the near field of sound sources and reconstructing the three-dimensional sound field using the measurement as the boundary condition. The sound field radiated by actual sources can be

[1]Corresponding author.

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WENG Yongpeng, ZHOU Weihao, et al. An invention relates to a semi-active magneto-rheological elastomer dynamic vibration absorber and a selection and installation method.

Patent code: ZL201711133363.2

证书号第3413087号

发明专利证书

发 明 名 称：一种磁流变弹性体半主动式动力吸振器及选型安装方法

发 明 人：文永蓬;周伟浩;孙倩;郭林生;宗志祥;邹钰;祁慧;纪忠辉

专 利 号：ZL 2017 1 1133363.2

专利申请日：2017年11月16日

专 利 权 人：上海工程技术大学

地 址：201620 上海市松江区龙腾路333号

授权公告日：2019年06月14日　　　授权公告号：CN 107939901 B

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第1页（共2页）

其他事项参见背面

ZHENG Shubin, PENG Lele, et al. An invention relates to a micro-grid solar charging pile and a charging method. Patent code: ZL201610554009.6

证书号第3189241号

发明专利证书

发 明 名 称：一种微网型太阳能充电桩及充电方法

发 明 人：郑树彬;彭乐乐;柴晓冬;张雯柏;王玉玲

专 利 号：ZL 2016 1 0554009.6

专利申请日：2016年07月14日

专 利 权 人：上海工程技术大学

地 址：201620 上海市松江区龙腾路333号

授权公告日：2018年12月21日　　授权公告号：CN 106208192 B

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2018年12月21日

第 1 页 (共 2 页)

其他事项参见背面

WENG Yongpeng, ZHEN Xiaoming, LI Fengen, ZHOU Weihao, ZONG Zhixiang, GUO Lingsheng, YING Borun, JI Zhonghui, Qi Hui. A utility model relates to a 3S model spokes structure of urban rail transit vehicle wheel. Patent code: ZL201710585351.7.

证书号第3752903号

发明专利证书

发 明 名 称：一种城市轨道交通车辆车轮的“3S”型辐板结构

发 明 人：文永蓬；郑晓明；李丰恩；周伟浩；宗志祥；郭林生；尹波润；纪忠辉；祁慧

专 利 号：ZL 2017 1 0585351.7

专利申请日：2017年07月18日

专 利 权 人：上海工程技术大学

地 址：201620 上海市松江区龙腾路333号

授权公告日：2020年04月14日　　　授权公告号：CN 107415576 B

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2020年04月14日

第1页（共2页）

其他事项参见续页

PENG Lele, ZHEN Shubin, CHAI Xiaodong, YANG Jian, LI Liming, YUAN Tianchen, ZHANG Wenbo. An invention relates to a solar power supply device and a control method. Patent code: ZL201610530460.4.

证书号第3219787号

发明专利证书

发 明 名 称：一种太阳能电源装置及控制方法

发 明 人：彭乐乐;郑树彬;柴晓冬;杨俭;李立明;袁天辰;张雯柏

专 利 号：ZL 2016 1 0530460.4

专利申请日：2016年07月07日

专 利 权 人：上海工程技术大学

地 址：201620 上海市松江区龙腾路333号

授权公告日：2019年01月18日　　授权公告号：CN 106160161 B

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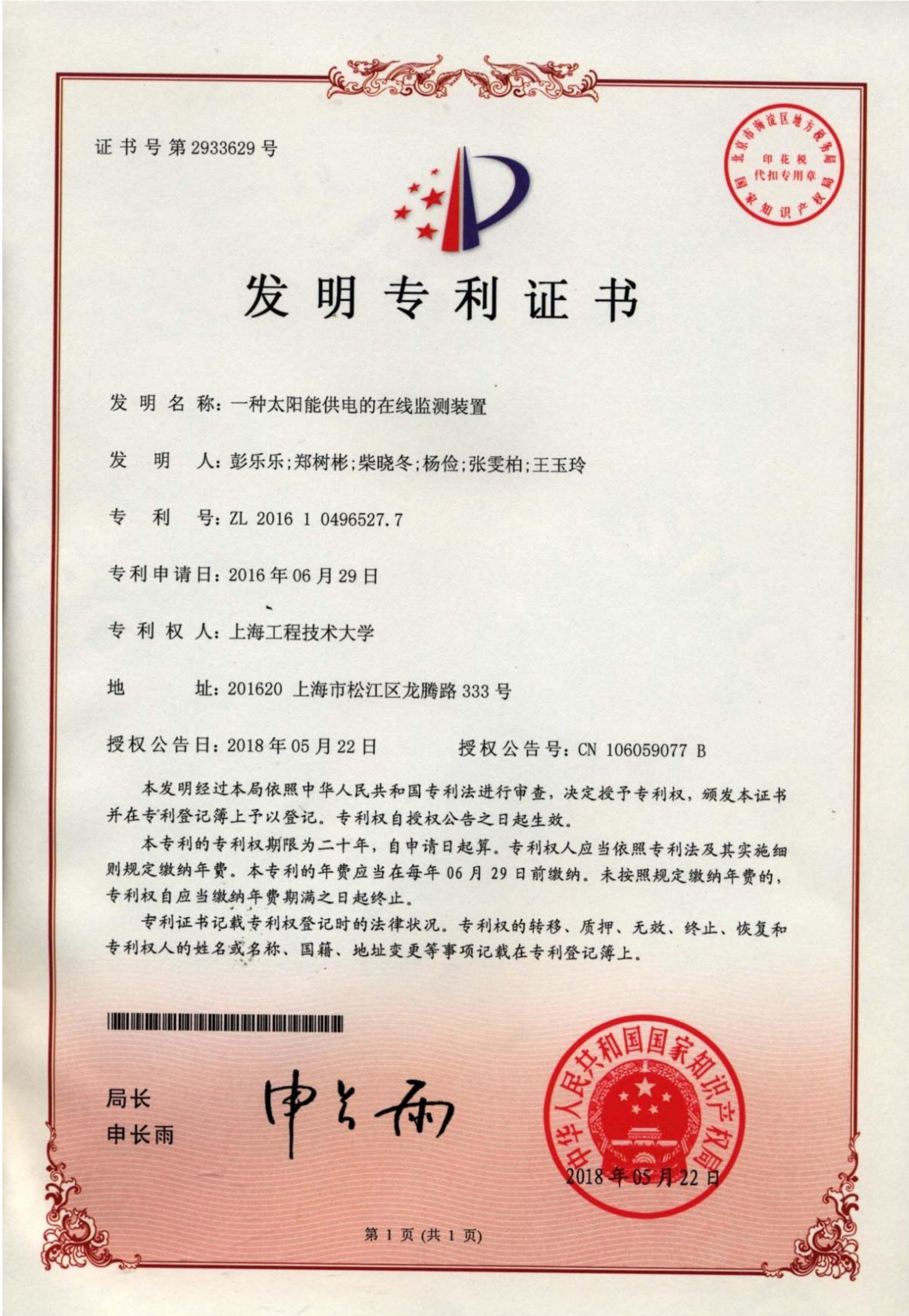
第1页（共2页）

其他事项参见背面

PENG Lele, ZHEN Shubin, CHAI Xiaodong, YANG Jian, ZHANG Wenbo, WANG Yuling. A utility model relates to an on-line monitoring device powered by solar energy. Patent code: ZL201610496527.7



证书号第2933629号

发明专利证书

发明名称：一种太阳能供电的在线监测装置

发明人：彭乐乐;郑树彬;柴晓冬;杨俭;张雯柏;王玉玲

专利号：ZL 2016 1 0496527.7

专利申请日：2016年06月29日

专利权人：上海工程技术大学

地址：201620 上海市松江区龙腾路333号

授权公告日：2018年05月22日　　授权公告号：CN 106059077 B

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2018年05月22日

第1页（共1页）

PENG Lele, ZHANG Wenbo, YANG Jian, CHAI Xiaodong, WANG Yuling. A utility model relates to a PHOTOVOLTAIC DC charging pile system. Patent code: ZL201610973550.0.

证书号第3591214号

发明专利证书

发 明 名 称：一种光伏直流充电桩系统

发　明　人：彭乐乐;张雯柏;杨俭;柴晓冬;王玉玲

专　利　号：ZL 2016 1 0973550.0

专利申请日：2016年11月07日

专 利 权 人：上海工程技术大学

地　　　址：201620 上海市松江区龙腾路333号

授权公告日：2019年11月12日　　　授权公告号：CN 106627202 B

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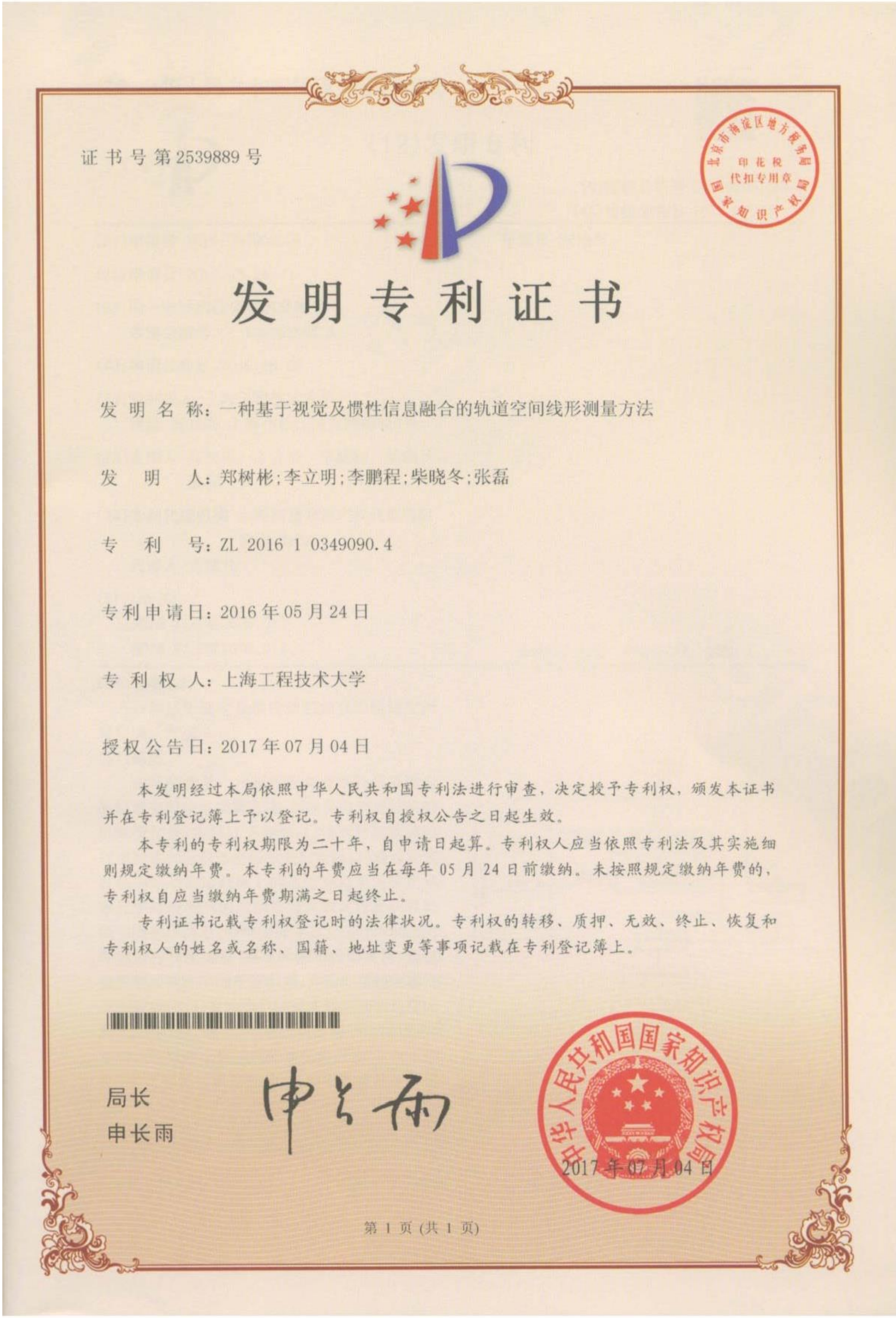
国家知识产权局
2019年11月12日

ZHEN Shubin, LI Liming, LI Pengchen, et al. A linear measurement method of rail space based on visual and inertial information fusion: Patent code: ZL201610349090.4



证书号第2539889号

发明专利证书

发 明 名 称：一种基于视觉及惯性信息融合的轨道空间线形测量方法

发 明 人：郑树彬；李立明；李鹏程；柴晓冬；张磊

专 利 号：ZL 2016 1 0349090.4

专利申请日：2016年05月24日

专 利 权 人：上海工程技术大学

授权公告日：2017年07月04日

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2017年07月04日

第1页（共1页）

WENG Yongpeng, ZOU Yu, JI Zhonghui, et al. A utility model relates to a built-in metal vibrator structure for vibration and noise reduction: Patent code: ZL201810549989.X

证书号第3582737号

发明专利证书

发明名称：一种钢轨的内置式金属振子减振降噪动力吸振器结构

发明人：文永蓬;邹钰;纪忠辉;祁慧;孙倩;尹波润;郭林生;宗志祥
郑晓明

专利号：ZL 2018 1 0549989.X

专利申请日：2018年05月31日

专利权人：上海工程技术大学

地址：201620 上海市松江区龙腾路333号

授权公告日：2019年11月05日　　授权公告号：CN 108708231 B

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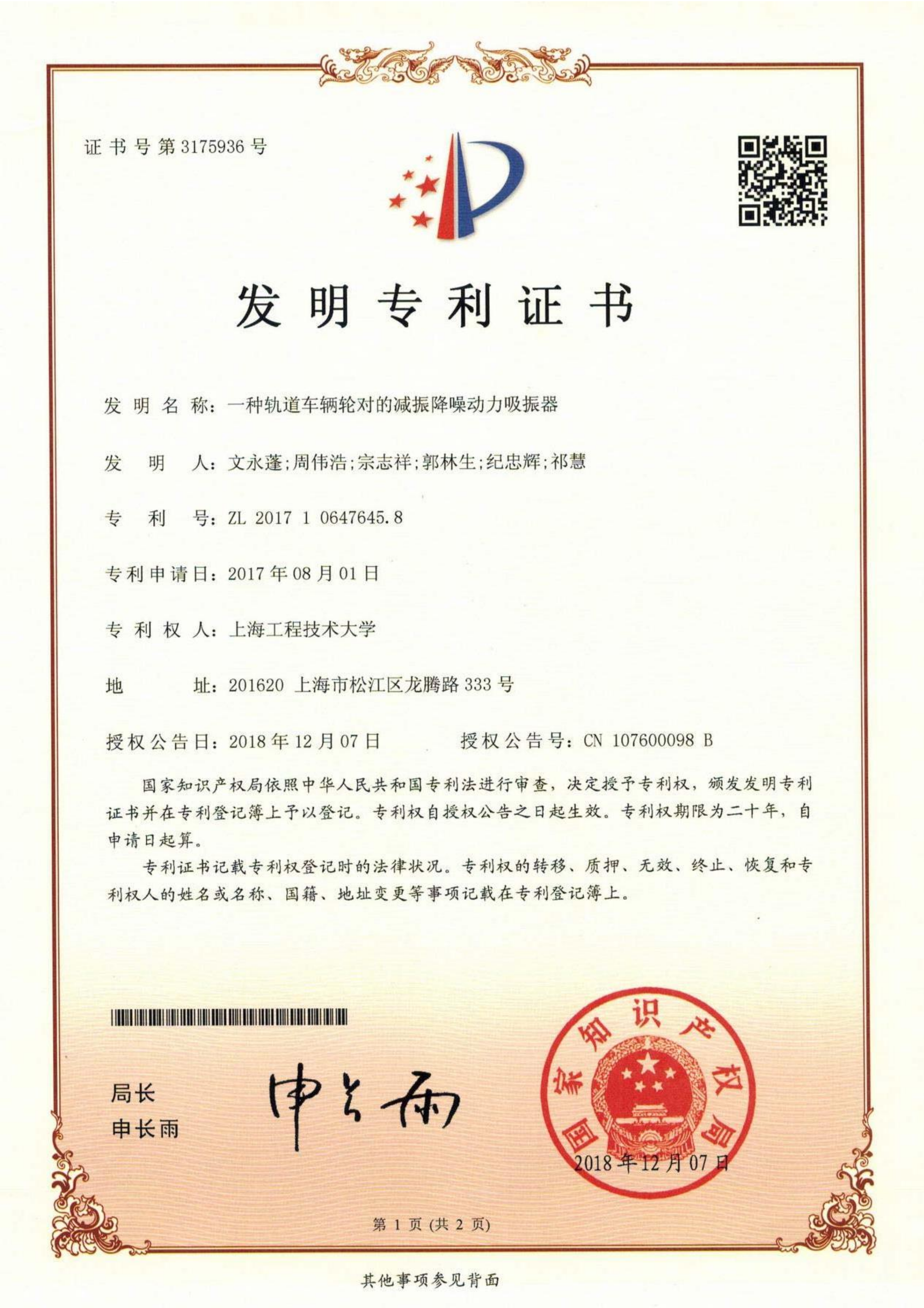
国家知识产权局
2019年11月05日

第1页（共2页）

其他事项参见背面

WENG Yongpeng, ZHOU Weihao, ZONG Zhixiang, et al. A utility model relates to a dynamic vibration absorber for vibration reduction and noise reduction of a rail vehicle wheel set: Patent code: ZL201710647645.8.



证书号第3175936号

发明专利证书

发 明 名 称：一种轨道车辆轮对的减振降噪动力吸振器

发　明　人：文永蓬；周伟浩；宗志祥；郭林生；纪忠辉；祁慧

专　利　号：ZL 2017 1 0647645.8

专利申请日：2017年08月01日

专 利 权 人：上海工程技术大学

地　　址：201620 上海市松江区龙腾路333号

授权公告日：2018年12月07日　　授权公告号：CN 107600098 B

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2018年12月07日

第 1 页 (共 2 页)

其他事项参见背面

SHI Wei, HU Yu. WENG Yongpeng, ZHOU Weihao, ZONG Zhixiang, GUO Lingsheng, JI Zhonghui, QI Hui. Urban rail vehicle control circuit and gas road semi-physical simulation teaching equipment: Patent code: ZL201610254744.5


证书号第3275562号

发明专利证书

发明名称：城市轨道车辆控制电路及气路半实物仿真教学设备

发明人：师蔚;扈宇

专利号：ZL 2016 1 0254744.5

专利申请日：2016年04月21日

专利权人：上海工程技术大学

地址：201620 上海市松江区龙腾路333号

授权公告日：2019年03月01日　　授权公告号：CN 105719528 B

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第1页（共2页）

其他事项参见背面

YANG Jian, CUI Qinxia, YUAN Tianchen, SONG Ruigang. A utility model relates to a device for recovering the vertical vibration energy of car frame and bogie. Patent code: ZL201711063530.0

证书号第3453600号

发明专利证书

发明名称：一种回收车架与转向架垂向振动能量的装置

发明人：杨俭；崔庆霞；袁天辰；宋瑞刚

专利号：ZL 2017 1 1063530.0

专利申请日：2017年11月02日

专利权人：上海工程技术大学

地址：201620 上海市松江区龙腾路333号

授权公告日：2019年07月12日　　授权公告号：CN 107872170 B

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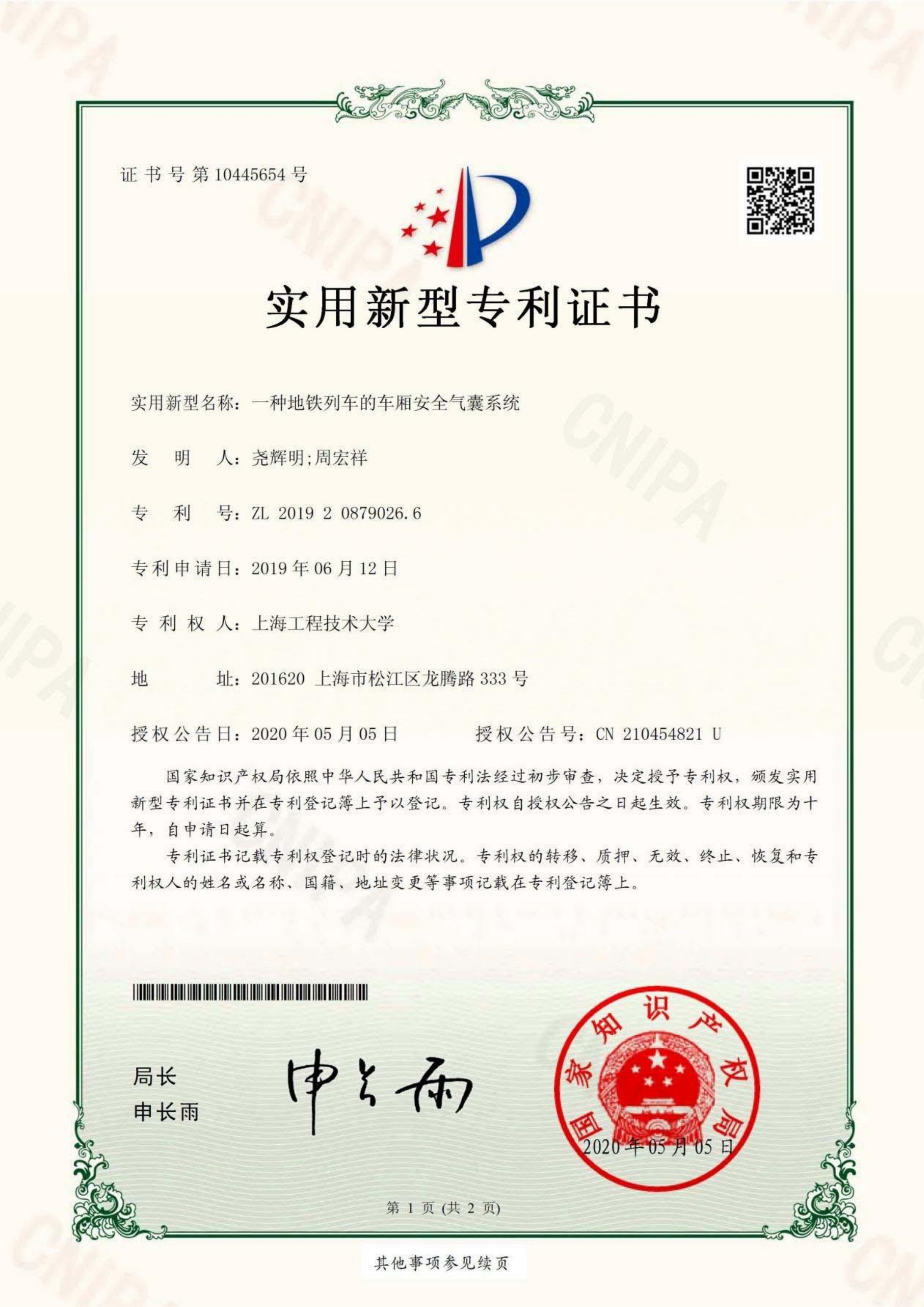
2019年07月12日

第1页（共2页）

其他事项参见背面

YAO Huiming, ZHOU Hongxiang. An air bag system in the carriage of a subway train:

Patent code: ZL201920879026.6



证书号第 10445654 号

实用新型专利证书

实用新型名称：一种地铁列车的车厢安全气囊系统

发 明 人：尧辉明;周宏祥

专 利 号：ZL 2019 2 0879026.6

专利申请日：2019 年 06 月 12 日

专 利 权 人：上海工程技术大学

地 址：201620 上海市松江区龙腾路 333 号

授权公告日：2020 年 05 月 05 日　　授权公告号：CN 210454821 U

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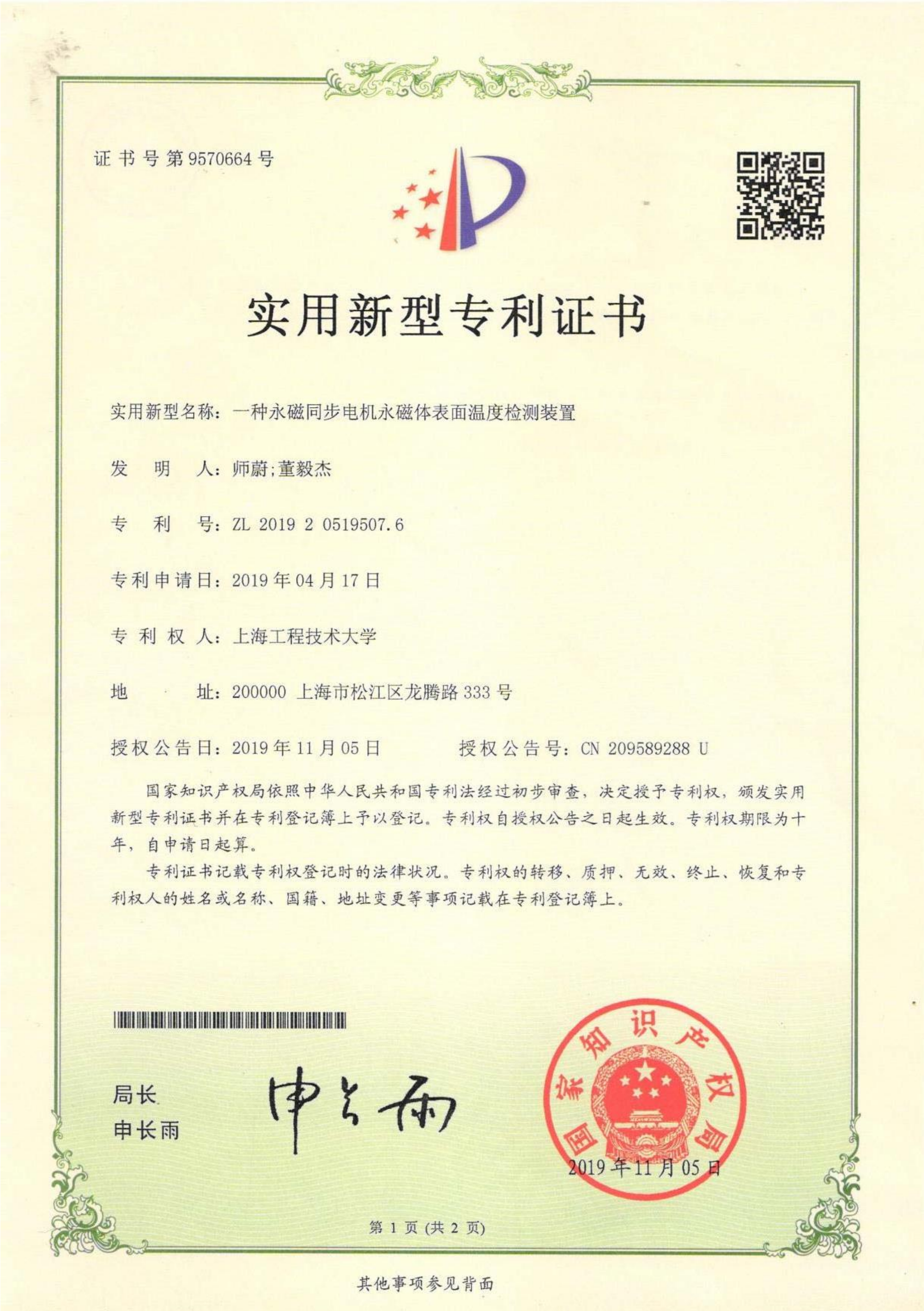
2020 年 05 月 05 日

第 1 页 (共 2 页)

其他事项参见续页

SHI Wei, Dong Yijie. An invention relates to a surface temperature detecting device for permanent magnet of permanent magnet synchronous motor. Patent code: ZL201920519507.6



证书号第9570664号

实用新型专利证书

实用新型名称：一种永磁同步电机永磁体表面温度检测装置

发　明　人：师蔚;董毅杰

专　利　号：ZL 2019 2 0519507.6

专利申请日：2019年04月17日

专 利 权 人：上海工程技术大学

地　　　址：200000 上海市松江区龙腾路333号

授权公告日：2019年11月05日　　　授权公告号：CN 209589288 U

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局长
申长雨

国家知识产权局
2019年11月05日

第1页（共2页）

其他事项参见背面

Dingyu Hu (4/5) “Research on fundamental theories of sound quality evaluation and vehicle interior noise control”, Shanghai Natural Science Award, 2019. Certificate number: 20192016-2-R04

上海市科学技术奖

证 书

为表彰上海市自然科学奖获得者，特颁发此证书。

项目名称：车内噪声声品质评价及控制的若干基础理论研究

获 奖 者：胡定玉

奖励等级：二等奖

上海市人民政府

2020年04月02日

证书号：20192016-2-R04

YANG Jian, SONG Ruigang, YUAN Tianchen, et al. Research and application of braking energy recovery technology based on on-board for urban rail vehicles, Third prize of Shanghai Science and Technology Progress Award, The Shanghai Municipal People's Government, 2018. Certificate number: 20184166-3-D01

上海市科学技术奖

证 书

为表彰上海市科技进步奖获得者，特颁发此证书。

项目名称：基于车载的城市轨道车辆制动能量回收技术研究及应用

获 奖 者：上海工程技术大学

奖励等级：三等奖

上海市人民政府

2019年01月10日

证书号：20184166-3-D01

ZHENG Shubin. Vision and inertia fusion of rail geometric state measurement key technology

Certificate number: 20174120-3-D01

上海市科学技术奖

证 书

为表彰上海市科技进步奖获得者，特颁发此证书。

项目名称：视觉与惯性融合的轨道几何状态测量关键技术

获 奖 者：上海工程技术大学

奖励等级：三等奖

上海市人民政府

2017年11月16日

证书号：20174120-3-D01

ZHENG Shubin, SHI Wei, LIAO Aihua, SHI Xuan, CHONG Lei, HUANG Yuanchun. The connotation promotion and practice of urban rail vehicle engineering with the goal of excellence plan. Certificate number: 063

上海工程技术大学教学成果奖

获奖证书

获奖成果：以“卓越计划”为目标的城市轨道车辆工程专业内涵提升与实践

获 奖 者：郑树彬、师蔚、廖爱华、石璇、冲蕾、黄远春

完成单位： 城市轨道交通学院

获奖等级： 三等奖

证书编号： 063

上海工程技术大学

二〇一四年五月

LIU Zhigang, CHAI Xiaodong, QIU Weihua, SONG Ruigang, HUANG Lu, CHEN Wenjie, HU Hua. With demand traction as the guide, realizing the characteristic innovation of the demonstration center of urban rail transit experimental teaching. Certificate number: 062

上海工程技术大学教学成果奖

获奖证书

获奖成果：以需求牵引为导向，实现城市轨道实验教学示范中心的特色创新

获 奖 者：刘志钢、柴晓冬、邱薇华、宋瑞刚、黄璐、陈文杰、胡华

完成单位：城市轨道交通学院

获奖等级：三等奖

证书编号：062

上海工程技术大学

二〇一四年五月

FANG Yu, YE Huaping, ZHU Haiyan, SHI Wei, LI Liming, HU Guo, XV Jianhua. Achievements and innovative experience in the construction of national Engineering Practice education Center of urban rail transit. Certificate number: 043

上海工程技术大学教学成果奖

获奖证书

获奖成果：城市轨道交通国家级工程实践教育中心建设成效与创新经验

获 奖 者 方宇、叶华平、朱海燕、师蔚、李立明、户国、徐建华

完成单位： 城市轨道交通学院

获奖等级： 二等奖

证书编号： 043

上海工程技术大学

二〇一四年五月

YANG Jian, YAO Huiming, Song Ruigang, SHU Qiping, LI Xiaobo, CHEN Xiaoli. Teaching and Practice of urban rail transit vehicle braking technology. Certificate number: 044

上海工程技术大学教学成果奖

获奖证书

获奖成果：“城市轨道交通车辆制动技术”的教学与实践

获 奖 者 杨俭、尧辉明、宋瑞刚、殳企平、李小波、陈晓丽

完成单位： 城市轨道交通学院

获奖等级： 二等奖

证书编号： 044

上海工程技术大学

二〇一四年五月

CHAI Xiaodong, FANG Yu, LIU Zhigang, LU Jiahua, HE Yuanlei, YE Huaping, ZHENG Shubin, YANG Jian, XV Jianhua, LI Liming. Construction and Application of teaching system of urban rail transit characteristic specialty group. Certificate number: 022

上海工程技术大学教学成果奖

获奖证书

获奖成果：城市轨道交通特色专业群教学体系建设与成果应用

获 奖 者：柴晓冬、方宇、刘志钢、鲁嘉华、何越磊、叶华平（申通地铁集团）、郑树彬、杨俭、 徐建华、李立明

完成单位： 城市轨道交通学院

获奖等级： 一等奖

证书编号： 022

上海工程技术大学

二〇一四年五月

CHAI Xiaodong, FANG Yu, LIU Zhigang, LU Jiahua, HE Yuanlei. Construction and Application of urban rail transit Characteristic specialty group education System. Certificate number: G-2-2013163

上海市级教学成果奖

获奖证书

获奖成果：城市轨道交通特色专业群教学体系建设与成果应用

获 奖 者：柴晓冬　方　宇　刘志钢　鲁嘉华　何越磊

完成单位：上海工程技术大学

获奖等级：二等奖

证书编号：G-2-2013163

上海市教育委员会

上海市人力资源和社会保障局

二〇一三年