Mechanical Optimization Design of Sugarcane Cane Species Stripping Method

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Abstract: The traditional method of harvesting sugarcane has no advantage and is inefficient. Mechanization harvesting is gradually gaining popularity, which leads to higher utilization rate of sugarcane harvester machinery. Feedback information based on actual field operation. The need for sugarcane harvester is no longer the basic requirement of breaking rate and low heterosis rate. It is to keep the sugarcane seedlings under the premise of keeping the leaves clean, so that they can be planted again in the second year. In this paper, a linear displacement sensor is added to automatically identify sugarcane sugarcane nodes and avoid the damage of sugarcane seedlings. Therefore, the rationality of sugarcane peeling is improved, and the benefit of mechanized harvesting of sugarcane is improved.

1 INTRODUCTION

Guangxi is the largest province of sugarcane cultivation in China, and the largest sugarcane and sugar production base in China. It's the most important sugar area in the country.

Sugarcane is an important production of sucrose raw material by using stem buds for asexual reproduction. At present, in the process of sugarcane stripping, the cane bud of sugarcane is destroyed, and the planting of sugarcane will be affected, thus affecting the development of the whole industry. It is of great significance to study how to avoid the cutting process of sugarcane peeling, and to realize the effective planting of sugarcane in the second year.

According to observation, sugar cane buds are long in the next to next to sugarcane stem section and, in the side of the sugar cane kind if use cameras to collect images may be taken less than sugarcane shoots and therefore cannot be directly by identifying sugarcane sprout methods to achieve the purpose of injury prevention buds. The stems of sugarcane species have the characteristics of a week around sugarcane, and can be accurately identified from any Angle. Therefore, this paper USES the identification of sugarcane planting stem to indirectly obtain the position of sugarcane bud to achieve the accurate identification of the sugarcane bud, and provides the accurate signal for the study of the control system.

This paper will use the MATLAB genetic algorithm and direct search toolbox (GADS), genetic algorithm and direct search toolbox extends the ability to deal with optimization problems in MATLAB, can be used to deal with traditional optimization technology is difficult to solve the problem, including those that are difficult to define or not convenient for mathematical modeling problem, can also be used to solve the problem of objective function is relatively complex. In this paper, MATLAB6.0 is used to solve the optimal design of sugarcane stripping device.

2 THE RESEARCH STATUS

First, Moshashai of Iran used the method of gray image threshold segmentation to make a preliminary study on sugarcane stem node identification. According to the characteristics of sugarcane grayscale image, the accuracy rate of the stalk festival was 88 percent. Lu is equal people introduce technology of machine vision recognition sugarcane stem section, the first by the support vector machine SVM (support vector machine) method of internodes

and internode classification, to identify to identify the clustering of the internodes class, obtain internodes number and position of internodes; Yellow is the person with Matlab as development platform, this paper proposes a of sugarcane stem section recognition method, through the gray processing, Sobel edge detection, combined with the mathematical morphology of expansion and corrosion, obtain the edge of the cane internodes straight line, identification of sugarcane stem section. Huang Yi Qi, Wang Xiao Bo et al. designed a strain - resistant strain - based sugarcane plant - resistant bud system. These research directions have high accuracy, but the feasibility is not high in actual production.

Stripping is the key process in the harvesting process of sugarcane. The quality of foliation directly affects the harvest quality of sugarcane. At present, the small leaf-stripping machine is divided into two types: tail feeding and root feeding. The stripping element in the rear feeding is mostly made of nylon brush. As the name implies, sugarcane is fed from the end of cane, and the cane is torn and removed under the action of reverse comb of the leaf brush. The root feeding machine mainly adopts nylon strip brush or rubber finger stripping element, and sugarcane is fed by sugarcane root to peel the leaves. The stripping element of the nylon strip is used to crack the sugarcane leaves and break the cane leaves. The Angle of the rubber finger can be wedged into the sheath, and the friction of the stem will peel off the leaves. The principle of the whole - pole cane harvester was basically the same as that of the root feeding.

At present, most studies have been carried out from heterogeneity, stem fracture rate, skin injury rate and the life of the stripping element. In our country, most of the sugarcane stripping device is centrifugal impingement, and its mechanism mainly consists of the input and output roller and the stripping roller. Stripping leaves components installed in a certain way on the strip leaf roller, work, stripping leaves components with high speed rotation roller impact on sugar cane, extrusion, friction and tear effect, making the sugarcane leaf peeling off.

3 DESIGN PRINCIPLE

To strip off leaf element structure size optimization analysis, first of all to analyze strip leaf element in the process of work stress: peel leaf element is at work is to rely on high speed rotating shell leaf element of sugarcane stalk push, friction, and makes the sugarcane leaves from. The stripping mechanism is mainly composed of input roller, output roller, stripping roller and frame.

In this paper, design of stripping leaves device is mainly composed of frame, type roller, 1 strip leaf roll, 2 strip leaf roller and output roller chain drive mechanism and motor etc plane diagram is shown in figure 1. In each part, the upper and lower rollers are included, and the rotation speed is the same with a four gear group, and the reverse is reversed. Generally speaking, it is not enough to have a set of leaf-stripping roller. In particular, the sugarcane leaves are more tightly packed. Therefore, we use two sets of stripping roller, the first and the second stage stripping roller. The speed is controlled by three motors respectively. The distance between the upper and lower input rollers is adjustable, and the horizontal distance of the roller is adjustable. In addition, the horizontal distance between the output roller and the stripping roller can be adjusted.

Feeding roller, stripping roller (including the first level stripping and second stripping roller) and the output drum are driven by the driving motor and driving chain and driving gear. The upper drum of each drum group can be driven by the floating gear connecting plate and the floating connecting plate, and the driving shaft is floating in the circular arc groove of the side plate. Under the force of rubber strip, the root of sugarcane is entered into the leaf roller. The elastic teeth of the stripping element are in contact with the cane leaves. After stripping, the sugarcane is output by the output roller.

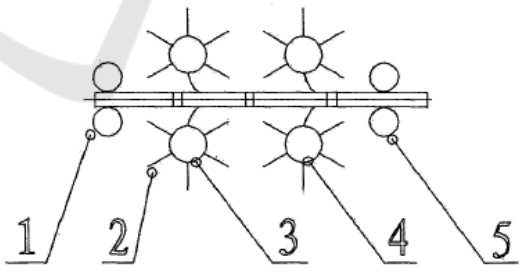

Fig.1 Schematic diagram of leaf-stripping device.
1. Output roller 2. Stripping element 3. First stage peeling roller 4. Second stage stripping roller 5. Input roller.

The device enters the roller to choose rubber material, and adopts the design method of hanging rubber on the input roller. The outer cylinder of rubber material can avoid the situation of damage to sugar cane in the case of greater pressure and friction. In order to increase the friction between

rubber drum and cane stem, it is necessary to use groove design for rubber roller.

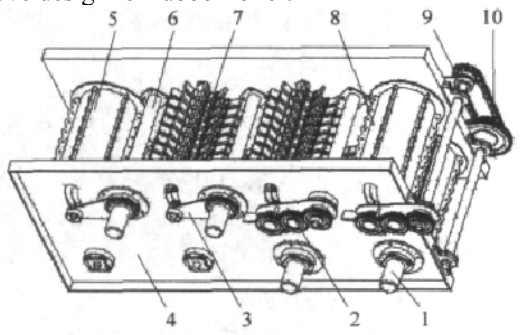

Fig.2 Structure of sugarcane leaf-stripping device.
1. Drive motor 2. Floating gear connecting plate 3. Floating connection plate 4. Side board 5. Feeding roller group 6. Drive shaft 7. Stripping roller 8. Output drum group 9. Transmission chain 10. Transmission gear train.

In order to make sure that the sugarcane leaves have low heterosis, at the same time it will not harm sugarcane seedling, especially a sugarcane stalk recognition device. The core component of this device is a one-way displacement sensor. The installation of the sensor shall be connected with a fixed shaft section. The fixed shaft is fixed on the base, side support plate and axial support plate. The sugarcane seedling is usually long on the stem node, and the one-way displacement sensor is selected here. In addition, the data acquisition equipment to be prepared is the data acquisition instrument and DASP data signal processing software.

The main design principle is that when sugar cane is introduced into the cane harvester through the feeding device, if the stripping element is rolled, it is the cane segment of the stem node, and the stripping element is normally stripped; When the sugarcane stalk is pushed through the roller, it is the sudden increase or decrease of the diameter of the sugarcane. In order to detect this floating change, a detection platform can be connected to the stripping element, which can reflect the compressed motion of the stripping element to the detection platform. At this point, the displacement value is measured by one-way displacement sensor, and the sensor output signal detects the position of the stem node.

The linear displacement sensor used in this experiment, also known as linear sensor, is a linear device belonging to metal induction. The function of the sensor is to convert the measured physical quantity into electricity. Generally speaking, it consists of pull rod, aluminum tube, circuit board, brush, brush holder, high frequency absorption circuit, end cover and assembly parts. The working principle is a sliding rheostat, which is used as a voltage divider to display the actual position of the measured position with relative voltage. The pull rod is connected with the brush equal to the resistance element for straight back and forth motion. When the measurement changes, the linear transformation is carried out between the resistance and the brush contact. The function of linear displacement sensor is to convert the mechanical linear displacement into electrical signal, and the signal can be proportional to the mechanical movement. The linear displacement sensor used in this paper is ktr-50, the power supply voltage is dc 24V, the output signal is 0-10v, the range is 50mm, and the maximum working speed of the probe is 5m/s. The precision can reach 0.05% of the range, i.e. 0.0025mm, which can meet the detection. The data acquisition system includes charge amplifier, data acquisition card, processor and display equipment.

4 OPTIMUM DESIGN OF SUGARCANE PEELING LEAVES

The stripping element is mounted on the stripping roller by means of the clamping device. When the leaf roller is rotating, it is mainly used to peel the leaves by the fingertip of the stripping element, and the root is fixed on the leaf roller. In this way, one end is fixed end, the other end is free, and the free end is bent. The deformation degree of the stripping element is large.

Fig.3 The Tester of Sugarcane Detaching machine.

5 MATLAB OPTIMIZATION ALGORITHM GEOMETRIC DESCRIPTION

MATLAB optimization technology mainly includes the following two aspects:

5.1 Mathematical Modelling

Use mathematical methods to describe optimization problems. Mathematical relations in the model reflect the goals and constraints to be achieved in the optimization problem. MATLAB commonly used mathematical model is:

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Error! Reference source not found. (linear equality constraints)

Error! Reference source not found. (nonlinear inequality constrained)

Error! Reference source not found. (non-linear equality constraints)

Error! Reference source not found. (The lower bound and the upper bound of x)

In the formula, x, beq, lb and ub are vectors, A and Aeq are matrices, c(x) and ceq(x) are functions.

Finally we measure the parameters of peeling leaves quality for impurity rate (y), y = (remaining amount of sugarcane leaf/sugarcane total quality after peeling leaves) x 100%, here with rubber resin as the shell element, through mathematical statistics software SPSS regression analysis of data, can get strip element mathematical model of the impurity rate

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Equation above is the regression value of the heterogeneity of rubber fat stripping element. Where x1 represents the input roller speed; x2 is the rotating speed of the stripping roller; The spacing of the horizontal direction between the input roller and the stripping roller; X4 is the output roller speed.

5.2 Mathematical Determination

After the mathematical model is built, a reasonable optimization method is selected to solve the problem. Due to mechanical optimization design is mostly nonlinear constraint minimum optimization problem, the commonly used method is by constructing penalty function and so on will have a constrained optimization problem into unconstrained optimization problems to solve. Here we use the sequential quadratic programming method (SQP method) to analyze. The implementation of SQP method in MATLAB is mainly divided into three steps:

(1) Update of the Lagrange function Hessian matrix;

(2) Quadratic programming problem solving;

(3) The calculation of one-dimensional search and objective functions.

5.3 The Calculation of One-Dimensional Search and Objective Functions.

In this paper, using the SQP method to solving nonlinear constrained optimization problems, stripping leaves device in MATLAB algorithm, to solve nonlinear optimization problems is mainly composed of femion function to achieve, their calls the format and syntax is as follows: x = fmincon(fun.X0,A,b,Aeq,beq,lb,ub,nonlcon,options) Results show that the optimal interval is: input roller speed range is 150-250 r/min, stripping leaves roller speed range is 600-900 r/min, stripping leaves roller speed range is 600-900 r/min, the input is 200-300 - mm, roller spacing interval output roller speed range is 280-350 r/min. After the optimization interval was determined, the regression equation was optimized by MATLAB, and the optimal value of y3min=0.3% was obtained. The optimization effect is the best.

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