Viser Technology Pte. Ltd.
Mechanical Engineering Science
DOI: 10.33142/mes.v7i1.16747

Research Article Open Access

# Design of Automatic Correction Device for Belt Conveyor

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**Abstract**

Belt conveyors are prone to problems such as conveyor belt deviation during operation. The main correction method is to adjust the angle of the roller frame, but the current adjustment is mostly manual. In order to solve the problem of low equipment transportation efficiency and low safety caused by conveyor belt deviation, a detection mechanism that can effectively detect conveyor belt deviation parameters is designed, and the working condition information is accurately transmitted to the PLC controller. If an abnormality is found, the designed correction device will correct the deviation, effectively ensuring the reliable and stable operation of the belt conveyor.

***Keywords:*** *belt conveyor; deviation correction; fully automatic*

## 1 Introduction

Belt conveyors have the advantages of long conveying distance, low manual intervention, reliable performance, easy maintenance, high efficiency and energy saving. They are widely used in chemical, mining, agriculture and other industries, saving a lot of costs for the transportation of large and small pieces. They play an important role in industrial assembly line operations, and their operation directly affects the stability of the entire production process. Among the failures that occur during the operation of belt conveyors, conveyor belt deviation is a major problem. "Deviation" is due to the unique dynamic characteristics and structure of belt conveyors. During the operation, the conveyor belt deviates from the established center line track due to uneven force.

Many scholars have conducted in-depth research on this issue. Wang Yemu [1] analyzed the causes of conveyor belt deviation and designed an automatic feeding and correction control system based on hydraulic power source and PLC control system for coal mine conveyor belts. The experimental results show that the automatic correction control system uses hydraulic devices to respond quickly to deviations and can correct the production affected by conveyor belt deviation in a short time. Yu Ruixiang [2] designed an automatic correction device based on machine vision technology. Through image preprocessing, feature extraction and other steps, it automatically identifies and extracts the angle deviation of image fault-deviation, records the fault image in real time and performs timely correction processing. It has greatly improved the correction accuracy and work efficiency.Zhao Puhui [3] proposed an active deviation correction scheme that integrates deviation detection, automatic deviation correction, and intelligent protection. The system uses a deviation correction vertical roller with a two-stage rotating mechanism as the core mechanism for deviation detection and correction, and designs a corresponding monitoring system. The experimental results show that the design realizes active belt deviation correction without human intervention. The traditional deviation correction process requires stopping the machine to correct the conveyor belt, which will affect the production progress and increase unnecessary working time [4]. Therefore, in response to the above problems, this paper designs a fully automatic deviation correction system for belt conveyors. The deviation correction is carried out by adjusting the swing angle of the roller frame, and the roller frame is controlled by a control system to achieve the purpose of fully automatic deviation correction. It can effectively reduce a series of indirect hazards such as resource waste, environmental pollution, and fire safety, and reduce the dependence of belt conveyor deviation correction on human resources, thereby forming a virtuous cycle in all aspects.

## 2 Structure Design Cheme of Automatic Correction Device

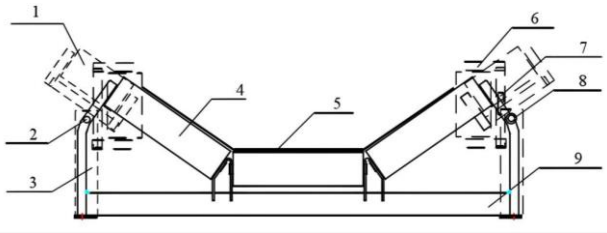
### 2.1 The overall structure of automatic correction device

The belt conveyor automatic deviation correction



Received on March 8th, 2025; Accepted on April 13, 2025

device consists of induction rollers, bearings and rotating shafts, bearing seats, support rollers, conveyor belts, detection roller fixing brackets, angle sensors, shaft rotation angle encoders, conveyor roller frames, etc., as shown in Figure 1.




1-induction roller;2-bearings and rotating shafts;3-bearing seats;4-support rollers;5-conveyor belts; 6-detection roller fixing brackets;7-angle sensors;8-shaft rotation angle encoders 9-conveyor roller frames

**Figure 1** Overall structure diagram of the fully automatic deviation correction system

### 2.2 Working principle of automatic deviation correction device

When the device is in use, the angle encoder 7 is connected to the rotating shaft 2 of the roller frame. When the conveyor belt 5 deviates, it will push the roller frame 1, thereby triggering the angle encoder 7. The angle encoder 8 transmits the signal to the controller, and the controller calculates the deviation amount according to the preset algorithm. The edge of the conveyor belt 5 is pushed to make the inclination sensor and the roller frame 1 swing. The inclination sensor transmits the inclination change signal to the controller, and the controller calculates the deviation angle accordingly; when the angle is detected to be offset, the push rod motor is started, and the push motor frame starts to move in the track. There is a correction roller and the auxiliary plate end hinged. When the push motor is in action, it calculates the offset distance according to the controller and automatically adjusts the position of the correction roller, so that the material is sorted.

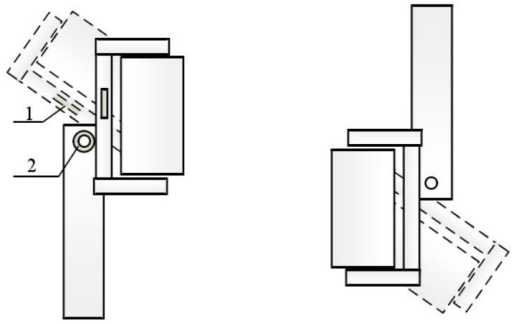
## 3 Automatic Correction Device Main System Design

The automatic correction device consists of three systems: detection system, correction system and control system.

### 3.1 Design of automatic correction device detection system

The detection system is used to detect the running position and running trend of the conveyor belt. The angle encoder is connected to the rotating shaft of the roller frame. When the conveyor belt deviates, it pushes the roller frame, thereby triggering the angle encoder [5]. The angle encoder transmits the signal to the controller, and the controller calculates the deviation amount according to the preset algorithm. The edge of the conveyor belt is pushed, causing the inclination sensor and the roller frame to swing. The inclination sensor transmits the inclination change signal to the controller, and the controller calculates the deviation angle based on it [6].

There are four ways to install the detection device. They are front detection, return detection, single-side detection and double-side detection, as shown in Figure 2. When installed on one side, the induction roller should be moved to the center line of the conveyor belt, and the offset of one side is used to determine the position of the conveyor belt; when installed on both sides, the signals of the two roller frames are detected by each other, and the conveyor belt position information obtained is more accurate.



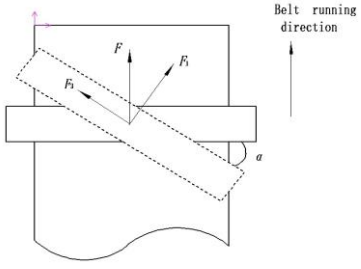

(a) Front deviation detection (b) Return deviation detection

1- Angle sensor; 2- Angle encoder

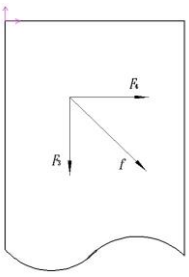
**Figure 2** Detection system installation diagram

### 3.2 Design of automatic correction device correction system

The deviation correction system designed in this paper corrects the deviation by adjusting the angle between the return roller and the running direction of the conveyor belt. When the conveyor belt deviates, the angle between the return roller and the running direction of the conveyor belt is adjusted so that the return roller generates a traction force to the conveyor belt [7]. The force analysis is shown in Figure 3. $\alpha$ is the change in the angle of the return roller, $F$ is the friction force exerted by the conveyor belt on the return roller, $F_1$ is the component force in the direction of rotation of the return roller, and $F_2$ is the component force in the direction of running of the conveyor belt. $F_1$ pulls the roller to rotate, and the $F_2$ roller generates a reverse friction force f on the conveyor belt. $F_4$ is the component force perpendicular to the running direction of the conveyor belt, thereby achieving the purpose of deviation correction.




(a) Traction force F of conveyor belt on return roller



(b) Friction resistance f of roller on conveyor belt

**Figure 3** Force analysis of roller angle change and correction

### 3.3 Design of control system for fully automatic deviation correction device

The control flow of the fully automatic deviation correction system is shown in Figure 4. The control system makes advance adjustments by predicting whether the conveyor belt has a tendency to deviate, and performs delayed deviation correction by detecting the current conveyor belt position. In this way, the conveyor belt running position can be controlled at the lowest cost. The prediction of the conveyor belt running trend is to analyze the recent trajectory of the conveyor belt, determine the conveyor belt deviation time, and issue adjustment commands to the drive device.

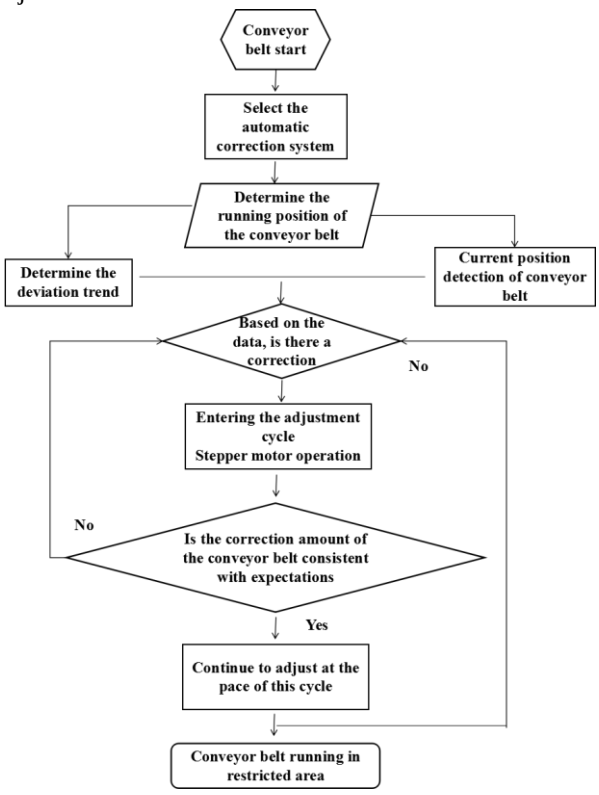



**Figure 4** Control flow chart of the fully automatic deviation correction system

## 4 Conclusion

This paper designs a fully automatic deviation correction system for belt conveyors. This system does not require human intervention and will greatly reduce production costs.

(1) Find out the reasons for the deviation of the conveyor belt when carrying different materials under different stress conditions; formulate dynamic conveyor belt deviation correction measures, and come up with a solution for using rollers for deviation correction.

(2) Design a deviation detection device. Calculate the deviation of the conveyor belt by detecting the movement amplitude of the roller frame, and analyze the calculation method of the relationship between the movement amplitude of the roller frame and the deviation.

(3) Use automatic control logic to design a fully automatic deviation correction control system for belt conveyors, and predict and control the deviation in real time.

**Fund Projects:** The authors acknowledge the 2024 Yingkou Institute of Technology Undergraduate Innovation and Entrepreneurship Training Program; Yingkou Institute of Technology school-level scientific research project (Grant: ZDIL202302).

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