Application research of solidworks in modeling of straw carbonization preparation plant

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Abstract. This article focuses on the basic overview, main functions of and specific applications solidworks software in the field of agricultural preparation. Namely the modeling design of the screw feeder in the orchard fertilizing machine, the design of a small elastic toothed pepper harvester and in-depth analysis of the application of various aspects such as the application of the sugarcane harvester drainage device design. In the meantime the in-depth study of the practicality and advancement of the Solidworks software in the field of agricultural preparation, as well as the specific use of the software and its advantages briefly stated. It is expected to play an important role in promoting the application of the software in the field of agricultural preparation and promote related enterprises to achieve greater development in the field of agricultural preparation and to improve the competitiveness of enterprises in the market in order to meet the needs of modern social and economic development.

1. Introduction

Solidworks software is essentially a three-dimensional (3D) solid model component system and an upgraded version of the computer aided design (CAD) 3D software modeling system developed by the Windows operating system [1]. Three-dimensional (3D) actually presents more intuitive and solid entities through three dimensions or three coordinates, and two-dimensional (2D) presents the graphics to be expressed by two coordinates. Built with parametric as the core driver, Solidworks software is equipped with powerful modeling functions and efficient modeling efficiency, which makes it stand out in many 3D modeling software and become one of the most easy to master software for operation and interface. Solidworks software has unique modular features, each with its own characteristics. For example, the sketch drawing module is the starting point for building complex models. It can simplify complex models and outline the most compact and clear 2D line drawings. This functional module is only the most basic module in the solidworks software module. It also includes multiple modules such as part design, assembly, engineering drawing, sheet metal design, mold design and motion simulation. Modules can be switched and modified, and their parts models, drawings, and assemblies are fully associative, and modifications to the model enable simultaneous updates.
2. Application research of Solidworks in agricultural preparation

With the rapid development of modern industry and agriculture and the expansion of production scale, material transportation has become one of the important processes in production. The application of Solidworks to the modeling and design of the screw feeding device in the orchard fertilizing machine. It can facilitate the accurate feeding of orchard in the agricultural production process, which greatly saves manpower and materials. In addition, Solidworks modeling has prepared for the static and modal analysis of the screw feeder of the orchard fertiliser, and also provides reference for the design of other screw conveyors [2]. Therefore, the application of Solidworks modeling to the agricultural field can be described as a bole. The following is a modeling design diagram of the screw feeding device in the orchard fertilizing machine using Solidworks software. The spiral mechanism can be visually observed in the following perspective view as shown in Figure 1. Such a spiral member can use the technology that is highly advantageous by Solidworks software, that is, parameterized size modeling technology. The size of the spiral can be modified to achieve the goal of optimizing the modeling pattern.

![Figure 1. Screw mechanism diagram [3].](image)

Solidworks has been widely used in agriculture. For example, the pepper planting industry has developed rapidly in recent years. At present, the area of planting is constantly expanding, and the manual picking of pepper by manpower has not been able to adapt to the current development. According to the actual planting mode of pepper and the physical and mechanical properties of the pepper, a small elastic toothed pepper harvester needs to be designed. It was modeled according to Solidworks modeling software and the components of the pepper harvester were analyzed in detail. Through the prototype trial and the picking test, the reasonable structural parameters and motion parameters were determined. The following perspective view as shown in Figure 2 is the modeling of the main components of the pepper harvester using Solidworks modeling software, which can be further analyzed in detail to finally obtain the desired results. Therefore, Solidworks modeling software has an excellent application effect in the field of agricultural preparation and the promotion degree also meets the actual needs.

![Figure 2. Main components of the pepper harvester [4].](image)

In addition, there are many examples of Solidworks applications in the field of agricultural preparation. For example, Solidworks 3D modeling of the sugarcane harvester discharge device
carefully analyzes the motion state, flow rate, velocity and pressure distribution of the internal airflow [5]. The following is the cover and rotation domain and grid division diagram of the sugarcane harvester discharge device. This is the unique advantage of the Solidworks software, that is, the finite element analysis function to mesh the internal appearance structure of the sugarcane harvester drainage device. Divide, and prepare for the next step of parameter simulation analysis. The following perspective view as shown in Figure 3.

![Figure 3. Cover and rotation fields and mesh map [5].](image)

The 3D model of the edamame picking device was established by Solidworks, which provided a solid foundation for the later finite element force simulation analysis. And it provided a reference for the design parameters of the picking device so as to innovate in the future. The following is a modeling diagram of the edama picking device, which is convenient for analyzing the intrinsic parameters and so on. The following perspective view as shown in Figure 4.

![Figure 4. Picking device [6].](image)

3. Comparative analysis of the advantages of Solidworks

Compared with the application of UG, PRO/E and CATIA modeling software in the field of agricultural equipment, Solidworks modeling software is more simple and easy to learn, widely used, basic functions can be realized. And beginners of modeling software can be obtained the intrinsic theme of solidworks in a short time. In summary, acquirement easily, operation, powerfulness and practicality has become the four highlights of the selection of Solidworks software for 3D modeling.

(1) The design modification of Solidworks is easy and convenient. It is easy to modify repeatedly in the design process. In the design process, the design interface is very simple and comfortable. Not only the dialog box is simple, it is convenient for the user to operate and the user can view and modify the program more conveniently.

(2) The virtual assembly of solidworks is powerful [2]. The implementation of virtual assembly helps to analyze and optimize the performance of unproduced products. In terms of solidworks assembly design, an assembly method that combines bottom-up, top-down, or a combination of both methods is provided. In this paper, the bottom-up design method is used to design all the parts of the carbonization furnace, and the 3D models of each part are inserted into the assembly environment one
by one according to the assembly sequence. This method conforms to the general engineering habits and is easy to grasp.

The advantages of Solidworks software and other simulation software in the field of agricultural equipment simulation are compared and analyzed. The technical advantages of Solidworks software are mainly reflected in the high degree of matching of the intersecting lines, which can make the intersections between the two planes or surfaces become neat, without secondary operation. In addition, the arbitrary selection and control of the datum is also the essence of other modeling software. The straw carbonization device is taken as an example for detailed analysis.

The first is the pedestal design of the carbonization furnace body. Using the sketching function in the main interface of Solidworks, the base of the carbonization furnace is drawn on the sketch as a 2D figure. Because the carbonization furnace is a cylindrical structure, the 2D graphics are mainly several concentric circles. The five concentric circles of the carbonization furnace body are designed. The total height of the carbonization furnace body is 2.5m, and the thickness of the furnace bottom is 5cm. The pedestal and the furnace body of the carbonization furnace body and the furnace body are used below by the characteristic stretching function in Solidworks software. The edge profile is stretched, and then the internal and stove door cuts are performed using the stretch cut function module and the feature array module, and the fine cuts of the 12 ignition ports are performed. The following perspective view as shown in Figure 5 and Figure 6 is the effect diagram after the stretch cut:

**Figure 5.** Stretch diagram of top of biochar furnace.

**Figure 6.** The profile and top view of the biochar furnace.

**Figure 7.** Complete internal diagram of biochar furnace.

**Figure 8.** Perspective after internal and external assembly of biochar furnace.

After designing the overall outline of the carbonization furnace and the ignition port, it is necessary to design the internal structure of the carbonization furnace including two rotating blades of the carbonization furnace for stirring the rice straw, in addition to, there are tar-removing piping designs and biochar-conveying pipelines. The appearance structure and internal structure design of the
carbonization furnace body are completed. Next, the assembly function option in solidworks software is applied to assemble the external structure and internal components of the carbonization furnace body. The following is a perspective view of the internal model of the carbonization furnace and the overall model of the assembled carbonization furnace: The following perspective view as shown in Figure 7 and Figure 8.

Final assembly drawing: The following perspective view as shown in Figure 9.

4. Results and discussion

In summary, solidworks software is widely used in the field of agricultural preparation including the design of spiral feeding system in the orchard fertilizing machine, the research of the line pepper harvesting machine, the application of the sugarcane harvester and the virtual simulation analysis of the soybean bean picking equipment in these areas of research. The examples of application in the field of agricultural preparation at various levels fully explain the important role of Solidworks software. This paper also focuses on the whole process of modeling the carbonization furnace with Solidworks software, which can prepare the relevant parameters required for the biochar preparation process, and provide a relatively complete model basis for the final analysis of the characteristics of the preparation device. The example of modeling the straw carbonization furnace by Solidworks software fully proves the positive effect of Solidworks software on the application of agricultural preparation and provides a powerful practical tool for the sustainable development of agriculture.

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