

PRECISION COMPENSATION METHOD AND SYSTEM FOR DOUBLE-SHAFT SCRIBING MACHINE

CROSS-REFERENCE TO RELATED APPLICATION

[001] The present disclosure claims the priority to the Chinese patent application with the filling No. 202211250440.3 filed with the Chinese Patent Office on October 13, 2022, and entitled “PRECISION COMPENSATION METHOD AND SYSTEM FOR DOUBLE-SHAFT SCRIBING MACHINE”, the contents of which are incorporated herein by reference in entirety.

TECHNICAL FIELD

[002] The present disclosure relates to the field of scribing machine compensation, and specifically, to a precision compensation method and system for a double-shaft scribing machine.

BACKGROUND ART

[003] The double-shaft scribing machine, as specialized equipment for an important process in wafer and IC packaging processing, has very high requirements for positioning accuracy. Due to the limited mechanical precision of the transmission system, it is difficult to meet the required specifications. Typically, a grating scale is mounted, and a compensation mechanism is adopted to improve the repeat positioning accuracy of the equipment, thereby improving the cutting accuracy of the double-shaft scribing machine.

[004] The existing grating compensation methods usually include mounting a visual module for the double-shaft scribing machine and using vision recognition for the linear scale to calibrate the unit stepping distance.

[005] Since there is usually a certain offset between the visual module and the cutting blade, and the grating compensation cannot achieve zero deviation throughout the entire process, there is a certain difference in accuracy between the visual module and the cutting blade, and the compensation accuracy cannot fully represent the cutting accuracy.

SUMMARY

[006] The objective of the present disclosure is to provide a precision compensation method and a system for a double-shaft scribing machine, which can improve the cutting accuracy of the double-shaft scribing machine.

[007] In order to achieve the above objective, the technical solution adopted by the present disclosure is as follows.

[008] In a first aspect, the present disclosure provides a precision compensation method for a double-shaft scribing machine.

[009] The double-shaft scribing machine includes a first Y-shaft, a second Y-shaft, a visual module, and a cutting table. The first Y-shaft includes a first main shaft, and the second Y-shaft includes a second main shaft. The first main shaft and the visual module are fixedly connected to the first Y-shaft. The cutting table is provided with a component to be cut or a linear scale. The method includes:

[010] controlling, during compensation for the visual module, the first Y-shaft to drive the visual module to move to a reference marked line zero point of the linear scale, moving towards the second Y-shaft according to a unit stepping length of the linear scale, and recording a marked line image of the linear scale at the visual module after the movement;

[011] compensating the visual module based on a center point of a marked line in the marked line image and a center line of the marked line image;

[012] controlling the first main shaft of the first Y-shaft to cut the component to be cut, and determining a first image at the first main shaft, after completing the compensation of the visual module and when compensating the first Y-shaft;

[013] determining a first cutting distance of the first Y-shaft from the first image;

[014] compensating the first Y-shaft based on the first cutting distance;

[015] controlling the second Y-shaft to cut the component to be cut, after completing the compensation of the first Y-shaft and when compensating the second Y-shaft;

[016] acquiring the cutting image at the second Y-shaft; and

[017] compensating the second Y-shaft based on the cutting image.

[018] In optional embodiments, the step of compensating the visual module based on a center point of a marked line in the marked line image and a center line of the marked line image includes:

[019] determining a first center point of a scale in the marked line image and a first center line of the marked line image;

[020] determining a first distance between the first center point and the first center line; and

[021] compensating the visual module based on the first distance.

[022] In optional embodiments, the method further comprises:

[023] outputting prompt information when the first distance is greater than a preset value, to alert the user to inspect the double-shaft scribing machine.

[024] In optional embodiments, the step of compensating the first Y-shaft based on the first cutting distance includes:

[025] determining an offset value corresponding to the first cutting distance, wherein the offset value characterizes an interval between the visual module and the first main shaft, with different first cutting distances corresponding to different offset values; and

[026] compensating the first Y-shaft based on the offset value.

[027] In optional embodiments, the step of compensating the second Y-shaft based on the cutting image includes:

[028] determining a cutting position of a cutting mark in the cutting image and a preset cutting point of the component to be cut, wherein the preset cutting point is the theoretical cutting position of the cutting mark in the cutting image;

[029] determining a first deviation value between the cutting position and the preset cutting point; and

[030] compensating the second Y-shaft based on the first deviation value.

[031] In optional embodiments, the method further comprises:

[032] controlling the first Y-shaft to cut the component to be cut in a preset distance;

[033] determining a total cutting distance of the component to be cut;

[034] calculating a difference value between the total cutting distance and the preset cutting distance, as a second cutting distance for the second Y-shaft; and

[035] the step of controlling the second Y-shaft to cut the component to be cut includes:

[036] controlling the second Y-shaft to cut the component to be cut in the second cutting distance; and

[037] the step of compensating the second Y-shaft based on the cutting image includes:

[038] determining a second deviation value between the cutting position in the cutting image and a target position corresponding to the second cutting distance; and

[039] compensating the second Y-shaft based on the second deviation value.

[040] In optional embodiments, the method further comprises:

[041] building a corresponding relationship between the offset value and the first cutting distance; and

[042] the step of building a corresponding relationship between the offset value and the first cutting distance includes:

[043] controlling the first Y-shaft to cut the component to be cut in different first cutting distances;

[044] determining, for each first cutting distance, a distance between the visual module and the first main shaft, as the offset value; and

[045] building a corresponding relationship between different first cutting distances and their corresponding offset values.

[046] In optional embodiments, the step of building a corresponding relationship between the offset value and the first cutting distance includes:

[047] recording the corresponding relationship between the offset value and the first cutting distance within different travel interval segments.

[048] In a second aspect, the present disclosure provides a precision compensation system for a double-shaft scribing machine, and the system includes a double-shaft scribing machine, a component to be cut, or a linear scale. The double-shaft scribing machine includes a Y-shaft base, a first Y-shaft, a second Y-shaft, a Z1 sliding plate, a Z2 sliding plate, a first main shaft, a second main shaft, a visual module, a cutting table, and a control unit.

[049] The visual module and the first main shaft are fixedly arranged on the first Y-shaft at a preset interval, and the second main shaft is arranged on the second Y-shaft.

[050] The first Y-shaft and the second Y-shaft move left and right on the Y-shaft base, with the Z1 sliding plate driving the first main shaft and the visual module to move up and down, and the Z2 sliding plate driving the second main shaft to move up and down.

[051] The linear scale or the component to be cut is fixedly arranged on the cutting table.

[052] The visual module is configured to acquire the corresponding marked line image at the visual module after the first Y-shaft moves from the reference marked line zero point of the linear scale according to the unit stepping length.

[053] The control unit is configured for compensating the visual module based on a center point of a marked line in the marked line image and a center line of the marked line image.

[054] When compensating the first Y-shaft, the visual module is configured to acquire the first image after the first main shaft of the first Y-shaft cuts the component to be cut.

[055] The control unit is configured for determining the first cutting distance of the first Y-shaft based on the first image and compensating the first Y-shaft based on the first cutting distance.

[056] The visual module is configured for acquiring the cutting image at the second Y-shaft after the second main shaft of the second Y-shaft cuts the component to be cut.

[057] The control unit is configured for compensating the second Y-shaft based on the cutting image.

[058] The present disclosure has the following beneficial effects.

[059] In the present disclosure, by first compensating the visual module of the double-shaft scribing machine based on the linear scale; compensating the first Y-shaft and the second Y-shaft of the double-shaft scribing machine after the visual module compensation is complete; compensating the first Y-shaft by determining the cutting distance in the first image at the first Y-shaft; and controlling the second Y-shaft to cut the component to be cut, so as to obtain the cutting image for compensation, after the three components, i.e., the visual module, the first Y-shaft and the second Y-shaft, are all compensated, the cutting precision of the double-shaft scribing machine is improved.

BRIEF DESCRIPTION OF DRAWINGS

[060] In order to more clearly illustrate the technical solutions of the embodiments of the present disclosure, the following will briefly introduce the drawings used in the embodiments. It should be understood that the following drawings only show some embodiments of the present disclosure, and therefore it should not be regarded as a limitation on the scope. Those ordinary skilled in the art can also obtain other related drawings based on these drawings without inventive effort.

[061] FIG. 1 is a flow diagram of a precision compensation method for a double-shaft scribing machine provided in the embodiment of the present disclosure;

[062] FIG. 2 is another flow diagram of a precision compensation method for a double-shaft scribing machine provided in the embodiment of the present disclosure;

[063] FIG. 3 is another flow diagram of a precision compensation method for a double-shaft scribing machine provided in the embodiment of the present disclosure;

[064] FIG. 4 is a spatial schematic diagram of a first Y-shaft and a visual module provided in the embodiment of the present disclosure;

[065] FIG. 5 is another flow diagram of a precision compensation method for a double-shaft scribing machine provided in the embodiment of the present disclosure;

[066] FIG. 6 is another flow diagram of a precision compensation method for a double-shaft scribing machine provided in the embodiment of the present disclosure; and

[067] FIG. 7 is a structural schematic diagram of a precision compensation system for a double-shaft scribing machine provided in the embodiment of the present disclosure.

DETAILED DESCRIPTION OF EMBODIMENTS

[068] In order to make the objectives, technical solutions, and advantages of the embodiments of the present disclosure clearer, the technical solutions in the embodiments of the present disclosure will be clearly and completely described below in conjunction with the drawings in the embodiments of the present disclosure. It is evident that the described embodiments are part of the embodiments of the present disclosure, but not all of the embodiments. The components of the embodiments of the present disclosure described and illustrated in the drawings can typically be arranged and designed in various configurations.

[069] Therefore, the following detailed description of the embodiments of the present disclosure provided in the drawings is not intended to limit the scope of the present disclosure for which protection is claimed, but merely represents selected embodiments of the present disclosure. Based on the embodiments of the present disclosure, all other embodiments obtained by those skilled in the art without inventive effort shall fall within the scope of protection of the present disclosure.

[070] It should be noted that similar numerals and letters denote similar terms in the following drawings so that once an item is defined in one drawing, it does not need to be further discussed in subsequent drawings.

[071] In the description of the present disclosure, it should be noted that the terms “up”, “down”, “inner”, “outer”, and similar directional or positional terms are based on the orientation or positional relationship shown in the drawings, or they represent the customary orientation or positional relationship when the disclosed product is used. These terms are used solely for describing the present disclosure and simplifying the description, and do not indicate or imply that the device or component referred to must have a specific orientation, be constructed and operated in a particular orientation. Therefore, they should not be understood as limiting the scope of the present disclosure.

[072] In addition, the terms, such as “first” and “second”, are only used to distinguish the descriptive and are not to be construed as indicating or implying relative importance.

[073] In the description of the present disclosure, it should also be noted that unless otherwise clearly stipulated and limited, the terms “provide”, “mount”, “interconnect”, and “connect” should be understood in a broad sense, for example, it can be a fixed connection, a detachable connection, or an integral connection; it can be a mechanical connection or an electrical connection; and it can be a direct connection, an indirect connection through an intermediary, or

an internal communication between two components. Those of ordinary skill in the art can understand the meanings of the above terms in the present disclosure according to specific situations.

[074] After extensive research by the inventor, it was found that, since there is usually a certain offset between the visual module and the cutting blade of a double-shaft scribing machine, and the grating compensation cannot achieve zero deviation throughout the entire process, there is a certain difference in accuracy between the visual module and the cutting blade, and the compensation accuracy cannot fully represent the cutting accuracy. Moreover, the trend of dual-shaft compensation accuracy cannot be guaranteed to be the same, and the dual-shaft positioning accuracy during cutting is affected by each other.

[075] In view of the discovery of the above problems, the present embodiments provide a precision compensation method and a system for a double-shaft scribing machine. By first compensating the visual module of the double-shaft scribing machine based on the linear scale; compensating the first Y-shaft and the second Y-shaft of the double-shaft scribing machine after the visual module compensation is complete; compensating the first Y-shaft by determining the cutting distance in the first image at the first Y-shaft; and controlling the second Y-shaft to cut the component to be cut, so as to obtain the cutting image for compensation, after the three components, i.e., the visual module, the first Y-shaft and the second Y-shaft are all compensated, the cutting precision of the double-shaft scribing machine is improved. The solution provided by the embodiments is described in detail below.

[076] Referring to FIG. 1, FIG. 1 is a flowchart of a precision compensation method for a double-shaft scribing machine. The following will provide a detailed explanation of each step in the method.

[077] The double-shaft scribing machine includes a first Y-shaft, a second Y-shaft, a visual module, and a cutting table. The first Y-shaft includes a first main shaft, and the second Y-shaft includes a second main shaft. The first main shaft and the visual module are fixedly connected to the first Y-shaft. The cutting table is provided with a component to be cut or a linear scale.

[078] Step 101: controlling, during compensation for the visual module, the first Y-shaft to drive the visual module to move to a reference marked line zero point of the linear scale, moving towards the second Y-shaft according to a unit stepping length of the linear scale, and recording a marked line image of the linear scale at the visual module after the movement.

[079] Step 102: compensating the visual module based on a center point of a marked line in the marked line image and a center line of the marked line image.

[080] Step 103: controlling the first main shaft of the first Y-shaft to cut the component to be cut, and determining a first image at the first main shaft, after completing the compensation of the visual module and when compensating the first Y-shaft.

[081] Step 104: determining a first cutting distance of the first Y-shaft from the first image.

[082] Step 105: compensating the first Y-shaft based on the first cutting distance.

[083] Step 106: controlling the second Y-shaft to cut the component to be cut, after completing the compensation of the first Y-shaft and when compensating the second Y-shaft.

[084] Step 107: acquiring the cutting image at the second Y-shaft.

[085] Step 108: compensating the second Y-shaft based on the cutting image.

[086] The linear scale is a length measuring and positioning device made of metal or glass, with accurately engraved equidistant parallel lines on its surface, also known as a scale ruler. The spacing between the lines on the linear scale is generally 1 mm or 0.1 mm.

[087] The linear scale is arranged on the cutting table, and the linear scale directly faces the visual module. The reference marked line zero point of the linear scale can be determined within the visual module. Starting from the reference marked line zero point, the visual module moves in the second Y-shaft according to a unit stepping length of the linear scale, and the marked line image of the linear scale at the position of the visual module after each movement is recorded. Based on each acquired marked line image, it is determined whether the lines in the marked line image align with the unit stepping length of the linear scale. If they do not align, the visual module is compensated based on the difference value between the lines in the marked line image and the unit stepping length of the linear scale.

[088] After completing the compensation of the visual module of the double-shaft scribing machine, the compensated visual module is used as a reference to compensate the first Y-shaft of the double-shaft scribing machine. The first main shaft of the first Y-shaft is controlled to cut the component to be cut, and after cutting, the first image is obtained at the first main shaft based on the visual module.

[089] It should be noted that there are various methods for controlling the first main shaft of the first Y-shaft to cut the component to be cut, for example, cutting can be started from the reference marked line zero point of the linear scale, and the start position and the end position, when the first main shaft of the first Y-shaft cuts the component to be cut, can also be recorded.

[090] In one example, when controlling the first main shaft of the first Y-shaft to start cutting from the reference marked line zero point of the linear scale, the cutting distance of the first Y-

shaft is directly determined from the acquired first image based on the lines of the current linear scale after the cutting is completed.

[091] In another example, when controlling the first main shaft of the first Y-shaft to start cutting from any position, the cutting distance of the first Y-shaft is determined based on the starting position and the ending position of the cut.

[092] Ultimately, the first Y-shaft is compensated based on the cutting distance of the first Y-shaft.

[093] After compensating the first Y-shaft, the second Y-shaft is then compensated. There are multiple methods for compensating the second Y-shaft. In one example, the second Y-shaft is controlled to cut the component to be cut, and the second Y-shaft moves towards the first Y-shaft for cutting. The cutting image at the second Y-shaft is obtained, and the second Y-shaft is compensated based on the cutting image.

[094] In another example, after the compensation of the first Y-shaft is completed, the movement and cutting of the second Y-shaft are consistent with the required cutting and movement distances. In this case, the first Y-shaft and the second Y-shaft can be controlled to cut the component to be cut oppositely at the same time, with the first Y-shaft moving towards the second Y-shaft and the second Y-shaft moving towards the first Y-shaft, thereby allowing the compensation of the second Y-shaft based on the cutting distance of first Y-shaft and the cutting distance of the second Y-shaft.

[095] In the present disclosure, by first compensating the visual module of the double-shaft scribing machine based on the linear scale; compensating the first Y-shaft and the second Y-shaft of the double-shaft scribing machine after the visual module compensation is complete; compensating the first Y-shaft by determining the cutting distance in the first image at the first Y-shaft; and controlling the second Y-shaft to cut the component to be cut, so as to obtain the cutting image for compensation, after the three components, i.e., the visual module, the first Y-shaft and the second Y-shaft are all compensated, the cutting precision of the double-shaft scribing machine is improved. Moreover, the present disclosure allows for compensation of the double-shaft scribing machine without the need for additional aiming devices or other compensation components, resulting in lower costs.

[096] There are various ways of compensating the visual module, and in an example, as shown in FIG. 2, a flow diagram of a precision compensation method for a double-shaft scribing machine provided in the present disclosure specifically includes the following steps.

[0097] Step 102-1: determining a first center point of a scale in the marked line image and a first center line of the marked line image.

[0098] Step 102-2: determining a first distance between the first center point and the first center line.

[0099] Step 102-3: compensating the visual module based on the first distance.

[0100] The first distance between the first center point in the marked line image and the first center line of the marked line image is determined. When the first distance is positive, the next movement distance of the visual module is controlled to be the difference value between the unit stepping length and the first distance; when the first distance is negative, the next movement distance of the visual module is controlled to be the sum of the unit stepping length and the first distance.

[0101] The prompt information is output when the first distance is greater than a preset value, to alert the user to inspect the double-shaft scribing machine.

[0102] When the first distance is greater than the preset value, it indicates that the precision of the double-shaft scribing machine cannot be improved through compensation of the double-shaft scribing machine. Therefore, when the first distance is too large, exceeding the preset value, prompt information for prompting the user or operator is output.

[0103] It should be noted that the preset distance can be set by those skilled in the art according to practical circumstances, and the embodiments of the present disclosure do not impose specific restrictions on this.

[0104] There are various ways to compensate the first Y-shaft based on the first cutting distance, and in an example, as shown in FIG. 3, a flow diagram of a precision compensation method for a double-shaft scribing machine provided in the present disclosure specifically includes the following steps.

[0105] Step 105-1: determining the offset value corresponding to the first cutting distance,

[0106] wherein the offset value characterizes an interval between the visual module and the first main shaft, with different first cutting distances corresponding to different offset values.

[0107] Step 105-2: compensating the first Y-shaft based on the offset value.

[0108] A fixed difference value is present in the space between the visual module and the first main shaft of the first Y-shaft. As shown in FIG. 4, this is a spatial schematic diagram of the first Y-shaft and the visual module.

[0109] Due to hardware characteristics, the difference value is dynamically changing across the entire travel range of Y1 and Y2 shafts; thus, the interval between the visual module and the first

Y-shaft also varies at different travels. Therefore, by cutting through fixed intervals, finding the offset value, which is the difference value between the knife marks of the first main shaft obtained by the visual module and the coordinates of the first Y-shaft within different travel ranges, a corresponding relationship is formed, with the cutting distance as the X-axis and the deviation value as the Y-axis. Through the first cutting distance, the offset value of the Y-shaft can be determined based on the above corresponding relationship, and the first Y-shaft can be compensated based on the offset value.

[0110] For example, when the cutting distance is 10 mm, if the offset value corresponding to 10 mm in the corresponding relationship is determined to be 0.3 mm, then when the first Y-shaft cuts a knife mark of 10 mm, the distance observed by the visual module is 9.7 mm, and it is required that the first Y-shaft moves 10.3 mm to ensure that the cutting distance of the first Y-shaft is 10 mm.

[0111] The relationship between the first distance and the offset value can be selected for a subsequent learning mode. In the mode, the corresponding relationship will be recorded over a period of time, and once a certain scale is reached or the difference value between two adjacent coordinates is less than a certain limit, the corresponding relationship can be further refined to obtain an approximate curve, thus achieving a complete compensation effect over the entire travel. In other words, the corresponding relationship between the offset value and the first cutting distance within different travel interval segments is recorded.

[0112] There are many ways to build the corresponding relationship between the first distance and the offset value, and in an example, the following method can be used: controlling the first Y-shaft to cut the component to be cut in different first cutting distances; determining, for each first cutting distance, a distance between the visual module and the first main shaft, as the offset value; and building a corresponding relationship between different first cutting distances and their corresponding offset values.

[0113] There are various ways to compensate the second Y-shaft based on the cutting image, and in an example, as shown in FIG. 5, a flow diagram of a precision compensation method for a double-shaft scribing machine provided in the present disclosure specifically includes the following steps.

[0114] Step 108-1: determining a cutting position of a cutting mark in the cutting image and a preset cutting point of the component to be cut,

[0115] wherein the preset cutting point is the theoretical cutting position of the cutting mark in the cutting image.

[0116] Step 108-2: determining a first deviation value between the cutting position and the preset cutting point.

[0117] Step 108-3: compensating the second Y-shaft based on the first deviation value.

[0118] The second Y-shaft is controlled to perform cutting on the preset cutting point of the component to be cut. When the second Y-shaft does not require compensation, after the second Y-shaft completes the cutting, the final cutting position in the cutting image will coincide with the preset cutting point. When the second Y-shaft requires compensation, the final cutting position in the cutting image will not coincide with the preset cutting point. In this case, the first deviation value between the final cutting position and the preset cutting point is determined, and the second Y-shaft is compensated based on the first deviation value.

[0119] In another example, as shown in FIG. 6, a flow diagram of a precision compensation method for a double-shaft scribing machine provided in the present disclosure specifically includes the following steps.

[0120] Step 201: controlling the first Y-shaft to cut the component to be cut in a preset distance.

[0121] Step 202: determining a total cutting distance of the component to be cut.

[0122] Step 203: calculating a difference value between the total cutting distance and the preset cutting distance, as a second cutting distance for the second Y-shaft.

[0123] Step 204: controlling the second Y-shaft to cut the component to be cut in the second cutting distance.

[0124] Step 205: determining a second deviation value between the cutting position in the cutting image and a target position corresponding to the second cutting distance.

[0125] Step 206: compensating the second Y-shaft based on the second deviation value.

[0126] In one example, after the compensation of the first Y-shaft is completed, the first Y-shaft and the second Y-shaft are controlled to perform cutting on the component to be cut, and the cutting directions of the first Y-shaft and the second Y-shaft are in opposite directions. Additionally, the first Y-shaft is controlled to cut the preset distance.

[0127] Since the total length of the component to be cut is constant, which means that the total cutting distance of the component to be cut is constant, when the first Y-shaft and the second Y-shaft need to cut to the preset position of the component to be cut, the first Y-shaft cuts the preset distance of the component to be cut, and the remaining distance of the total cutting distance is the second cutting distance. At this time, the endpoint of the second cutting distance is the target position of the component to be cut. When the first Y-shaft and the second Y-shaft do not require compensation, the final cutting position of the first Y-shaft coincides with the target position of

the component to be cut, and the final cutting position of the second Y-shaft coincides with the target position of the component to be cut. Since the first Y-shaft has been compensated, based on the preset cutting distance of the first Y-shaft and the second cutting distance of the second Y-shaft, the compensation parameters of the second Y-shaft can be determined.

[0128] When there is a deviation value between the sum of the second cutting distance of the second Y-shaft and the preset cutting distance, and the total cutting distance of the component to be cut, the deviation value is the second deviation value, and the second Y-shaft is compensated based on the second deviation value.

[0129] When the sum of the second cutting distance of the second Y-shaft and the preset cutting distance is consistent with the total cutting distance of the component to be cut, it indicates that the second Y-shaft does not require compensation.

[0130] Referring to FIG. 7, the embodiments of the present disclosure provide a precision compensation system for a double-shaft scribing machine. The system includes a double-shaft scribing machine, and the double-shaft scribing machine includes:

[0131] a Y-shaft base 301, a first Y-shaft 302, a second Y-shaft 303, a Z1 sliding plate 304, a Z2 sliding plate 305, a first main shaft 306, a second main shaft 307, and a visual module 308. The precision compensation system of the double-shaft scribing machine also includes a linear scale 309 or a component to be cut.

[0132] The double-shaft scribing machine further includes a cutting table and a control unit, with the control unit arranged inside the double-shaft scribing machine.

[0133] The visual module and the first main shaft are fixedly arranged on the first Y-shaft at a preset interval, and the second main shaft is arranged on the second Y-shaft. The first Y-shaft and the second Y-shaft move left and right on the Y-shaft base, with the Z1 sliding plate driving the first main shaft and the visual module to move up and down, and the Z2 sliding plate driving the second main shaft to move up and down. The linear scale or the component to be cut is fixedly arranged on the cutting table. The visual module is configured to acquire the corresponding marked line image at the visual module after the first Y-shaft moves from the reference marked line zero point of the linear scale according to the unit stepping length. The control unit is configured for compensating the visual module based on a center point of a marked line in the marked line image and a center line of the marked line image; When compensating the first Y-shaft, the visual module is configured to acquire the first image after the first main shaft of the first Y-shaft cuts the component to be cut. The control unit is configured for determining the first cutting distance of the first Y-shaft based on the first image

and compensating the first Y-shaft based on the first cutting distance. The visual module is configured for acquiring the cutting image at the second Y-shaft after the second main shaft of the second Y-shaft cuts the component to be cut. The control unit is configured for compensating the second Y-shaft based on the cutting image.

[0134] The visual module is a microscope.

[0135] To sum up, in the present disclosure, by first compensating the visual module of the double-shaft scribing machine based on the linear scale; compensating the first Y-shaft and the second Y-shaft of the double-shaft scribing machine after the visual module compensation is complete; compensating the first Y-shaft by determining the cutting distance in the first image at the first Y-shaft; and controlling the second Y-shaft to cut the component to be cut, so as to obtain the cutting image for compensation, after the three components, i.e., the visual module, the first Y-shaft and the second Y-shaft are all compensated, the cutting precision of the double-shaft scribing machine is improved.

[0136] In the embodiments provided in the present disclosure, it should be understood that the devices and methods disclosed can be implemented in other ways. The embodiments of the device described above are merely illustrative. For example, the flowcharts and diagrams in the drawings illustrate possible implementations, architectures, functions, and operations of devices, methods, and computer program products according to multiple embodiments of the present disclosure. At this point, each box in the flowchart or diagram can represent a module, program segment, or part of the code. Each part of the module, program segment, or code includes one or more executable instructions for implementing the specified logical functions. It should also be noted that in some alternative implementations, the functions indicated in the boxes may occur in a different order than those indicated in the drawings. For example, two consecutive boxes can actually be executed in parallel, and sometimes they can also be executed in reverse order, depending on the functionality involved. It should also be noted that each box in the block diagram and/or flowchart, and the combination of boxes in the block diagram and/or flowchart, can be implemented by specialized hardware systems designed to perform the specified functions or actions, or by a combination of specialized hardware and computer instructions.

[0137] Further, each functional module in each embodiment of the present disclosure can be integrated together to form a separate part, or each module may exist separately, or two or more modules may be integrated to form a separate part. The functionality, when implemented as a software functional module and sold or used as a stand-alone product, can be stored in a computer-readable storage medium. Based on this understanding, the technical solution of the

present disclosure in essence, the part that contributes to the prior art, or the part of the technical solution can be embodied in the form of a software product. The computer software product is stored in a storage medium and includes several instructions that enable a computer device (which can be a personal computer, server, network device, etc.) to execute all or part of the steps of the methods described in various embodiments of the present disclosure. The aforementioned storage media include various media that can store program code, such as USB drives, external hard drives, read-only memory (ROM), random access memory (RAM), disks, or optical discs.

[0138] It is important to note that, in the context, relationship terms such as first and second are used only to distinguish one entity or operation from another entity or operation, without necessarily requiring or implying any such actual relationship or order between those entities or operations. Furthermore, the terms “comprise”, “include”, or any other variations are intended to encompass non-exclusive inclusion. This allows a process, method, item, or device that includes a series of elements to not only include those elements but also include other elements that are not explicitly listed, or elements that are inherent to the process, method, item, or device. In the absence of further limitations, the inclusion of an element specified by the phrase "comprising a..." does not exclude the presence of additional identical elements in the process, method, article, or apparatus that includes the specified element.

[0139] The above are just various embodiments of the present disclosure, but the scope of protection of the present disclosure is not limited to the embodiments. Any variations or substitutions readily apparent to those skilled in the art within the technical scope disclosed in the present disclosure should be encompassed within the scope of protection of the present disclosure. Therefore, the scope of protection of the present disclosure shall be stated to be subject to the scope of protection of the claims.

CLAIMS

1. A precision compensation method for a double-shaft scribing machine, wherein the double-shaft scribing machine comprises a first Y-shaft, a second Y-shaft, a visual module, and a cutting table, the first Y-shaft comprises a first main shaft, the second Y-shaft comprises a second main shaft; the first main shaft and the visual module are fixedly connected to the first Y-shaft, and the cutting table is provided with a component to be cut or a linear scale; and the method comprises:
controlling, during compensation for the visual module, the first Y-shaft to drive the visual module to move to a reference marked line zero point of the linear scale, moving towards the second Y-shaft according to a unit stepping length of the linear scale, and recording a marked line image of the linear scale at the visual module after a movement;
compensating the visual module based on a center point of a marked line in the marked line image and a center line of the marked line image;
controlling the first main shaft of the first Y-shaft to cut the component to be cut, and determining a first image at the first main shaft, after completing the compensation for the visual module and when compensating the first Y-shaft;
determining a first cutting distance of the first Y-shaft from the first image;
compensating the first Y-shaft based on the first cutting distance;
controlling the second Y-shaft to cut the component to be cut, after completing the compensation for the first Y-shaft and when compensating the second Y-shaft;
acquiring a cutting image at the second Y-shaft; and
compensating the second Y-shaft based on the cutting image.
2. The precision compensation method for the double-shaft scribing machine according to claim 1, wherein the step of compensating the visual module based on a center point of a marked line in the marked line image and a center line of the marked line image comprises:
determining a first center point of a scale in the marked line image and a first center line of the marked line image;
determining a first distance between the first center point and the first center line; and
compensating the visual module based on the first distance.

3. The precision compensation method for the double-shaft scribing machine according to claim 2, wherein the method further comprises:
outputting prompt information when the first distance is greater than a preset value, to alert a user to inspect the double-shaft scribing machine.
4. The precision compensation method for the double-shaft scribing machine according to claim 1, wherein the step of compensating the first Y-shaft based on the first cutting distance comprises:
determining an offset value corresponding to the first cutting distance, wherein the offset value characterizes an interval between the visual module and the first main shaft, with different first cutting distances corresponding to different offset values; and
compensating the first Y-shaft based on the offset value.
5. The precision compensation method for the double-shaft scribing machine according to claim 1, wherein the step of compensating the second Y-shaft based on the cutting image comprises:
determining a cutting position of a cutting mark in the cutting image and a preset cutting point of the component to be cut, wherein the preset cutting point is a theoretical cutting position of the cutting mark in the cutting image;
determining a first deviation value between the cutting position and the preset cutting point;
and
compensating the second Y-shaft based on the first deviation value.
6. The precision compensation method for the double-shaft scribing machine according to claim 1, wherein the method further comprises:
controlling the first Y-shaft to cut the component to be cut in a preset distance;
determining a total cutting distance of the component to be cut;
calculating a difference value between the total cutting distance and the preset cutting distance, as a second cutting distance for the second Y-shaft; and
the step of controlling the second Y-shaft to cut the component to be cut comprises:
controlling the second Y-shaft to cut the component to be cut in the second cutting distance;
and
the step of compensating the second Y-shaft based on the cutting image comprises:

determining a second deviation value between a cutting position in the cutting image and a target position corresponding to the second cutting distance; and
compensating the second Y-shaft based on the second deviation value.

7. The precision compensation method for the double-shaft scribing machine according to claim 4, wherein the method further comprises:
building a corresponding relationship between the offset value and the first cutting distance;
and
the step of building a corresponding relationship between the offset value and the first cutting distance comprises:
controlling the first Y-shaft to cut the component to be cut in different first cutting distances;
determining, for each first cutting distance, a distance between the visual module and the first main shaft, as the offset value; and
building a corresponding relationship between different first cutting distances and corresponding offset values.
8. The precision compensation method for the double-shaft scribing machine according to claim 7, wherein the step of building a corresponding relationship between the offset value and the first cutting distance comprises:
recording the corresponding relationship between the offset value and the first cutting distance within different travel interval segments.
9. A precision compensation system for a double-shaft scribing machine, wherein the system comprises the double-shaft scribing machine, a component to be cut or a linear scale, and the double-shaft scribing machine comprises a Y-shaft base, a first Y-shaft, a second Y-shaft, a Z1 sliding plate, a Z2 sliding plate, a first main shaft, a second main shaft, a visual module, a cutting table, and a control unit;
the visual module and the first main shaft are fixedly arranged on the first Y-shaft at a preset interval, and the second main shaft is arranged on the second Y-shaft;
the first Y-shaft and the second Y-shaft move left and right on the Y-shaft base, with the Z1 sliding plate driving the first main shaft and the visual module to move up and down, and the Z2 sliding plate driving the second main shaft to move up and down;
the linear scale or the component to be cut are fixedly arranged on the cutting table;

the visual module is configured for acquiring a corresponding marked line image at the visual module after the first Y-shaft moves from a reference marked line zero point of the linear scale according to a unit stepping length;

the control unit is configured for compensating the visual module based on a center point of a marked line in the marked line image and a center line of the marked line image;

when compensating the first Y-shaft, the visual module is configured for acquiring a first image after the first main shaft of the first Y-shaft cuts the component to be cut;

the control unit is configured for determining a first cutting distance of the first Y-shaft based on the first image and compensating the first Y-shaft based on the first cutting distance;

the visual module is configured for acquiring a cutting image at the second Y-shaft after the second main shaft of the second Y-shaft cuts the component to be cut; and

the control unit is configured for compensating the second Y-shaft based on the cutting image.

10. The system according to claim 9, wherein the visual module is a microscope.