POSITION CALIBRATION METHOD AND APPARATUS

[0001] The present disclosure claims the priority to Chinese Patent Application No.202311736493.0, titled "POSITION CALIBRATION METHOD AND APPARATUS", filed with the China National Intellectual Property Administration on December 18, 2023, which is incorporated herein by reference in its entirety.

FIELD

[0002] The present disclosure relates to the technical field of semiconductor processing, and more specifically, to a method for position calibration, an apparatus for position calibration, an electronic device, and a storage medium.

BACKGROUND

[0003] In the manufacturing industry, an X, Y, R positioning system in conjunction with a vision positioning camera is applied in various devices for product positioning and processing. With the X, Y, R positioning system, a product to be processed is translated along an X-axis and a Y-axis, and is rotated around an R-axis. In practical calculations, an axis coordinate (the coordinate in the XY coordinate system) where a rotation axis of the R-axis coincides with the center of the camera's field of view is often used. For example, in the semiconductor industry, in the case of a wafer cleaving process (where a cleaving blade cleaves the wafer along a dicing street), the angle θ° of the wafer dicing street is determined through vision positioning, and then the R-axis is rotated by θ° to make the wafer dicing street horizontal. The purpose of this operation is to allow the cleaving blade accurately cleaving along the dicing street during the cleaving process. For calculating the position of the dicing street after rotation, the axis coordinate corresponding to a case that the rotation axis of the R-axis coincides with the center of the camera's field of view is used. According to a conventional method, the R-axis is moved to the camera's field of view, and then the R-axis is rotated, so as to visually identify the rotation axis of the R-axis. The position of to-be-processed workpiece in the XY coordinate system is moved and rotation axis of the R-axis is gradually adjusted, enabling the rotation axis of the R-axis to coincide with the center of the camera's field of view. Apparently, the positioning

accuracy of this method is unstable and relies on subjective determination by the operator.

SUMMARY

[0004] In view of the above issues, the present disclosure is provided.

[0005] In a first aspect of the present disclosure, a method for position calibration is provided. The method includes:

determining a position coordinate of a feature point in a first target image and a position coordinate of the feature point in a second target image, where the first target image is acquired by an image acquisition apparatus when the feature point is located at a first position, the second target image is acquired by the image acquisition apparatus when the feature point is located at a second position, the feature point is an identification point on a target object that is distinguishable from other points, and the second position is a position to which the feature point is moved from the first position when the target object is rotated by a predetermined angle around a rotation center;

determining a position coordinate of the rotation center in the first target image and/or in the second target image based on the position coordinate of the feature point in the first target image, the position coordinate of the feature point in the second target image, and the predetermined angle; and

determining a position coordinate corresponding to a case that the rotation center coincides with a center of a field of view of the image acquisition apparatus based on the position coordinate of the rotation center in the first target image and/or in the second target image and the position coordinate of the center of the field of view.

[0006] In an embodiment, the determining a position coordinate of a feature point in a first target image and a position coordinate of the feature point in a second target image includes:

acquiring a physical position coordinate of the target object when the feature point is located at the first position, and denoting the physical position coordinate of the target object as a first physical position coordinate;

acquiring a physical position coordinate of the target object when the feature point is located at a first target position, and denoting the physical position coordinate of the target

object as a second physical position coordinate, where the feature point is moved from the first position to the first target position to coincide with the center of the field of view of the image acquisition apparatus; and

determining the position coordinate of the feature point in the first target image based on the first physical position coordinate and the second physical position coordinate.

[0007] In an embodiment, the determining the position coordinate of the feature point in the first target image based on the first physical position coordinate and the second physical position coordinate includes:

determining a position difference between the first physical position coordinate and the second physical position coordinate as a first position coordinate difference, and determining the position coordinate of the feature point in the first target image based on the first position coordinate difference and the first physical position coordinate.

[0008] In an embodiment, the method further includes:

determining, in response to a first position determination instruction inputted by a user on a first user interface, the physical position coordinate when the feature point is located at the first target position

[0009] In an embodiment, the determining a position coordinate of a feature point in a first target image and a position coordinate of the feature point in a second target image includes:

acquiring a physical position coordinate of the target object when the feature point is located at the second position, and denoting the physical position coordinate of the target object as a third physical position coordinate;

acquiring a physical position coordinate of the target object when the feature point is located at a second target position, and denoting the physical position coordinate of the target object as a fourth physical position coordinate, where the feature point is moved from the second position to the second target position to coincide with the center of the field of view of the image acquisition apparatus; and

determining the position coordinate of the feature point in the second target image based on the third physical position coordinate and the fourth physical position coordinate.

[0010] In an embodiment, the determining the position coordinate of the feature point in the

second target image based on the third physical position coordinate and the fourth physical position coordinate includes:

determining a position difference between the third physical position coordinate and the fourth physical position coordinate as a second position coordinate difference, and determining the position coordinate of the feature point in the second target image based on the second position coordinate difference and the third physical position coordinate.

[0011] In an embodiment, the method further includes:

determining, in response to a second position determination instruction inputted by a user on a second user interface, the physical position coordinate when the feature point is located at the second target position.

[0012] In an embodiment, determining the position coordinate of the feature point in the second target image, the method further includes:

controlling, in response to a rotation instruction inputted by a user on a third user interface, the target object to rotate by the predetermined angle, to cause the feature point to move from the first position to the second position, where the rotation instruction includes the predetermined angle.

[0013] In an embodiment, the determining a position coordinate corresponding to a case that the rotation center coincides with a center of a field of view of the image acquisition apparatus based on the position coordinate of the rotation center in the first target image and/or in the second target image and the position coordinate of the center of the field of view includes:

determining a position deviation between the position coordinate of the rotation center in the first target image and/or in the second target image and the position coordinate of the center of the field of view of the image acquisition apparatus; and

determining the position coordinate corresponding to the case that the rotation center coincides with the center of the field of view based on the position deviation.

[0014] In an embodiment, determining a position coordinate of the rotation center in the first target image and/or in the second target image based on the position coordinate of the feature point in the first target image, the position coordinate of the feature point in the second target image, and the predetermined angle includes:

in response to a rotation center determination instruction inputted by a user on a fourth user interface, determining the position coordinate of the rotation center in the first target image and/or in the second target image based on the position coordinate of the feature point in the first target image, the position coordinate of the feature point in the second target image, and the predetermined angle.

[0015] In a second aspect of the present disclosure, an apparatus for position calibration is further provided. The apparatus includes:

a first determination module, configured to determine a position coordinate of a feature point in a first target image and a position coordinate of the feature point in a second target image, where the first target image is acquired by an image acquisition apparatus when the feature point is located at a first position, the second target image is acquired by the image acquisition apparatus when the feature point is located at a second position, the feature point is an identification point on a target object that is distinguishable from other points, and the second position is a position to which the feature point is moved from the first position when the target object is rotated by a predetermined angle around a rotation center;

a second determination module, configured to determine a position coordinate of the rotation center in the first target image and/or in the second target image based on the position coordinate of the feature point in the first target image, the position coordinate of the feature point in the second target image, and the predetermined angle; and

a third determination module, configured to determine a position coordinate corresponding to a case that the rotation center coincides with a center of a field of view of the image acquisition apparatus based on the position coordinate of the rotation center in the first target image and/or in the second target image and the position coordinate of the center of the field of view.

[0016] In a third aspect of the present disclosure, an electronic device is further provided. The electronic device includes a processor and a memory. The memory is configured to store a computer program instruction. The computer program instruction, when executed by the processor, implements the method for position calibration as described in the first aspect.

[0017] In a fourth aspect of the present disclosure, a storage medium is further provided. The storage medium stores a program instruction. The program instruction, when being executed,

implements the method for position calibration as described above.

[0018] According to the method for position calibration in the embodiments of the present disclosure, the target object with the feature point may be arranged at the first position and at the second position respectively, and the position coordinate of the feature point at the first position and the position coordinate of the feature point at the second position are determined. Then, based on to the position coordinates of the feature point when the feature point is located at the first position and the second position, the coordinate of the rotation center is determined, so that the physical position corresponding to a case that the rotation center coincides with the center of the field of view can be determined. According to the above solution, in view of the fact that the feature point at the first position and the feature point at the second position lie on two points on a circle centered on the rotation center, the physical position corresponding to a case that the rotation axis coincides with the center of the field of view is automatically determined based on the difference between the physical positions of the target object, combined with a visual positioning technology. This solution has low requirements for the technical level of operators, strong applicability, high precision, and only requires determining the coordinates of two points, making it efficient.

[0019] The above description is merely an overview of the technical solutions of the present disclosure. Embodiments of the present disclosure are described hereinafter in order for a clear understanding of the technical solutions of the present disclosure so as to implement the technical solutions based on the specification, and further for a clear and easy understanding of the above and other objects, features and advantages of the present disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] Above and other objects, features, and advantages of the present disclosure will become more apparent with reference to the detailed description of the embodiments of the present disclosure made in conjunction with the drawings. The drawings are intended to provide further understanding of the embodiments of the present disclosure, and constitute a part of the specification. The drawings are intended to describe the present disclosure in conjunction with the embodiments of the present disclosure, and do not limit the present disclosure. In the drawings, same reference numerals generally represent same components or steps.

[0021] FIG. 1 illustrates a schematic flowchart of a method for position calibration according

to an aspect of the present disclosure;

[0022] FIG. 2 illustrates a schematic diagram of a user interface (a first user interface and a second user interface) in a method for position calibration according to an aspect of the present disclosure;

[0023] FIG. 3 illustrates a schematic block diagram of an apparatus for position calibration according to an embodiment of the present disclosure; and

[0024] FIG. 4 illustrates a schematic block diagram of an electronic device according to an embodiment of the present disclosure.

DETAILED DESCRIPTION

[0025] Exemplary embodiments of the present disclosure are described in detail with reference to the drawings to make purposes, technical solutions, and advantages of the present disclosure more apparent. Apparently, the described embodiments are merely a part of the embodiments instead of all embodiments of the present disclosure. It should be understood that, the present disclosure is not limited by the exemplary embodiments described herein. Based on the embodiments of the present disclosure described herein, all other embodiments obtained by those skilled in the art without creative efforts are deemed to fall into the scope of protection of the present disclosure.

[0026] In order to at least partially address the above issues, a method for position calibration is provided in the embodiments of the present disclosure. The method for position calibration may be applied, for example, in the field of wafer processing, such as in a wafer cleaving system, which is configured to cleave the wafer along a dicing street on the wafer after the wafer is diced. The wafer cleaving system includes an X-direction motion assembly, a Y-direction motion assembly, an image acquisition apparatus and a turntable assembly.

[0027] The turntable assembly is arranged at the Y-direction motion assembly, where the turntable assembly is capable of rotating (for example, θ axis serve as the rotation axis), and is capable of moving with the Y-direction motion assembly. The image acquisition apparatus is arranged at an X-direction motion assembly and is capable of moving with the X-direction motion assembly along the X-direction. Before wafer cleaving, a dicing street is calibrated so that the dicing street is parallel to a preset reference direction (such as the X direction). The

position coordinate where the rotation center of the turntable coincides with the center of the field of view is required before calibrating the dicing street. During the wafer cleaving process, cleaving is first performed along a dicing street parallel to the X direction, and then, the turntable is rotated by 90°, cleaving is performed on the wafer along a dicing street parallel to the Y direction. To calculate the specific position for the cleaving after rotating by 90° (actually, it is also to determine the position of the dicing street and calibrate the dicing street), the position coordinate where the rotation center of the turntable coincides with the center of the field of view is required. The position coordinate corresponding to a case that the rotation center of the turntable coincides with the center of the field of view is to be determined according to the method for position calibration provided in the present disclosure.

[0028] It should be noted that the above application scenario is an application scenario of the method for position calibration provided in the present disclosure, and the method for position calibration is applicable to other application scenarios, which fall within the scope of protection of the present disclosure.

[0029] FIG. 1 illustrates a schematic flowchart of a method 100 for position calibration according to an aspect of the present disclosure. As shown in FIG. 1, the method 100 may include the following steps S110, S120, and S130.

[0030] In step S110, a physical position coordinate of a feature point in a first target image and a physical position coordinate of the feature point in a second target image are determined. The first target image is acquired by an image acquisition apparatus when the feature point is located at a first position, the second target image is acquired by the image acquisition apparatus when the feature point is located at a second position, the feature point is an identification point on a target object that is distinguishable from other points, and the second position is a position to which the feature point is moved from the first position when the target object is rotated by a predetermined angle around a rotation center.

[0031] In step S110, the target object is arranged within the field of view of the image acquisition apparatus, and the feature point is determined within the field of view. A case that the target object is a wafer is taken as an example, the feature point may be any identification point on the wafer that is distinguishable from other points on the wafer. For example, an only black spot in the image is determined as the feature point. Then, at the current position, which is the first position, an image is acquired by the image acquisition apparatus to obtain the first

target image. The position coordinate of the feature point in the first target image is determined.

[0032] For the second target image, for example, the turntable as described above carrying the target object is rotated by a predetermined angle from the first position so that the feature point is located at the second position. Then, similarly, an image is acquired by the image acquisition apparatus to obtain the second target image, and the position coordinate of the feature point in the second target image is determined.

[0033] It can be understood that in the present disclosure, since the feature point is an identifier on the target object, when the physical position of the target object remains unchanged, the position of the feature point does not change. Thus, herein a position, such as the first position and the second position, "of the feature point" may also be worded as that "of the target object".

[0034] In an embodiment, the above position coordinates may be physical position coordinates. Specifically, various physical position coordinates described in present disclosure may be represented by coordinates in the same world coordinate system. An example of establishing such a world coordinate system is described below. The target object (e.g., a wafer) may be placed on a movable apparatus (e.g., a movable stage, which specifically, may include an X-direction motion assembly and a Y-direction motion assembly).

[0035] The movable stage may be translated in a plane (which is referred to as the "movement plane") and may also be rotated around a fixed rotation axis (such as the rotation axis or the rotation center of the turntable described above) in the movement plane. Since the target object (e.g. a wafer) is moved synchronously with the movable stage, the physical position of the movable stage and the physical position of the target object (e.g. a wafer) described herein are regarded as the same, both of which may be represented interchangeably. In addition, since the feature point is an identification point on the target object, the physical position of the feature point and the physical position of the target object (e.g. a wafer) are regarded as the same at the same moment for the convenience of calculation. Moreover, in a case that the target object (e.g. a wafer) is located within the field of view of the image acquisition apparatus, it is considered that the physical position of the target object (e.g. the wafer), the physical position of the image acquisition apparatus and the physical position of the movable stage are the same.

[0036] Two grating scales perpendicular to each other may be provided within the movement range of the movable stage. For example, in a case that the movable stage stays at a

predetermined initial physical position, the readings on the grating scales in this case may be set to 0, and the predetermined initial physical position is determined as the origin O of the world coordinate system. A first grating scale is arranged along the first direction and passing through the origin O, and the axis on which the first grating scale is located serves as the X-axis of the world coordinate system. A second grating scale is arranged perpendicular to the X-axis and passing through the origin O. The axis on which the second grating scale is located serves as the Y-axis of the world coordinate system. Based on the world coordinate system established above, each time the movable stage is moved, that is, when the target object (e.g. the wafer) is moved, the X-axis coordinate is read from the first grating scale and the Y-axis coordinate is read from the second grating scale. The coordinate (X, Y) is assigned to the target object (e.g. the wafer) as a physical position of the target object. In a case that the target object (e.g., the wafer) is within the field of view of the image acquisition apparatus, the X-axis coordinate is read from the first grating scale and the Y-axis coordinate is read from the second grating scale. The coordinate (X, Y) is assigned to the target object (e.g., the wafer) as a physical position of the target object or is assigned to the image acquisition apparatus as a physical position of the image acquisition apparatus. In another embodiment, the above position coordinates may also be pixel coordinates. In this case, in order to determine the position coordinate of the rotation center and the coordinate corresponding to a case that the rotation center coincides with the center of the field of view hereinafter, the pixel coordinates are converted into physical position coordinates.

[0037] In step S120, a position coordinate of the rotation center in the first target image and/or in the second target image is determined based on the position coordinate of the feature point in the first target image, the position coordinate of the feature point in the second target image, and the predetermined angle.

[0038] In step S120, since the second position is obtained by rotating the first position by the predetermined angle, the position of the feature point in the first target image and the position of the feature point in the second target image are regarded as two points on a circle centered on the rotation center. In this way, since the position coordinates of the two points (i.e., the position coordinate of the feature point in the first target image and the position coordinate of the feature point in the second target image) are determined, and the central angle corresponding to the two points is also determined, the position coordinate of the rotation center is obtained through a simple geometric operation as follows. Firstly, a chord length between the points

corresponding to the two position coordinates on the circle centered on the rotation center is calculated based on the position coordinate of the feature point in the first target image and the position coordinate of the feature point in the second target image. Then, the distance (that is, the radius) from the rotation center to the feature point, is obtained based on the chord length and the rotation angle, so that the coordinate of the center of the circle, that is, the position coordinate of the rotation center, can be determined based on the radius, the position coordinate of the feature point in the first target image and the predetermined rotation angle, where the rotation center may be represented by a coordinate (Xr, Yr).

[0039] It can be understood that since the first target image and the second target image are taken from two different angles with the rotation center as the axis, the coordinate of the rotation center is the same for the first target image and the second target image.

[0040] In an embodiment, the predetermined angle is determined based on a physical coordinate before rotation and a physical coordinate after the rotation. Specifically, an angle before the rotation of the turntable and an angle after the rotation of the turntable are determined according to the related parameters of the encoder and the like on the driving assembly that drives the turntable to rotate, thereby determining the predetermined angle. Since calculating the rotation angle of the driven component (such as the turntable in the present disclosure) based on the related parameters of the encoder and the like is well-known to those skilled in the art, it is not repeated here.

[0041] In step S130, based on the position coordinate of the rotation center in the first target image and/or in the second target image and the position coordinate of the center of the field of view, a position coordinate corresponding to a case that the rotation center coincides with the center of the field of view of the image acquisition apparatus is determined.

[0042] In step S130, the rotation center is the rotation center of the turntable assembly, and the first target image and the second target image are obtained respectively before and after rotating the turntable without translating the turntable assembly. Thus, the position coordinate of the rotation center is the same for the first target image and the second target image, which is (Xr, Yr). The first position corresponding to the first target image is taken as an example, when the feature point is located at the first position, the readings on the first grating scale and the second grating scale are X1 and Y1, respectively. Thus, the position coordinate of the center of the field of view of the image acquisition apparatus is (X1, Y1), so that the position

coordinate corresponding to a case that the rotation center coincides with the center of the field of view can be determined.

[0043] In an embodiment, step S130, determining a position coordinate corresponding to a case that the rotation center coincides with the center of the field of view of the image acquisition apparatus based on the position coordinate of the rotation center in the first target image and/or in the second target image and the position coordinate of the center of the field of view includes: determining a position deviation between the position coordinate of the rotation center in the first target image and/or in the second target image and the position coordinate of the center of the field of view of the image acquisition apparatus; and determining, based on the position deviation, the position coordinate corresponding to the case that the rotation center coincides with the center of the field of view.

[0044] In an embodiment, in a case that the feature point is located at the first position, the coordinate of the center of the field of view of the image acquisition apparatus is readings on the first grating scale and the second grating scale in this case, which is represented by a coordinate (X1, Y1). In addition, the position coordinate of the rotation center is determined in step S120, so that the relative position deviation between the rotation center and the center of the field of view is determined by $\Delta xr = Xr \pm X1$, $\Delta yr = Yr \pm Y1$. It can be understood that whether to select "+" or "-" in "±" depends on the position relationship between the rotation center and the center of the field of view. After the relative position deviation between the rotation center and the center of the field of view is determined in this way, the X-direction motion assembly is moved by Δxr and the Y-direction motion assembly is moved by Δyr, so that the rotation center coincides with the center of the field of view. In this case, the readings on the first grating scale and the second grating scale are the position coordinate corresponding to a case that the rotation center coincides with the center of the field of view. This method is more accurate and efficient as it is based on the position deviation instead of specific coordinates.

[0045] According to the method for position calibration in the embodiments of the present disclosure, the target object with the feature point may be arranged at the first position and at the second position respectively, and the position coordinate of the feature point at the first position and the position coordinate of the feature point at the second position are determined. Then, based on to the position coordinates of the feature point when the feature point is located

at the first position and the second position, the coordinate of the rotation center is determined, so that the physical position corresponding to a case that the rotation center (or the rotation axis) coincides with the center of the field of view can be determined. According to the above solution, in view of the fact that the feature point at the first position and the feature point at the second position lie on two points on a circle centered on the rotation center, the physical position corresponding to a case that the rotation axis coincides with the center of the field of view is automatically determined based on the difference between the physical positions of the target object, combined with a visual positioning technology. This solution has low requirements for the technical level of operators, strong applicability, high precision, and only requires determining the coordinates of two points, making it efficient.

[0046] In an embodiment, in step S110, determining a position coordinate of a feature point in a first target image and a position coordinate of the feature point in a second target image includes: acquiring a physical position coordinate of a target object when the feature point is located at a first position, and denoting the physical position coordinate as a first physical position coordinate; acquiring a physical position coordinate of the target object when the feature point is located at a first target position, and denoting the physical position coordinate as a second physical position coordinate, where the feature point is moved from the first position to the first target position to coincide with the center of the field of view of the image acquisition apparatus; and determining the position coordinate of the feature point in the first target image based on the first physical position coordinate and the second physical position coordinate.

[0047] As described above, since the feature point is an identification point on the target object, the physical positions of the feature point and the target object are regarded as the same at the same moment for convenience of calculation. In an embodiment, the target object is moved to be within the field of view of the image acquisition apparatus by means of an X-direction motion assembly and a Y-direction motion assembly, and the feature point is determined within the field of view. The current position may be determined as the first position, and in this case, the readings on the first grating scale and the second grating scale are obtained, which may be represented by a coordinate (X1, Y1). The coordinate (X1, Y1) is determined as the first physical position coordinate. On this basis, the feature point on the target object is moved to coincide with the center of the field of view of the image acquisition apparatus (the position where they coincide with each other is the first target position) by means of the X-direction motion assembly and the Y-direction motion assembly, and the readings on the first

grating scale and the second grating scale in this case are obtained, which may be represented by a coordinate (X2, Y2). The coordinate (X2, Y2) is determined as a second physical position coordinate. Based on the first physical position coordinate and the second physical position coordinate, the position coordinate of the feature point in the first target image is determined.

[0048] In an embodiment, the determining the position coordinate of the feature point in the first target image based on the first physical position coordinate and the second physical position coordinate includes: determining a position coordinate difference between the first physical position coordinate and the second physical position coordinate as a first position coordinate difference, and determining the position coordinate of the feature point in the first target image based on the first position coordinate difference and the first physical position coordinate.

[0049] In the above embodiment, the first physical position coordinate (X1, Y1) and the second physical position coordinate (X2, Y2) are determined, so that the position coordinate (X3, Y3) of the feature point in the first target image is determined based on the first physical position coordinate (X1, Y1) and the second physical position coordinate (X2, Y2), where $X3=X1\pm\Delta x1$; $Y3=Y1\pm\Delta y1$.

[0050] In the above technical solution, the position coordinate of the feature point in the first target image is obtained based on the difference between the physical position coordinate of the target object when the feature point is located at the first position and the physical position coordinate corresponding to a case that the feature point coincides with the center of the field of view of the image acquisition apparatus. The difference between the coordinates accurately reflects the difference between the two positions, thereby allowing for accurate determination of the position coordinate of the feature point in the first target image.

[0051] In an embodiment, when the feature point is located at the first target position, a physical position coordinate of the target object at the first target position is determined in response to a first position determination instruction inputted by a user on a first user interface.

[0052] The user may input any of the instructions described herein, such as a first position determination instruction, a second position determination instruction, a rotation instruction, and the like, to an apparatus (e.g. a host computer system) for performing the method 100 for position calibration through an input apparatus. The input apparatus may include, but is not limited to, one or more of the following: a mouse, a keyboard, a touch screen, a microphone,

and the like. In an embodiment, a visual interface, including a first user interface, may be displayed on a display apparatus. The user may interact with an operable control in the first user interface through a mouse, a keyboard, or the like to input the first position determination instruction. For example, as shown in FIG. 2, the user may input the first position determination instruction by clicking on a first operable control in the user interface. The first operable control may be displayed as an "Acquire" control on the first user interface. The apparatus for performing the method 100 for position calibration may include the input apparatus and/or the display apparatus described above or may be communicatively connected to the input apparatus and/or the display apparatus described above to enable transmission of information.

[0053] When the feature point is located at the first target position (i.e., the position where the feature point coincides with the center of the field of view of the image acquisition apparatus after moving from the first position), in response to the first position determination instruction inputted by the user, the apparatus for performing the method 100 for position calibration automatically acquires readings on the first grating scale and the second grating scale, that is, (X2, Y2). For example, as shown in FIG. 2, when the target object is located at the first target position, the user clicks on the "Acquire" control on a right side of "First point" on the interface. The position coordinate "x = 41.0603, y = 45.2925" corresponding to a case that the current feature point coincides with the center of the field of view is displayed in the interface. Meanwhile, the current angle coordinate −55.1990 of the turntable is acquired. The interface where the "Acquire" control is located and the interface that displays the position coordinate corresponding to the case that the current feature point coincides with the center of the field of view may be the same interface, that is, the first user interface, or they may be different interfaces.

[0054] According to the above technical solution, the physical position coordinate corresponding to a case that the feature point is located at the first target position is automatically determined and displayed in the first user interface according to an instruction inputted by the user, allowing users to operate intuitively, and featuring simple operations and strong interactivity.

[0055] In an embodiment, the determining a position coordinate of a feature point in a first target image and a position coordinate of the feature point in a second target image includes: acquiring a physical position coordinate of a target object when the feature point is located at a

second position, and denoting the physical position coordinate as a third physical position coordinate; acquiring a physical position coordinate of the target object when the feature point is located at a second target position, and denoting the physical position coordinate as a fourth physical position coordinate, where the feature point is moved from the second position to the second target position to coincide with the center of the field of view of the image acquisition apparatus; and determining the position coordinate of the feature point in the second target image according to the third physical position coordinate and the fourth physical position coordinate.

[0056] As described above, since the feature point is an identification point on the target object, the physical positions of the feature point and the target object are regarded as the same at the same moment for convenience of calculation. In an embodiment, the target object is moved to be within the field of view of the image acquisition apparatus by means of an X-direction motion assembly and a Y-direction motion assembly, and the feature point is adjusted to be at the first position. After adjustment, the readings on the first grating scale and the second grating scale are X1, Y1. On this basis, the turntable is rotated by a predetermined angle, so that the feature point is located at the second position. The readings on the first grating scale and the second grating scale in this case are obtained, which are represented by a coordinate (X4, Y4). The coordinate (X4, Y4) is determined as a third physical position coordinate. The feature point on the target object is moved to coincide with the center of the field of view of the image acquisition apparatus (that is, they coincide with each other at the first target position) by means of the X-direction motion assembly and the Y-direction motion assembly, and the readings on the first grating scale and the second grating scale in this case are obtained and are represented by a coordinate (X5, Y5). The coordinate (X5, Y5) is determined as a fourth physical position coordinate. The position coordinate of the feature point in the second target image may be determined according to the third physical position coordinate (X4, Y4) and the fourth physical position coordinate (X5, Y5).

[0057] In an embodiment, the determining the position coordinate of the feature point in the second target image based on the third physical position coordinate and the fourth physical position coordinate includes: determining a position coordinate difference between the third physical position coordinate and the fourth physical position coordinate as a second position coordinate difference, and determining the position coordinate of the feature point in the second target image based on the second position coordinate difference and the third physical position

coordinate.

[0058] In the above embodiment, based on the third physical position coordinate (X4, Y4) and the fourth physical position coordinate (X5, Y5), the position coordinate (X6, Y6) of the feature point in the second target image is determined by $X6=X4\pm\Delta x2$; $Y6=Y4\pm\Delta y2$.

[0059] According to the above technical solution, the position coordinate of the feature point in the second target image is determined based on the coordinates of the target object at different positions, featuring a simple algorithm and straightforward implementation.

[0060] In an embodiment, when the feature point is located at the second target position, a physical position coordinate of the target object at the second target position is determined in response to a second position determination instruction inputted by a user on a second user interface.

[0061] When the target object is located at the second target position (i.e., the position where the feature point coincides with the center of the field of view of the image acquisition apparatus after moving from the second position), in response to the second position determination instruction inputted by the user, the apparatus for performing the method 100 for position calibration automatically acquires readings on the first grating scale and the second grating scale, that is, (X5, Y5). For example, when the target object is located at the second target position, the user clicks on the "Acquire" control on a right side of "Second point" on the interface. The position coordinate "x = 40.8637, y = 45.2194" corresponding to a case that the current feature point coincides with the center of the field of view is displayed in the second user interface. Meanwhile, the current angle coordinate −39.2320 of the turntable is acquired. The interface where the "Acquire" control is located and the interface that displays the position coordinate corresponding to the case that the current feature point coincides with the center of the field of view may be the same interface, that is, the first user interface, or they may be different interfaces. The first user interface and the second user interface may be the same interface, or different interfaces.

[0062] In an embodiment, the determining a position coordinate of the rotation center in the first target image and/or in the second target image based on the position coordinate of the feature point in the first target image, the position coordinate of the feature point in the second target image, and the predetermined angle includes: in response to a rotation center determination instruction inputted by the user on the fourth user interface, determining the

position coordinate of the rotation center in the first target image and/or in the second target image based on the position coordinate of the feature point in the first target image, the position coordinate of the feature point in the second target image, and the predetermined angle.

[0063] In an embodiment, in response to a second position determination instruction inputted by the user on the second user interface, a position coordinate corresponding to a case that the rotation center coincides with the center of the field of view is further determined. In another embodiment, when the target object is located at the second target position, a physical position coordinate of the target object at the second target position is determined in response to the second position determination instruction inputted by the user on the second user interface. Further, in response to another position determination instruction inputted by the user on another interface, the position coordinate corresponding to the case that the rotation center coincides with the center of the field of view is determined. The another position determination instruction may be different from the second position determination instruction, and the another interface may be the same as or different from the second user interface.

[0064] In an embodiment, when the target object is located at the second target position, the user clicks on the "Acquire" control on a right side of the "Second point" on the interface. In addition to displaying coordinates such as "x = 40.8637, y = 45.2194", the second user interface further displays the position coordinate corresponding to the case that the rotation center coincides with the center of the field of view, "x = 40.7014, y = 45.9569". In this case, the second interface and the fourth interface are the same interface, and alternatively, the second interface and the fourth interface may be different according to actual requirements.

[0065] It should be noted that the interface shown in the figure is based on the method for position calibration provided in present disclosure which is applied to the wafer cleaving system, and the wafer cleaving system includes two image acquisition apparatuses: the upper CCD and the lower CCD in the figure. The upper CCD is described herein as an example. The lower CCD is similar to the upper CCD, which is not described in detail herein.

[0066] According to the above technical solution, the physical position coordinate of the target object at the second target position is automatically determined and displayed in the second user interface according to an instruction inputted by the user, allowing the user to operate intuitively and featuring simple operations and strong interactivity.

[0067] In an embodiment, before determining the physical position coordinate of the feature

point in the second target image in step S110, the method further includes: in response to a rotation instruction inputted by the user on a third user interface, controlling the target object to rotate by the predetermined angle with reference to the first position to cause the feature point to reach the second position, where the rotation instruction includes the predetermined angle.

[0068] In an embodiment, the visual interface described above further includes the third user interface. The third user interface and any one of the first user interface and the second user interface described above may be the same user interface or different user interfaces. With reference to the initial physical position, the user may input a rotation instruction through the third user interface. A processing apparatus such as a wafer cleaving system automatically controls the target object to rotate by a predetermined angle. The third user interface includes an information input control and a third operable control. The user inputs a predetermined angle, such as 20 degrees, into the information input control via a keyboard or the like. After input is completed, the target object is controlled to rotate by the predetermined angle (20 degrees) by clicking on the third operable control on a side of the information input control.

[0069] According to the above technical solution, based on the third user interface, the user intuitively inputs a rotation instruction, and then the to-be-processed workpiece is automatically controlled to rotate by the predetermined angle. According to the method, the accurate rotation of a predetermined rotation angle is ensured without requiring complex user operations.

[0070] According to another aspect of the present disclosure, an apparatus for position calibration is further provided. FIG. 3 illustrates a schematic block diagram of an apparatus 300 for position calibration according to an embodiment of the present disclosure. As shown in FIG. 3, the apparatus 300 includes a first determination module 310, a second determination module 320, and a third determination module 330.

[0071] The first determination module 310 is configured to determine a position coordinate of a feature point in a first target image and a position coordinate of the feature point in a second target image, where the first target image is acquired by an image acquisition apparatus when the feature point is located at a first position, the second target image is acquired by the image acquisition apparatus when the feature point is located at a second position, the feature point is an identification point on a target object that is distinguishable from other points, and the second position is a position to which the feature point is moved from the first position when the target object is rotated by a predetermined angle around a rotation center.

[0072] The second determination module 320 is configured to determine a position coordinate of the rotation center in the first target image and/or in the second target image based on the position coordinate of the feature point in the first target image, the position coordinate of the feature point in the second target image, and the predetermined angle.

[0073] The third determination module 330 is configured to determine a position coordinate corresponding to a case that the rotation center coincides with a center of a field of view of the image acquisition apparatus based on the position coordinate of the rotation center in the first target image and/or in the second target image and the position coordinate of the center of the field of view.

[0074] According to another aspect of the present disclosure, an electronic device is further provided. FIG. 4 illustrates a schematic block diagram of an electronic device 400 according to an embodiment of the present disclosure. As shown in FIG. 4, the electronic device 400 includes a processor 410 and a memory 420. The memory 420 stores a computer program instruction, and the computer program instruction, when executed by the processor 410, is to perform the method 100 for position calibration described above.

[0075] According to another aspect of the present disclosure, a storage medium is further provided. The storage medium stores a program instruction, and the program instruction is to perform the method 100 for position calibration described above when executed. The storage medium may include, for example, a storage component of a tablet computer, a hard disk of a personal computer, a read-only memory (ROM), an erasable programmable read-only memory (EPROM), a portable compact disc read-only memory (CD-ROM), a USB memory, or any combination of the above mentioned storage media. The described computer-readable storage medium may be any combination of one or more computer-readable storage media.

[0076] Specific implementation solutions of the above apparatus for position calibration, the electronic device and the storage medium may be understood by those skilled in the art by reading the above descriptions of the method for position calibration, which is not described in detail herein for brevity.

[0077] Embodiment

[0078] Embodiment 1

A method for position calibration is provided, and the method includes:

determining a position coordinate of a feature point in a first target image and a position coordinate of the feature point in a second target image, where the first target image is acquired by an image acquisition apparatus when the feature point is located at a first position, the second target image is acquired by the image acquisition apparatus when the feature point is located at a second position, the feature point is an identification point on a target object that is distinguishable from other points, and the second position is a position to which the feature point is moved from the first position when the target object is rotated by a predetermined angle around a rotation center;

determining a position coordinate of the rotation center in the first target image and/or in the second target image based on the position coordinate of the feature point in the first target image, the position coordinate of the feature point in the second target image, and the predetermined angle; and

determining a position coordinate corresponding to a case that the rotation center coincides with a center of a field of view of the image acquisition apparatus based on the position coordinate of the rotation center in the first target image and/or in the second target image and the position coordinate of the center of the field of view.

[0079] Embodiment 2

The method according to embodiment 1 is provided, where the determining a position coordinate of a feature point in a first target image and a position coordinate of the feature point in a second target image includes:

acquiring a physical position coordinate of the target object when the feature point is located at the first position, and denoting the physical position coordinate of the target object as a first physical position coordinate;

acquiring a physical position coordinate of the target object when the feature point is located at a first target position, and denoting the physical position coordinate of the target object as a second physical position coordinate, where the feature point is moved from the first position to the first target position to coincide with the center of the field of view of the image acquisition apparatus; and

determining the position coordinate of the feature point in the first target image based on the first physical position coordinate and the second physical position coordinate.

[0080] Embodiment 3

The method according to embodiment 1 or embodiment 2 is provided, where the determining the position coordinate of the feature point in the first target image based on the first physical position coordinate and the second physical position coordinate includes:

determining a position difference between the first physical position coordinate and the second physical position coordinate as a first position coordinate difference, and determining the position coordinate of the feature point in the first target image based on the first position coordinate difference and the first physical position coordinate.

[0081] Embodiment 4

The method according to any one of embodiments 1 to 3 is provided, the method further includes:

determining, in response to a first position determination instruction inputted by a user on a first user interface, the physical position coordinate of the target object located at the first target position when the feature point is located at the first target position.

[0082] Embodiment 5

The method according to any one of embodiments 1 to 4 is provided, where the determining a position coordinate of a feature point in a first target image and a position coordinate of the feature point in a second target image includes:

acquiring a physical position coordinate of the target object when the feature point is located at the second position, and denoting the physical position coordinate of the target object as a third physical position coordinate;

acquiring a physical position coordinate of the target object when the feature point is located at a second target position, and denoting the physical position coordinate of the target object as a fourth physical position coordinate, where the feature point is moved from the second position to the second target position to coincide with the center of the field of view of the image acquisition apparatus; and

determining the position coordinate of the feature point in the second target image based on the third physical position coordinate and the fourth physical position coordinate.

[0083] Embodiment 6

The method according to any one of embodiments 1 to 5 is provided, where the determining the position coordinate of the feature point in the second target image based on the third physical position coordinate and the fourth physical position coordinate includes:

determining a position difference between the third physical position coordinate and the fourth physical position coordinate as a second position coordinate difference, and determining the position coordinate of the feature point in the second target image based on the second position coordinate difference and the third physical position coordinate.

[0084] Embodiment 7

The method according to any one of embodiments 1 to 6 is provided, and the method further includes:

determining, in response to a second position determination instruction inputted by a user on a second user interface, the physical position coordinate of the target object located at the second target position when the feature point is located at the second target position.

[0085] Embodiment 8

The method according to any one of embodiments 1 to 7 is provided. Before determining the position coordinate of the feature point in the second target image, the method further includes:

controlling, in response to a rotation instruction inputted by a user on a third user interface, the target object to rotate by the predetermined angle, to cause the feature point to move from the first position to the second position, where the rotation instruction includes the predetermined angle.

[0086] Embodiment 9

The method according to any one of embodiments 1 to 8 is provided, where the determining a position coordinate corresponding to a case that the rotation center coincides with a center of a field of view of the image acquisition apparatus based on the position coordinate of the rotation center in the first target image and/or in the second target image and the position coordinate of the center of the field of view includes:

determining a position deviation between the position coordinate of the rotation center in the first target image and/or in the second target image and the position coordinate of the center

of the field of view of the image acquisition apparatus; and

determining the position coordinate corresponding to the case that the rotation center coincides with the center of the field of view based on the position deviation.

[0087] Embodiment 10

The method according to any one of embodiments 1 to 9 is provided, where the determining a position coordinate of the rotation center in the first target image and/or in the second target image based on the position coordinate of the feature point in the first target image, the position coordinate of the feature point in the second target image, and the predetermined angle includes:

in response to a rotation center determination instruction inputted by a user on a fourth user interface, determining the position coordinate of the rotation center in the first target image and/or in the second target image based on the position coordinate of the feature point in the first target image, the position coordinate of the feature point in the second target image, and the predetermined angle.

[0088] Embodiment 11

An apparatus for position calibration is provided, and the apparatus includes:

a first determination module, configured to determine a position coordinate of a feature point in a first target image and a position coordinate of the feature point in a second target image, where the first target image is acquired by an image acquisition apparatus when the feature point is located at a first position, the second target image is acquired by the image acquisition apparatus when the feature point is located at a second position, the feature point is an identification point on a target object that is distinguishable from other points, and the second position is a position to which the feature point is moved from the first position when the target object is rotated by a predetermined angle around a rotation center;

a second determination module, configured to determine a position coordinate of the rotation center in the first target image and/or in the second target image based on the position coordinate of the feature point in the first target image, the position coordinate of the feature point in the second target image, and the predetermined angle; and

a third determination module, configured to determine a position coordinate corresponding to a case that the rotation center coincides with a center of a field of view of the image

acquisition apparatus based on the position coordinate of the rotation center in the first target image and/or in the second target image and the position coordinate of the center of the field of view.

[0089] Embodiment 12

An electronic device is provided, and the electronic device includes a processor and a memory. The memory is configured to store a computer program, and the processor is configured to execute the computer program to implement the method for position calibration according to any one of embodiments 1 to 10.

[0090] Embodiment 13

A storage medium is provided, and the storage medium stores a computer program/instruction. The computer program/instruction, when being executed by a processor, implements the method for position calibration according to any one of embodiments 1 to 10.

[0091] Although the example embodiments have been described herein with reference to the drawings, it should be understood that the above-described example embodiments are merely exemplary and are not intended to limit the scope of the present disclosure. Various changes and modifications may be made by those skilled in the art without departing from the scope and spirit of the present disclosure. All such changes and modifications are deemed to fall into the scope of the claims of the present disclosure.

[0092] Those skilled in the art may realize that the units and algorithm steps of each example described in conjunction with the embodiments herein may be implemented by electronic hardware, or a combination of computer software and electronic hardware. Whether these functions are performed in hardware or software depends on the specific application and design constraints of the technical solution. Those skilled in the art may use different methods to implement the described functions for each specific application, but such implementation should not be regarded as exceeding the scope of the present disclosure.

[0093] It should be understood that the apparatuses and methods disclosed in the embodiments of the present disclosure may be implemented in other manners. For example, the device embodiments described hereinabove are only schematic. For example, the division of the units is only based on logical functions, and there may be other division ways in actual implementation, such as multiple units or components can be combined or integrated into

another device, or some features can be neglected or not executed.

[0094] In the specification provided herein, a lot of specific details are described. However, it can be understood that the embodiments of the present disclosure may be practiced without these specific details. In some examples, well-known methods, structures and technologies are not described in detail so as not to obscure the understanding of this specification.

[0095] Similarly, it should be understood that in order to simplify the present disclosure and help to understand one or more of the various aspects of the disclosure, in the description of the exemplary embodiments of the present disclosure, the various features of the present disclosure are sometimes grouped together into a single embodiment, figure, or description thereof. However, the method according to the present disclosure should not be interpreted as reflecting the following intention: the claimed application requires more features than those explicitly stated in each claim. More specifically, as reflected in the corresponding claims, the inventive point is that the corresponding technical problem can be solved with features fewer than all the features of a single embodiment being disclosed. Therefore, the claims following the detailed description are hereby expressly incorporated into the detailed description, where each claim itself serves as an independent embodiment of the present disclosure.

[0096] It can be understood by those skilled in the art that, except for mutually exclusive features, all features disclosed in this specification (including the claims, abstract and drawings) and all processes or units of any method or device disclosed in this specification can be combined in any way. Unless otherwise expressly stated, each feature disclosed in this specification (including the claims, abstract and drawings) may be replaced by an alternative feature that provides the same, equivalent or similar purpose.

[0097] In addition, it may be understood by those skilled in the art that, although some embodiments described herein include certain features included in other embodiments instead of other features, the combination of features of different embodiments is meant to be within the scope of the present disclosure and form different embodiments. For example, in the claims, any one of the claimed embodiments can be used in any combination.

[0098] The various component embodiments of the present disclosure may be implemented in hardware, or in software modules running on one or more processors, or in a combination thereof. It should be understood by those skilled in the art that a microprocessor or a digital signal processor (DSP) may be used in practice to implement some or all functions of some

modules of the apparatus for position calibration according to the embodiments of the present disclosure. The present disclosure may also be implemented as a device program (e.g., a computer program and a computer program product) for executing a part of or the entire method described herein. Such a program implementing the present disclosure may be stored on a computer-readable medium, or may be in the form of one or more signals. Such signals may be downloaded from Internet sites, or provided on carrier signals, or in any other form.

[0099] It should be noted that the above embodiments illustrate rather than limit the present disclosure, and alternative embodiments may be designed by those skilled in the art without departing from the scope of the claims. In the claims, any reference signs placed in parentheses shall not be construed as limiting the claims. The word "comprising" does not exclude the presence of elements or steps not listed in the claims. The word "a" or "an" preceding an element does not exclude the presence of a plurality of such elements. The present disclosure may be implemented by means of hardware comprising several different elements and by means of a suitably programmed computer. In a unit claim enumerating several apparatuses, several of these apparatuses may be embodied by a same hardware item. The use of the words "first", "second", and "third", etc. does not indicate any order. These words may be interpreted as names.

[0100] Described above are only specific embodiments of the present disclosure or explanation for the specific embodiments of the present disclosure, and the protection scope of the present disclosure is not limited thereto. Any changes or alternations that can be easily envisaged by those skilled in the art within the technical scope disclosed in the present disclosure shall be covered within the protection scope of the present disclosure. The protection scope of the present disclosure shall be in accordance with the protection scope of the claims.

CLAIMS

1. A method for position calibration, comprising:

determining a position coordinate of a feature point in a first target image and a position coordinate of the feature point in a second target image, wherein the first target image is acquired by an image acquisition apparatus when the feature point is located at a first position, the second target image is acquired by the image acquisition apparatus when the feature point is located at a second position, the feature point is an identification point on a target object that is distinguishable from other points, and the second position is a position to which the feature point is moved from the first position when the target object is rotated by a predetermined angle around a rotation center;

determining a position coordinate of the rotation center in the first target image and/or in the second target image based on the position coordinate of the feature point in the first target image, the position coordinate of the feature point in the second target image, and the predetermined angle; and

determining a position coordinate corresponding to a case that the rotation center coincides with a center of a field of view of the image acquisition apparatus based on the position coordinate of the rotation center in the first target image and/or in the second target image and the position coordinate of the center of the field of view.

2. The method according to claim 1, wherein the determining a position coordinate of a feature point in a first target image and a position coordinate of the feature point in a second target image comprises:

acquiring a physical position coordinate of the target object when the feature point is located at the first position, and denoting the physical position coordinate of the target object as a first physical position coordinate;

acquiring a physical position coordinate of the target object when the feature point is located at a first target position, and denoting the physical position coordinate of the target object as a second physical position coordinate, wherein the feature point is moved from the first position to the first target position to coincide with the center of the field of view of the image acquisition apparatus; and

determining the position coordinate of the feature point in the first target image based on

the first physical position coordinate and the second physical position coordinate.

3. The method according to claim 2, wherein the determining the position coordinate of the feature point in the first target image based on the first physical position coordinate and the second physical position coordinate comprises:

determining a position difference between the first physical position coordinate and the second physical position coordinate as a first position coordinate difference, and determining the position coordinate of the feature point in the first target image based on the first position coordinate difference and the first physical position coordinate.

4. The method according to claim 2, further comprising:

determining, in response to a first position determination instruction inputted by a user on a first user interface, the physical position coordinate when the feature point is located at the first target position.

5. The method according to claim 1, wherein the determining a position coordinate of a feature point in a first target image and a position coordinate of the feature point in a second target image comprises:

acquiring a physical position coordinate of the target object when the feature point is located at the second position, and denoting the physical position coordinate of the target object as a third physical position coordinate;

acquiring a physical position coordinate of the target object when the feature point is located at a second target position, and denoting the physical position coordinate of the target object as a fourth physical position coordinate, wherein the feature point is moved from the second position to the second target position to coincide with the center of the field of view of the image acquisition apparatus; and

determining the position coordinate of the feature point in the second target image based on the third physical position coordinate and the fourth physical position coordinate.

6. The method according to claim 5, wherein the determining the position coordinate of the feature point in the second target image based on the third physical position coordinate and the fourth physical position coordinate comprises:

determining a position difference between the third physical position coordinate and the fourth physical position coordinate as a second position coordinate difference, and determining

the position coordinate of the feature point in the second target image based on the second position coordinate difference and the third physical position coordinate.

7. The method according to claim 5, further comprising:

determining, in response to a second position determination instruction inputted by a user on a second user interface, the physical position coordinate when the feature point is located at the second target position.

8. The method according to claim 5, wherein before determining the position coordinate of the feature point in the second target image, the method further comprises:

controlling, in response to a rotation instruction inputted by a user on a third user interface, the target object to rotate by the predetermined angle, to cause the feature point to move from the first position to the second position, wherein the rotation instruction comprises the predetermined angle.

9. The method according to claim 1, wherein the determining a position coordinate corresponding to a case that the rotation center coincides with a center of a field of view of the image acquisition apparatus based on the position coordinate of the rotation center in the first target image and/or in the second target image and the position coordinate of the center of the field of view comprises:

determining a position deviation between the position coordinate of the rotation center in the first target image and/or in the second target image and the position coordinate of the center of the field of view of the image acquisition apparatus; and

determining the position coordinate corresponding to the case that the rotation center coincides with the center of the field of view based on the position deviation.

10. The method according to claim 1, wherein the determining a position coordinate of the rotation center in the first target image and/or in the second target image based on the position coordinate of the feature point in the first target image, the position coordinate of the feature point in the second target image, and the predetermined angle comprises:

in response to a rotation center determination instruction inputted by a user on a fourth user interface, determining the position coordinate of the rotation center in the first target image and/or in the second target image based on the position coordinate of the feature point in the first target image, the position coordinate of the feature point in the second target image, and

the predetermined angle.

11. An apparatus for position calibration, comprising:

a first determination module, configured to determine a position coordinate of a feature point in a first target image and a position coordinate of the feature point in a second target image, wherein the first target image is acquired by an image acquisition apparatus when the feature point is located at a first position, the second target image is acquired by the image acquisition apparatus when the feature point is located at a second position, the feature point is an identification point on a target object that is distinguishable from other points, and the second position is a position to which the feature point is moved from the first position when the target object is rotated by a predetermined angle around a rotation center;

a second determination module, configured to determine a position coordinate of the rotation center in the first target image and/or in the second target image based on the position coordinate of the feature point in the first target image, the position coordinate of the feature point in the second target image, and the predetermined angle; and

a third determination module, configured to determine a position coordinate corresponding to a case that the rotation center coincides with a center of a field of view of the image acquisition apparatus based on the position coordinate of the rotation center in the first target image and/or in the second target image and the position coordinate of the center of the field of view.

12. An electronic device, comprising:

a processor, and

a memory, wherein

the memory is configured to store a computer program; and

the processor is configured to execute the computer program to implement the method for position calibration according to any one of claims 1 to 10.

13. A storage medium, storing a computer program or an instruction, wherein

the computer program or the instruction, when being executed by a processor, implements the method for position calibration according to any one of claims 1 to 10.