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CONTROL METHOD AND IMAGING APPARATUS

Abstract

A control method used in a system including a moving body and an imaging apparatus includes an acquisition step of acquiring factor information, including movement information related to the moving body, via the imaging apparatus, an adjustment step of adjusting a position of a moving mechanism that moves an image sensor or an imaging lens provided in the imaging apparatus, based on the factor information, an imaging step of imaging a subject by using the image sensor after the adjustment step is executed, and a correction step of correcting a shake applied to the image sensor or the imaging lens by using the moving mechanism in a case in which the imaging step is executed.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS [0001] This application is a Continuation of U.S. patent application Ser. No. 17/932,193, filed on Sep. 14, 2022, which claims priority under 35 USC 119 from Japanese Patent Application No. 2021-161789, filed on Sep. 30, 2021, the disclosure of which is incorporated by reference herein.

BACKGROUND OF THE INVENTION
1. Field of the Invention
[0002] The technology of the present disclosure relates to a control method and an imaging apparatus.
2. Description of the Related Art
[0003] JP2021-082932A discloses an optical device including a calculation unit that calculates a subject angular velocity based on a captured image, and a controller that corrects an image shake related to a subject during panning by driving a correction unit based on the calculated subject angular velocity, in which the controller determines a correction position of the image shake related to the subject in accordance with an imaging scene based on subject information including the imaging scene, and drives the correction unit based on the subject angular velocity calculated based on the correction position of the image shake.
[0004] JP2019-092037A discloses an imaging apparatus that can perform panning, the imaging apparatus comprising a first calculation unit that calculates an angular velocity of a subject with respect to the imaging apparatus based on a movement vector of the subject and movement of the imaging apparatus based on temporally continuous images, a second calculation unit that calculates angular acceleration of the subject with respect to the imaging apparatus based on a plurality of angular velocities calculated by the first calculation unit, a determination unit that determines the angular velocity of the subject with respect to the imaging apparatus during exposure in accordance with the angular acceleration calculated by the second calculation unit, and a correction unit that corrects an image shake of the subject by moving a correction element based on the angular velocity determined by the determination unit, in which the determination unit changes the angular acceleration used to determine the angular velocity of the subject with respect to the imaging apparatus during exposure in accordance with whether or not the angular acceleration calculated by the second calculation unit is included in a range corresponding to the angular velocity calculated by the first calculation unit.
[0005] JP1992-163535A (JP-H04-163535A) discloses a camera shake prevention device including an image shake detection unit that detects a shake of an image based on an output of an image sensor, a mechanical shake detection unit that detects a shake based on an output of a mechanical sensor provided inside a camera to calculate the shake of the image due to the shake, a subject moving speed detection unit that detects information related to a moving speed of a subject from the output of the image shake detection unit and the mechanical shake detection unit, a shake correction amount calculation unit that calculates a shake correction amount during exposure from

the moving speed of the subject and an exposure time, an initial position setting unit that presets an initial position of a shake correction mechanism of the camera based on the shake correction amount, and a shake correction controller that controls the shake correction mechanism based on the outputs of the image shake detection unit and the mechanical shake detection unit.

SUMMARY OF THE INVENTION

[0006] One embodiment according to the technology of the present disclosure provides a control method and an imaging apparatus capable of correcting, for example, a shake applied to an image sensor or an imaging lens in accordance with a factor related to a moving body.

[0007] A first aspect according to the technology of the present disclosure relates to a control method used in a system including a moving body and an imaging apparatus, the method comprising an acquisition step of acquiring factor information, including movement information related to the moving body, via the imaging apparatus, an adjustment step of adjusting a position of a moving mechanism that moves an image sensor or an imaging lens provided in the imaging apparatus, based on the factor information, an imaging step of imaging a subject by using the image sensor after the adjustment step is executed, and a correction step of correcting a shake applied to the image sensor or the imaging lens by using the moving mechanism in a case in which the imaging step is executed.

[0008] A second aspect according to the technology of the present disclosure relates to a control method used in a system including a moving body and an imaging apparatus, the method comprising an acquisition step of acquiring factor information, including movement information related to a speed and a direction of the moving body, via the imaging apparatus, an imaging step of imaging a subject by using an image sensor provided in the imaging apparatus, and a correction step of correcting a shake applied to the image sensor based on the factor information by using a moving mechanism that moves the image sensor in a case in which the imaging step is executed.

[0009] A third aspect according to the technology of the present disclosure relates to an imaging apparatus mounted on a moving body, the apparatus comprising a processor, in which the processor executes an acquisition process of acquiring factor information including movement information related to a speed and a direction of the moving body, an adjustment process of adjusting a position of a moving mechanism that moves an image sensor or an imaging lens provided in the imaging apparatus, based on the factor information, an imaging process of imaging a subject by using the image sensor after the adjustment process is executed, and a correction process of correcting a shake applied to the image sensor or the imaging lens by using the moving mechanism in a case in which the imaging process is executed.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] FIG. **1** is a plan view showing an example of an imaging system.

[0011] FIG. **2** is a side view showing an example of an imaging apparatus and a flying object.

[0012] FIG. **3** is a block diagram showing an example of a hardware configuration of the flying object.

[0013] FIG. **4** is a block diagram showing an example of a hardware configuration of the imaging apparatus.

[0014] FIG. **5** is a block diagram showing an example of a functional configuration of a CPU mounted on the imaging apparatus.

[0015] FIG. **6** is a block diagram showing an example of an operation of an acquisition unit.

[0016] FIG. **7** is a block diagram showing an example of an operation of an estimation unit.

[0017] FIG. **8** is a block diagram showing an example of a first operation of a setting unit.

[0018] FIG. **9** is a block diagram showing an example of a second operation of the setting unit.

[0019] FIG. **10** is a block diagram showing an example of a first operation of an adjustment processing unit.
[0020] FIG. **11** is a block diagram showing an example of a second operation of the adjustment processing unit.
[0021] FIG. **12** is a block diagram showing an example of an operation of an imaging processing unit.
[0022] FIG. **13** is a block diagram showing an example of a first operation of a correction processing unit.
[0023] FIG. **14** is a block diagram showing an example of a second operation of the correction processing unit.
[0024] FIG. **15** is a block diagram showing an example of an operation of a data output unit.
[0025] FIG. **16** is a flowchart showing an example of a flow of an imaging support process.
[0026] FIG. **17** is a block diagram showing a first modification example of the acquisition unit.
[0027] FIG. **18** is a block diagram showing a second modification example of the acquisition unit.
[0028] FIG. **19** is a block diagram showing a third modification example of the acquisition unit.
[0029] FIG. **20** is a block diagram showing a modification example in which an estimation unit different from the estimation unit is added.
[0030] FIG. **21** is a flowchart showing a modification example of the flow of the imaging support process.
[0031] FIG. **22** is a block diagram showing a modification example of another estimation unit.
[0032] FIG. **23** is a block diagram showing an anti-vibration function of the imaging apparatus and a modification example of the adjustment processing unit.
[0033] FIG. **24** is a block diagram showing an anti-vibration function of the imaging apparatus and a modification example of the correction processing unit.
[0034] FIG. **25** is a block diagram showing a modification example of the imaging system, the acquisition unit, and the adjustment processing unit.
[0035] FIG. **26** is a block diagram showing a modification example of the imaging system, the acquisition unit, and the correction processing unit.
[0036] FIG. **27** is a block diagram showing a modification example of the imaging system.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0037] In the following, an example of an embodiment of a control method and an imaging apparatus according to the technology of the present disclosure will be described with reference to the accompanying drawings.
[0038] As an example, as shown in FIG. **1**, an imaging system S is a system capable of imaging a target object **2**, and comprises a flying object **10**, an imaging apparatus **50**, a transmitter **150**, and an anemometer **160**. The flying object **10** is an example of a "moving body" according to the technology of the present disclosure. The target object **2** is an example of a "subject" according to the technology of the present disclosure.
[0039] The flying object **10** is an unmanned aerial vehicle, such as a drone. The flying object **10** has a plurality of rotor blades **12**. By adjusting the rotation speed of the plurality of rotor blades **12**, the flying object **10** can move in a vertical direction, move in a horizontal direction, revolve, hover, and the like. FIG. **1** shows, as an example, a state in which the flying object **10** moves in the horizontal direction along the target object **2**.
[0040] The imaging apparatus **50** is mounted on the flying object **10**. The imaging apparatus **50** is a digital camera, for example. The imaging apparatus **50** is disposed in a direction of imaging the front of the flying object **10**. While the flying object **10** moves in the horizontal direction along the target object **2**, the imaging apparatus **50** images the target object **2** a plurality of times, so that panning is performed on the target object **2**.
[0041] The transmitter **150** is communicably connected to the flying object **10** and the imaging apparatus **50**. In a case in which the transmitter **150** receives a flight instruction by a user **4**, the

transmitter **150** transmits flight instruction information **200** indicating the flight instruction to the flying object **10**. The flight instruction information **200** is instruction information for causing the flying object **10** to move in the vertical direction, move in the horizontal direction, revolve, hover, and the like. The flight instruction information **200** includes instruction information related to a speed and a direction in which the flying object **10** moves. The flying object **10** flies based on the flight instruction information **200**.

[0042] In addition, in a case in which the transmitter **150** receives an imaging instruction by the user **4**, the transmitter **150** transmits imaging instruction information **202** indicating the imaging instruction to the imaging apparatus **50**. The imaging instruction information **202** is instruction information for causing the imaging apparatus **50** to image a subject (target object **2** as an example). The imaging apparatus **50** images the subject based on the imaging instruction information **202**.

[0043] The anemometer **160** is communicably connected to the imaging apparatus **50**. The anemometer **160** is installed in an environment in which the flying object **10** flies (hereinafter, referred to as flight environment). The anemometer **160** detects a speed of wind **6** generated in the flight environment (hereinafter, referred to as wind speed), and transmits wind information **208** corresponding to the detected wind speed to the imaging apparatus **50**. The wind information **208** is an example of “wind information” according to the technology of the present disclosure.

[0044] As an example, as shown in FIG. **2**, the flying object **10** comprises a gimbal mechanism **14**. The gimbal mechanism **14** supports the imaging apparatus **50** with respect to the flying object **10**. As an example, the gimbal mechanism **14** is a three-axis gimbal mechanism which is configured to absorb vibration generated around three axes. The gimbal mechanism **14** is attached to the imaging apparatus **50** in a direction in which the three axes of the gimbal mechanism **14** coincide with a yaw axis, a pitch axis, and a roll axis of the imaging apparatus **50**. As an example, an axis Y, an axis P, and an axis R shown in FIG. **2** indicate the yaw axis, the pitch axis, and the roll axis of the imaging apparatus **50**, respectively. The yaw axis, the pitch axis, and the roll axis of the imaging apparatus **50** coincide with the yaw axis, the pitch axis, and the roll axis of the flying object **10**, respectively.

[0045] The gimbal mechanism **14** may be a mechanical gimbal mechanism that absorbs vibration by a mechanical configuration, or may be an electric gimbal mechanism that absorbs vibration by an electric actuator. In addition, the gimbal mechanism **14** may be a two-axis gimbal mechanism. In a case in which the gimbal mechanism **14** is a two-axis gimbal mechanism, a first axis of two axes of the gimbal mechanism **14** coincides with any one of the yaw axis, the pitch axis, or the roll axis, and a second axis of the two axes of the gimbal mechanism **14** coincides with the other of the yaw axis, the pitch axis, or the roll axis. The gimbal mechanism **14** is an example of a “gimbal mechanism” according to the technology of the present disclosure.

[0046] As an example, as shown in FIG. **3**, the flying object **10** comprises a computer **20**, a flight device **22**, an acceleration sensor **24**, a positioning unit **26**, a communication interface (I/F) **28**, and an input and output I/F **30**.

[0047] The computer **20** comprises a central processing unit (CPU) **32**, a non-volatile memory (NVM) **34**, and a random access memory (RAM) **36**. The CPU **32**, the NVM **34**, and the RAM **36** are connected to each other via a bus **38**, and the bus **38** is connected to the input and output I/F **30**.

[0048] The NVM **34** is a non-temporary storage medium, and stores various parameters and various programs. For example, the NVM **34** is a flash memory (for example, electrically erasable and programmable read only memory (EEPROM)). It should be noted that this is merely an example, and a hard disk drive (HDD) or the like may be applied as the NVM **34** together with the flash memory. The RAM **36** temporarily stores various information, and is used as a work memory.

[0049] The CPU **32** reads out a necessary program from the NVM **34** and executes the read out program on the RAM **36**. The CPU **32** controls the entire flying object **10** in accordance with the program executed on the RAM **36**.

[0050] The flight device **22** has the plurality of rotor blades **12**, a plurality of motors **42**, and a motor driver **44**. In the example shown in FIG. **3**, the number of the plurality of rotor blades **12** is four, as an example. The number of the plurality of motors **42** is the same as the number of the plurality of rotor blades **12**. The motor driver **44** is connected to the CPU **32** via the input and output I/F **30** and the bus **38**. The motor driver **44** individually controls the plurality of motors **42** in accordance with an instruction from the CPU **32**. The rotor blade **12** is fixed to a rotation shaft of each motor **42**. Each motor **42** rotates the rotor blade **12**.

[0051] The acceleration sensor **24** detects acceleration in each axial direction of the pitch axis, the yaw axis, and the roll axis of the flying object **10**. The acceleration sensor **24** outputs acceleration information **220** corresponding to the acceleration in each axial direction of the flying object **10**.

[0052] The positioning unit **26** detects a position of the flying object **10**. The positioning unit **26** includes a receiver **46**. The receiver **46** receives, for example, position information (not shown) transmitted from a global navigation satellite system (GNSS). Examples of GNSS include a global positioning system (GPS). The positioning unit **26** detects the position of the flying object **10** based on the position information received by the receiver **46**, and outputs positioning information **222** corresponding to the position of the flying object **10**.

[0053] The communication I/F **28** is communicably connected to the transmitter **150** and the imaging apparatus **50**. The communication I/F **28** may be communicably connected to the transmitter **150** and the imaging apparatus **50** by a predetermined wireless communication standard, or may be communicably connected to the transmitter **150** and the imaging apparatus **50** by a predetermined wired communication standard. Examples of the predetermined wireless communication standard include Bluetooth (registered trademark). It should be noted that other wireless communication standards (for example, Wi-Fi or 5G) may be used. The communication I/F **28** receives the information transmitted from the transmitter **150** to output the received information to the CPU **32** via the bus **38**. In addition, the communication I/F **28** transmits the information in response to a request from the CPU **32** to the imaging apparatus **50**.

[0054] As an example, as shown in FIG. **4**, the imaging apparatus **50** comprises an imaging apparatus body **52** and a lens unit **54**. The imaging apparatus body **52** comprises a mechanical shutter **56**, an actuator for shutter **58**, a driver for shutter **60**, an image sensor **62**, a driver for image sensor **64**, a shake correction mechanism **66**, a driver for shake correction **68**, a driver for lens **70**, an acceleration sensor **72**, a computer **74**, an image memory **76**, a communication I/F **78**, and an input and output I/F **80**.

[0055] The driver for shutter **60**, the driver for image sensor **64**, the driver for shake correction **68**, the driver for lens **70**, the acceleration sensor **72**, the computer **74**, the image memory **76**, and the communication I/F **78** are connected to the input and output I/F **80**.

[0056] The computer **74** comprises a CPU **82**, an NVM **84**, and a RAM **86**. The CPU **82**, the NVM **84**, and the RAM **86** are connected via a bus **88**, and the bus **88** is connected to the input and output I/F **80**.

[0057] The NVM **84** is a non-temporary storage medium, and stores various parameters and various programs. For example, the NVM **84** is a flash memory (for example, EEPROM). It should be noted that this is merely an example, and an HDD or the like may be applied as the NVM **84** together with the flash memory. The RAM **86** temporarily stores various information, and is used as a work memory.

[0058] The CPU **82**, which is a processor, reads out a necessary program from the NVM **84** and executes the read out program on the RAM **86**. The CPU **82** controls the entire imaging apparatus **50** in accordance with the program executed on the RAM **86**. In the example shown in FIG. **4**, the driver for shutter **60**, the driver for image sensor **64**, the driver for shake correction **68**, the driver for lens **70**, the acceleration sensor **72**, the image memory **76**, and the communication I/F **78** are controlled by the CPU **82**.

[0059] The image sensor **62** is a complementary metal oxide semiconductor (CMOS) image sensor, for example. Here, the CMOS image sensor is described as an example of the image sensor **62**, but the technology of the present disclosure is not limited to this, and for example, the technology of the present disclosure is satisfied even in a case in which the image sensor **62** is another type of image sensor, such as a charge coupled device (CCD) image sensor.

[0060] The driver for image sensor **64** is connected to the image sensor **62**. The driver for image sensor **64** supplies an imaging timing signal defining a timing of the imaging performed by the image sensor **62** to the image sensor **62** in accordance with the instruction from the CPU **82**. The image sensor **62** performs resetting, exposure, and output of an electric signal in response to the imaging timing signal supplied from the driver for image sensor **64**. A moving mechanism **90** is assembled to the image sensor **62**, and the image sensor **62** is fixed to the moving mechanism **90**. The moving mechanism **90** is, for example, a holder that supports the image sensor **62**. The moving mechanism **90** is an example of a “moving mechanism” according to the technology of the present disclosure.

[0061] Subject light is incident on an imaging lens **96**. The subject light is imaged on a light-receiving surface **62**A of the image sensor **62** by the imaging lens **96**. The image sensor **62** includes a signal processing circuit (not shown). The signal processing circuit generates digital image data **232** by digitizing analog image data, and outputs the image data **232**.

[0062] The image memory **76** is an EEPROM, for example. It should be noted that this is merely an example, and an HDD, a solid state drive (SSD) or the like may be applied as the image memory **76** instead of the EEPROM or together with the EEPROM. The image data **232** generated by the image sensor **62** is stored in the image memory **76**. The CPU **82** acquires the image data **232** from the image memory **76**, and executes various processes using the acquired image data **232**.

[0063] The mechanical shutter **56** is, for example, a focal plane shutter, and is disposed between a stop **104** and the light-receiving surface **62**A. The mechanical shutter **56** comprises a front curtain **56**A and a rear curtain **56**B. The actuator for shutter **58** opens and closes the front curtain **56**A and the rear curtain **56**B. It should be noted that the imaging apparatus **50** may have an electronic shutter function instead of the mechanical shutter **56**.

[0064] The acceleration sensor **72** detects the acceleration in each axial direction of the pitch axis, the yaw axis, and the roll axis of the imaging apparatus **50**. The acceleration sensor **72** outputs acceleration information **230** corresponding to the acceleration in each axial direction of the imaging apparatus **50**.

[0065] The shake correction mechanism **66** is a mechanism that corrects the shake of the image by moving the image sensor **62** integrally with the moving mechanism **90** in a direction in which the shake of the image is corrected, in a case in which the shake is generated in the image obtained by being captured using the image sensor **62** due to the vibration of the imaging apparatus **50**.

[0066] The shake correction mechanism **66** comprises a position sensor **92** and an actuator for shake correction **94**. The position sensor **92** comprises, for example, a Hall element and a sensor magnet, and detects a position of the image sensor **62** in a yaw axis direction, a position in a pitch axis direction, and a position around the pitch axis of the image sensor **62**. The position sensor **92** outputs position information corresponding to the position of the image sensor **62** in the yaw axis direction, the position in the pitch axis direction, and the position around the pitch axis. The yaw axis, the pitch axis, and the roll axis of the image sensor **62** coincide with the yaw axis, the pitch axis, and the roll axis of the imaging apparatus **50**.

[0067] The actuator for shake correction **94** comprises, for example, a voice coil motor or a piezoelectric element, and is driven in response to a drive signal output from the driver for shake correction **68**. The actuator for shake correction **94** moves the image sensor **62** in the yaw axis direction and the pitch axis direction, and rotates the image sensor **62** around the pitch axis. The driver for shake correction **68** controls the actuator for shake correction **94** in accordance with the instruction from the CPU **82**. The actuator for shake correction **94** applies power to the moving mechanism **90**. The moving mechanism **90** moves the image sensor **62** based on the power applied from the actuator for shake correction **94**. A movable range of the image sensor **62** and the moving mechanism **90** is limited by a movable range of the actuator for shake correction **94**.

[0068] It should be noted that the “shake of the imaging apparatus **50**” refers to a phenomenon in which the positional relationship between an optical axis OA of the imaging lens **96** and the light-receiving surface **62**A fluctuates in the imaging apparatus **50**. In a case in which the shake of the imaging apparatus **50** occurs, the shake of the image occurs. Examples of the image include an image obtained by being captured using the image sensor **62** or an optical image obtained by being imaged on the light-receiving surface **62**A (hereinafter, simply “image” or “subject image”).

[0069] The “shake of the image” refers to a phenomenon in which the subject image deviates from a reference position due to the tilt of the optical axis OA due to a vibration phenomenon, that is, a phenomenon in which the subject image deviates from the reference position due to the relative movement of the optical axis OA with respect to the subject. The vibration phenomenon refers to a phenomenon in which the imaging lens **96** vibrates in a case in which the vibration is transmitted to the imaging lens **96** from the outside of the imaging apparatus **50** (for example, wind or flying object **10**). In addition, “tilt of the optical axis OA” means that, for example, the optical axis OA is tilted with respect to a reference axis (for example, the optical axis OA before the vibration phenomenon occurs (that is, the optical axis OA in a case in which the imaging apparatus **50** is stationary)). In addition, the “reference position” refers to, for example, the position of the subject image obtained in a state in which the vibration is not applied to the imaging lens **96** (for example, the position of the subject image in the light-receiving surface **62**A).

[0070] In addition, “correcting the shake of the image” also includes bringing the position of the image shaken by the shake of the imaging apparatus **50** closer to the position of the image before the shake of the imaging apparatus **50** is generated, in addition to causing the position of the image shaken by the shake of the imaging apparatus **50** to coincide with the position of the image before the shake of the imaging apparatus **50** is generated.

[0071] The communication I/F **78** is communicably connected to the flying object **10**, the transmitter **150**, and the anemometer **160**. The same technology as the communication I/F **28** can be applied to the communication I/F **78**. The communication I/F **78** receives the information transmitted from the flying object **10** to output the received information to the CPU **82** via the bus **88**. In addition, the communication I/F **78** receives the information transmitted from the transmitter **150** to output the received information to the CPU **82** via the bus **88**. Further, the communication I/F **78** receives the information transmitted from the anemometer **160** to output the received information to the CPU **82** via the bus **88**.

[0072] The lens unit **54** comprises the imaging lens **96**. The imaging lens **96** has, for example, an objective lens **98**, a focus lens **100**, a zoom lens **102**, and the stop **104**.

[0073] In addition, the lens unit **54** comprises a driver for lens **70**, a first actuator **108**, a second actuator **110**, a third actuator **112**, a first position sensor **114**, a second position sensor **116**, and an aperture stop amount sensor **118**. The driver for lens **70** controls the first actuator **108**, the second actuator **110**, and the third actuator **112** in accordance with the instruction from the CPU **82**.

[0074] The first position sensor **114** detects a position of the focus lens **100** on the optical axis OA, and outputs first position information corresponding to the detected position of the focus lens **100** to the CPU **82** via the driver for lens **70**. The second position sensor **116** detects a position of the zoom lens **102** on the optical axis OA, and outputs second position information corresponding to the detected position of the zoom lens **102** to the CPU **82** via the driver for lens **70**. The aperture stop amount sensor **118** detects an aperture size (that is, aperture stop amount), and outputs third position information corresponding to the detected aperture size to the CPU **82** via the driver for lens **70**. Examples of the first position sensor **114**, the second position sensor **116**, and the aperture stop amount sensor **118** include a potentiometer.

[0075] As an example, as shown in FIG. **5**, an imaging support program **120** is stored in the NVM **84** of the imaging apparatus **50**. The imaging support program **120** is an example of a “program” according to the technology of the present disclosure. The CPU **82** reads out the imaging support program **120** from the NVM **84**, and executes the read out imaging support program **120** on the RAM **86**. The CPU **82** performs an imaging support process in accordance with the imaging support program **120** executed on the RAM **86**. The imaging support process is executed by the CPU **82** to operate as an acquisition unit **122**, an acquisition determination unit **124**, an estimation unit **126**, a setting unit **128**, an adjustment processing unit **130**, an imaging processing unit **132**, a correction processing unit **134**, and a data output unit **136** in accordance with the imaging support program **120**.

[0076] As an example, as shown in FIG. **6**, the acquisition unit **122** acquires factor information **204**A. The factor information **204**A includes movement information **206**, the wind information **208**, distance information **210**, and gimbal information **212**. The movement information **206** includes speed information **206**A related to the speed at which the flying object **10** moves and direction information **206**B related to the direction in which the flying object **10** moves. The wind information **208** is information related to the wind speed of the flight environment. The distance information **210** is information related to a distance L between the imaging apparatus **50** and the target object **2**. The gimbal information **212** is information related to the gimbal mechanism **14**. In the following manner, the acquisition unit **122** acquires the movement information **206**, the wind information **208**, the distance information **210**, and the gimbal information **212**.

[0077] The transmitter **150** transmits the flight instruction information **200** related to the speed and the direction of the flying object **10** to the flying object **10** in accordance with the instruction by the user **4**. The flying object **10** transmits the received flight instruction information **200** as the movement information **206** to the imaging apparatus **50**. The acquisition unit **122** acquires the movement information **206** received by the imaging apparatus **50**. That is, the movement information **206** is information based on the flight instruction information **200** related to the speed and the direction input from the transmitter **150** to the flying object **10**. The flight instruction information **200** is an example of “instruction information” according to the technology of the present disclosure.

[0078] The anemometer **160** detects the wind speed in the flight environment and transmits the wind information **208** corresponding to the detected wind speed to the imaging apparatus **50**. The acquisition unit **122** acquires the wind information **208** received by the imaging apparatus **50**. The wind information **208** is an example of “wind information” according to the technology of the present disclosure.

[0079] The first position sensor **114** detects the position of the focus lens **100** on the optical axis OA, and outputs first position information **240** corresponding to the detected position of the focus lens **100** to the CPU **82**. The acquisition unit **122** acquires the distance information **210** based on the first position information **240**.

[0080] Specifically, the acquisition unit **122** calculates an object distance as an example of the distance L between the imaging apparatus **50** and the target object **2**. The object distance is the distance along a depth direction from a principal point of the imaging lens **96** to the subject in an in-focus state (for example, target object **2**). The acquisition unit **122** calculates the object distance based on the first position information **240** indicating the position of the focus lens **100** detected by the first position sensor **114** to acquire the distance information **210** indicating the object distance. The distance information **210** is an example of “distance information” according to the technology of the present disclosure.

[0081] The gimbal information **212** is stored in advance in the NVM **84**. The gimbal information **212** includes, as an example, axis information **212**A and frequency band information **212**B. The axis information **212**A is information related to the axis of the gimbal mechanism **14**. As an example, the axis information **212**A is information related to the number of axes of the gimbal mechanism **14**. The frequency band information **212**B is information related to a frequency band that can be corrected by using the gimbal mechanism **14** with respect to the vibration transmitted from the flying object **10** to the imaging apparatus **50**. It should be noted that the gimbal information **212** may not include the axis information **212**A or the frequency band information **212**B. The gimbal information **212** is an example of "gimbal information" according to the technology of the present disclosure.

[0082] As an example, as shown in FIG. **7**, the acquisition determination unit **124** determines whether or not the acquisition of the movement information **206** by the acquisition unit **122** is successful. For example, in a case in which the acquisition unit **122** acquires the movement information **206**, and the CPU **82** obtains communication normality information (not shown) indicating that a communication state between the flying object **10** and the imaging apparatus **50** is normal, the acquisition determination unit **124** determines that the acquisition of the movement information **206** by the acquisition unit **122** is successful. On the other hand, for example, in a case in which the acquisition unit **122** acquires the movement information **206**, and the CPU **82** obtains communication abnormality information (not shown) indicating that a communication state between the flying object **10** and the imaging apparatus **50** is abnormal, the acquisition determination unit **124** determines that the acquisition of the movement information **206** by the acquisition unit **122** fails. FIG. **7** shows a case in which the communication state between the flying object **10** and the imaging apparatus **50** is abnormal, and the acquisition determination unit **124** determines that the acquisition of the movement information **206** by the acquisition unit **122** fails.

[0083] In a case in which the acquisition determination unit **124** determines that the acquisition of the movement information **206** by the acquisition unit **122** fails, for example, the estimation unit **126** estimates movement information **236**, which is estimation information related to the speed and the direction of the flying object **10**, in the following manner.

[0084] That is, the estimation unit **126** acquires the acceleration information **230** from the acceleration sensor **72** provided in the imaging apparatus **50**. Moreover, the estimation unit **126** acquires first speed information **216**A related to the speed of the flying object **10** by integrating the acceleration indicated by the acceleration information **230**. In addition, the estimation unit **126** acquires first direction information **216**B related to the direction of the flying object **10** based on the direction of the acceleration indicated by the acceleration information **230**. As a result, first movement information **216** including the first speed information **216**A and the first direction information **216**B is obtained.

[0085] Further, the estimation unit **126** sequentially acquires first image data **232**A and second image data **232**B from the image memory **76**. The first image data **232**A and the second image data **232**B are first newest image data and second newest image data among a plurality of image data **232** recorded in the image memory **76**. Moreover, the estimation unit **126** acquires second speed information **226**A related to the speed of the flying object **10** based on a time interval in which the first image data **232**A and the second image data **232**B are recorded, and a moving distance of the flying object **10** derived based on the first image data **232**A and the second image data **232**B. In addition, the estimation unit **126** acquires second direction information **226**B related to the direction of the flying object **10** based on the change in the position of the flying object **10** indicated by the first image data **232**A and the second image data **232**B. As a result, second movement information **226** including the second speed information **226**A and the second direction information **226**B is obtained.

[0086] Moreover, for example, the estimation unit **126** acquires speed information **236**A, which is estimation information related to the speed of the flying object **10**, by calculating an average value of a first speed indicated by the first speed information **216**A and a second speed indicated by the second speed information **226**A and the like. In addition, for example, the estimation unit **126** acquires direction information **236**B, which is estimation information related to the direction of the flying object **10**, by calculating an average value of an azimuthal angle in a first direction indicated by the first direction information **216**B and an azimuthal angle in a second direction indicated by the second direction information **226**B, and the like. In the above manner, the movement information **236**, which is estimation information related to the speed and the direction of the flying object **10**, is estimated.

[0087] It should be noted that the estimation unit **126** may acquire the movement information **236**, which is the estimation information, based on the first movement information **216** obtained from the acceleration information **230**. In addition, the estimation unit **126** may acquire the movement information **236**, which is the estimation information, based on the second movement information **226** obtained from the first image data **232**A and the second image data **232**B. The acceleration information **230** from the acceleration sensor **72** provided in the imaging apparatus **50** is an example of "second acceleration sensor information" according to the technology of the present disclosure. The first image data **232**A and the second image data **232**B obtained by being captured by the image sensor **62** are examples of "second image information" according to the technology of the present disclosure. The movement information **236** estimated by the estimation unit **126** is an example of "second movement information" according to the technology of the present disclosure.

[0088] As an example, as shown in FIG. **8**, in a case in which the acquisition determination unit **124** determines that the acquisition of the movement information **206** by the acquisition unit **122** is successful, the setting unit **128** sets the shutter speed in a main exposure period to be described below based on the factor information **204**A acquired by the acquisition unit **122**. As an example, the setting unit **128** changes the shutter speed set based on an imaging condition obtained from the imaging apparatus **50** based on the factor information **204**A.

[0089] For example, in a case in which the moving speed of the flying object **10** indicated by the movement information **206** is equal to or higher than a predetermined speed, the setting unit **128** sets the shutter speed to a value shorter than the set value, which is set based on the imaging condition. Generally, as the moving speed of the flying object **10** is higher, the shake of the image is greater. The predetermined speed is defined as, for example, a lower limit value of a speed range in which the shake of the image cannot be corrected by using the correction processing unit **134** described below even in a case in which the position of the image sensor **62** is adjusted in advance by the adjustment processing unit **130** described below. In a case in which the moving speed of the flying object **10** is equal to or higher than the predetermined speed, the shutter speed is set to the value shorter than the set value, which is set based on the imaging condition, so that it is possible to suppress the shake of the image as compared with a case in which the shutter speed is maintained at the set value, which is set based on the imaging condition.

[0090] In addition, for example, in a case in which the object distance indicated by the distance information **210** is equal to or less than a predetermined distance, the setting unit **128** sets the shutter speed to the value shorter than the set value, which is set based on the imaging condition. In general, as the object distance is shorter, it is easier to perceive the shake of the image. The predetermined distance is defined as, for example, an upper limit value of a distance range in which the shake of the image cannot be corrected by using the correction processing unit **134** described below even in a case in which the position of the image sensor **62** is adjusted in advance by the adjustment processing unit **130** described below. In a case in which the object distance is equal to or less than the predetermined distance, the shutter speed is set to the value shorter than the set value, which is set based on the imaging condition, so that it is possible to make it difficult to perceive the shake of the image as compared with a case in which the shutter speed is maintained at the set value, which is set based on the imaging condition.

[0091] In addition, for example, in a case in which the frequency band indicated by the frequency band information **212**B included in the gimbal information **212** is lower than a predetermined frequency, the setting unit **128** sets the shutter speed to the value shorter than the set value, which is set based on the imaging condition. The frequency band that can be corrected by using the correction processing unit **134**, which will be described below, is a band higher than the frequency band that can be corrected by using the gimbal mechanism **14**. In a case in which the frequency band that can be corrected by using the correction processing unit **134** (hereinafter, referred to as high frequency band) and the frequency band that can be corrected by using the gimbal mechanism **14** (hereinafter, referred to as low frequency band) deviate from each other, the shake of the image in an intermediate frequency band between the high frequency band and the low frequency band is larger than a case in which the high frequency band and the low frequency band are continuous. The predetermined frequency is defined by, for example, the lower limit value described above of the high frequency band. In a case in which the frequency band indicated by the frequency band information **212**B included in the gimbal information **212** is lower than the predetermined frequency, the shutter speed is set to the value shorter than the set value, which is set based on the imaging condition, so that it is possible to suppress the shake of the image as compared with a case in which the shutter speed is maintained at the set value, which is set based on the imaging condition.

[0092] In addition, for example, in a case in which the number of axes of the gimbal mechanism **14** indicated by the axis information **212**A included in the gimbal information **212** is less than a predetermined number, the setting unit **128** sets the shutter speed to the value shorter than the set value, which is set based on the imaging condition. Generally, as the number of axes of the gimbal mechanism **14** is decreased, the vibration absorption performance of the gimbal mechanism **14** is decreased, so that the shake of the image is increased. The predetermined number is set to 3, for example, which corresponds to the three-axis gimbal mechanism. In a case in which the number of axes of the gimbal mechanism **14** is less than the predetermined number, the shutter speed is set to the value shorter than the set value, which is set based on the imaging condition, so that it is possible to suppress the shake of the image as compared with a case in which the shutter speed is maintained at the set value, which is set based on the imaging condition.

[0093] In addition, for example, in a case in which the wind speed indicated by the wind information **208** is equal to or higher than a predetermined wind speed, the setting unit **128** sets the shutter speed to the value shorter than the set value, which is set based on the imaging condition. Generally, as the wind speed in the flight environment is higher, the vibration generated in the flying object **10** is stronger, and the shake of the image is greater. The predetermined wind speed is defined as, for example, a lower limit value of a wind speed range in which the shake of the image cannot be corrected by using the correction processing unit **134** described below even in a case in which the position of the image sensor **62** is adjusted in advance by the adjustment processing unit **130** described below. In a case in which the wind speed in the flight environment is equal to or higher than the predetermined wind speed, the shutter speed is set to the value shorter than the set value, which is set based on the imaging condition, so that it is possible to suppress the shake of the image as compared with a case in which the shutter speed is maintained at the set value, which is set based on the imaging condition.

[0094] It should be noted that the setting unit **128** may calculate a focal length of the imaging lens **96** based on the second position information **241** indicating the position of the zoom lens **102** detected by the second position sensor **116**, and may make the shutter speed shorter than the set value, which is set based on the imaging condition in a case in which the focal length is equal to or larger than a predetermined focal length. In general, as the focal length is longer (that is, a distance is larger), it is easier to perceive the shake of the image. The predetermined focal length is defined as, for example, a lower limit value of a focal length range in which the shake of the image cannot be corrected by using the correction processing unit **134** described below even in a case in which the position of the image sensor **62** is adjusted in advance by the adjustment processing unit **130** described below. In a case in which the focal length is equal to or larger than the predetermined focal length, the shutter speed is set to the value shorter than the set value, which is set based on the imaging condition, so that it is possible to make it difficult to perceive the shake of the image as compared with a case in which the shutter speed is maintained at the set value, which is set based on the imaging condition.

[0095] In addition, in a case in which the shutter speed is changed by the setting unit **128**, change information **242** indicating that the shutter speed is changed may be transmitted to the transmitter **150**. Moreover, on a display **152** of the transmitter **150**, characters or the like indicating that the change or an error may occur may be displayed based on the change information **242**.

[0096] As an example, as shown in FIG. **9**, in a case in which the acquisition determination unit **124** determines that the acquisition of the movement information **206** by the acquisition unit **122** fails, the setting unit **128** sets the shutter speed in the main exposure period to be described below based on factor information **204**B in which the movement information **236** estimated by the estimation unit **126** is added to the distance information **210**, the wind information **208**, and the gimbal information **212** acquired by the acquisition unit **122**. In a case in which the acquisition determination unit **124** determines that the acquisition of the movement information **206** by the acquisition unit **122** fails, the setting unit **128** sets the shutter speed in the main exposure period based on the factor information **204**B in the same manner as in a case in which the acquisition determination unit **124** determines that the acquisition of the movement information **206** by the acquisition unit **122** is successful (see FIG. **8**). It should be noted that, in a case in which it is not necessary to distinguish between the factor information **204**A (see FIG. **8**) and the factor information **204**B (see FIG. **9**), the factor information **204**A and the factor information **204**B are referred to as factor information **204**, respectively.

[0097] As an example, as shown in FIG. **10**, the adjustment processing unit **130** adjusts the position of the moving mechanism **90** that moves the image sensor **62** by controlling the actuator for shake correction **94** via the driver for shake correction **68**. The position of the image sensor **62** is adjusted by adjusting the position of the moving mechanism **90**. As an example, in a case in which the acquisition determination unit **124** determines that the acquisition of the movement information **206** by the acquisition unit **122** is successful, the adjustment processing unit **130** adjusts the position of the moving mechanism **90** based on the factor information **204**A acquired by the acquisition unit **122**.

[0098] The adjustment processing unit **130** adjusts the position of the moving mechanism **90** based on the direction indicated by the movement information **206** (that is, the direction in which the flying object **10** moves). For example, in a case in which the flying object **10** moves along the pitch axis, the adjustment processing unit **130** adjusts the position of the moving mechanism **90** in the same direction as the direction in which the flying object **10** moves along the pitch axis. In addition, for example, in a case in which the flying object **10** moves along the yaw axis, the adjustment processing unit **130** adjusts the position of the moving mechanism **90** in the same direction as the direction in which the flying object **10** moves along the yaw axis. As an example, FIG. **10** shows a state in which the position of the moving mechanism **90** is adjusted in the same direction as the direction in which the flying object **10** moves along the pitch axis in accordance with the movement of the flying object **10** along the pitch axis.

[0099] It should be noted that, in a case in which the moving direction of the flying object **10** is a direction tilted with the pitch axis in a plan view, the adjustment processing unit **130** adjusts the position of the moving mechanism **90** in the same direction as a movement component of the flying object **10** in the pitch axis direction. In addition, in a case in which the moving direction of the flying object **10** is a direction tilted with the yaw axis and the pitch axis in a front view, the adjustment processing unit **130** adjusts the position of the moving mechanism **90** in the same direction as the movement component of the flying object **10** in the yaw axis direction and the same direction as the movement component of the flying object **10** in the pitch axis direction.

[0100] The adjustment processing unit **130** adjusts the position of the moving mechanism **90** with respect to a central axis C of the image sensor **62**. The central axis C of the image sensor **62** is an axis passing through a center of the image sensor **62** in a state before the position of the moving mechanism **90** is adjusted by the adjustment processing unit **130** and the correction processing unit **134**.

[0101] As an example, the adjustment processing unit **130** changes an amount of adjusting the position of the moving mechanism **90** (hereinafter, referred to as position adjustment amount) based on the factor information **204**A. The position adjustment amount of the moving mechanism **90** corresponds to a change amount of the position of the moving mechanism **90** with respect to the central axis.

[0102] For example, the adjustment processing unit **130** sets a larger position adjustment amount of the moving mechanism **90** as the moving speed of the flying object **10** indicated by the movement information **206** is higher. Generally, as the moving speed of the flying object **10** is higher, the moving distance of the flying object **10** that moves in the main exposure period is longer. By setting a larger position adjustment amount of the moving mechanism **90** as the moving speed of the flying object **10** indicated by the movement information **206** is higher, a movable distance (hereinafter, referred to as shake correction distance) of the image sensor **62** in a direction opposite to the direction in which the flying object **10** moves in the main exposure period is increased. As a result, the shake correction distance in accordance with the moving speed of the flying object **10** is secured.

[0103] In addition, for example, the adjustment processing unit **130** sets a larger position adjustment amount of the moving mechanism **90** as the object distance indicated by the distance information **210** is shorter. Generally, as the object distance is shorter, the distance in which the subject moves relative to the imaging apparatus **50** in the main exposure period is longer. By setting a larger position adjustment amount of the moving mechanism **90** as the object distance indicated by the distance information **210** is shorter, the shake correction distance of the image sensor **62** in the main exposure period is increased. As a result, the shake correction distance in accordance with the object distance is secured.

[0104] In addition, for example, in a case in which the frequency band indicated by the frequency band information **212**B included in the gimbal information **212** is lower than the predetermined frequency, the adjustment processing unit **130** sets a larger position adjustment amount of the moving mechanism **90** than a case in which the frequency band is equal to or higher than the predetermined frequency. As described above, in a case in which the high frequency band that can be corrected by using the correction processing unit **134** and the low frequency band that can be corrected by using the gimbal mechanism **14** deviate from each other, the shake of the image in an intermediate frequency band between the high frequency band and the low frequency band is larger than a case in which the high frequency band and the low frequency band are continuous. In a case in which the frequency band indicated by the frequency band information **212**B included in the gimbal information **212** is lower than the predetermined frequency, by setting a larger position adjustment amount of the moving mechanism **90** than a case in which the frequency band is equal to or higher than the predetermined frequency, the shake correction distance of the image sensor **62** in the main exposure period is longer than a case in which the frequency band is equal to or higher than the predetermined frequency. As a result, the shake correction distance in accordance with the vibration absorption performance of the gimbal mechanism **14** is secured.

[0105] In addition, for example, in a case in which the number of axes of the gimbal mechanism **14** indicated by the axis information **212**A included in the gimbal information **212** is less than the predetermined number, the adjustment processing unit **130** sets a larger position adjustment amount of the moving mechanism **90** than a case in which the number of axes of the gimbal mechanism **14** is equal to or larger than the predetermined number. As described above, as the number of axes of the gimbal mechanism **14** is decreased, the vibration absorption performance of the gimbal mechanism **14** is decreased, so that the shake of the image is increased. In a case in which the number of axes of the gimbal mechanism **14** indicated by the axis information **212**A included in the gimbal information **212** is less than the predetermined number, the shake correction distance of the image sensor **62** in the main exposure period is longer than a case in which the number of axes of the gimbal mechanism **14** is equal to or larger than the predetermined number. As a result, the shake correction distance in accordance with the vibration absorption performance of the gimbal

mechanism **14** is secured.
[0106] In addition, for example, the adjustment processing unit **130** sets a larger position adjustment amount of the moving mechanism **90** as the wind speed indicated by the wind information **208** is higher. Generally, as the wind speed in the flight environment is higher, the vibration generated in the flying object **10** is stronger, and the shake of the image is greater. By setting a larger position adjustment amount of the moving mechanism **90** as the wind speed indicated by the wind information **208** is higher, the shake correction distance of the image sensor **62** in the main exposure period is increased. As a result, the shake correction distance in accordance with the wind speed of the flight environment is secured.
[0107] It should be noted that, for example, the adjustment processing unit **130** may set a larger position adjustment amount of the moving mechanism **90** as the acceleration indicated by the acceleration information **220** from the acceleration sensor **24** provided in the flying object **10** is higher. In general, as the acceleration acting on the flying object **10** is higher, the vibration generated in the flying object **10** is stronger, and the shake of the image is greater. By setting a larger position adjustment amount of the moving mechanism **90** as the acceleration indicated by the acceleration information **220** is higher, the shake correction distance of the image sensor **62** in the main exposure period is increased. As a result, a shake correction distance in accordance with the acceleration acting on the flying object **10** is secured.
[0108] Similarly, for example, the adjustment processing unit **130** may set a larger position adjustment amount of the moving mechanism **90** as the acceleration indicated by the acceleration information **230** from the acceleration sensor **72** provided in the imaging apparatus **50** is higher.
[0109] In addition, the adjustment processing unit **130** may acquire wind direction information (not shown) related to a direction of the wind **6** generated in the flight environment, and may change the position adjustment amount of the moving mechanism **90** based on the acquired wind direction information.
[0110] In addition, the adjustment processing unit **130** may adjust the position of the moving mechanism **90** such that the image sensor **62** moves to an end of the movable range regardless of the factor information **204**.
[0111] In a case in which the position of the moving mechanism **90** is adjusted by the adjustment processing unit **130** as described above, the position of the moving mechanism **90** is maintained until a correction process by the correction processing unit **134** described below is executed.
[0112] As an example, as shown in FIG. **11**, in a case in which the acquisition determination unit **124** determines that the acquisition of the movement information **206** by the acquisition unit **122** fails, the adjustment processing unit **130** adjusts the position of the moving mechanism **90** based on factor information **204**B in which the movement information **236** estimated by the estimation unit **126** is added to the distance information **210**, the wind information **208**, and the gimbal information **212** acquired by the acquisition unit **122**. In a case in which the acquisition determination unit **124** determines that the acquisition of the movement information **206** by the acquisition unit **122** fails, the adjustment processing unit **130** adjusts the position of the moving mechanism **90** based on the factor information **204**B in the same manner as in a case in which the acquisition determination unit **124** determines that the acquisition of the movement information **206** by the acquisition unit **122** is successful (see FIG. **10**).
[0113] As an example, as shown in FIG. **12**, the imaging instruction information **202** transmitted from the transmitter **150** is received by the imaging apparatus **50**. In a case in which the imaging instruction information **202** is received by the imaging apparatus **50**, the CPU **82** of the imaging apparatus **50** controls the actuator for shutter **58** via the driver for shutter **60** to open or close the front curtain **56**A and open or close the rear curtain **56**B to execute the main exposure. In this case, the CPU **82** executes the main exposure based on the shutter speed set by the setting unit **128**. In a case in which the main exposure is executed, the image sensor **62** images the target object **2** to generate the image data **232** for one frame. The image data **232** generated by the image sensor **62** is

stored in the image memory **76**.

[0114] The CPU **82** acquires the image data **232** from the image memory **76**, and executes various processes on the acquired image data **232**. Moreover, the CPU **82** records the image data **232** subjected to various processes in the NVM **84**. It should be noted that, in a case in which a memory card (not shown) is connected to the imaging apparatus **50**, the CPU **82** may record the image data **232** subjected to various processes in the memory card.

[0115] The imaging processing unit **132** determines whether or not the main exposure is started. In a case in which the CPU **82** starts the main exposure, the imaging processing unit **132** determines that the main exposure is started. In addition, the imaging processing unit **132** determines whether or not the main exposure is terminated. In a case in which the CPU **82** terminates the main exposure, the imaging processing unit **132** determines that the main exposure is terminated.

[0116] As an example, as shown in FIG. **13**, the correction processing unit **134** performs a process of correcting the shake of the image (hereinafter, referred to as correction process) in a case in which the main exposure is executed. Stated another way, the correction processing unit **134** performs the correction process such that the shake of the image is corrected together with the main exposure. The correction processing unit **134** starts the correction process in a case in which the imaging processing unit **132** determines that the main exposure is started, and terminates the correction process in a case in which the imaging processing unit **132** determines that the main exposure is terminated. A period in which the correction process is performed may overlap with the entire period of the main exposure, or may overlap with a partial period of the main exposure.

[0117] The correction processing unit **134** corrects the shake applied to the image sensor **62** by using the moving mechanism **90** as the correction process. That is, the correction processing unit **134** controls the actuator for shake correction **94** via the driver for shake correction **68** to move the image sensor **62** in the direction in which the shake of the image is corrected. As an example, in a case in which the acquisition determination unit **124** determines that the acquisition of the movement information **206** by the acquisition unit **122** is successful, the correction processing unit **134** moves the image sensor **62** in the direction in which the shake of the image is corrected, based on the factor information **204**A acquired by the acquisition unit **122**.

[0118] The correction processing unit **134** moves the image sensor **62** based on the direction indicated by the movement information **206**. For example, in a case in which the flying object **10** moves along the pitch axis, the correction processing unit **134** moves the image sensor **62** in a direction opposite to the direction in which the flying object **10** moves along the pitch axis. In addition, for example, in a case in which the flying object **10** moves along the yaw axis, the correction processing unit **134** moves the image sensor **62** in a direction opposite to the direction in which the flying object **10** moves along the yaw axis. As an example, FIG. **13** shows a state in which the image sensor **62** moves in the direction opposite to the direction in which the flying object **10** moves along the pitch axis in accordance with the movement of the flying object **10** along the pitch axis.

[0119] It should be noted that, in a case in which the moving direction of the flying object **10** is the direction tilted with the pitch axis in a plan view, the correction processing unit **134** moves the image sensor **62** in the direction opposite to the movement component of the flying object **10** in the pitch axis direction. In addition, in a case in which the moving direction of the flying object **10** is the direction tilted with the yaw axis and the pitch axis in a front view, the correction processing unit **134** moves the image sensor **62** in a direction opposite to the movement component of the flying object **10** in the yaw axis direction and a direction opposite to the movement component of the flying object **10** in the pitch axis direction.

[0120] In addition, for example, in a case in which the correction processing unit **134** moves the image sensor **62** based on the direction indicated by the movement information **206**, the correction processing unit **134** acquires the acceleration information **230** from the acceleration sensor **72** provided in the imaging apparatus **50** and calculates a shake amount of the imaging apparatus **50** based on the acceleration information **230**. Moreover, the correction processing unit **134** adjusts the direction and the moving amount in which the image sensor **62** moves based on the shake amount of the imaging apparatus **50**.

[0121] It should be noted that the correction processing unit **134** may acquire the acceleration information **220** from the acceleration sensor **24** provided in the flying object **10** and may calculate the shake amount of the flying object **10** based on the acceleration information **220**. Moreover, the correction processing unit **134** may adjust the moving direction and the moving amount in which the image sensor **62** moves based on the shake amount of the flying object **10**.

[0122] In addition, in a case in which the image sensor **62** is moved based on the direction indicated by the movement information **206**, the correction processing unit **134** may calculate the shake amount of the imaging apparatus **50** based on the distance information **210**, the wind information **208**, or the gimbal information **212**, and the acceleration information **230**, and may adjust the direction and the moving amount in which the image sensor **62** moves based on the calculated shake amount of the imaging apparatus **50**.

[0123] In addition, the correction processing unit **134** may acquire the wind direction information (not shown) related to the wind direction of the flight environment in a case in which the image sensor **62** is moved based on the direction indicated by the movement information **206**. Moreover, the correction processing unit **134** calculates the shake amount of the imaging apparatus **50** based on the wind direction information, the wind information **208**, and the acceleration information **230**, and may adjust the direction and the moving amount in which the image sensor **62** moves based on the calculated shake amount of the imaging apparatus **50**.

[0124] As an example, as shown in FIG. **14**, in a case in which the acquisition determination unit **124** determines that the acquisition of the movement information **206** by the acquisition unit **122** fails, the correction processing unit **134** moves the image sensor **62** in the direction in which the shake of the image is corrected, based on factor information **204**B in which the movement information **236** estimated by the estimation unit **126** is added to the distance information **210**, the wind information **208**, and the gimbal information **212** acquired by the acquisition unit **122**. In a case in which the acquisition determination unit **124** determines that the acquisition of the movement information **206** by the acquisition unit **122** fails, the correction processing unit **134** moves the image sensor **62** in the direction in which the shake of the image is corrected, based on the factor information **204**B in the same manner as in a case in which the acquisition determination unit **124** determines that the acquisition of the movement information **206** by the acquisition unit **122** is successful (see FIG. **13**).

[0125] As an example, as shown in FIG. **15**, in a case in which the transmitter **150** does not receive the imaging instruction from the user **4**, the imaging instruction information (not shown) is not transmitted from the transmitter **150** to the imaging apparatus **50**. In this case, the imaging processing unit **132** determines that the main exposure is not started.

[0126] In a case in which the imaging processing unit **132** determines that the main exposure is not started, the data output unit **136** generates live view image data **250** based on the image data **232** stored in the image memory **76**.

[0127] The transmitter **150** comprises a display **152**, and the data output unit **136** outputs the generated live view image data **250** to the display **152**. The display **152** displays a live view image based on the live view image data **250**. The display **152** is an example of a "display device" according to the technology of the present disclosure.

[0128] In a case in which a data output process by the data output unit **136** is executed in this way, the shake applied to the imaging apparatus **50** is corrected by using the gimbal mechanism **14**. In addition, in a case in which the data output unit **136** executes a generation process and an output process of the live view image data **250**, the position of the moving mechanism **90** is maintained by the control by the driver for shake correction **68**.

[0129] It should be noted that, in a case in which the data output process by the data output unit

136 is executed, the shake of the image may be corrected by electronic image stabilization (EIS). In addition, the live view image data **250** may be output to a display device other than the display **152** provided in the transmitter **150**.

[0130] Next, an action of the imaging apparatus **50** according to the present embodiment will be described with reference to FIG. **16**. FIG. **16** shows an example of a flow of the imaging support process according to the present embodiment.

[0131] In the imaging support process shown in FIG. **16**, first, in step ST**10**, the acquisition unit **122** acquires the factor information **204**A including the movement information **206**, the wind information **208**, the distance information **210**, and the gimbal information **212**. After the process of step ST**10** is executed, the imaging support process proceeds to step ST**11**. Step ST**10** is an example of an "acquisition step" according to the technology of the present disclosure. The process executed by the acquisition unit **122** is an example of an "acquisition process" according to the technology of the present disclosure.

[0132] In step ST**11**, the acquisition determination unit **124** determines whether or not the acquisition of the movement information **206** by the acquisition unit **122** is successful. In a case in which the acquisition of the movement information **206** by the acquisition unit **122** fails in step ST**11**, a negative determination is made, and the imaging support process proceeds to step ST**12**. In a case in which the acquisition of the movement information **206** by the acquisition unit **122** is successful in step ST**11**, a positive determination is made, and the imaging support process proceeds to step ST**13**.

[0133] In step ST**12**, the estimation unit **126** estimates the movement information **236** related to the speed and the direction of the flying object **10** based on the acceleration information **230** from the acceleration sensor **72** provided in the imaging apparatus **50**, for example. As a result, the factor information **204**B in which the movement information **236** estimated by the estimation unit **126** is added to the distance information **210**, the wind information **208**, and the gimbal information **212** acquired by the acquisition unit **122** is obtained. After the process of step ST**12** is executed, the imaging support process proceeds to step ST**13**. Step ST**12** is an example of a "second estimation step" according to the technology of the present disclosure.

[0134] In step ST**13**, the setting unit **128** sets the shutter speed in the main exposure period based on the factor information **204**A acquired in step ST**10** or the factor information **204**B obtained in step ST**12**. After the process of step ST**13** is executed, the imaging support process proceeds to step ST**14**. Step ST**13** is an example of a "setting step" according to the technology of the present disclosure. The process executed by the setting unit **128** is an example of a "setting process".

[0135] In step ST**14**, the adjustment processing unit **130** adjusts the position of the moving mechanism **90** that moves the image sensor **62** based on the factor information **204**A acquired in step ST**10** or the factor information **204**B obtained in step ST**12**. After the process of step ST**14** is executed, the imaging support process proceeds to step ST**15**. Step ST**14** is an example of an "adjustment step" according to the technology of the present disclosure. The process executed by the adjustment processing unit **130** is an example of an "adjustment process".

[0136] In step ST**15**, the imaging processing unit **132** determines whether or not the main exposure is started. In a case in which the main exposure is started in step ST**15**, a positive determination is made, and the imaging support process proceeds to step ST**16**. In a case in which the main exposure is not started in step ST**15**, a negative determination is made, and the imaging support process proceeds to step ST**18**. Step ST**15** and step ST**17**, which will be described below, are examples of an "imaging step" according to the technology of the present disclosure. The process executed by the imaging processing unit **132** is an example of the "imaging process".

[0137] In step ST**16**, the correction processing unit **134** corrects the shake applied to the image sensor **62** by using the moving mechanism **90** based on the factor information **204**A acquired in step ST**10** or the factor information **204**B obtained in step ST**12**. After the process of step ST**16** is executed, the imaging support process proceeds to step ST**17**. Step ST**16** is an example of a “correction step” according to the technology of the present disclosure. The process executed by the correction processing unit **134** is an example of a “correction process”.

[0138] In step ST**17**, the imaging processing unit **132** determines whether or not the main exposure is terminated. In a case in which the main exposure is not terminated in step ST**17**, a negative determination is made, and the imaging support process proceeds to step ST**16**. In a case in which the main exposure is terminated in step ST**17**, a positive determination is made, and the imaging support process proceeds to step ST**20**.

[0139] In step ST**18**, the data output unit **136** generates the live view image data **250** based on the image data **232** stored in the image memory **76**. After the process of step ST**18** is executed, the imaging support process proceeds to step ST**19**.

[0140] In step ST**19**, the data output unit **136** outputs the live view image data **250** generated in step ST**18** to the display **152**. In a case in which the data output unit **136** executes the generation process and the output process of the live view image data **250**, the position of the moving mechanism **90** is maintained by the control by the driver for shake correction **68**. After the process of step ST**19** is executed, the imaging support process proceeds to step ST**10**. Step ST**18** and step ST**19** are examples of an “output step” according to the technology of the present disclosure.

[0141] In step ST**20**, the CPU **82** determines whether or not a condition for terminating the imaging support process is satisfied. Examples of the condition for terminating the imaging support process include a condition that the imaging apparatus **50** receives a termination instruction (for example, an instruction to switch the imaging apparatus **50** to a mode other than the imaging mode) which is an instruction to terminate the imaging mode of the imaging apparatus **50**. In a case in which the condition for terminating the imaging support process is not satisfied in step ST**20**, a negative determination is made, and the imaging support process proceeds to step ST**10**. In a case in which the condition for terminating the imaging support process is satisfied in step ST**20**, a positive determination is made, and the imaging support process is terminated. The control method described as the action of the imaging apparatus **50** described above is an example of a “control method” according to the technology of the present disclosure.

[0142] As described above, in the imaging apparatus **50** according to the present embodiment, the factor information **204**A including the movement information **206** of the flying object **10** is acquired by the acquisition unit **122**. In addition, based on the factor information **204**A, the position of the moving mechanism **90** that moves the image sensor **62** provided in the imaging apparatus **50** is adjusted by the adjustment processing unit **130**. Moreover, after the position of the moving mechanism **90** is adjusted, in a case in which the imaging process of imaging the subject by using the image sensor **62** is executed by the imaging processing unit **132**, the shake applied to the image sensor **62** is corrected by using the moving mechanism **90** by the correction processing unit **134**. Therefore, by adjusting the position of the moving mechanism **90** based on the factor information **204**A, it is possible to secure a movable distance (that is, shake correction distance) of the image sensor **62** in a case in which the imaging process is executed. As a result, for example, the shake of the image can be suppressed in accordance with the factor information **204** as compared with a case in which the position of the moving mechanism **90** is not adjusted based on the factor information **204**A.

[0143] In addition, the movement information **206** included in the factor information **204**A acquired by the acquisition unit **122** is information based on the flight instruction information **200** related to the speed and the direction input to the flying object **10**. Therefore, for example, based on the acceleration information **220** from the acceleration sensor **24** provided in the flying object **10** or the acceleration information **230** from the acceleration sensor **72** provided in the imaging apparatus **50**, the calculation processing amount of the acquisition unit **122** can be reduced as compared with a case in which the acquisition unit **122** generates the movement information **206** related to the speed and the direction of the flying object **10**, so that the responsiveness of the imaging apparatus **50** can be improved.

[0144] In addition, in a case in which the acquisition of the movement information **206** by the acquisition unit **122** fails, the estimation unit **126** estimates the movement information **206** based on, for example, the acceleration information **230** from the acceleration sensor **72** provided in the imaging apparatus **50**, or the first image data **232**A and the second image data **232**B obtained by being captured by using the image sensor **62**. Therefore, even in a case in which the acquisition of the movement information **206** by the acquisition unit **122** fails, it is possible to obtain the factor information **204**B in which the movement information **236** estimated by the estimation unit **126** is added to the distance information **210**, the wind information **208**, and the gimbal information **212** acquired by the acquisition unit **122**. As a result, based on the factor information **204**B, the setting process by the setting unit **128**, the adjustment process by the adjustment processing unit **130**, and the correction process by the correction processing unit **134** can be executed.
[0145] In addition, the setting unit **128** sets the shutter speed as an example of the imaging condition of the imaging apparatus **50** based on the factor information **204** (that is, the factor information **204**A or the factor information **204**B). Therefore, the shutter speed can be set to a value in accordance with the factor information **204**. As a result, for example, the imaging process can be executed at the shutter speed in accordance with the factor information **204**, as compared with a case in which the shutter speed is set without being based on the factor information **204**.
[0146] In addition, the adjustment process executed by the adjustment processing unit **130** (that is, the process of adjusting the position of the moving mechanism **90** that moves the image sensor **62**) is executed based on the factor information **204**. Therefore, in the adjustment process, the position of the moving mechanism **90** can be adjusted in accordance with the factor information **204**. As a result, for example, the shake correction distance can be secured in accordance with the factor information **204** as compared with a case in which the adjustment process is executed without being based on the factor information **204**.
[0147] In addition, the correction process by the correction processing unit **134** (that is, the process of correcting the shake applied to the image sensor **62** by using the moving mechanism **90**) is executed based on the factor information **204**. Therefore, it is possible to correct the shake applied to the image sensor **62** in accordance with the factor information **204**. As a result, for example, it is possible to suppress the shake of the image in accordance with the factor information **204**, as compared with a case in which the correction process is executed without being based on the factor information **204**.
[0148] In addition, the factor information **204** includes the wind information **208** related to the wind generated in the environment in which the moving body flies. Therefore, in the setting process executed by the setting unit **128** (that is, the process of setting the shutter speed), the shutter speed can be set in accordance with the wind information **208**. As a result, for example, the imaging process can be executed at the shutter speed in accordance with the wind information **208** as compared with a case in which the setting process is executed without being based on the wind information **208**.
[0149] In addition, since the factor information **204** includes the wind information **208**, the position of the moving mechanism **90** can be adjusted in accordance with the wind information **208** in the adjustment process executed by the adjustment processing unit **130**. As a result, for example, the shake correction distance can be secured in accordance with the wind information **208** as compared with a case in which the adjustment process is executed without being based on the wind information **208**.
[0150] In addition, since the factor information **204** includes the wind information **208**, the shake applied to the image sensor **62** can be corrected in accordance with the wind information **208** in the correction process executed by the correction processing unit **134**. As a result, for example, the shake of the image can be suppressed in accordance with the wind information **208** as compared with a case in which the correction process is executed without being based on the wind information **208**.

[0151] In addition, the factor information **204** includes the distance information **210** related to the distance between the imaging apparatus **50** and the subject. Therefore, in the setting process executed by the setting unit **128**, the shutter speed can be set in accordance with the distance information **210**. As a result, for example, the imaging process can be executed at the shutter speed in accordance with the distance information **210** as compared with a case in which the setting process is executed without being based on the distance information **210**.
[0152] In addition, since the factor information **204** includes the distance information **210**, the position of the moving mechanism **90** can be adjusted in accordance with the distance information **210** in the adjustment process executed by the adjustment processing unit **130**. As a result, for example, the shake correction distance can be secured in accordance with the distance information **210** as compared with a case in which the adjustment process is executed without being based on the distance information **210**.
[0153] In addition, since the factor information **204** includes the distance information **210**, the shake applied to the image sensor **62** can be corrected in accordance with the distance information **210** in the correction process executed by the correction processing unit **134**. As a result, for example, the shake of the image can be suppressed in accordance with the distance information **210** as compared with a case in which the correction process is executed without being based on the distance information **210**.
[0154] In addition, the factor information **204** includes the gimbal information **212** related to the gimbal mechanism **14** that supports the imaging apparatus **50** with respect to the flying object **10**. Therefore, in the setting process executed by the setting unit **128**, the shutter speed can be set in accordance with the gimbal information **212**. As a result, for example, the imaging process can be executed at the shutter speed in accordance with the gimbal information **212** as compared with a case in which the setting process is executed without being based on the gimbal information **212**.
[0155] In addition, since the factor information **204** includes the gimbal information **212**, the position of the moving mechanism **90** can be adjusted in accordance with the gimbal information **212** in the adjustment process executed by the adjustment processing unit **130**. As a result, for example, the shake correction distance can be secured in accordance with the gimbal information **212** as compared with a case in which the adjustment process is executed without being based on the gimbal information **212**.
[0156] In addition, since the factor information **204** includes the gimbal information **212**, the shake applied to the image sensor **62** can be corrected in accordance with the gimbal information **212** in the correction process executed by the correction processing unit **134**. As a result, for example, the shake of the image can be suppressed in accordance with the gimbal information **212** as compared with a case in which the correction process is executed without being based on the gimbal information **212**.
[0157] In addition, the gimbal information **212** includes the axis information **212**A which is information related to the axis of the gimbal mechanism **14**. Therefore, it is possible to execute the setting process by the setting unit **128** based on the axis information **212**A. As a result, for example, the imaging process can be executed at the shutter speed in accordance with the axis information **212**A as compared with a case in which the setting process is executed without being based on the axis information **212**A.
[0158] In addition, since the gimbal information **212** includes the axis information **212**A, the position of the moving mechanism **90** can be adjusted in accordance with the axis information **212**A in the adjustment process executed by the adjustment processing unit **130**. As a result, for example, the shake correction distance can be secured in accordance with the axis information **212**A as compared with a case in which the adjustment process is executed without being based on the axis information **212**A.
[0159] In addition, since the gimbal information **212** includes the axis information **212**A, the shake applied to the image sensor **62** can be corrected in accordance with the axis information **212**A in

the correction process executed by the correction processing unit **134**. As a result, for example, the shake of the image can be suppressed in accordance with the axis information **212**A as compared with a case in which the correction process is executed without being based on the axis information **212**A.

[0160] In addition, the gimbal information **212** includes the frequency band information **212**B which is information related to the frequency band that can be corrected by using the gimbal mechanism **14**. Therefore, it is possible to execute the setting process by the setting unit **128** based on the frequency band information **212**B. As a result, for example, the imaging process can be executed at the shutter speed in accordance with the frequency band information **212**B as compared with a case in which the setting process is executed without being based on the frequency band information **212**B.

[0161] In addition, since the gimbal information **212** includes the frequency band information **212**B, the position of the moving mechanism **90** can be adjusted in accordance with the frequency band information **212**B in the adjustment process executed by the adjustment processing unit **130**. As a result, for example, the shake correction distance can be secured in accordance with the frequency band information **212**B as compared with a case in which the adjustment process is executed without being based on the frequency band information **212**B.

[0162] In addition, since the gimbal information **212** includes the frequency band information **212**B, the shake applied to the image sensor **62** can be corrected in accordance with the frequency band information **212**B in the correction process executed by the correction processing unit **134**. As a result, for example, the shake of the image can be suppressed in accordance with the frequency band information **212**B as compared with a case in which the correction process is executed without being based on the frequency band information **212**B.

[0163] In addition, in the output process executed by the data output unit **136** after the adjustment process executed by the adjustment processing unit **130** (that is, the process of outputting the live view image data **250** obtained by imaging the subject using the image sensor **62** to the display **152**), the position of the moving mechanism **90** is maintained. Therefore, in a case in which the main exposure is started, the image sensor **62** can be moved by the correction processing unit **134** from the position adjusted by the adjustment processing unit **130**. As a result, for example, the shake correction distance can be secured as compared with a case in which the position of the image sensor **62** is not adjusted by the adjustment processing unit **130**.

[0164] In addition, in the output process executed by the data output unit **136**, the shake applied to the imaging apparatus **50** is corrected by using the gimbal mechanism **14** that supports the imaging apparatus **50** with respect to the flying object **10**. Therefore, it is possible to suppress the shake of the image in the output process. As a result, for example, the live view image with good image quality can be obtained as compared with a case in which the output process is executed without correcting the shake applied to the imaging apparatus **50** by using the gimbal mechanism **14**.

[0165] In addition, the imaging apparatus **50** is mounted on the flying object **10**. Therefore, for example, a degree of freedom of the target object **2** that can be imaged by using the imaging apparatus **50** can be improved as compared with a case in which a person carries the imaging apparatus **50** or the imaging apparatus **50** is mounted on a vehicle or the like.

[0166] It should be noted that, as an example, as shown in FIG. **17**, the acquisition unit **122** may acquire the acceleration information **220** from the acceleration sensor **24** of the flying object **10**. Moreover, the acquisition unit **122** may acquire the speed information **206**A related to the speed of the flying object **10** by integrating the acceleration indicated by the acceleration information **220**. In addition, the acquisition unit **122** may acquire the direction information **206**B related to the direction in which the flying object **10** moves based on the direction of the acceleration indicated by the acceleration information **220**. In addition, for example, in a case in which the speed information **206**A and the direction information **206**B are generated from the acceleration information **220** in the flying object **10**, the acquisition unit **122** may acquire the speed information

206A and the direction information **206**B from the flying object **10**.

[0167] In addition, a gyro sensor may be used instead of the acceleration sensor **24**. The gyro sensor detects a rotation shake amount around each axis of the pitch axis, the yaw axis, and the roll axis of the flying object **10**. The rotation shake amount around the pitch axis and the rotation shake amount around the yaw axis detected by the gyro sensor are converted into the shake amount in a two-dimensional plane parallel to the pitch axis and the yaw axis in the pitch axis direction, so that the shake amounts of the flying object **10** in the pitch axis direction and the yaw axis direction are detected.

[0168] In addition, as shown in FIG. **18**, as an example, the acquisition unit **122** may sequentially acquire first positioning information **222**A and second positioning information **222**B from the positioning unit **26** of the flying object **10**. The second positioning information **222**B is information obtained after the first positioning information **222**A. Moreover, the acquisition unit **122** may acquire the speed information **206**A related to the speed of the flying object **10** based on a time interval between the first positioning information **222**A and the second positioning information **222**B, and the moving distance of the flying object **10** indicated by the first positioning information **222**A and the second positioning information **222**B. In addition, the direction information **206**B related to the direction in which the flying object **10** moves may be acquired based on the change in the position of the flying object **10** indicated by the first positioning information **222**A and the second positioning information **222**B.

[0169] In addition, as shown in FIG. **19**, as an example, the acquisition unit **122** may acquire the acceleration information **230** from the acceleration sensor **72** provided in the imaging apparatus **50**. Moreover, the acquisition unit **122** may acquire the speed information **206**A related to the speed of the flying object **10** moving integrally with the imaging apparatus **50** by integrating the acceleration indicated by the acceleration information **230** from the acceleration sensor **72**. In addition, the acquisition unit **122** may acquire the direction information **206**B related to the direction in which the flying object **10** moves based on the direction of the acceleration indicated by the acceleration information **230**. In addition, a gyro sensor may be used instead of the acceleration sensor **72**.

[0170] In addition, as shown in FIG. **20** as an example, the CPU **82** may operate as an estimation unit **138** in a case in which the acquisition determination unit **124** determines that the acquisition of the movement information **206** by the acquisition unit **122** is successful. The estimation unit **138** estimates movement information **256**, which is estimation information, based on the movement information **206** acquired by the acquisition unit **122** and the acceleration information **230** from the acceleration sensor **72** provided in the imaging apparatus **50** as an example.

[0171] That is, the estimation unit **138** acquires speed information **246**A related to the speed of the flying object **10** by integrating the acceleration indicated by the acceleration information **230**. In addition, the estimation unit **138** acquires direction information **246**B related to the direction of the flying object **10** based on the direction of the acceleration indicated by the acceleration information **230**. As a result, movement information **246** including the speed information **246**A and the direction information **246**B is obtained.

[0172] In addition, for example, the estimation unit **138** estimates the speed of the flying object **10** by calculating the average value of the first speed indicated by the speed information **206**A and the second speed indicated by the speed information **246**A, and acquires speed information **256**A which is estimation information related to the estimated speed. In addition, for example, the estimation unit **138** estimates the direction of the flying object **10** by calculating the average value of the azimuthal angle in the first direction indicated by the direction information **206**B and the azimuthal angle in the second direction indicated by the direction information **246**B, and acquires direction information **256**B, which is estimation information related to the estimated direction. As a result, the movement information **256** including the speed information **256**A and the direction information **256**B is obtained. Moreover, the movement information **256** estimated by the estimation unit **138** may be applied to the factor information **204**A. The acceleration information

230 is an example of “first acceleration sensor information” according to the technology of the present disclosure. The movement information **256** estimated by the estimation unit **138** is an example of “first movement information” according to the technology of the present disclosure.

[0173] FIG. **21** shows an example of a flowchart of the imaging support process according to a modification example shown in FIG. **20**. In the imaging support process shown in FIG. **21**, step ST**21** executed by the estimation unit **138** is added. Step ST**21** is executed in a case in which it is determined in step ST**11** that the acquisition of the movement information **206** by the acquisition unit **122** is successful. In step ST**21**, the estimation unit **138** estimates the movement information **256** based on the movement information **206** acquired by the acquisition unit **122** and the acceleration information **230** from the acceleration sensor **72** provided in the imaging apparatus **50**. After the process of step ST**21** is executed, the imaging support process proceeds to step ST**13**. Step ST**21** is an example of a “first estimation step” according to the technology of the present disclosure.

[0174] In the example shown in FIGS. **20** and **21**, the estimation unit **138** estimates the movement information **256** based on the movement information **206** acquired by the acquisition unit **122** and the acceleration information **230** from the acceleration sensor **72** provided in the imaging apparatus **50**. Therefore, the speed and the direction of the flying object **10** are obtained based on the movement information **206** acquired by the acquisition unit **122** and the acceleration information **230** from the acceleration sensor **72** provided in the imaging apparatus **50**. As a result, for example, the accuracy of the speed and the direction of the flying object **10** can be improved as compared with a case in which the speed and the direction of the flying object **10** are obtained only from the movement information **206** acquired by the acquisition unit **122**.

[0175] It should be noted that, in the examples shown in FIGS. **20** and **21**, the movement information **206** obtained from the flying object **10** may be information based on the acceleration information **220** from the acceleration sensor **24**, or may be information based on the first positioning information **222**A and the second positioning information **222**B from the positioning unit **26**. In addition, the movement information **206** may be the movement information **206** based on the flight instruction information **200**.

[0176] In addition, in the examples shown in FIGS. **20** and **21**, the estimation unit **138** may estimate the movement information **256** based on the movement information **206** based on the flight instruction information **200**, the acceleration information **220** from the acceleration sensor **24**, the first positioning information **222**A and the second positioning information **222**B from the positioning unit **26**, and the acceleration information **230** from the acceleration sensor **72**.

[0177] In addition, as shown in FIG. **22** as an example, the estimation unit **138** may acquire the movement information **246** in the following manner. In the example shown in FIG. **22**, the estimation unit **138** sequentially acquires the first image data **232**A and the second image data **232**B from the image memory **76**. The first image data **232**A and the second image data **232**B are first newest image data **232** and second newest image data **232** among the plurality of image data **232** recorded in the image memory **76**. Moreover, the estimation unit **138** acquires the speed information **246**A related to the speed of the flying object **10** based on a time interval in which the first image data **232**A and the second image data **232**B are recorded, and a moving distance of the flying object **10** derived based on the first image data **232**A and the second image data **232**B. In addition, the estimation unit **138** acquires the direction information **246**B related to the direction in which the flying object **10** moves based on the change in the position of the flying object **10** indicated by the first image data **232**A and the second image data **232**B. As a result, the movement information **246** including the speed information **246**A and the direction information **246**B is obtained.

[0178] Moreover, the movement information **256** estimated based on the movement information **206** acquired by the acquisition unit **122** and the movement information **246** obtained by the estimation unit **138** may be applied to the factor information **204**A. The first image data **232**A and the second image data **232**B are examples of “first image information” according to the technology of the present disclosure.

[0179] In the example shown in FIG. **22**, the estimation unit **138** estimates the movement information **256** based on the movement information **206** acquired by the acquisition unit **122** and the first image data **232**A and the second image data **232**B stored in the image memory **76**. Therefore, the speed and the direction of the flying object **10** are obtained based on the movement information **206** acquired by the acquisition unit **122**, and the first image data **232**A and the second image data **232**B. As a result, for example, the accuracy of the speed and the direction of the flying object **10** can be improved as compared with a case in which the speed and the direction of the flying object **10** are obtained only from the movement information **206** acquired by the acquisition unit **122**.

[0180] It should be noted that, in the examples shown in FIG. **22**, the movement information **206** obtained from the flying object **10** may be information based on the acceleration information **220** from the acceleration sensor **24**, or may be information based on the first positioning information **222**A and the second positioning information **222**B from the positioning unit **26**. In addition, the movement information **206** may be information based on the flight instruction information **200**.

[0181] In addition, in the example shown in FIG. **22**, the estimation unit **138** may estimate the movement information **256** based on the movement information **206** based on the flight instruction information **200**, the acceleration information **220** from the acceleration sensor **24**, the first positioning information **222**A and the second positioning information **222**B from the positioning unit **26**, and the first image data **232**A and the second image data **232**B.

[0182] In addition, in the embodiment described above, the imaging apparatus **50** has a body image stabilization (BIS) type shake correction function, but as shown in FIG. **23**, the imaging apparatus **50** may have an optical image stabilization (OIS) type shake correction function. In the example shown in FIG. **23**, the imaging apparatus **50** comprises a shake correction lens **142** constituting the imaging lens **96**, and an actuator for shake correction lens **144**. The actuator for shake correction lens **144** comprises, for example, a voice coil motor or a piezoelectric element. The shake correction lens **142** is fixed to a moving mechanism **140**. The shake correction lens **142** is an example of a “part of an imaging lens” according to the technology of the present disclosure, and is, for example, the objective lens **98**, the focus lens **100**, or the zoom lens **102** in FIG. **4**. The moving mechanism **140** moves the imaging lens **96** in accordance with the shake applied to the imaging lens **96**. The target of the imaging lens **96** moved by the moving mechanism **140** may be the entire imaging lens or may be a part of a component group.

[0183] The adjustment processing unit **130** adjusts the position of the moving mechanism **140** that moves the shake correction lens **142** by controlling the actuator for shake correction lens **144** via the driver for lens **70**. By adjusting the position of the moving mechanism **140**, the position of the shake correction lens **142** is adjusted.

[0184] The adjustment processing unit **130** adjusts the position of the moving mechanism **140** based on the direction indicated by the movement information **206**. In the example shown in FIG. **23**, the position of the moving mechanism **140** is adjusted in the same direction as the direction in which the flying object **10** moves, but the direction in which the position of the moving mechanism **140** is adjusted is determined by whether the power of the imaging lens **96** including the shake correction lens **142** is positive or negative.

[0185] In addition, as shown in FIG. **24**, the correction processing unit **134** corrects the shake applied to the shake correction lens **142** by using the moving mechanism **140** as the correction process. That is, the correction processing unit **134** controls the actuator for shake correction lens **144** via the driver for lens **70** to move the shake correction lens **142** in the direction in which the shake of the image is corrected. It should be noted that the imaging apparatus **50** may have both the BIS type shake correction function and the OIS type shake correction function.

[0186] In addition, as shown in FIG. **25**, the imaging apparatus **50** may be mounted on an automobile **300**. The automobile **300** is an example of an “automobile” according to the technology of the present disclosure. In the example shown in FIG. **25**, the automobile **300** is a passenger car, but may be an automobile other than the passenger car. For example, the NVM **84** stores specification information **214**. The specification information **214** is information for specifying an imaging direction of the imaging apparatus **50**.

[0187] In the example shown in FIG. **25**, the imaging apparatus **50** is disposed in an orientation of imaging the left side of the automobile **300**, but the imaging apparatus **50** may be disposed in a direction of imaging the right side, front, rear, upper side, lower side, or the like of the automobile **300**. In addition, in the example shown in FIG. **25**, the imaging apparatus **50** is installed on the roof of the automobile **300**, but may be installed on the windshield, side mirror, trunk lid, or the like of the automobile **300**.

[0188] The acquisition unit **122** acquires the factor information **204**A including the specification information **214**. It should be noted that, in a case in which moving direction information (not shown) indicating a moving direction of the automobile **300** is obtained from the automobile **300**, the acquisition unit **122** may acquire the specification information **214** by specifying the imaging direction of the imaging apparatus **50** based on the moving direction information, and the acceleration information **230** obtained from the acceleration sensor **72** of the imaging apparatus **50**.

[0189] In addition, in a case in which the imaging apparatus **50** imaging direction information (not shown) indicating the imaging direction of the imaging apparatus **50** is applied to the imaging apparatus **50** by the user **4**, the acquisition unit **122** may acquire the specification information **214** based on the imaging direction information received by the imaging apparatus **50**. In addition, the imaging apparatus **50** may be rotatably supported around the yaw axis with respect to the automobile **300**. In this case, the specification information **214** for specifying the imaging direction may be acquired in accordance with the imaging direction of the imaging apparatus **50**.

[0190] The adjustment processing unit **130** adjusts the position of the moving mechanism **90** that moves the image sensor **62** by controlling the actuator for shake correction **94** via the driver for shake correction **68** based on the factor information **204**A. In addition, as shown in FIG. **26**, the correction processing unit **134** adjusts the position of the moving mechanism **90** by controlling the actuator for shake correction **94** via the driver for shake correction **68** based on the factor information **204**A.

[0191] In the example shown in FIGS. **25** and **26**, the imaging apparatus **50** is mounted on the automobile **300**. Therefore, the target object **2** can be imaged by using the imaging apparatus **50** while the automobile **300** travels.

[0192] In addition, the factor information **204**A includes the specification information **214** for specifying the imaging direction of the imaging apparatus **50**. Therefore, the imaging direction of the imaging apparatus **50** can be specified based on the specification information **214**. As a result, in the adjustment process executed by the adjustment processing unit **130**, the position of the moving mechanism **90** can be adjusted in accordance with the imaging direction of the imaging apparatus **50**.

[0193] In addition, since the factor information **204**A includes the specification information **214**, in the correction process executed by the correction processing unit **134**, the shake applied to the image sensor **62** can be corrected in accordance with the imaging direction of the imaging apparatus **50**.

[0194] It should be noted that the specification information **214** may be information for specifying an attachment position of the imaging apparatus **50** with respect to the automobile **300**.

[0195] In addition, the target object to be moved by the adjustment processing unit **130** and the correction processing unit **134** may be an object, a structure, a mechanism, a device, or the like other than the image sensor **62** or the shake correction lens **142**.

[0196] In addition, the imaging system S may be applied to a moving body (for example, a ship or an aerial vehicle) other than the flying object **10** or the automobile **300**. In addition, the imaging system S may be applied to a vehicle (motorcycle, bicycle, or the like) other than the automobile **300**.

[0197] In addition, as shown in FIG. **27** as an example, the technology according to the embodiment described above (that is, technology of executing the processes by the acquisition unit **122**, the acquisition determination unit **124**, the estimation unit **126**, the adjustment processing unit **130**, and the correction processing unit **134**) may be applied to a flying object system comprising the flying object **10** and the anti-vibration device **500**.

[0198] The anti-vibration device **500** includes a target object **502**, a moving mechanism **504**, an actuator **506**, and a driver **508**. The target object **502** is a target object of the anti-vibration by the anti-vibration device **500**, and is supported by the moving mechanism **504**. The actuator **506** adjusts the position of the moving mechanism **504** that moves the target object **502**. The driver **508** controls the actuator **506** in accordance with the instruction the CPU **82**. By controlling the actuator **506** via the driver **508**, the adjustment processing unit **130** adjusts the position of the moving mechanism **504**. The correction processing unit **134** corrects the shake applied to the target object **502** by using the moving mechanism **504** after the position of the moving mechanism **504** is adjusted by the adjustment processing unit **130**.

[0199] In addition, the adjustment process by the adjustment processing unit **130** may be omitted. Similarly, the estimation process by the estimation unit **126** may be omitted.

[0200] In addition, the image acquired by the imaging processing unit **132** may be a moving image instead of a still image.

[0201] In addition, a vane anemometer may be used instead of the anemometer **160**, and wind speed/wind direction information related to the wind speed and the wind direction of the flight environment may be transmitted from the vane anemometer to the imaging apparatus **50**.

[0202] In addition, the factor information **204** includes the movement information **206**, the wind information **208**, the distance information **210**, and the gimbal information **212**, but the wind information **208**, the distance information **210**, or the gimbal information **212** may be omitted.

[0203] In addition, the distance information **210** is information indicating the object distance as an example of the distance L between the imaging apparatus **50** and the target object **2**, but may be information indicating a distance other than the object distance. For example, the distance information **210** may be information obtained by measuring the distance L between the imaging apparatus **50** and the target object **2** by a stereo camera, a dual pixel camera, or a light detection and ranging (LiDAR) system.

[0204] In addition, although the setting unit **128** sets the shutter speed based on the factor information **204**, the imaging condition other than the shutter speed (for example, sensitivity or frame rate) may be set based on the factor information **204**. The imaging condition in this case is an example of an “imaging condition” according to the technology of the present disclosure.

[0205] In addition, in the embodiment described above, the form example has been described in which the imaging support program **120** is stored in the NVM **84**, but the technology of the present disclosure is not limited to this. For example, the imaging support program **120** may be stored in a portable computer-readable non-temporary storage medium, such as an SSD or a universal serial bus (USB) memory. The imaging support program **120** stored in the non-temporary storage medium is installed in the computer **74** of the imaging apparatus **50**. The CPU **82** executes the imaging support process in accordance with the imaging support program **120**.

[0206] In addition, the imaging support program **120** may be stored in a storage device of another computer, a server device, or the like connected to the imaging apparatus **50** via a network, and the imaging support program **120** may be downloaded in response to a request of the imaging apparatus **50** and installed in the computer **74**.

[0207] It should be noted that it is not necessary to store the entire imaging support program **120** in the storage device of another computer, a server device, or the like connected to the imaging apparatus **50**, or the NVM **84**, and a part of the imaging support programs **120** may be stored.

[0208] In addition, although the computer **74** is built in the imaging apparatus **50**, the technology of the present disclosure is not limited to this, and for example, the computer **74** may be provided outside the imaging apparatus **50**.

[0209] In the embodiment described above, the computer **74** is described as an example, but the technology of the present disclosure is not limited to this, and instead of the computer **74**, a device including an application specific integrated circuit (ASIC), a field-programmable gate array (FPGA), or a programmable logic device (PLD) may be applied. In addition, instead of the computer, a hardware configuration and a software configuration may be used in combination.

[0210] As the hardware resource for executing the imaging support process described in the embodiment described above, the following various processors can be used. Examples of the processor include software, that is, a CPU, which is a general-purpose processor that functions as the hardware resource for executing the imaging support process by executing the program. In addition, examples of the processor include a dedicated electric circuit which is a processor having a circuit configuration designed to be dedicated to executing a specific process, such as an FPGA, a PLD, or an ASIC. A memory is built in or connected to any processor, and each processor executes the imaging support process by using the memory.

[0211] The hardware resource for executing the imaging support process may be composed of one of those various processors or may be composed of a combination of two or more processors of the same type or different types (for example, a combination of a plurality of FPGAs or a combination of a CPU and an FPGA). In addition, the hardware resource for executing the imaging support process may be one processor.

[0212] As an example of configuring with one processor, first, there is a form in which one processor is composed of a combination of one or more CPUs and software, and this processor functions as the hardware resource for executing the imaging support process. Second, as represented by system-on-a-chip (SoC), there is a form in which a processor that realizes the functions of the entire system including a plurality of hardware resources for executing the imaging support process with a single integrated circuit (IC) chip. As described above, the imaging support process is realized by using one or more of the various processors described above as the hardware resource.

[0213] Further, as the hardware structure of these various processors, more specifically, it is possible to use an electric circuit in which circuit elements, such as semiconductor elements, are combined. In addition, the imaging support process is merely an example. Therefore, it is needless to say that unnecessary steps may be deleted, new steps may be added, or the process order may be changed within a range that does not deviate from the gist.

[0214] The above described contents and shown contents are the detailed description of the parts according to the technology of the present disclosure, and are merely examples of the technology of the present disclosure. For example, the above descriptions of the configuration, the function, the action, and the effect are the descriptions of examples of the configuration, the function, the action, and the effect of the parts according to the technology of the present disclosure. Accordingly, it is needless to say that unnecessary parts may be deleted, new elements may be added, or replacements may be made with respect to the above described contents and shown contents within a range that does not deviate from the gist of the technology of the present disclosure. In addition, in order to avoid complications and facilitate understanding of the parts according to the technology of the present disclosure, in the above described contents and shown contents, the descriptions of common technical knowledge and the like that do not particularly require description for enabling the implementation of the technology of the present disclosure are omitted.

[0215] In the present specification, “A or B” is synonymous with “at least one of A or B”. That is, “A or B” means that it may be only A, only B, or a combination of A and B. In addition, in the present specification, in a case in which three or more matters are associated and expressed by “or”, the same concept as “A or B” is applied.

[0216] All documents, patent applications, and technical standards described in the present specification are incorporated into the present specification by reference to the same extent as in a case in which the individual documents, patent applications, and technical standards are specifically and individually stated to be incorporated by reference.
[0217] The following supplementary notes are further disclosed with regard to the embodiment described above.
SUPPLEMENTARY NOTE 1
[0218] A control method used in a system including a moving body and an anti-vibration device, the method including an adjustment step of adjusting a position of a moving mechanism that moves a target object of anti-vibration by the anti-vibration device, based on factor information including movement information related to a speed and a direction of the moving body, and a correction step of correcting a shake applied to the target object by using the moving mechanism after the adjustment step is executed.
SUPPLEMENTARY NOTE 2
[0219] A program causing a computer of an imaging apparatus mounted on a moving body to execute an acquisition process of acquiring factor information including movement information related to a speed and a direction of the moving body, an adjustment process of adjusting a position of a moving mechanism that moves an image sensor or an imaging lens, based on the factor information, an imaging process of imaging a subject by using the image sensor after the adjustment process is executed, and a correction process of correcting a shake applied to the image sensor or the imaging lens by using the moving mechanism in a case in which the imaging process is executed.

Claims

1-20. (canceled)
21. An imaging system including a mobile body and an imaging device, comprising a processor, wherein the processor is configured to: acquire movement information regarding a position of the mobile body, and vary a shutter speed of the imaging device in accordance with the movement information.
22. The imaging system according to claim 21, wherein the movement information includes information relating to a speed or an acceleration of the mobile body.
23. The imaging system according to claim 22, wherein the processor is configured to shorten the shutter speed as the speed or the acceleration increases.
24. The imaging system according to claim 22, wherein the processor is configured to set the shutter speed to be shorter than a preset value determined based on imaging conditions when the speed is equal to or greater than a predetermined speed.
25. The imaging system according to claim 21, wherein the movement information includes information relating to a distance between the imaging device and a subject.
26. The imaging system according to claim 25, wherein the processor is configured to shorten the shutter speed as the distance becomes shorter.
27. The imaging system according to claim 25, wherein the processor is configured to set the shutter speed to be shorter than a preset value determined based on imaging conditions when the distance is equal to or less than a predetermined distance.
28. The imaging system according to claim 21, wherein the processor is configured to: acquire focal length information relating to a focal length of the imaging device, and shorten the shutter speed as the focal length becomes longer toward a telephoto side.
29. The imaging system according to claim 21, wherein the processor is configured to: acquire focal length information relating to a focal length of the imaging device, and set the shutter speed

to be shorter than a preset value determined based on imaging conditions when the focal length is equal to or greater than a predetermined focal length.