is present even though an obstacle hindering the traveling of the vehicle is absent. In other words, accuracy in determination of presence or absence of an obstacle is insufficient.

PRIOR ART DOCUMENT

PATENT DOCUMENT

[0007]

Patent Document 1: Japanese patent application Kokai publication No. Hei 06-187036

SUMMARY

[0008]

The present disclosure has been made in view of the aforementioned problems and an object thereof is to provide an obstacle sensing system and an obstacle sensing method that can improve accuracy in determination of presence or absence of an obstacle.

[0009]

In a first aspect, the present disclosure provides an obstacle sensing system including a transmission part that is installed in a moving body and that emits laser light beams while changing an emission angle and a reception part that receives reflected light beams of the laser light beams, characterized in that the obstacle sensing system comprises: a sensing region setting mechanism that sets a sensing region in advance in a region around reflection positions where the laser light beams are reflected when an obstacle is absent; and a determination mechanism that determines whether an

obstacle is present or absent depending on the reflected light beams reflected inside the sensing region wherein the determination mechanism has a configuration that calculates a fullness percentage which is a ratio of the number of the reflected light beams reflected inside the sensing region to a total number of laser light beams emitted from the transmission part, determines that an obstacle is absent when the fullness percentage is equal to or more than a predetermined threshold, and determines that an obstacle is present when the fullness percentage is smaller than the threshold.

[0009a]

In a second aspect, the present disclosure provides an obstacle sensing system including a transmission part that is installed in a moving body and that emits laser light beams while changing an emission angle and a reception part that receives reflected light beams of the laser light beams, characterized in that the obstacle sensing system comprises: a sensing region setting mechanism that sets a sensing region in advance in a region around reflection positions where the laser light beams are reflected when an obstacle is absent; and a determination mechanism that determines whether an obstacle is present or absent depending on the reflected light beams reflected inside the sensing region, wherein the obstacle sensing system comprises a comparison mechanism that sends ON signals to the determination mechanism when the reflection positions where the laser light beams are reflected are inside the sensing region and sends OFF signals to the determination mechanism when the reflection positions where the laser light beams are reflected are outside the

sensing region, and the determination mechanism has a configuration that calculates a fullness percentage which is a ratio of the number of the ON signals to a total number of the ON signals and the OFF signals obtained from the comparison mechanism, determines that an obstacle is absent when the fullness percentage is equal to or more than a predetermined threshold, and determines that an obstacle is present when the fullness percentage is smaller than the threshold.

[0009b]

In a third aspect, the present disclosure provides an obstacle sensing system including a transmission part that is installed in a moving body and that emits laser light beams while changing an emission angle and a reception part that receives reflected light beams of the laser light beams, characterized in that the obstacle sensing system comprises: a sensing region setting mechanism that sets a sensing region in advance in a region around reflection positions where the laser light beams are reflected when an obstacle is absent; and a determination mechanism that determines whether an obstacle is present or absent depending on the reflected light beams reflected inside the sensing region, wherein the sensing region is a quadrilateral region surrounded by paired long sides that extend in a direction along a moving direction of the moving body and that are set above and below the reflection positions where the laser light beams are reflected when an obstacle is absent and paired short sides that extend in an up-down direction and that connect end portions of the paired long sides facing one another.

[0010]

In a fourth aspect, the present disclosure provides an obstacle sensing method including emitting laser light beams from a transmission part installed in a moving body while changing an emission angle and receiving reflected light beams of the laser light beams with a reception part to sense presence or absence of an obstacle, characterized in that the obstacle sensing method comprises: setting a sensing region in advance in a region around reflection positions where the laser light beams are reflected when an obstacle is absent; and causing a determination mechanism to determine whether an obstacle is present or absent depending on the reflected light beams reflected inside the sensing region, wherein the determination mechanism calculates a fullness percentage which is a ratio of the number of the reflected light beams reflected inside the sensing region to a total number of laser light beams emitted from the transmission part, determines that an obstacle is absent when the fullness percentage is equal to or more than a predetermined threshold, and determines that an obstacle is present when the fullness percentage is smaller than the threshold.

[0010a]

In a fifth aspect, the present disclosure provides an obstacle sensing method including emitting laser light beams from a transmission part installed in a moving body while changing an emission angle and receiving reflected light beams of the laser light beams with a reception part to sense presence or absence of an obstacle, characterized in that the obstacle sensing method comprises: setting a sensing region in advance in a region around reflection positions

where the laser light beams are reflected when an obstacle is absent; and causing a determination mechanism to determine whether an obstacle is present or absent depending on the reflected light beams reflected inside the sensing region, wherein the obstacle sensing method comprises arranging a comparison mechanism between the reception part and the determination mechanism and sending ON signals from the comparison mechanism to the determination mechanism when the reflection positions where the laser light beams are reflected are inside the sensing region and sending OFF signals from the comparison mechanism to the determination mechanism when the reflection positions where the laser light beams are reflected are outside the sensing region, and the determination mechanism calculates a fullness percentage which is a ratio of the number of the ON signals to a total number of the ON signals and the OFF signals obtained from the comparison mechanism, determines that an obstacle is absent when the fullness percentage is equal to or more than a predetermined threshold, and determines that an obstacle is present when the fullness percentage is smaller than the threshold.

[0010b]

In a sixth aspect, the present disclosure provides an obstacle sensing method including emitting laser light beams from a transmission part installed in a moving body while changing an emission angle and receiving reflected light beams of the laser light beams with a reception part to sense presence or absence of an obstacle, characterized in that the obstacle sensing method comprises: setting a sensing region in advance in a region around reflection positions

where the laser light beams are reflected when an obstacle is absent; and causing a determination mechanism to determine whether an obstacle is present or absent depending on the reflected light beams reflected inside the sensing region, wherein in the setting of the sensing region, the sensing region is a quadrilateral region surrounded by paired long sides that extend in a direction along a moving direction of the moving body and that are set above and below the reflection positions where the laser light beams are reflected when an obstacle is absent and paired short sides that extend in an up-down direction and that connect end portions of the paired long sides facing one another.

[0011]

The obstacle sensing system and the obstacle sensing method of the present disclosure are configured to determine whether an obstacle is present or absent based on the reflected light beams from the inside of the sensing region. Since no reflected light beams from the sensing region can be obtained when an obstacle is present, it is possible to sense an obstacle even if the obstacle is an object less likely to reflect the laser light beams. This is advantageous in improving accuracy in the determination of presence or absence of an obstacle.

[0012]

Moreover, according to the obstacle sensing system and

the like of the present disclosure, when the reflected light beams cannot be sensed due to problems such as a failure of the transmission part that emits the laser light beams or the light reception part that receives the reflected light beams, the reflected light beams from the sensing region cannot be obtained and an obstacle is thus determined to present. Since safe-side measures can be taken, this is advantageous in improving safety.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013]

[Fig. 1] Fig. 1 is an explanatory perspective view illustrating a gantry crane in which an obstacle sensing system of the present invention is installed.

[Fig. 2] Fig. 2 is an explanatory view illustrating a configuration of the obstacle sensing system of the present invention.

[Fig. 3] Fig. 3 is an explanatory plan view illustrating a reflection positions on a travel surface when an obstacle is absent.

[Fig. 4] Fig. 4 is an explanatory view illustrating a state in which the obstacle sensing system of Fig. 2 senses an obstacle.

[Fig. 5] Fig. 5 is an explanatory plan view illustrating the reflection positions on the travel surface when an obstacle is present.

[Fig. 6] Fig. 6 is an explanatory view illustrating a modified example of a sensing region in Fig. 4.

[Fig. 7] Fig. 7 is an explanatory view illustrating a modified example of the sensing region in Fig. 4.

[Fig. 8] Fig. 8 is an explanatory view illustrating a

CLAIMS

[Claim 1] An obstacle sensing system including a transmission part that is installed in a moving body and that emits laser light beams while changing an emission angle and a reception part that receives reflected light beams of the laser light beams, characterized in that the obstacle sensing system comprises:

a sensing region setting mechanism that sets a sensing region in advance in a region around reflection positions where the laser light beams are reflected when an obstacle is absent; and

a determination mechanism that determines whether an obstacle is present or absent depending on the reflected light beams reflected inside the sensing region, wherein

the determination mechanism has a configuration that calculates a fullness percentage which is a ratio of the number of the reflected light beams reflected inside the sensing region to a total number of laser light beams emitted from the transmission part, determines that an obstacle is absent when the fullness percentage is equal to or more than a predetermined threshold, and determines that an obstacle is present when the fullness percentage is smaller than the threshold.

[Claim 2] An obstacle sensing system including a transmission part that is installed in a moving body and that emits laser light beams while changing an emission angle and a reception part that receives reflected light beams of the laser light beams, characterized in that the obstacle

sensing system comprises:

a sensing region setting mechanism that sets a sensing region in advance in a region around reflection positions where the laser light beams are reflected when an obstacle is absent; and

a determination mechanism that determines whether an obstacle is present or absent depending on the reflected light beams reflected inside the sensing region, wherein

the obstacle sensing system comprises a comparison mechanism that sends ON signals to the determination mechanism when the reflection positions where the laser light beams are reflected are inside the sensing region and sends OFF signals to the determination mechanism when the reflection positions where the laser light beams are reflected are outside the sensing region, and

the determination mechanism has a configuration that calculates a fullness percentage which is a ratio of the number of the ON signals to a total number of the ON signals and the OFF signals obtained from the comparison mechanism, determines that an obstacle is absent when the fullness percentage is equal to or more than a predetermined threshold, and determines that an obstacle is present when the fullness percentage is smaller than the threshold.

[Claim 3] An obstacle sensing system including a transmission part that is installed in a moving body and that emits laser light beams while changing an emission angle and a reception part that receives reflected light beams of the laser light beams, characterized in that the obstacle

sensing system comprises:

a sensing region setting mechanism that sets a sensing region in advance in a region around reflection positions where the laser light beams are reflected when an obstacle is absent; and

a determination mechanism that determines whether an obstacle is present or absent depending on the reflected light beams reflected inside the sensing region, wherein

the sensing region is a quadrilateral region surrounded by paired long sides that extend in a direction along a moving direction of the moving body and that are set above and below the reflection positions where the laser light beams are reflected when an obstacle is absent and paired short sides that extend in an up-down direction and that connect end portions of the paired long sides facing one another.

[Claim 4] The obstacle sensing system according to claim 3, characterized in that the sensing region is a trapezoidal region in which the short side located far from the moving body is longer than the short side located near the moving body.

[Claim 5] The obstacle sensing system according to any one of claims 1 to 4, characterized in that the sensing region setting mechanism has a configuration that sets a plurality of the sensing regions and the thresholds which are different are set respectively for the sensing regions.

[Claim 6] An obstacle sensing method including emitting

laser light beams from a transmission part installed in a moving body while changing an emission angle and receiving reflected light beams of the laser light beams with a reception part to sense presence or absence of an obstacle, characterized in that the obstacle sensing method comprises:

setting a sensing region in advance in a region around reflection positions where the laser light beams are reflected when an obstacle is absent; and

causing a determination mechanism to determine whether an obstacle is present or absent depending on the reflected light beams reflected inside the sensing region, wherein

the determination mechanism calculates a fullness percentage which is a ratio of the number of the reflected light beams reflected inside the sensing region to a total number of laser light beams emitted from the transmission part, determines that an obstacle is absent when the fullness percentage is equal to or more than a predetermined threshold, and determines that an obstacle is present when the fullness percentage is smaller than the threshold.

[Claim 7] An obstacle sensing method including emitting laser light beams from a transmission part installed in a moving body while changing an emission angle and receiving reflected light beams of the laser light beams with a reception part to sense presence or absence of an obstacle, characterized in that the obstacle sensing method comprises:

setting a sensing region in advance in a region around reflection positions where the laser light beams are reflected when an obstacle is absent; and

causing a determination mechanism to determine whether an obstacle is present or absent depending on the reflected light beams reflected inside the sensing region, wherein

the obstacle sensing method comprises arranging a comparison mechanism between the reception part and the determination mechanism and sending ON signals from the comparison mechanism to the determination mechanism when the reflection positions where the laser light beams are reflected are inside the sensing region and sending OFF signals from the comparison mechanism to the determination mechanism when the reflection positions where the laser light beams are reflected are outside the sensing region, and

the determination mechanism calculates a fullness percentage which is a ratio of the number of the ON signals to a total number of the ON signals and the OFF signals obtained from the comparison mechanism, determines that an obstacle is absent when the fullness percentage is equal to or more than a predetermined threshold, and determines that an obstacle is present when the fullness percentage is smaller than the threshold.

[Claim 8] An obstacle sensing method including emitting laser light beams from a transmission part installed in a moving body while changing an emission angle and receiving reflected light beams of the laser light beams with a reception part to sense presence or absence of an obstacle, characterized in that the obstacle sensing method comprises:

setting a sensing region in advance in a region around reflection positions where the laser light beams are reflected when an obstacle is absent; and

causing a determination mechanism to determine whether an obstacle is present or absent depending on the reflected light beams reflected inside the sensing region, wherein

in the setting of the sensing region, the sensing region is a quadrilateral region surrounded by paired long sides that extend in a direction along a moving direction of the moving body and that are set above and below the reflection positions where the laser light beams are reflected when an obstacle is absent and paired short sides that extend in an up-down direction and that connect end portions of the paired long sides facing one another.

[Claim 9] The obstacle sensing method according to claim 8, characterized in that the sensing region is set to a trapezoidal region in which the short side located far from the moving body is longer than the short side located near the moving body.

[Claim 10] The obstacle sensing method according to any one of claims 6 to 9, characterized in that a plurality of the sensing regions are set and the thresholds which are different are set respectively for the sensing regions.