

HEIGHT DETECTION LASER DEVICE FOR SAFETY HARNESS AND DETECTION METHOD THEREOF

Technical Field

The invention relates to the technical field of high-altitude operations, in particular to a height detection laser device for a safety harness and a detection method thereof.

Background Art

Safety harnesses are protective equipment primarily used to prevent people from falling. Workers must wear safety harnesses as required by regulations when working at falling height of 2 meters or more above the datum plane.

Currently, safety harnesses on the market have low levels of intelligence and cannot measure the working height of the operators or monitor the operators, posing potential safety risks. Alternatively, the working height of the operators is measured by measuring the safety rope with measuring tools, resulting in inaccurate measuring result.

Summary of the Invention

The invention aims to solve the technical problems of relatively low intelligence level of the safety harness, incapability of obtaining the working height of the operator or inaccurate measuring results in the prior art. In view of the above defects of the prior art, the invention provides a height detection laser device for a safety harness and a detection method thereof.

The invention adopts the following technical proposal to solve the technical problems:

a height detection laser device for a safety harness comprises a laser host, a main laser device and at least one auxiliary laser device, wherein the laser host is electrically connected to the main laser device and the auxiliary laser device; the main laser device comprises a plurality of first laser detectors for detecting the back working height; the auxiliary laser device comprises a plurality of second laser detectors for detecting the front working height; the main laser device and the auxiliary laser device are respectively provided with a plurality of placement planes and placement slots, the placement slots are respectively located within the placement planes, and the orientations of the placement planes are different; the first laser detectors and the second laser detectors are respectively located in the placement slots.

Further, the main laser device comprises an upper shell, a lower shell and a backing plate, the upper shell and the backing plate are respectively arranged on both sides of the lower shell;

the upper shell is provided with at least one positioning column, the lower shell and the backing plate are respectively provided with positioning holes corresponding to the positioning columns, and the positioning columns pass through the positioning holes.

Further, the upper shell is provided with a plurality of first clamping parts, and the lower shell is provided with a plurality of second clamping parts corresponding to the first clamping parts;

the first laser detectors are respectively clamped between the first clamping parts and the second clamping parts.

Further, each of the first clamping parts comprises a plurality of sheet bodies, which are arranged in the upper shell; each of the sheet bodies is provided with a notch, and a plurality of notches form a first clamping position.

Further, each of the second clamping parts comprises blocks, which are fixedly connected to the lower shell; the blocks are provided with skewed slots, which are arc-shaped and correspond to the first laser detectors; the skewed slot comprises a first inclined plane and a second inclined plane, the first inclined plane is in contact with the first surface of the first laser detector, and the second inclined plane is in contact with the second surface of the first laser detector; the first inclined plane and the second inclined plane form a second clamping position; the first laser detectors are respectively clamped between the first clamping position and the second clamping position.

Further, the placement slots are respectively provided with openings; detection ports of the first laser detectors and the second laser detectors respectively face towards the openings.

Further, the auxiliary laser device comprises a first shell, a second shell and a fixing plate, and the first shell and the fixing plate are respectively arranged on both sides of the second shell; the first shell is provided with a plurality of first fixing parts, and the second shell is provided with a plurality of second fixing parts; each of the first fixing parts comprises a third clamping position; each of the second fixing parts comprises a fourth clamping position; the second laser detectors are respectively clamped between the third clamping position and the fourth clamping position.

Further, the skewed slots are respectively provided with filleted corners, which are in contact with the first surface.

Further, the main laser device comprises an angle measuring component for measuring the bending angle of the human body, a communication component for receiving data, a temperature measuring component, a humidity measuring component and an area positioning component, and the angle measuring component is movably arranged between the upper shell and the lower shell; the communication component, the temperature measuring component, the humidity measuring component and the area positioning component are respectively arranged in the upper shell.

The invention proposes a detection method of the height detection laser device for the safety harness, comprising the following steps:

- obtain the height values of the operators through the main laser device and the auxiliary laser device;

- obtain the height values at various angles through the main laser device and the auxiliary laser device, and take the maximum height value as the maximum laser height;

- perform primary filtering and secondary filtering on the maximum laser height to obtain the effective laser height;

- calculate the working height based on the effective laser height.

Further, the step of performing primary and secondary filtering on the maximum laser

height to obtain the effective laser height comprises:

primary filtering: determine whether the bending value of the human body is within the preset range through the preset angle measuring component; the preset range is 40-140 degrees;

if yes, determine as the effective laser height;

if no, retrieve the effective laser height for the previous times;

secondary filtering: compare the effective laser height with the first maximum laser height, the second maximum laser height and the third maximum laser height within the preset time period; wherein, the first maximum laser height, the second maximum laser height and the third maximum laser height are the effective laser heights for the first three times;

if the height values of the effective laser height, the first maximum laser height, the second maximum laser height and the third maximum laser height are respectively more than or equal to 2m, determine as high altitude, and select the effective laser height;

if the height values of the effective laser height, the first maximum laser height, the second maximum laser height and the third maximum laser height are respectively less than 2m, determine as low altitude, and select no effective laser height.

Further, the calculation process of the working height is as follows:

Working height = effective laser height - height value of operator.

The invention has the following beneficial effects: the main laser device and the auxiliary laser device are provided to jointly measure the front working height and the back working height of the operators, improving the accuracy of the measured data; a plurality of first laser detectors and second laser detectors are arranged in different orientations and adapt to the changes in the body angle of the operators during the operation, filter and calculate the obtained operation height data, and finally obtain the actual operation height of the operators; the operation height data is transmitted to a server through the laser host for monitoring the operators, significantly improving the degree of intelligence and enabling highly accurately measured data.

Brief Description of the Drawings

FIG. 1 is the overall structural diagram of a height detection laser device for a safety harness in an embodiment of the invention.

FIG. 2 is the exploded view of a main laser device in an embodiment of the invention.

FIG. 3 is the perspective view of an upper shell in an embodiment of the invention.

FIG. 4 is the stereoscopic view of a lower shell in an embodiment of the invention.

FIG. 5 is one stereoscopic view showing a first laser detector installed on the lower shell in an embodiment of the invention.

FIG. 6 is another stereoscopic view showing the first laser detector installed on the lower shell in an embodiment of the invention.

FIG. 7 is one exploded view of an auxiliary laser device in an embodiment of the invention.

FIG. 8 is the stereoscopic view of a first shell in an embodiment of the invention.

FIG. 9 is another exploded view of the auxiliary laser device in an embodiment of the invention.

FIG. 10 shows a detection method of a height detection laser device for a safety harness in an embodiment of the invention.

Reference signs: laser host 1, main laser device 2, auxiliary laser device 3, first laser detector 201, second laser detector 301, placement plane 4, placement slot 5, upper shell 202, lower shell 203, backing plate 204, positioning column 205, first clamping part 207, second clamping part 208, sheet body 209, notch 210, first clamping position 211, block 212, skewed slot 213, first inclined plane 214, second inclined plane 215, first surface 216, second surface 217, second clamping position 218, opening 501, detection port 219, filleted corner 220, first shell 302, second shell 303, fixing plate 304, first fixing part 305, second fixing part 306, third clamping position 307, fourth clamping position 308.

Detailed Description of the Invention

In order to make the purpose, technical proposals and advantages of the invention clearer, the invention is further elaborated in detail with reference to the drawings and embodiments. It should be understood that the embodiments described herein are only for interpreting the invention and are not intended to limit the invention.

As shown in FIG. 1, the invention proposes a height detection laser device for a safety harness, which comprises a laser host 1, a main laser device 2 and at least one auxiliary laser device 3, wherein the laser host 1 is electrically connected to the main laser device 2 and the auxiliary laser device 3; the main laser device 2 comprises a plurality of first laser detectors for detecting the back working height; the auxiliary laser device 3 comprises a plurality of second laser detectors devices 301 for detecting the front working height; the main laser device 2 and the auxiliary laser device 3 are respectively provided with a plurality of placement planes 4 and placement slots 5, the placement slots 5 are respectively located within the placement planes 4, and the orientations of the placement planes 4 are different; the first laser detectors 201 and the second laser detectors 301 are respectively located in the placement slots 5.

In the embodiment, the main laser device 2 and the auxiliary laser device 3 are respectively in wire connection to the laser host 1, the auxiliary laser device 3 transmits the data to the main laser device 2, the main laser device 2 summarizes the data and then transmits the data to the laser host 1 through a data cable. The main laser device 2 can be fixed or detachably installed on the back of the safety harness and be capable of measuring the working height on the back of the operator; the auxiliary laser device 3 is installed on the front of the safety harness and is capable of measuring the working height on the front of the operator. The main laser device 2 and the auxiliary laser device 3 installed on the safety harness can transmit data and measure the working height, being more intelligent and enabling automatic detection.

Specifically, as shown in FIG. 2 and FIG. 7, the main laser device 2 is provided with a plurality of first laser detectors 201, and the auxiliary laser device 3 is provided with a plurality of second laser detectors 301, and the first laser detectors 201 and the second laser detectors

301 are laser rangefinders or laser ranging sensors. Preferably, five first laser detectors 201 and three second laser detectors 301 are arranged to detect the working height of the operator from different angles.

As shown in FIG. 2, the main laser device 2 and the auxiliary laser device 3 are respectively provided with a plurality of placement planes 4 and placement slots 5, the placement planes 4 are arranged respectively in different directions, and the placement slots 5 are respectively located within the placement planes 4. In the main laser device 2, the first laser detectors 201 are respectively located in the placement slots 5. Since the placement planes 4 are arranged in different directions, the first laser detectors 201 are capable of measuring the working height at different angles. In the auxiliary laser device 3, the second laser detectors 301 are respectively located in the placement slots 5. Since the placement planes 4 are arranged in different directions, the second laser detectors 301 are capable of measuring the working height at different angles.

More specifically, on the basis of the main laser device 2, the auxiliary laser device 3 is added to prevent the phenomenon where data cannot be measured or the measuring results are inaccurate due to the obstruction behind the operators working at heights. Moreover, the added auxiliary laser device 3 can further measure the working height and improve the accuracy of the data.

In one embodiment, the main laser device 2 comprises an upper shell 202, a lower shell 203 and a baking plate 204, wherein the upper shell 202 and the baking plate 204 are respectively arranged on both sides of the lower shell 203; the upper shell 202 is provided with at least one positioning column 205, the lower shell 203 and the baking plate 204 are respectively provided with positioning holes corresponding to the positioning columns 205, and the positioning columns 205 run through the positioning holes.

Specifically, as shown in FIG. 2 and FIG. 3, the main laser device 2 is provided with an upper shell 202, a lower shell 203 and a baking plate 204. During installation, the lower shell 203 is installed on the top of the baking plate 204, the first laser detectors 201 are installed respectively, the upper shell 202 is closed, and finally, the baking plate 204, the lower shell 203 and the upper shell 202 are tightened and fixed through screws or bolts.

More specifically, the upper shell 202 is also provided with positioning columns 205. When the upper shell 202 is installed, the positioning columns 205 are aligned with the corresponding positioning holes of the lower shell 203 and then installed to position the upper shell 202 and avoid the phenomenon of incorrect installation. As shown in FIG. 3, when the positioning columns 205 can be cylinders, the positioning holes are circular holes. The positioning columns 205 can also be square columns. When the positioning columns 205 are square columns, the positioning holes are square holes to be installed in coordination with the positioning columns 205.

As shown in FIG. 3 and FIG. 4, the upper shell 202 is provided with a plurality of first clamping parts 207, and the lower shell 203 is provided with a plurality of second clamping

parts 208 corresponding to the first clamping parts 207; the first laser detectors 201 are respectively clamped between the first clamping parts 207 and the second clamping parts 208.

In the specific implementation, the first laser detectors 201 are respectively clamped between the first clamping parts 207 and the second clamping parts 208, preventing the first laser detectors 201 from loosening during high-altitude operations and avoid inaccurate measuring results.

As shown in FIG. 3, each of the first clamping parts 207 comprises a plurality of sheet bodies 209, which are arranged in the upper shell 202; each of the sheet bodies 209 is provided with a notch 210, and a plurality of notches 210 form a first clamping position 211.

In the specific implementation, the first clamping part 207 comprises a plurality of sheet bodies 209, which are perpendicular to the inner top surface of the upper shell 202 and are evenly arranged on the inner top surface of the upper shell 202. A plurality of sheet bodies 209 are respectively provided with notches 210, which form the first clamping position 211 to clamp part of part of the first laser detectors 201 into the upper shell 202.

As shown in FIG. 4 to FIG. 6, each second clamping part 208 comprises blocks 212, and the blocks 212 are fixedly connected to the lower shell 203; the blocks 212 are provided with skewed slots 213, which are arc-shaped and correspond to the first laser detectors 201; the skewed slot 213 comprises a first inclined plane 214 and a second inclined plane 215, the first inclined plane 214 fits the first surface 216 of the first laser detector 201, and the second inclined plane 215 fits the second surface 217 of the first laser detector 201; the first inclined plane 214 and the second inclined plane 215 form a second clamping position 218; the first laser detectors 201 are respectively clamped between the first clamping position 211 and the second clamping position 218.

In the specific implementation, the second clamping parts 208 corresponds to the first clamping parts 207, one second clamping part 208 corresponds to one first clamping part 207, and the first laser detectors 201 are fixed. each block 212 is respectively provided with a skewed slot 213, the skewed slots 213 are arc-shaped, and the layout angle corresponds to the shape of the first laser detectors 201 to better fit the first laser detectors 201. In addition, the skewed slot 213 comprises a first inclined plane 214 and a second inclined plane 215; after the first laser detectors 201 are arranged in the skewed slots 213, the first inclined plane 214 can fit the first surface 216 of the first laser detectors 201, and the second inclined plane 215 can fit the second surface 217 of the first laser detectors 201. The first surface 216 is the bottom surface of the first laser detectors 201, and the second surface 217 is the back surface of the first laser detectors 201. The first inclined plane 214 is connected to the second inclined plane 215 and forms the second clamping position 218, and the first clamping position 211 and the second clamping position 218 jointly restrict the first laser detectors 201, preventing the first laser detectors 201 from displacement and affecting the measuring results.

As shown in FIG. 4 and FIG. 5, the skewed slots 213 are respectively provided with filleted corners 220, and the filleted corners 220 are in contact with the first surface 216.

In the specific implementation, the skewed slots 213 are respectively provided with filleted corners 220. Compared with the contact at the folded corner, the filleted corners 220 have a buffering effect, is less likely to be worn, and can increase the service life.

As shown in FIG. 2, the placement slots 5 are respectively provided with openings 501; detection ports 219 of the first laser detectors 201 and the second laser detectors 301 respectively face towards the opening 501.

In the specific implementation, the detection ports 219 of the first laser detectors 201 and the second laser detectors 301 are respectively installed towards the openings 501 to project lasers for height detection.

As shown in FIG. 7, the auxiliary laser device 3 comprises a first shell 302, a second shell 303 and a fixing plate 304, wherein the first shell 302 and the fixing plate 304 are respectively located on both sides of the second shell 303.

In the specific implementation, the auxiliary laser device 3 comprises a first shell 302, a second shell 303 and a fixing plate 304, wherein the first shell 302 and the second shell 303 are respectively provided with a plurality of mounting holes; after the mounting holes on the first shell 302 are aligned with those on the second shell 303, the first shell 302 and the second shell 303 are fixed through screws or pins. The fixing plate 304 is also provided with mounting holes and can be installed on the safety harness to fix the auxiliary laser device 3.

As shown in FIG. 8 and FIG. 9, the first shell 302 is provided with a plurality of first fixing parts 305, and the second shell 303 is provided with a plurality of second fixing parts 306; each of the first fixing parts 305 comprises a third clamping position 307; each of the second fixing parts 306 comprises a fourth clamping position 308; the second laser detectors 301 are respectively clamped between the third clamping position 307 and the fourth clamping position 308.

In the specific implementation, the first fixing parts 305 are located on the inner surface of the first shell 302, and the second fixing parts 306 are located on the upper surface of the second shell 303. After the second laser detectors 301 are respectively installed in the fourth clamping position 308 arranged in the second shell 303, the first shell 302 is closed. At this point, the third clamping position 307 arranged in the first shell 302 just comes into contact with the second laser detectors 301 and fix the second laser detectors 301 together with the fourth clamping position 308.

As shown in FIG. 2, the main laser device 2 comprises an angle measuring component for measuring the bending angle of the human body, a communication component for receiving data, a temperature measuring component, a humidity measuring component and an area positioning component, and the angle measuring component is movably arranged between the upper shell 202 and the lower shell 203; the communication component, the temperature measuring component, the humidity measuring component and the area positioning component are respectively arranged in the upper shell 202.

In the specific implementation, the angle measuring component is a gyroscope, which

can measure the bending angle of the operators during the operation. The communication component is a data receiving module, which is capable of receiving data from other components arranged on the safety harness, such as hook and clip. The temperature measuring component is a thermometer, which is capable of measuring the working environment temperature of the operators. The humidity measuring component is a hygrometer, which is capable of measuring the humidity of the working environment. After the temperature and humidity are measured, the environment of the operators can be monitored in a timely manner to prevent the operators from working in harsh conditions. The regional positioning component is a UWB module, Ultra Wide Band or wireless communication carrier module, which is capable of identifying the operation areas of the operators to determine whether the operators operate in the operation areas.

As shown in FIG. 10, the invention proposes a detection method of the height detection laser device for the safety harness, comprising the following steps:

S1: obtain the height values of the operators through the main laser device 2 and the auxiliary laser device 3;

S2: obtain the height values at various angles through the main laser device 2 and the auxiliary laser device 3, and take the maximum height value as the maximum laser height;

S3: perform primary filtering and secondary filtering on the maximum laser height to obtain the effective laser height;

S3-1: primary filtering: determine whether the bending value of the human body is within the preset range through the preset angle measuring component; the preset range is 40-140 degrees;

S3-2: if yes, determine as the effective laser height; if no, retrieve the effective laser height for the previous times;

S3-3: secondary filtering: compare the effective laser height with the first maximum laser height, the second maximum laser height and the third maximum laser height within the preset time period; wherein, the first maximum laser height, the second maximum laser height and the third maximum laser height are the effective laser heights for the first three times;

S3-4: if the height values of the effective laser height, the first maximum laser height, the second maximum laser height and the third maximum laser height are respectively more than or equal to 2m, determine as high altitude, and select the effective laser height; if the height values of the effective laser height, the first maximum laser height, the second maximum laser height and the third maximum laser height are respectively less than 2m, determine as low altitude, and select no effective laser height;

S4: calculate based on the effective laser height to obtain the working height.

In the embodiment, the height of the operator is measured after the main laser device 2 is turned on, i.e., the current laser height after startup is taken as the height of the operator to obtain the height value of the operator. Then, the first laser detectors 201 of the main laser device 2 and the second laser detectors 301 of the auxiliary laser device 3 measure the working

height of the operator at different angles to obtain the height values at various angles; the laser host 1 is equipped with a controller, which acquires the height values and selects the maximum height value as the maximum laser height. During the operation, the operator has different working postures at various angles, which affects the calculation of the working height. Since the human body cannot climb when the bending angle is too large, the maximum laser height is only effective when the operator stands normally or bends slightly. Therefore, the primary filtering is first performed on the obtained maximum laser height. That is, the bending angles in the X-axis, Y-axis and Z-axis directions of the human body are measured through a gyroscope. The bending angles is selected when the bending value of the human body is 40-140 degrees, and the bending value range of the human body can be optimized according to actual needs. If the bending value is not within the preset range, retrieve the effective laser height for the previous times. Then, perform secondary filtering to compare the current effective laser height with the first three consecutive effective laser heights, namely, the first maximum laser height, the second maximum laser height and the third maximum laser height. In one embodiment, the preset time period is 1 second. If the height values of the effective laser height, the first maximum laser height, the second maximum laser height and the third maximum laser height at an interval of 1 second are more than or equal to 2m, determine as high altitude, and select the effective height. If the height values of the effective laser height, the first maximum laser height, the second maximum laser height and the third maximum laser height at an interval of 1 second for three consecutive times are less than 2m, determine as low altitude and select no effective laser height to reduce misjudgment. Finally, calculate the most effective laser height to obtain the working height. The calculation process of the working height is as follows: working height = effective laser height - height value of operator.

It should be noted that the terms “comprise” and “consist of” herein or any other variations thereof are intended to cover non-exclusive inclusion, so that a process, device, article or method comprising a series of elements not only includes those elements but may also include other elements not explicitly listed or inherent to such process, device, article or method. Without further limitation, an element defined by the phrase “comprising a...” does not preclude the existence of additional identical elements in the process, device, article or method that includes such elements.

The above embodiments are merely preferred embodiments of the invention and do not limit the scope of the invention. Any equivalent structures or process transformations derived from the specification and drawings of the invention whether directly or indirectly applied in other related technical fields, shall similarly fall within the protection scope of the invention.

Claims

1. A height detection laser device for a safety harness, characterized by comprising a laser host, a main laser device and at least one auxiliary laser device, wherein the laser host is electrically connected to the main laser device and the auxiliary laser device;

the main laser device comprises a plurality of first laser detectors for detecting the back working height;

the auxiliary laser device comprises a plurality of second laser detectors for detecting the front working height;

the main laser device and the auxiliary laser device are respectively provided with a plurality of placement planes and placement slots, the placement slots are respectively located within the placement planes, and the orientations of the placement planes are different;

the first laser detectors and the second laser detectors are respectively located in the placement slots.

2. The height detection laser device for the safety harness according to claim 1, characterized in that the main laser device comprises an upper shell, a lower shell and a backing plate, the upper shell and the backing plate are respectively arranged on both sides of the lower shell;

the upper shell is provided with at least one positioning column, the lower shell and the backing plate are respectively provided with positioning holes corresponding to the positioning columns, and the positioning columns pass through the positioning holes.

3. The height detection laser device for the safety harness according to claim 2, characterized in that the upper shell is provided with a plurality of first clamping parts, and the lower shell is provided with a plurality of second clamping parts corresponding to the first clamping parts;

the first laser detectors are respectively clamped between the first clamping parts and the second clamping parts.

4. The height detection laser device for the safety harness according to claim 3, characterized in that each of the first clamping parts comprises a plurality of sheet bodies, which are arranged in the upper shell;

each of the sheet bodies is provided with a notch, and a plurality of notches form a first clamping position.

5. The height detection laser device for the safety harness according to claim 4, characterized in that each of the second clamping parts comprises blocks, which are fixedly connected to the lower shell;

the blocks are provided with skewed slots, which are arc-shaped and correspond to the first laser detectors;

the skewed slot comprises a first inclined plane and a second inclined plane, the first inclined plane is in contact with the first surface of the first laser detector, and the second

inclined plane is in contact with the second surface of the first laser detector;

the first inclined plane and the second inclined plane form a second clamping position;

the first laser detectors are respectively clamped between the first clamping position and the second clamping position.

6. The height detection laser device for the safety harness according to claim 1, characterized in that the placement slots are respectively provided with openings; detection ports of the first laser detectors and the second laser detectors respectively face towards the openings.

7. The height detection laser device for the safety harness according to claim 1, characterized in that the auxiliary laser device comprises a first shell, a second shell and a fixing plate, and the first shell and the fixing plate are respectively arranged on both sides of the second shell;

the first shell is provided with a plurality of first fixing parts, and the second shell is provided with a plurality of second fixing parts;

each of the first fixing parts comprises a third clamping position;

each of the second fixing parts comprises a fourth clamping position;

the second laser detectors are respectively clamped between the third clamping position and the fourth clamping position.

8. The height detection laser device for the safety harness according to claim 5, characterized in that the skewed slots are respectively provided with filleted corners, which are in contact with the first surface.

9. The height detection laser device for the safety harness according to claim 2, characterized in that the main laser device comprises an angle measuring component for measuring the bending angle of the human body, a communication component for receiving data, a temperature measuring component, a humidity measuring component and an area positioning component, and the angle measuring component is movably arranged between the upper shell and the lower shell;

the communication component, the temperature measuring component, the humidity measuring component and the area positioning component are respectively arranged in the upper shell.

10. A detection method of the height detection laser device for the safety harness, characterized by comprising the following steps:

obtain the height values of the operators through the main laser device and the auxiliary laser device;

obtain the height values at various angles through the main laser device and the auxiliary laser device, and take the maximum height value as the maximum laser height;

perform primary and secondary filtering on the maximum laser height to obtain the effective laser height;

calculate the working height based on the effective laser height.

11. The detection method of the height detection laser device for the safety harness according to claim 10, characterized in that the step of performing primary and secondary filtering on the maximum laser height to obtain the effective laser height comprises:

primary filtering: determine whether the bending value of the human body is within the preset range through the preset angle measuring component; the preset range is 40-140 degrees;

if yes, determine as the effective laser height;

if no, retrieve the effective laser height for the previous times;

secondary filtering: compare the effective laser height with the first maximum laser height, the second maximum laser height and the third maximum laser height within the preset time period; wherein, the first maximum laser height, the second maximum laser height and the third maximum laser height are the effective laser heights for the first three times;

if the height values of the effective laser height, the first maximum laser height, the second maximum laser height and the third maximum laser height are respectively more than or equal to 2m, determine as high altitude, and select the effective laser height;

if the height values of the effective laser height, the first maximum laser height, the second maximum laser height and the third maximum laser height are respectively less than 2m, determine as low altitude, and select no effective laser height.

12. The detection method of the height detection laser device for the safety harness according to claim 10, characterized in that the calculation process of the working height is as follows:

working height = effective laser height - height value of operator.