[0006] However, in the system disclosed in Patent Document 1, the positions of feature points are only corrected on scanning lines that extend along the epipolar lines of two images, and thus incorrect pairs of feature points that are not on the same scanning line are not corrected. Therefore, in the system disclosed in Patent Document 1, incorrect pairs of feature points are not sufficiently corrected, and it is difficult to suppress a decrease in the accuracy of a three-dimensional shape that is regenerated.

[0007] An example object of the disclosure is to solve the foregoing issues by providing an image processing apparatus, an image processing method, and a computer-readable recording medium that can suppress extraction of incorrect combinations of feature points when extracting combinations of corresponding feature points from a plurality of images.

[0008] In a first aspect, the present disclosure provides an image processing appratus for building a three-dimensional shape from a plurality of images, the apparatus comprising:

a feature point extraction unit configured to extract combinations of corresponding feature points from the plurality of images;

a matrix calculation unit configured to, if two or more line segments or two or more points corresponding to each other are designated in at least two images out of the plurality of images, specify a geometric relationship between the two or more line segments corresponding to each other or a geometric relationship between the two or more points corresponding to each other, different and independent from the extracted feature points,and calculate a numerical matrix that represents the specified geometric relationship; and

a shape building unit configured to specify a combination of feature points with a conflicting geometric relationship, from among the extracted combinations of feature points, using the numerical matrix, and build the three-dimensional shape using the combinations of feature points other than the specified combination of feature points.

[0009] In addition, in a second aspect, the present disclosure provides an image processing

method for building a three-dimensional shape from a plurality of images, the method comprising:

(a) a step of extracting combinations of corresponding feature points from the plurality of images;

(b) a step of, if two or more line segments or two or more points corresponding to each other are designated in at least two images out of the plurality of images, specifying a geometric relationship between the two or more line segments corresponding to each other or a geometric relationship between the two or more points corresponding to each other, different and independent from the extracted feature points, and calculating a numerical matrix that represents the specified geometric relationship; and

(c) a step of specifying a combination of feature points with a conflicting geometric relationship, from among the extracted combinations of feature points, using the numerical matrix, and building the three-dimensional shape using the combinations of feature points other than the specified combination of feature points.

[0010] Furthermore, in a third aspect, the present disclosure provides a computer-readable recording medium that includes a program recorded thereon for building a three-dimensional shape from a plurality of images, the program including instructions that cause a computer to carry out:

(a) a step of extracting combinations of corresponding feature points from the plurality of images;

(b) a step of, if two or more line segments or two or more points corresponding to each other are designated in at least two images out of the plurality of images, specifying a geometric relationship between the two or more line segments corresponding to each other or a geometric relationship between the two or more points corresponding to each other, different and independent from the extracted feature points, and calculating a numerical matrix that represents the specified geometric relationship; and

(c) a step of specifying a combination of feature points with a conflicting geometric relationship, from among the extracted combinations of feature points, using

the numerical matrix, and building the three-dimensional shape using the combinations of feature points other than the specified combination of feature points.

CLAIMS

1. An image processing apparatus for building a three-dimensional shape from a plurality of images, the apparatus comprising:

a feature point extraction unit configured to extract combinations of corresponding feature points from the plurality of images;

a matrix calculation unit configured to, if two or more line segments or two or more points corresponding to each other are designated in at least two images out of the plurality of images, specify a geometric relationship between the two or more line segments corresponding to each other or a geometric relationship between the two or more points corresponding to each other , different and independent from the extracted feature points,and calculate a numerical matrix that represents the specified geometric relationship; and

a shape building unit configured to specify a combination of feature points with a conflicting geometric relationship, from among the extracted combinations of feature points, using the numerical matrix, and build the three-dimensional shape using the combinations of feature points other than the specified combination of feature points.

2. The image processing apparatus according to claim 1,

wherein the shape building unit specifies feature points that overlap the two or more designated line segments or points corresponding to each other, from among feature points included in the extracted combinations of feature points, removes a combination of feature points that includes the specified feature points, and builds the three-dimensional shape.

3. The image processing apparatus according to claim 1 or 2, further comprising

a display unit configured to display the three-dimensional shape built by the shape building unit, on a screen.

4. The image processing apparatus according to claim 3,

wherein the shape building unit builds a temporary three-dimensional shape using the combinations of feature points extracted by the feature point extraction unit,

and

the display unit further displays the temporary three-dimensional shape on a screen.

5. An image processing method for building a three-dimensional shape from a plurality of images, the method comprising:

(a) a step of extracting combinations of corresponding feature points from the plurality of images;

(b) a step of, if two or more line segments or two or more points corresponding to each other are designated in at least two images out of the plurality of images, specifying a geometric relationship between the two or more line segments corresponding to each other or a geometric relationship between the two or more points corresponding to each other, different and independent from the extracted feature points, and calculating a numerical matrix that represents the specified geometric relationship; and

(c) a step of specifying a combination of feature points with a conflicting geometric relationship, from among the extracted combinations of feature points, using the numerical matrix, and building the three-dimensional shape using the combinations of feature points other than the specified combination of feature points.

6. The image processing method according to claim 5,

wherein, in the (c) step,

feature points that overlap the two or more designated line segments or points corresponding to each other are specified from among feature points included in the combinations of feature points extracted in the (a) step, a combination of feature points that includes the specified feature points is removed, and the three-dimensional shape is built.

7. The image processing method according to claim 5 or 6, further comprising

(d) a step of displaying the three-dimensional shape built in the (c) step, on a

screen.

8. The image processing method according to claim 7, further comprising:

(e) a step of building a temporary three-dimensional shape using the combinations of feature points extracted in the (a) step; and

(f) a step of displaying the temporary three-dimensional shape built in the (e) step, on a screen.

9. A computer-readable recording medium that includes a program recorded thereon for building a three-dimensional shape from a plurality of images, the program including instructions that cause a computer to carry out:

(a) a step of extracting combinations of corresponding feature points from the plurality of images;

(b) a step of, if two or more line segments or two or more points corresponding to each other are designated in at least two images out of the plurality of images, specifying a geometric relationship between the two or more line segments corresponding to each other or a geometric relationship between the two or more points corresponding to each other, different and independent from the extracted feature points, and calculating a numerical matrix that represents the specified geometric relationship; and

(c) a step of specifying a combination of feature points with a conflicting geometric relationship, from among the extracted combinations of feature points, using the numerical matrix, and building the three-dimensional shape using the combinations of feature points other than the specified combination of feature points.

10. The computer-readable recording medium according to claim 9,

wherein, in the (c) step,

feature points that overlap the two or more designated line segments or points corresponding to each other are specified from among feature points included in the combinations of feature points extracted in the (a) step, a combination of feature points that includes the specified feature points is removed, and the three-dimensional shape is built.