CLAIMS

1. A target used for calibration, comprising:

a first pattern of fiducial markers; and

a second pattern of fiducial markers,

wherein the first pattern is a scaled version of the second pattern, such that a calibration image captured of the target simulates multiple images of a single pattern captured at multiple calibration perspectives; and

one or more panel-identification fiducial markers that uniquely identify the target used for calibration.

2. The target of claim 1, wherein the fiducial markers in the first pattern and the fiducial markers in the second pattern are circular in shape.

3. The target of claim 1, wherein the fiducial markers in the first pattern have a different shape than the fiducial markers in the second pattern.

4. The target of claim 1, wherein each of the fiducial markers in the first pattern and each of the fiducial markers in the second pattern are uniquely identifiable relative to other fiducial markers of the target.

5. The target of claim 4, wherein the fiducial markers in the first pattern and the fiducial markers in the second pattern are each uniquely labeled by respective angular barcodes.

6. The target of claim 5, wherein the angular barcodes comprise a ten-bit encoding scheme where each bit is represented by a light or dark section representing a 1 or a 0.

7. The target of claim 5, wherein the angular barcodes are rotationally unique such that, even if rotated by any angle, the angular barcodes will not match one another.

8. A method, comprising:

recording a calibration image of a target using a camera, wherein the target comprises:

a first panel having a first arrangement of fiducial markers thereon,

wherein each of the fiducial markers in the first arrangement is uniquely identifiable among fiducial markers in the first arrangement; and

a second panel, disposed at a first angle relative to the first panel, having a second arrangement of fiducial markers thereon,

wherein each of the fiducial markers in the second arrangement is uniquely identifiable among fiducial markers in the second arrangement, and

wherein the first arrangement matches the second arrangement, and

wherein the first panel comprises one or more first panel-identification fiducial markers that uniquely identify the first panel; and

determining locations and identifications of one or more fiducial markers in the calibration image; and

based on the determined locations and identifications, calibrating the camera.

9. The method of claim 8, wherein the fiducial markers in the second arrangement are 180-degree rotations of the fiducial markers in the first arrangement at a corresponding location.

10. The method of claim 8,

wherein the fiducial markers in the first arrangement comprise a first color and the fiducial markers in the second arrangement comprise a second color, and

wherein the first color and the second color are different colors.

11. The method of claim 8,

wherein the second panel comprises one or more second-panel-identification fiducial markers.

12. The method of claim 11,

wherein the one or more first-panel-identification fiducial markers are disposed in one or more corners of the first panel, and

wherein the one or more second-panel-identification fiducial markers are disposed in one or more corners of the second panel.

13. The method of claim 8, wherein the target further comprises:

a third panel having a third arrangement of fiducial markers thereon,

wherein each of the fiducial markers in the third arrangement is uniquely identifiable among fiducial markers in the third arrangement; and

a fourth panel, disposed at a second angle relative to the third panel, having a fourth arrangement of fiducial markers thereon,

wherein each of the fiducial markers in the fourth arrangement is uniquely identifiable among fiducial markers in the fourth arrangement,

wherein the third arrangement of fiducial markers and the fourth arrangement of fiducial markers each match the first arrangement of fiducial markers and the second arrangement of fiducial markers, and

wherein the second angle is not equal to the first angle.

14. The method of claim 13,

wherein the third panel and the fourth panel are disposed at a third angle relative to the first panel and the second panel, and

wherein the third angle is about a different axis than the first angle and the second angle.

15. The method of claim 8, wherein calibrating the camera comprises using correlations between locations of the fiducial markers on the first panel and locations of the fiducial markers on the second panel to estimate parameters of a camera matrix using a pinhole camera model.

16. The method of claim 8,

wherein the first arrangement comprises a first pattern of fiducial markers and a second pattern of fiducial markers, and

wherein the second pattern of fiducial markers is a scaled version of the first pattern of fiducial markers.

17. The method of claim 8, further comprising:

rotating the camera relative to the target and recording an additional calibration image; and

determining locations and identifications of one or more fiducial markers in the additional calibration image.

18. The method of claim 17, wherein rotating the camera relative to the target comprises rotating the camera about a roll axis of the camera.

19. The method of claim 8, further comprising:

moving the camera and recording an additional calibration image; and

determining locations and identifications of one or more fiducial markers in the additional calibration image.

20. A system used for calibrating a camera, comprising:

a target, comprising:

a first pattern of fiducial markers; and

a second pattern of fiducial markers,

wherein the first pattern is a scaled version of the second pattern, such that a calibration image captured of the target simulates multiple images of a single pattern captured at multiple calibration perspectives; and

one or more panel-identification fiducial markers that uniquely identify the target; and

a stage configured to translate or rotate the camera with respect to the target.