CLAIMS

1. An optical measurement scaleplate comprising:

a substrate defining a first direction thereon;

a plurality of marking units each being borne on the substrate at a predetermined position, each marking unit including a plurality of optically detectable marking elements, each of said marking elements having an element value defined by an optical property thereof,

wherein each marking unit has a unit value determined by a permutation of the element value of each of the marking elements in said marking unit, each unit value corresponding to a physical quantity,

wherein the physical quantity includes a first distance between a reference position and said predetermined position along the first direction.

wherein the substrate defines a second direction across the first direction,

wherein at least two marking elements in each marking unit are arranged in a first alignment row parallel to the second direction; wherein each marking unit further includes at least two marking elements arranged in a second alignment row along the second direction and spaced apart from the first alignment row.

2. The optical measurement scaleplate of claim 1, wherein every two adjacent marking units are partially overlapped along the first direction by at least one marking element.

3. The optical measurement scaleplate of claim 2, wherein each subsequent marking unit is offset along the first direction by one marking element with respect to an antecedent marking unit adjacent to said subsequent marking unit.

4. The optical measurement scaleplate of claim 3, wherein the substrate has a flat surface, the first and second directions are linear directions perpendicular to each

other on the flat surface, the first distance is a linear distance along the first direction between the reference position and the first alignment row.

5. The optical measurement scaleplate of claim 3, wherein the substrate has a flat surface, the first direction is a circumferential direction and the second direction is a radial direction on the flat surface, the first distance is an angular distance along the circumferential direction between the reference position and the first alignment row.

6. The optical measurement scaleplate of claim 3, wherein the substrate has a revolving surface, the first direction is a circumferential direction and the second direction is an axial direction of the revolving surface, the first distance is an angular distance along the circumferential direction between the reference position and the first alignment row.

7. An optical measurement scaleplate comprising:

a substrate defining a first direction thereon;

a plurality of marking units each being borne on the substrate at a predetermined position, each marking unit including a plurality of optically detectable marking elements, each of said marking elements having an element value defined by an optical property thereof,

wherein each marking unit has a unit value determined by a permutation of the element value of each of the marking elements in said marking unit, each unit value corresponding to a physical quantity,

wherein the physical quantity includes a first distance between a reference position and said predetermined position along the first direction;

wherein the substrate defines a second direction across the first direction, wherein at least two marking elements in each marking unit are arranged in a first alignment row parallel to the second direction, and

wherein the marking units are arranged in a 2-dimensional matrix along the first and second directions, wherein the physical quantity further includes a

second distance between the reference position and said predetermined position along the second direction.

8. The optical measurement scaleplate of claim7, wherein every two adjacent marking units along the first direction are partially overlapped by at least one marking element, and every two adjacent marking units along the second direction are partially overlapped by at least one marking element.

9. The optical measurement scaleplate of claim8, wherein each subsequent marking unit is offset by one marking element with respect to an antecedent marking unit adjacent to said subsequent marking unit along the first direction, and each subsequent marking unit is offset by one marking element with respect to an antecedent marking unit adjacent to said subsequent marking unit along the second direction.

10. The optical measurement scaleplate of claim9, wherein the substrate has a flat surface, the first and second directions are linear directions perpendicular to each other on the flat surface, the first distance is a linear distance along the first direction between the reference position and the first alignment row.

11. The optical measurement scaleplate of claim 9, wherein the substrate has a revolving surface, the first direction is a circumferential direction and the second direction is an axial direction of the revolving surface, the first distance is an angular distance along the circumferential direction between the reference position and the first alignment row.

12. The optical measurement scaleplate of claim 1 or 7, wherein each marking element is a passive light reflector borne on the substrate and wherein the optical property is one of a colour, shape, greyscale, brightness, pattern or a combination thereof.

13. The optical measurement scaleplate of claim12, wherein each marking element is an optical image provided from a projector and the substrate is a projector screen bearing the optical image of each of the plurality of marking elements.

14. The optical measurement scaleplate of claim 1 or 7, wherein each marking element is a light source fixed on the substrate and wherein the optical property is one of a colour, brightness, illumination level or a combination thereof.

15. The optical measurement scaleplate of claim14, wherein each marking element is an active light emitter fixed on the substrate to form a display screen from which the marking elements emit optical signals.

16. An optical measurement method comprising:
positioning a scaleplate recited in claim 1 or 7 in front of an imaging apparatus;
capturing an optical image of a first marking unit on the scaleplate;
determining an element value of each marking element in said first marking unit based on the optical property of said marking element;
determining a first unit value of said first marking unit based on a permutation of the element value of the plurality of marking elements in said first marking unit;
matching the first unit value to a first physical quantity in a comparison table;
wherein the first physical quantity includes a first distance between the reference position and said predetermined position along the first direction on the substrate.

17. The method of claim16, wherein the first physical quantity includes a second distance between the reference position and said predetermined position along a second direction on the substrate perpendicular to the first direction.

18. The method of claim16, wherein the optical image of the first marking unit is captured at a first instant, the method further comprising:
capturing an optical image of a second marking unit at a second instant;

determining an element value of each marking element in said second marking unit based on the optical property of said each marking element;

determining a second unit value of said second marking unit based on a permutation of the element value of the plurality of marking elements in said second marking unit;

matching the second unit value to a second physical quantity in a comparison table, and

determining a movement status of the scaleplate based on the first physical quantity, the second physical quantity, the first instant and the second instant.

19. The method of claim 16 further comprising:

defining a measurement line passing through the first marking unit;

determining a relative position of the measurement line between an upper border and a lower border of the first marking unit,

determining a ratio value based on the relative position,

wherein the first physical quantity includes the first distance and the ratio value.

20. An optical measurement system comprising:

a scaleplate as recited in claim 1 or 7;

an imaging apparatus including:

an optical signal receiver for capturing an optical image of the scaleplate;

a processor coupled to the optical signal receiver for receiving the optical image, wherein the processor is to determine the element value of each marking element in the optical image based on the optical property thereof to determine the unit value based on a permutation of the element values, and

a comparison table matching the unit value to a corresponding physical quantity,

wherein the physical quantity includes a first distance between the reference position and said predetermined position along the first direction.

21. The optical measurement system of claim20, wherein the substrate further defining a second direction across the first direction, wherein the physical quantity includes a second distance between the reference position and said predetermined position along the second direction.

22. The optical measurement system of claim20, wherein each marking element is a light source, the optical property is one of a colour, brightness, illumination level or a combination thereof, and wherein the system further comprising a controller for independently controlling a lighting status of each marking element.

23. The optical measurement system of claim20, further comprising a screen superimposed to the scaleplate to display a visual image thereon, and a collimating system for directing a light beam onto the visual image to aim at the visual image.

24. The optical measurement system of claim23, wherein the optical measurement scaleplate has a brightness lower than that of the visual image.

CLAIMS

1. An optical measurement scaleplate comprising:

a substrate defining a first direction thereon;

a plurality of marking units each being borne on the substrate at a predetermined position, each marking unit including a plurality of optically detectable marking elements, each of said marking elements having an element value defined by an optical property thereof,

wherein each marking unit has a unit value determined by a permutation of the element value of each of the marking elements in said marking unit, each unit value corresponding to a physical quantity,

wherein the physical quantity includes a first distance between a reference position and said predetermined position along the first direction.

2. The optical measurement scaleplate of claim 1, wherein the substrate defines a second direction across the first direction, wherein at least two marking elements in each marking unit are arranged in a first alignment row parallel to the second direction.

3. The optical measurement scaleplate of claim 2, wherein all the marking elements in each marking unit are arranged in the first alignment row, the first distance being determined between the reference position and the first alignment row along the first direction.

4. The optical measurement scaleplate of claim 3, wherein the substrate has a flat surface, the first and second directions are linear directions perpendicular to each other on the flat surface, the first distance is a linear distance along the first direction between the reference position and the first alignment row.

5. The optical measurement scaleplate of claim 3, wherein the substrate has a flat surface, the first direction is a circumferential direction and the second direction is a radial direction on the flat surface, the first distance is an angular distance along

the circumferential direction between the reference position and the first alignment row.

6. The optical measurement scaleplate of claim 3, wherein the substrate has a revolving surface, the first direction is a circumferential direction and the second direction is an axial direction of the revolving surface, the first distance is an angular distance along the circumferential direction between the reference position and the first alignment row.

7. The optical measurement scaleplate of claim 3, wherein the plurality of marking units are arranged along the first direction with an even pitch between adjacent marking units.

8. The optical measurement scaleplate of claim 2, wherein each marking unit further includes at least two marking elements arranged in a second alignment row along the second direction and spaced apart from the first alignment row.

9. The optical measurement scaleplate of claim 8, wherein every two adjacent marking units are partially overlapped along the first direction by at least one marking element.

10. The optical measurement scaleplate of claim 9, wherein each subsequent marking unit is offset along the first direction by one marking element with respect to an antecedent marking unit adjacent to said subsequent marking unit.

11. The optical measurement scaleplate of claim 10, wherein the substrate has a flat surface, the first and second directions are linear directions perpendicular to each other on the flat surface, the first distance is a linear distance along the first direction between the reference position and the first alignment row.

12. The optical measurement scaleplate of claim 10, wherein the substrate has a flat surface, the first direction is a circumferential direction and the second direction is

a radial direction on the flat surface, the first distance is an angular distance along the circumferential direction between the reference position and the first alignment row.

13. The optical measurement scaleplate of claim 10, wherein the substrate has a revolving surface, the first direction is a circumferential direction and the second direction is an axial direction of the revolving surface, the first distance is an angular distance along the circumferential direction between the reference position and the first alignment row.

14. The optical measurement scaleplate of claim 2, wherein the marking units are arranged in a 2-dimensional matrix along the first and second directions, wherein the physical quantity further includes a second distance between the reference position and said predetermined position along the second direction.

15. The optical measurement scaleplate of claim 13, wherein every two adjacent marking units along the first direction are partially overlapped by at least one marking element, and every two adjacent marking units along the second direction are partially overlapped by at least one marking element.

16. The optical measurement scaleplate of claim 15, wherein each subsequent marking unit is offset by one marking element with respect to an antecedent marking unit adjacent to said subsequent marking unit along the first direction, and each subsequent marking unit is offset by one marking element with respect to an antecedent marking unit adjacent to said subsequent marking unit along the second direction.

17. The optical measurement scaleplate of claim 16, wherein the substrate has a flat surface, the first and second directions are linear directions perpendicular to each other on the flat surface, the first distance is a linear distance along the first direction between the reference position and the first alignment row.

18. The optical measurement scaleplate of claim 16, wherein the substrate has a revolving surface, the first direction is a circumferential direction and the second direction is an axial direction of the revolving surface, the first distance is an angular distance along the circumferential direction between the reference position and the first alignment row.

19. The optical measurement scaleplate of claim 1, wherein the marking elements in each marking unit are arranged in a first alignment column along the first direction, and the plurality of marking units are arranged along the first direction with an even pitch between adjacent marking units.

20. The optical measurement scaleplate of claim 19, wherein every two adjacent marking units are partially overlapped along the first direction by at least one marking element.

21. The optical measurement scaleplate of claim 20, wherein each subsequent marking unit is offset along the first direction by one marking element with respect to an antecedent marking unit adjacent to said subsequent marking unit.

22. The optical measurement scaleplate of claim 21, wherein the substrate has a flat surface, the first distance is a linear distance along the first direction between the reference position and the first alignment row.

23. The optical measurement scaleplate of claim 21, wherein the substrate has a flat surface, the first direction is a circumferential direction and first distance is an angular distance along the circumferential direction between the reference position and the first alignment row.

24. The optical measurement scaleplate of claim 21, wherein the substrate has a revolving surface, the first direction is a circumferential direction and the first distance is an angular distance along the circumferential direction between the reference position and the first alignment row.

25. The optical measurement scaleplate of claim 1, wherein each marking element is a passive light reflector borne on the substrate and wherein the optical property is one of a colour, shape, greyscale, brightness, pattern or a combination thereof.

26. The optical measurement scaleplate of claim 25, wherein each marking element is an optical image provided from a projector and the substrate is a projector screen bearing the optical image of each of the plurality of marking elements.

27. The optical measurement scaleplate of claim 1, wherein each marking element is a light source fixed on the substrate and wherein the optical property is one of a colour, brightness, illumination level or a combination thereof.

28. The optical measurement scaleplate of claim 27, wherein each marking element is an active light emitter fixed on the substrate to form a display screen from which the marking elements emit optical signals.

29. An optical measurement method comprising:

positioning a scaleplate recited in claim 1 in front of an imaging apparatus;

capturing an optical image of a first marking unit on the scaleplate;

determining an element value of each marking element in said first marking unit based on the optical property of said marking element;

determining a first unit value of said first marking unit based on a permutation of the element value of the plurality of marking elements in said first marking unit;

matching the first unit value to a first physical quantity in a comparison table;

wherein the first physical quantity includes a first distance between the reference position and said predetermined position along the first direction on the substrate.

30. The method of claim 29, wherein the first physical quantity includes a second distance between the reference position and said predetermined position along a second direction on the substrate perpendicular to the first direction.

31. The method of claim 29, wherein the optical image of the first marking unit is captured at a first instant, the method further comprising:

capturing an optical image of a second marking unit at a second instant;

determining an element value of each marking element in said second marking unit based on the optical property of said each marking element;

determining a second unit value of said second marking unit based on a permutation of the element value of the plurality of marking elements in said second marking unit;

matching the second unit value to a second physical quantity in a comparison table, and

determining a movement status of the scaleplate based on the first physical quantity, the second physical quantity, the first instant and the second instant.

32. The method of claim 29 further comprising:

defining a measurement line passing through the first marking unit;

determining a relative position of the measurement line between an upper border and a lower border of the first marking unit,

determining a ratio value based on the relative position,

wherein the first physical quantity includes the first distance and the ratio value.

33. An optical measurement system comprising:

a scaleplate as recited in claim 1;

an imaging apparatus including:

an optical signal receiver for capturing an optical image of the scaleplate;

a processor coupled to the optical signal receiver for receiving the optical image, wherein the processor is to determine the element value of each marking element in the optical image based on the optical property

thereof to determine the unit value based on a permutation of the element values, and

a comparison table matching the unit value to a corresponding physical quantity,

wherein the physical quantity includes a first distance between the reference position and said predetermined position along the first direction.

34. The optical measurement system of claim 33, wherein the substrate further defining a second direction across the first direction, wherein the physical quantity includes a second distance between the reference position and said predetermined position along the second direction.

35. The optical measurement system of claim 33, wherein each marking element is a light source, the optical property is one of a colour, brightness, illumination level or a combination thereof, and wherein the system further comprising a controller for independently controlling a lighting status of each marking element.

36. The optical measurement system of claim 33, further comprising a screen superimposed to the scaleplate to display a visual image thereon, and a collimating system for directing a light beam onto the visual image to aim at the visual image.

37. The optical measurement system of claim 36, wherein the optical measurement scaleplate has a brightness lower than that of the visual image.