CLAIMS

1. A movable body drive system that drives a movable body substantially along a predetermined plane, the system comprising:

an encoder that has a head that irradiates a detection light to a scale having a grating whose periodic direction is a predetermined direction parallel to the predetermined plane and receives a reflected light from the scale, and measures position information of the movable body in the predetermined direction; and

a drive device that drives the movable body in the predetermined direction, based on a measurement value of the encoder, and correction information in accordance with position information of the movable body in a direction different from the predetermined direction at the time of the measurement.

2. The movable body drive system according to Claim 1, wherein

the scale is placed on a surface of the movable body that is substantially parallel to the predetermined plane, and

the head is placed outside the movable body so as to be capable of facing the scale.

3. The movable body drive system according to one of Claims 1 and 2, wherein

the position information of the movable body in a direction different from the predetermined direction includes

position information of the movable body in at least one direction out of a direction orthogonal to the predetermined plane, a rotation direction within a plane parallel to the predetermined plane and a rotation direction around an axis in a direction orthogonal to the predetermined direction within a plane parallel to the predetermined plane.

4. The movable body drive system according to any one of Claims 1 to 3, further comprising:

a storage device in which the correction information is stored, wherein

the drive device obtains the correction information in accordance with position information of the movable body in a direction different from the predetermined direction, based on the position information of the movable body in a direction different from the predetermined direction and information stored in the storage device, at the time of measurement of position information of the movable body in the predetermined direction using the encoder.

5. The movable body drive system according to Claim 4, wherein

a plurality of the encoders are provided,

the correction information of each of the encoders is stored in the storage device, and

the drive device obtains the correction information in accordance with position information of the movable body in a direction different from the predetermined direction with respect to each of the encoders, based on the position

information of the movable body in a direction different from the predetermined direction and information stored in the storage device.

6. The movable body drive system according to any one of Claims 1 to 5, wherein

as the scale, a first scale that has a grating whose periodic direction is a first direction within a plane parallel to the predetermined plane, and a second scale that has a grating whose periodic direction is a second direction that intersects the first direction within a plane parallel to the predetermined plane are provided, and

as the encoder, a plurality of first encoders each of which has a plurality of first heads placed at different positions in the second direction and measures position information of the movable body in the first direction by at least one of the plurality of first heads that faces the first scale, and a plurality of second encoders each of which has a plurality of second heads placed at different positions in the first direction and measures position information of the movable body in the second direction by at least one of the plurality of second heads that faces the second scale are included.

7. The movable body drive system according to any one of Claims 1 to 6, further comprising:

a measurement device that measures position information of the movable body in a direction different from the predetermined direction.

8. The movable body drive system according to Claim 7, wherein

the measurement device includes an interferometer that measures position information of the movable body in a direction different from the predetermined direction by irradiating one, or two or more measurement beams to at least one reflection surface arranged at the movable body.

9. The movable body drive system according to one of Claims 7 and 8, further comprising:

a controller that obtains correction information of a subject encoder, by changing an attitude of the movable body to a plurality of different attitudes, moving the movable body in a predetermined stroke range in a direction orthogonal to the predetermined plane while irradiating a detection light from a head of the subject encoder to a specific area of a corresponding scale in a state where the attitude of the movable body is maintained based on measurement results of the measurement device and performing sampling of measurement results of the encoder during the movement with respect to each of the attitudes, and performing a predetermined computation based on results of the sampling.

10. The movable body drive system according to Claim 9, wherein

when obtaining the correction information for a plurality of encoders that correspond to the same scale, the controller obtains correction information of a subject

encoder taking into consideration a geometric error that occurs due to gradient of the head of the subject encoder.

11. A pattern formation apparatus, comprising:

a movable body on which an object is mounted and which can move substantially along a movement plane, holding the object;

a patterning device that generates a pattern on the object; and

the movable body drive system according to any one of Claims 1 to 10 that drives the movable body for pattern formation on the object.

12. An exposure apparatus that forms a pattern on an object by irradiation of an energy beam, the apparatus comprising:

a patterning device that irradiates the energy beam to the object; and

the movable body drive system according to any one of Claims 1 to 10, wherein

driving of the movable body on which the object is mounted by the movable body drive system is performed for relative movement of the energy beam and the object.

13. An exposure apparatus that exposes an object with an energy beam, the apparatus comprising:

a movable body that can move in at least first and second directions that are orthogonal to each other within a predetermined plane, holding the object;

an encoder system in which one of a grating section and a head unit is arranged on a surface of the movable body on which the object is held and the other of the grating section and the head unit is arranged facing the surface of the movable body, and which measures position information of the movable body in at least one of the first and second directions; and

a drive device that drives the movable body within the predetermined plane based on measurement information of the encoder system and position information of the movable body in a different direction from the first and the second directions.

14. The exposure apparatus according to Claim 13, wherein

the movable body is driven so that a measurement error of the encoder system that occurs due to a displacement of the movable body in the different direction is compensated.

15. The exposure apparatus according to Claim 14, wherein

correction information for compensating the measurement error to be used for driving of the movable body is obtained, based on the position information of the movable body in the different direction.

16. The exposure apparatus according to one of Claims 14 and 15, wherein

the measurement information of the encoder system or a target position at which the movable body is positioned is

corrected based on the position information of the movable body in the different direction.

17. The exposure apparatus according to any one of Claims 13 to 16, wherein

the object is exposed by the energy beam via a mask, and when the exposure is performed, the mask is moved so that a measurement error of the encoder system that occurs due to a displacement of the movable body in the different direction is compensated, while driving the movable body based on the measurement information of the encoder system.

18. The exposure apparatus according to any one of Claims 13 to 17, wherein

the different direction includes at least one of a direction orthogonal to the predetermined plane, a rotation direction around an axis orthogonal to the predetermined plane, and a rotation direction around an axis parallel to the predetermined plane.

19. The exposure apparatus according to any one of Claims 13 to 18, wherein

the movable body is movable in the different direction, and

the exposure apparatus further comprises a measurement device that measures position information of the movable body in the different direction.

20. An exposure apparatus that exposes an object with

an energy beam, the apparatus comprising:

a movable body that can move in at least first and second directions that are orthogonal to each other within a predetermined plane and can incline with respect to the predetermined plane, holding the object;

an encoder system in which one of a grating section and a head unit is arranged on a surface of the movable body on which the object is held and the other of the grating section and the head unit is arranged facing the surface of the movable body, and which measures position information of the movable body in at least one of the first and second directions; and

a drive device that drives the movable body within the predetermined plane based on measurement information of the encoder system and inclination information of the movable body.

21. The exposure apparatus according to Claim 20, wherein

the movable body is driven so that a measurement error of the encoder system that occurs due to inclination of the movable body is compensated.

22. The exposure apparatus according to Claim 21, wherein

correction information for compensating the measurement error to be used for driving of the movable body is obtained, based on the inclination information of the movable body.

23. The exposure apparatus according to one of Claims 21 and 22, wherein

the measurement information of the encoder system or a target position at which the movable body is positioned is corrected based on the inclination information of the movable body.

24. The exposure apparatus according to any one of Claims 20 to 23, wherein

the object is exposed by the energy beam via a mask, and when the exposure is performed, the mask is moved so that a measurement error of the encoder system that occurs due to the inclination of the movable body is compensated, while driving the movable body based on the measurement information of the encoder system.

25. The exposure apparatus according to any one of Claims 13 to 24, wherein

the movable body is driven based on characteristic information of the head unit that is a factor causing a measurement error of the encoder system.

26. An exposure apparatus that exposes an object with an energy beam, the apparatus comprising:

a movable body that can move in at least first and second directions that are orthogonal to each other within a predetermined plane, holding the object;

an encoder system in which one of a grating section and a head unit is arranged on a surface of the movable body on

which the object is held and the other of the grating section and the head unit is arranged facing the surface of the movable body, and which measures position information of the movable body in at least one of the first and second directions; and

a drive device that drives the movable body within the predetermined plane based on measurement information of the encoder system and characteristic information of the head unit that is a factor causing a measurement error of the encoder system.

27. The exposure apparatus according to one of Claims 25 and 26, wherein

the characteristic information includes optical characteristics of the head unit.

28. The exposure apparatus according to any one of Claims 25 to 27, wherein

correction information for compensating the measurement error to be used for driving of the movable body is obtained based on the characteristic information of the head unit.

29. The exposure apparatus according to Claim 28, wherein

the measurement information of the encoder system or a target position at which the movable body is positioned is corrected based on the characteristic information of the head unit.

30. The exposure apparatus according to any one of Claims 13 to 29, wherein

the movable body is driven so that a measurement error of the encoder system that occurs due to the head unit is compensated.

31. An exposure apparatus that exposes an object with an energy beam, the apparatus comprising:

a movable body that can move in at least first and second directions that are orthogonal to each other within a predetermined plane, holding the object;

an encoder system in which one of a grating section and a head unit is arranged on a surface of the movable body on which the object is held and the other of the grating section and the head unit is arranged facing the surface of the movable body, and which measures position information of the movable body in at least one of the first and second directions; and

a drive device that drives the movable body within the predetermined plane based on measurement information of the encoder system so that a measurement error of the encoder system that occurs due to the head unit is compensated.

32. The exposure apparatus according to any one of Claims 25 to 31, wherein

the object is exposed by the energy beam via a mask, and when the exposure is performed, the mask is moved so that the measurement error of the encoder system that occurs due to the head unit is compensated, while driving the movable body based on the measurement information of the encoder system.

33. The exposure apparatus according to any one of Claims 13 to 32, wherein

the grating section is arranged extending in the first direction as a longitudinal direction, the head unit has a plurality of heads placed at different positions in the second direction, and the encoder system measures position information of the movable body by a head that faces the grating section out of the plurality of heads.

34. The exposure apparatus according to any one of Claims 13 to 33, wherein

the grating section is arranged on a surface of the movable body, and the head unit is arranged facing the surface of the movable body.

35. The exposure apparatus according to any one of Claims 13 to 34, further comprising:

a measurement system that measures position information of the movable body in a third direction orthogonal to the predetermined plane, by a sensor that faces the grating section out of a plurality of sensors placed on the same side as the head unit, wherein

a position of the movable body in the third direction is controlled based on measurement information of the measurement system.

36. The exposure apparatus according to Claim 35, wherein

the measurement system measures position information in the third direction and inclination information of the movable body by a plurality of sensors that face the grating section.

37. The exposure apparatus according to one of Claims 35 and 36, wherein

out of position information of the movable body in directions of six degrees of freedom, position information in directions of three degrees of freedom including the first direction, the second direction and a rotation direction within the predetermined plane is measured by the encoder system, and position information in directions of the remaining three degrees of freedom is measured by the measurement system.

38. The exposure apparatus according to Claim 37, wherein

a position of the movable body at least when performing an exposure operation is controlled based on the measured position information in directions of six degrees of freedom.

39. The exposure apparatus according to any one of Claims 35 to 38, further comprising:

a position measurement device that measures position information of the object in the third direction, wherein

the encoder system, the measurement system and the position measurement device are used in a measurement operation of surface position information of the object.

40. The exposure apparatus according to any one of Claims 35 to 39, further comprising:

a mark detection system that detects a mark on the object, wherein

the encoder system and the mark detection system are used in a detection operation of the mark.

41. The exposure apparatus according to any one of Claims 13 to 40, further comprising:

an interferometer system that measures position information of the movable body in at least the first and second directions, wherein

in order to drive the movable body, measurement information of the encoder system is used in an exposure operation and measurement information of the interferometer system is used in an operation different from the exposure operation.

42. The exposure apparatus according to Claim 41, wherein

measurement information of the encoder system is used in a detection operation of the mark and/or surface position information of the object.

43. The exposure apparatus according to one of Claims 41 and 42, wherein

at least part of the measurement information of the interferometer system is used in the exposure operation.

44. A movable body drive method in which a movable body is driven substantially along a predetermined plane, the method including:

a process of measuring position information of the movable body in a predetermined direction parallel to the predetermined plane using an encoder that has a head that irradiates a detection light to a scale having a grating whose periodic direction is the predetermined direction and receives a reflected light from the scale, and of driving the movable body in the predetermined direction based on a measurement value of the encoder and correction information in accordance with position information of the movable body in a direction different from the predetermined direction at the time of the measurement.

45. The movable body drive method according to Claim 44, wherein

the scale is placed on a surface of the movable body that is substantially parallel to the predetermined plane, and

the head is placed outside the movable body, facing the scale.

46. The movable body drive method according to one of Claims 44 and 45, wherein

the position information of the movable body in a direction different from the predetermined direction includes position information of the movable body in at least one direction out of a direction orthogonal to the predetermined plane, a rotation direction within a plane parallel to the

predetermined plane and a rotation direction around an axis in a direction orthogonal to the predetermined direction within a plane parallel to the predetermined plane.

47. The movable body drive method according to any one of Claims 44 to 46, wherein:

when the movable body is driven using a plurality of the encoders,

in the process of measuring and driving, correction information in accordance with position information of the movable body in a direction different from the predetermined direction is obtained with respect to each of the encoders based on the position information of the movable body in a direction different from the predetermined direction, and the movable body is driven based on a result of correcting a measurement value of each of the encoders using the correction information of each of the encoders respectively.

48. The movable body drive method according to any one of Claims 44 to 47, wherein

as the scale, a first scale that has a grating whose periodic direction is a first direction within a plane parallel to the predetermined plane, and a second scale that has a grating whose periodic direction is a second direction that intersects the first direction within a plane parallel to the predetermined plane are provided, and

as the encoder, a plurality of first encoders each of which has a plurality of first heads placed at different positions in the second direction and measures position

information of the movable body in the first direction by at least one of the plurality of first heads that faces the first scale, and a plurality of second encoders each of which has a plurality of second heads placed at different positions in the first direction and measures position information of the movable body in the second direction by at least one of the plurality of second heads that faces the second scale are included.

49. The movable body drive method according to Claim 48, wherein

the first and second scales are placed on a surface of the movable body that is substantially parallel to the predetermined plane, and the first and second heads are placed outside the movable body, facing the scales.

50. The movable body drive method according to any one of Claims 44 to 49, further including:

a process of obtaining correction information of a subject encoder, prior to the process of measuring and driving, by changing an attitude of the movable body to a plurality of different attitudes, moving the movable body in a predetermined stroke range in a direction orthogonal to the predetermined plane while irradiating a detection light from a head of the subject encoder to a specific area of a corresponding scale in a state where the attitude of the movable body is maintained and performing sampling of measurement results of the encoder during the movement with respect to each of the attitudes, and performing a

predetermined computation based on results of the sampling.

51. The movable body drive method according to Claim 50, wherein

in the process of obtaining the correction information, when obtaining the correction information for a plurality of encoders that correspond to the same scale, correction information of a subject encoder is obtained taking into consideration a geometric error that occurs due to gradient of the head of the subject encoder.

52. A pattern formation method, including:

a process of mounting an object on a movable body that can move within a movement plane; and

a process of driving the movable body in the movable body drive method according to any one of Claims 44 to 51 in order to form a pattern on the object.

53. A device manufacturing method including a pattern formation process, wherein

in the pattern formation process, a pattern is formed on a substrate using the pattern formation method according to Claim 52.

54. An exposure method in which a pattern is formed on an object by irradiation of an energy beam, the method including:

driving a movable body on which the object is mounted, using the movable body drive method according to any one of

Claims 44 to 51, for relative movement of the energy beam and the object.

55. An exposure method in which an object is exposed with an energy beam, the method including:

mounting the object on a movable body that can move in at least first and second directions that are orthogonal to each other within a predetermined plane; and

driving the movable body within the predetermined plane, based on measurement information of an encoder system in which one of a grating section and a head unit is arranged on a surface of the movable body on which the object is mounted and the other of the grating section and the head unit is arranged facing the surface of the movable body, and which measures position information of the movable body in at least one of the first and second directions, and based on position information of the movable body in a different direction from the first and the second directions.

56. The exposure method according to Claim 55, wherein

the movable body is driven so that a measurement error of the encoder system that occurs due to a displacement of the movable body in the different direction is compensated.

57. The exposure method according to Claim 56, wherein

correction information for compensating the measurement error to be used for driving of the movable body is obtained, based on the position information of the movable body in the different direction.

58. The exposure method according to one of Claims 56 and 57, wherein

the measurement information of the encoder system or a target position at which the movable body is positioned is corrected based on the position information of the movable body in the different direction.

59. The exposure method according to any one of Claims 55 to 58, wherein

the object is exposed by the energy beam via a mask, and when the exposure is performed, the mask is moved so that a measurement error of the encoder system that occurs due to a displacement of the movable body in the different direction is compensated, while driving the movable body based on the measurement information of the encoder system.

60. The exposure method according to any one of Claims 55 to 59, wherein

the different direction includes at least one of a direction orthogonal to the predetermined plane, a rotation direction around an axis orthogonal to the predetermined plane, and a rotation direction around an axis parallel to the predetermined plane.

61. The exposure method according to any one of Claims 55 to 60, wherein

the movable body is movable in the different direction, and

the exposure method further includes a process of measuring position information of the movable body in the different direction by a measurement device.

62. An exposure method in which an object is exposed with an energy beam, the method including:

mounting the object on a movable body that can move in at least first and second directions that are orthogonal to each other within a predetermined plane and can incline with respect to the predetermined plane; and

driving the movable body within the predetermined plane, based on measurement information of an encoder system in which one of a grating section and a head unit is arranged on a surface of the movable body on which the object is mounted and the other of the grating section and the head unit is arranged facing the surface of the movable body, and which measures position information of the movable body in at least one of the first and second directions, and based on inclination information of the movable body.

63. The exposure method according to Claim 62, wherein

the movable body is driven so that a measurement error of the encoder system that occurs due to inclination of the movable body is compensated.

64. The exposure method according to Claim 63, wherein

correction information for compensating the measurement error to be used for driving of the movable body is obtained, based on the inclination information of the

movable body.

65. The exposure method according to one of Claims 63 and 64, wherein

the measurement information of the encoder system or a target position at which the movable body is positioned is corrected based on the inclination information of the movable body.

66. The exposure method according to any one of Claims 62 to 65, wherein

the object is exposed by the energy beam via a mask, and when the exposure is performed, the mask is moved so that a measurement error of the encoder system that occurs due to the inclination of the movable body is compensated, while driving the movable body based on the measurement information of the encoder system.

67. The exposure method according to any one of Claims 55 to 66, wherein

the movable body is driven based on characteristic information of the head unit that is a factor causing a measurement error of the encoder system.

68. An exposure method in which an object is exposed with an energy beam, the method including:

mounting the object on a movable body that can move in at least first and second directions that are orthogonal to each other within a predetermined plane; and

driving the movable body within the predetermined plane, based on measurement information of an encoder system in which one of a grating section and a head unit is arranged on a surface of the movable body on which the object is mounted and the other of the grating section and the head unit is arranged facing the surface of the movable body, and which measures position information of the movable body in at least one of the first and second directions, and based on characteristic information of the head unit that is a factor causing a measurement error of the encoder system.

69. The exposure method according to one of Claims 67 and 68, wherein

the characteristic information includes optical characteristics of the head unit.

70. The exposure method according to any one of Claims 67 to 69, wherein

correction information for compensating the measurement error to be used for driving of the movable body is obtained based on the characteristic information of the head unit.

71. The exposure method according to Claim 70, wherein

the measurement information of the encoder system or a target position at which the movable body is positioned is corrected based on the characteristic information of the head unit.

72. The exposure method according to any one of Claims 55 to 71, wherein

the movable body is driven so that a measurement error of the encoder system that occurs due to the head unit is compensated.

73. An exposure method in which an object is exposed with an energy beam, the method including:

mounting the object on a movable body that can move in at least first and second directions that are orthogonal to each other within a predetermined plane; and

driving the movable body within the predetermined plane, based on measurement information of an encoder system in which one of a grating section and a head unit is arranged on a surface of the movable body on which the object is mounted and the other of the grating section and the head unit is arranged facing the surface of the movable body, and which measures position information of the movable body in at least one of the first and second directions, so that a measurement error of the encoder system that occurs due to the head unit is compensated.

74. The exposure method according to any one of Claims 67 to 73, wherein

the object is exposed by the energy beam via a mask, and when the exposure is performed, the mask is moved so that a measurement error of the encoder system that occurs due to the head unit is compensated, while driving the movable body based on the measurement information of the encoder system.

75. The exposure method according to any one of Claims 55 to 74, wherein

the grating section is arranged extending in the first direction as a longitudinal direction, the head unit has a plurality of heads placed at different positions in the second direction, and the encoder system measures position information of the movable body by a head that faces the grating section out of the plurality of heads.

76. The exposure method according to any one of Claims 55 to 75, wherein

the grating section is arranged on a surface of the movable body, and the head unit is arranged facing the surface of the movable body.

77. The exposure method according to any one of Claims 55 to 76, wherein

by further using a measurement system that measures position information of the movable body in a third direction orthogonal to the predetermined plane by a sensor that faces the grating section out of a plurality of sensors placed on the same side as the head unit, a position of the movable body in the third direction is controlled based on measurement information of the measurement system.

78. The exposure method according to Claim 77, wherein

the measurement system measures position information in the third direction and inclination information of the movable

body by a plurality of sensors that face the grating section.

79. The exposure method according to one of Claims 77 and 78, wherein

out of position information of the movable body in directions of six degrees of freedom, position information in directions of three degrees of freedom including the first direction, the second direction and a rotation direction within the predetermined plane is measured by the encoder system, and position information in directions of the remaining three degrees of freedom is measured by the measurement system.

80. The exposure method according to Claim 79, wherein

a position of the movable body at least when performing an exposure operation is controlled based on the measured position information in directions of six degrees of freedom.

81. The exposure method according to any one of Claims 77 to 80, wherein

in addition to the encoder system and the measurement system, a position measurement device that measures position information of the object in the third direction is further used in a measurement operation of surface position information of the object.

82. The exposure method according to any one of Claims 77 to 81, wherein

the encoder system and a mark detection system that

detects a mark on the object are used in a detection operation of the mark.

83. The exposure method according to any one of Claims 55 to 82, wherein:

in order to drive the movable body, the measurement information of the encoder system is used in an exposure operation and measurement information of an interferometer system that measures position information of the movable body in at least the first and second directions is used in an operation different from the exposure operation.

84. The exposure method according to Claim 83, wherein

the measurement information of the encoder system is used in a detection operation of the mark and/or surface position information of the object.

85. The exposure method according to one of Claims 83 and 84, wherein

at least part of the measurement information of the interferometer system is used in the exposure operation.

86. A device manufacturing method including a lithography process, wherein

in the lithography process, a sensitive object is exposed and a pattern is formed on the sensitive object using the exposure method according to any one of Claims 55 to 85.

87. A decision-making method in which correction

information of a measurement value of an encoder system is decided, the encoder system having a head, which irradiates a detection light to a scale that is arranged on a movable body capable of moving substantially along a predetermined plane and that has a grating whose periodic direction is a predetermined direction within a plane parallel to the predetermined plane and which receives a reflected light from the scale, and measuring position information of the movable body in the predetermined direction, the method including:

a process of performing sampling of measurement results of the encoder system, in which an attitude of the movable body is changed to a plurality of different attitudes, the movable body is moved in a predetermined stroke range in a direction orthogonal to the predetermined plane while irradiating a detection light from the head to a specific area of the scale in a state where the attitude of the movable body is maintained, and the sampling of the measurement results is performed during the movement of the movable body with respect to each of the attitudes; and

a process of obtaining correction information of a measurement value of the encoder system in accordance with position information of the movable body in a direction different from the predetermined direction by performing a predetermined computation based on results of the sampling.

88. The decision-making method according to Claim 87, wherein

the attitude change of the movable body is performed with respect to at least one of rotation within a plane parallel

to the predetermined plane and inclination in the predetermined direction.

89. A decision-making method in which correction information of a measurement value of an encoder system equipped with a head unit is decided, the head unit having a plurality of heads each of which irradiates a detection light to a scale, which is arranged on a movable body capable of moving substantially along a predetermined plane and whose periodic direction is a predetermined direction within a plane parallel to the predetermined plane, and receives a reflected light from the scale, and constituting a plurality of encoders each of which measures position information of the movable body in the predetermined direction, the method including:

a process of performing, to each of the plurality of heads, changing of an attitude of the movable body to a plurality of different attitudes, moving of the movable body in a predetermined stroke range in a direction orthogonal to the predetermined plane while irradiating a detection light from a subject head to a specific area of the scale in a state where the attitude of the movable body is maintained, and sampling of measurement results of the encoder constituted by the subject head during the movement with respect to each of the attitudes; and

a process of obtaining correction information of a measurement value of each of the plurality of encoders in accordance with position information of the movable body in a direction different from the predetermined direction by performing a predetermined computation based on results of

the sampling.

CLAIMS

1. A movable body drive system that drives a movable body along a predetermined plane, the system comprising:

an encoder system that has a plurality of heads that each irradiates a detection beam to a scale, the scale being parallel to the predetermined plane and having a grating, and receives a reflected beam from the scale, the encoder system measuring first position information of the movable body in a predetermined direction using one or more heads of the plurality of heads; and

a drive system that drives the movable body in the predetermined direction based on the first position information and correction information of a measurement error of the encoder system, the measurement error of the encoder system being caused by a relative motion of the head and the scale in a direction different from the predetermined direction, wherein second position information of the movable body that shows the relative motion is measured at the time of the measurement of the first position information, wherein

the one or more heads used in the measurement of the first position information are at least partially switched to another head of the plurality of heads according to movement of the movable body in the predetermined plane.

2. The movable body drive system according to claim 1,

wherein

the scale is placed on a surface of the movable body that is substantially parallel to the predetermined plane, and each of the plurality of heads is placed outside the movable body, facing the scale.

3. The movable body drive system according to claim 1, wherein

the second position information includes position information of the movable body in at least one direction out of a direction orthogonal to the predetermined plane, a rotation direction within a plane parallel to the predetermined plane and a rotation direction around an axis in a direction orthogonal to the predetermined direction within a plane parallel to the predetermined plane.

4. The movable body drive system according to Claim I, further comprising:

a storage unit in which the correction information is stored, wherein

the drive system obtains the correction information based on the second position information of the movable body and information stored in the storage unit, at the time of measurement of the first position information of the movable body using the encoder system.

5. The movable body drive system according to claim 4, wherein

the correction information with respect to each of the plurality of heads is stored in the storage unit, and

the drive system obtains the correction information with respect to each of the plurality of heads, based on the second position information of the movable body and the information stored in the storage unit.

6. The movable body drive system according to claim 1, wherein

the scale includes a first scale that has a grating whose periodic direction is a first direction within a plane parallel to the predetermined plane, and a second scale that has a grating whose periodic direction is a second direction that intersects the first direction within the plane parallel to the predetermined plane, and

the encoder system includes a plurality of first heads placed at different positions in the second direction and a plurality of second heads placed at different positions in the first direction, and measures position information of the movable body in the first direction by at least one of the plurality of first heads that faces the first scale and measures position information of the movable body in the second direction by at least one of the plurality of second heads that faces the second scale.

7. The movable body drive system according to claim 1, further comprising:

a measurement unit that measures the second position information of the movable body.

8. The movable body drive system according to claim 7, wherein

the measurement unit includes an interferometer that measures the second position information of the movable body by irradiating one, or two or more measurement beams to at least one reflection surface arranged at the movable body.

9. The movable body drive system according to claim 7, further comprising:

a controller that obtains the correction information of a subject head, by changing an attitude of the movable body to a plurality of different attitudes, moving the movable body in a predetermined stroke range in a direction orthogonal to the predetermined plane while irradiating a detection beam from the subject head to a specific area of the scale in a state where the attitude of the movable body is maintained based on measurement results of the measurement unit and performing sampling of measurement results of the head during the movement with respect to each of the attitudes, and performing a predetermined computation based on results of the sampling.

10. The movable body drive system according to claim 9, wherein

when obtaining the correction information for a plurality of heads that correspond to the same scale, the controller obtains the correction information of a subject head taking into consideration a geometric error that occurs due to gradient of the subject head.

11. A pattern formation apparatus, comprising:

a movable body on which an object is mounted and which can move substantially along a moving plane, holding the object;

a patterning unit that generates a pattern on the object; and

the movable body drive system according to claim 1 that drives the movable body for pattern formation on the object.

12. An exposure apparatus that forms a pattern on an object by irradiation of an energy beam, the apparatus comprising:

a patterning unit that irradiates the energy beam to the object; and

the movable body drive system according to claim 1, wherein

driving of the movable body on which the object is mounted by the movable body drive system is performed for relative movement of the energy beam and the object.

13. The movable body drive system according to claim 1, wherein

the grating is a two-dimensional grating with periodic directions in two directions orthogonal to each other.

14. The movable body drive system according to claim 1, wherein

the predetermined direction is one of a direction parallel to the predetermined plane and a direction perpendicular to the predetermined plane.

15. A movable body drive method in which a movable body is driven along a predetermined plane, the method comprising:

measuring first position information of the movable body in a predetermined direction using an encoder system that has a plurality of heads that each irradiates a detection beam to a scale, the scale being parallel to the predetermined plane and having a grating, and receives a reflected beam from the scale, and

driving the movable body in the predetermined direction based on the first position information and correction information of a measurement error of the encoder system, the measurement error of the encoder system being caused by a relative motion of the head and the scale in a direction different from the predetermined direction, wherein second position information of the movable body that shows the relative motion is measured

at the time of the measurement of the first position information, wherein

one or more heads of the plurality of heads are used in the measurement of the first position information, and the one or more heads are at least partially switched to another head of the plurality of heads according to movement of the movable body in the predetermined plane.

16. The movable body drive method according to claim 15, wherein

the scale is placed on a surface of the movable body that is substantially parallel to the predetermined plane, and each of the plurality of heads is placed outside the movable body, facing the scale.

17. The movable body drive method according to claim 15, wherein

the second position information of the movable body includes position information of the movable body in at least one direction out of a direction orthogonal to the predetermined plane, a rotation direction within a plane parallel to the predetermined plane and a rotation direction around an axis in a direction orthogonal to the predetermined direction within a plane parallel to the predetermined plane.

18. The movable body drive method according to claim 15,

wherein:

in the process of measuring and driving, the correction information is obtained with respect to each of the plurality of heads based on the second position information of the movable body, and the movable body is driven based on a result of correcting a measurement value of each of the plurality of heads using the correction information of each of the plurality of heads respectively.

19. The movable body drive method according to claim 15, wherein

the scale includes a first scale that has a grating whose periodic direction is a first direction within a plane parallel to the predetermined plane, and a second scale that has a grating whose periodic direction is a second direction that intersects the first direction within a plane parallel to the predetermined plane, and

the encoder system includes a plurality of first heads placed at different positions in the second direction and a plurality of second heads placed at different positions in the first direction, and measures position information of the movable body in the first direction by at least one of the plurality of first heads that faces the first scale and measures position information of the movable body in the second direction by at least one of the plurality of second heads that faces the second scale.

20. The movable body drive method according to claim 19, wherein

the first scale and the second scale are placed on a surface of the movable body that is substantially parallel to the predetermined plane, and the first heads and the second heads are placed outside the movable body, facing the scales.

21. The movable body drive method according to claim 15, further comprising:

obtaining the correction information of a subject head, prior to the process of measuring and driving, by changing an attitude of the movable body to a plurality of different attitudes,

moving the movable body in a predetermined stroke range in a direction orthogonal to the predetermined plane while irradiating a detection beam from the subject head to a specific area of the scale in a state where the attitude of the movable body is maintained,

performing sampling of measurement results of the head during the movement with respect to each of the attitudes, and

performing a predetermined computation based on results of the sampling.

22. The movable body drive method according to claim 21, wherein

in the process of obtaining the correction information,

when obtaining the correction information for a plurality of heads that correspond to the same scale, the correction information of a subject head is obtained taking into consideration a geometric error that occurs due to gradient of the subject head.

23. A pattern formation method, comprising:

a process of mounting an object on a movable body that can move within a moving plane; and

a process of driving the movable body in the movable body drive method according to claim 15 in order to form a pattern on the object.

24. A device manufacturing method including a pattern formation process, wherein

in the pattern formation process, a pattern is formed on a substrate using the pattern formation method according to claim 23.

25. An exposure method in which a pattern is formed on an object by irradiation of an energy beam, the method comprising:

driving a movable body on which the object is mounted, using the movable body drive method according to claim 15, for relative movement of the energy beam and the object.

26. The movable body drive method according to claim 15, wherein

the grating is a two-dimensional grating with periodic directions in two directions orthogonal to each other.

27. The movable body drive method according to claim 15, wherein

the predetermined direction is one of a direction parallel to the predetermined plane and a direction perpendicular to the predetermined plane.