CLAIMS

1 A measurement fixture for use in determining the position and orientation of an object, the fixture mountable in use in a fixed spatial relationship with the object and comprising a plurality of optically-detectable elements that in use can be detected by an optical measuring device remote from the measurement fixture; characterised in that the optically-detectable elements are distributed around the measurement fixture such that in use at least three reference points are within the field of view of the optical measuring device for all positions and orientations of the object.

2 A measurement fixture as claimed in claim 1, in which in use the object is modified by a tool, and in which the geometry of the measurement fixture is arranged to permit unobstructed access of the tool to the object in use.

3 A measurement fixture as claimed in claim 1 or claim 2, in which in use the object is subjected to a machining operation.

4 A measurement fixture as claimed in claim 2 or claim 3, in which the measurement fixture is mounted in use at one end of the object.

5 A measurement fixture as claimed in any one of the preceding claims, the fixture comprising a base and a plurality of projections extending from the base, in which the optically-detectable elements are located on the projections.

6 A measurement fixture as claimed in any one of the preceding claims, in which the projections extend from the base generally perpendicularly to the plane of the base.

7 A measurement fixture as claimed in claim 5 or claim 6, in which in use the base extends around the object at least 180°.

8 A measurement fixture as claimed in any one of claims 5 to 7, in which the optically-detectable elements are equally spaced around the projections in at least three positions.

9 A measurement fixture as claimed in any one of claims 5 to 8, in which the projections comprise prisms whose bases have at least three sides.

10 A measurement fixture as claimed in claim 9, in which the ends of the projections comprise pyramids and in which optically-detectable elements are located on the faces of the pyramids.

11 A measurement fixture as claimed in any one of the preceding claims, in which the optically-detectable elements are intermittently illuminated in use.

12 A measurement fixture as claimed in any one of the preceding claims, in which the optically-detectable elements are light-emitting diodes.

13 A measurement fixture for use in determining the position and orientation of an object, the fixture comprising a substantially planar circular base mountable in use in a fixed spatial relationship with the object and a plurality of projections mounted on the base and extending in a direction substantially perpendicular to the plane of the base, the projections having a substantially square cross-section, the fixture further comprising a plurality of light-emitting diodes spaced apart on the sides and ends of each projection.

14 A measurement fixture substantially as described in this specification, with reference to and as shown in the accompanying drawings.

15 A measurement system for use in determining the position and orientation of an object, the system comprising the following elements:
a measurement fixture mountable in use in a fixed spatial relationship with the object and comprising a plurality of optically-detectable elements;
an optical measuring device remote from the measurement fixture;
characterised in that the optically-detectable elements are distributed around the measurement fixture such that in use at least three reference points are within the field of view of the optical measuring device for all positions and orientations of the measurement fixture.

16 A measurement system substantially as described in this specification, with reference to and as shoen in the accompanying drawings.

17 A method of determining the position and orientation of an object relative to a reference, comprising the steps of:
mounting the object in a fixed spatial relationship with a measurement fixture, the measurement fixture having a plurality of optically detectable elements;
detecting the positions of at least some of the elements;

detecting the position and orientation of the reference;

comparing the detected positions to determine the position and orientation of the measurement fixture relative to the reference.

18 A method as claimed in claim 17, and further comprising the step of:

if the determined position and orientation differ from a predetermined desired position and orientation, applying a correction to the position and orientation.

19 A method of determining the position and orientation of an object relative to a reference substantially as described in this specification, with reference to and as shown in the accompanying drawings.

CLAIMS

1 A measurement fixture (24) for use in determining the position and orientation of an object (22), the fixture mountable in use in a fixed spatial relationship with the object and comprising a plurality of optically-detectable elements (42, 44) that in use can be detected by an optical measuring device (50) remote from the measurement fixture; characterised in that the optically-detectable elements are distributed around the measurement fixture such that in use at least three reference points are within the field of view of the optical measuring device for all positions and orientations of the object.

2 A measurement fixture as claimed in claim 1, in which in use the object is modified by a tool (30), and in which the geometry of the measurement fixture is arranged to permit unobstructed access of the tool to the object in use.

3 A measurement fixture as claimed in claim 1 or claim 2, in which in use the object is subjected to a machining operation.

4 A measurement fixture as claimed in claim 2 or claim 3, in which the measurement fixture is mounted in use at one end of the object.

5 A measurement fixture as claimed in any one of the preceding claims, the fixture comprising a base (34) and a plurality of projections (36) extending from the base, in which the optically-detectable elements are located on the projections.

6 A measurement fixture as claimed in any one of the preceding claims, in which the projections extend from the base generally perpendicularly to the plane of the base.

7 A measurement fixture as claimed in claim 5 or claim 6, in which in use the base extends around the object at least 180°.

8 A measurement fixture as claimed in any one of claims 5 to 7, in which the optically-detectable elements are equally spaced around the projections in at least three positions.

9 A measurement fixture as claimed in any one of claims 5 to 8, in which the ends of the projections comprise pyramids and in which optically-detectable elements are located on the faces of the pyramids.

10 A measurement fixture as claimed in any one of the preceding claims, in which the optically-detectable elements are intermittently illuminated in use.

11 A measurement fixture as claimed in any one of the preceding claims, in which the optically-detectable elements are light-emitting diodes.

12 A measurement fixture for use in determining the position and orientation of an object, the fixture comprising a substantially planar circular base mountable in use in a fixed spatial relationship with the object and a plurality of projections mounted on the base and extending in a direction substantially perpendicular to the plane of the base, the projections having a substantially square cross-section, the fixture further comprising a plurality of light-emitting diodes spaced apart on the sides and ends of each projection.

13 A measurement system for use in determining the position and orientation of an object (22), the system comprising the following elements:
a measurement fixture (24) mountable in use in a fixed spatial relationship with the object and comprising a plurality of optically-detectable elements (42, 44);
an optical measuring device (50) remote from the measurement fixture;
characterised in that the optically-detectable elements are distributed around the measurement fixture such that in use at least three reference points are within the field of view of the optical measuring device for all positions and orientations of the measurement fixture.

14 A method of determining the position and orientation of an object (22) relative to a reference, comprising the steps of:
mounting the object in a fixed spatial relationship with a measurement fixture (24), the measurement fixture having a plurality of optically detectable elements (42, 44);
detecting the positions of at least some of the elements;
detecting the position and orientation of the reference;
comparing the detected positions to determine the position and orientation of the measurement fixture relative to the reference.

15 A method as claimed in claim 14, and further comprising the step of:
if the determined position and orientation differ from a predetermined desired position and orientation, applying a correction to the position and orientation.