

WHAT IS CLAIMED IS:

1. An optical phase profilometry system, comprising:
 - a first operative coaxial camera-projector pair aligned at a first angle relative to a target surface that projects a first illumination on the target surface;
 - a second operative coaxial camera-projector pair aligned at a second angle relative to the target surface that projects a second illumination on the target surface;
 - wherein the first and second angles are equal and opposite to one another relative to the target surface such that the second operative coaxial camera-projector pair is configured to capture a first reflection from the first illumination and the first operative coaxial camera projector-pair is configured to capture a second reflection from the second illumination;
 - and
 - a controller configured to, based on the captured first and second reflections, generate a first and second estimation, each estimation comprising a respective point cloud of the target surface, and iteratively refine erroneous points in the first and second point clouds by moving each erroneous point in one point cloud toward a corresponding erroneous point in the other point cloud along the respective erroneous point's reflection ray, combine them, the controller being configured to merge the iteratively refined first and second point clouds to generate a dimensional profile of the target surface.
2. The optical phase profilometry system of claim 1 wherein the combination of the first and second estimations of the target surface is configured to reduce measurement errors caused by specular glints.
3. The optical phase profilometry system of claim 1 wherein the combination of the first and second estimations of the target surface is configured to reduce measurement errors caused by reflectance gradients of the target surface.

4. The optical phase profilometry system of claim 1 wherein the combination of the first and second estimations of the target surface is configured to reduce measurement errors caused by a tilt of the target surface.
5. The optical phase profilometry system of claim 1 wherein at least one of the first or second operative coaxial camera-projector pairs comprises a prism assembly configured to and oriented so as to reduce a tilt of a plane of best focus of the target surface.
6. The optical phase profilometry system of claim 5 wherein the prism assembly comprises a plurality of wedge prisms, wherein at least one of the plurality of wedge prisms has a wedge apex angle in a different direction than at least one of the other wedge prisms.

7. The optical phase profilometry system of claim 6 wherein the plurality of wedge prisms comprises a first, second and third wedge prism, each having a wedge apex angle, wherein the first wedge prism's wedge apex angle is towards a first direction and the second and third wedge prisms' wedge apex angles are towards a second direction.
8. The optical phase profilometry system of claim 7 wherein at least one of the plurality of wedge prisms comprises a different type of glass than at least one of the other wedge prisms.
9. The optical phase profilometry system of claim 1 wherein at least one of the first or second operative coaxial camera-projector pairs comprises a digital light processing (DLP) projector system.
10. The optical phase profilometry system of claim 9 wherein the DLP projector system comprises an optical low-pass filter (OLPF).
11. The optical phase profilometry system of claim 10 wherein the OLPF comprises at least one layer of birefringent material.
12. The optical phase profilometry system of claim 11 wherein OLPF comprises:
 - a first quartz wave plate;
 - a first quarter wave retarder;
 - a second quartz wave plate; and
 - a second quarter wave retarder.
13. The optical phase profilometry system of claim 12 wherein the first and second operative coaxial camera-projector pairs comprise telecentric lens assemblies.
14. The optical phase profilometry system of claim 13 wherein numerical apertures of the first and second coaxial camera-projector pairs are equivalent.
15. An optical phase profilometry system, comprising:
 - a first operative coaxial camera-projector pair aligned at a perpendicular point of view relative to a surface target that projects a first illumination on to the target surface;
 - a second operative coaxial camera-projector pair aligned at a first oblique angle relative to the first operative coaxial camera-projector pair and the surface target that projects a second illumination on to the target surface;

a third operative coaxial camera-projector pair aligned at a second oblique angle relative to the first operative coaxial camera-projector pair and the surface target that projects a third illumination on to the target surface;

wherein the first and second oblique angles are equal and opposite to one another relative to the first operative coaxial pair such that the third operative coaxial camera-projector pair is configured to receive a first specular reflection from the second illumination and the second operative coaxial camera-projector pair is configured to receive a second specular reflection from the third illumination; and

a controller configured to, based on the received first and second specular reflections, generate a first and second estimation, each estimation comprising a respective point cloud of the target surface, and iteratively refine erroneous points in the first and second point clouds by moving each erroneous point in one point cloud toward a corresponding erroneous point in the other point cloud along the respective erroneous point's reflection ray, ~~combine them~~ the controller being configured to merge the iteratively refined first and second point clouds to generate a dimensional profile of the target surface.

16. The optical phase profilometry system of claim 15 wherein the combination of the first and second estimations is configured to reduce measurement errors caused by specular glints.

17. The optical phase profilometry system of claim 15 wherein the combination of the first and second estimations is configured to reduce measurement errors caused by reflectance gradients of the target surface.

18. The optical phase profilometry system of claim 15 wherein the combination of the first and second estimations is configured to reduce measurement errors caused by a tilt of the target surface.

19. The optical phase profilometry system of claim 15 wherein the first operative coaxial camera-projector pair is configured to receive a first diffuse reflection from the second illumination and a second diffuse reflection from the third illumination.

20. The optical phase profilometry system of claim 19 wherein at least one of the second or third operative coaxial camera-projector pairs comprises a prism assembly configured to and oriented so as to reduce a tilt of a plane of best focus of the target surface.
21. The optical phase profilometry system of claim 20 wherein each the prism assembly comprises a plurality of wedge prisms, wherein at least one of the plurality of wedge prisms has a wedge apex angle in a different direction than at least one of the other wedge prisms.

22. The optical phase profilometry system of claim 21 wherein the plurality of wedge prisms comprises a first, second and third wedge prism, each having a wedge apex angle, wherein the first wedge prism's wedge apex angle is towards a first direction and the second and third wedge prisms' wedge apex angles are towards a second direction.
23. The optical phase profilometry system of claim 22 wherein at least one of the plurality of wedge prisms comprises a different type of glass than at least one of the other wedge prisms.
24. The optical phase profilometry system of claim 23 wherein at least one of the first, second or third operative coaxial camera-projector pairs comprises a digital light processing (DLP) projector system having an optical low-pass filter (OLPF) comprising at least one layer of birefringent material.
25. The optical phase profilometry system of claim 24 wherein the OLPF comprises:
a first quartz wave plate;
a first quarter wave retarder;
a second quartz wave plate; and
a second quarter wave retarder.
26. The optical phase profilometry system of claim 15 wherein numerical apertures of the first, second and third operative coaxial camera-projector pairs are equivalent.
27. The optical phase profilometry system of claim 15 wherein the controller is configured to generate control signals to operate the optical phase profilometry system with an interlaced timing sequence.
28. The optical phase profilometry system of claim 15 wherein the first, second and third operative coaxial camera-projector pairs comprise telecentric lens assemblies.
29. An optical phase profilometry system, comprising:
a first operative coaxial camera-projector pair aligned at a perpendicular point of view relative to a surface target;
a second operative coaxial camera-projector pair aligned at a first oblique angle relative to the first operative coaxial camera-projector pair and the surface target;

a third operative coaxial camera-projector pair aligned at a second oblique angle relative to the first operative coaxial camera-projector pair and the surface target;~~and~~

wherein the alignment of the first operative coaxial camera-projector pair and the second operative coaxial camera-projector pair relative to each other form a first and second counterposed channel, the alignment of the first operative coaxial camera-projector pair and the third operative coaxial camera-projector pair form a third and fourth counterposed channel, and the alignment of the second operative coaxial camera-projector pair and the third operative coaxial camera-projector pair form a fifth and sixth counterposed channel;and

a controller coupled to the first, second and third operative camera-projector pairs, the controller being configured to, based on received reflections, generate a first and second estimation, each estimation comprising a respective point cloud of the target surface, and iteratively refine erroneous points in the first and second point clouds by moving each erroneous point in one point cloud toward a corresponding erroneous point in the other point cloud along the respective erroneous point's reflection ray, the controller being configured to merge the iteratively refined first and second point clouds to generate a dimensional profile of the target surface.

30. The optical phase profilometry system of claim 29 wherein the first and second oblique angles are equal and opposite to one another relative to the target surface and the first operative coaxial camera-projector pair and wherein the second and third operative coaxial camera-projector pairs are configured to receive specular reflections from the target surface.

31. The optical phase profilometry system of claim 30 wherein:
the first, second and third operative coaxial camera-projector pairs generate first, second, and third estimations of the target surface; and
a controller configured to receive the first, second and third estimations of the target

surface and combine them to generate a dimensional profile of the target surface.

32. The optical phase profilometry system of claim 31 wherein the combination of the first, second and third estimations of the target surface is configured to reduce measurement error caused by a tilt of the target surface.

33. An optical phase profilometry system, comprising:
a first operative coaxial camera-projector pair aligned at a first angle relative to a
target surface that projects a first illumination on the target surface;
a second operative coaxial camera-projector pair aligned at a second angle
relative to the target surface that projects a second illumination on the target
surface;
wherein the second operative coaxial camera-projector pair is configured to capture
a first reflection from the first illumination and the first operative coaxial
camera projector-pair is configured to capture a second reflection from the
second illumination; and
a controller configured to, based on the captured first and second reflections,
generate a first and second estimation, each estimation comprising a
respective point cloud of the target surface, and iteratively refine erroneous
points in the first and second point clouds by moving each erroneous point
in one point cloud toward a corresponding erroneous point in the other point
cloud along a respective erroneous point's reflection ray, the controller
being configured to merge the iteratively refined first and second point
clouds to generate a dimensional profile of the target surface.