

WHAT IS CLAIMED IS:

1. A method of determining dimensional information of a target surface, comprising:
generating a first point cloud corresponding to a first plurality of reconstructed surface points of the target surface generated by a first imaging system-illumination source pair of a phase profilometry system having a first counterposed channel;
generating a second point cloud corresponding to a second plurality of reconstructed surface points of the target surface generated by a second imaging system-illumination source pair of the phase profilometry system having a second counterposed channel;
~~generating an initial estimate of the target surface based on the first and second point clouds~~
dividing a volume, corresponding to the target surface, into a set of voxels;
adding, for each reconstructed surface point in the first and second point clouds, the surface point's signed distance function (SDF) and corresponding weights to the set of voxels along an imaging system ray of each reconstructed surface point in the first and second point clouds;
identifying a level set of the SDFs for the first and second point clouds; and
~~refining the initial surface estimate using positions of the first and second point clouds~~
generating a final point cloud based on the first and second plurality of reconstructed surface points, the level set of SDFs, and geometry of the first and second imaging system-illumination source pairs ~~to generate a final point cloud~~.
2. The method of claim 1 wherein said refining of the initial surface estimate reduces measurement errors caused by specular glints.
3. The method of claim 1 wherein said refining of the initial surface estimate reduces measurement errors caused by reflection gradients of the target surface.
4. The method of claim 1 wherein said refining of the initial surface estimate reduces measurement errors caused by a tilt of the target surface.
5. ~~The method of claim 1 wherein generating the initial surface estimate comprises:~~

dividing a volume, corresponding to the target surface, into a set of voxels;
 adding, for each reconstructed surface point in the first and second point clouds, the
 surface point's signed distance function (SDF) and corresponding weights to the
 set of voxels along an imaging system ray of each reconstructed surface point in
 the first and second point clouds; and
 identifying a level set of the SDFs for the first and second point clouds.

6. — The method of claim 5 wherein the first imaging system illumination source pair
 comprises a first counterposed channel and the second imaging system illumination source pair
 comprises a second counterposed channel.

7. The method of claim 6 wherein the first imaging system-illumination source pair
 comprises a first camera from a first operative coaxial camera-projector pair and a first projector
 from a second operative coaxial camera-projector pair and the second imaging system-
 illumination source pair comprises a second camera from the second operative coaxial camera-
 projector pair and a second projector from the first operative coaxial camera-projector pair.

8. The method of claim 7 wherein at least one of the first or second operative coaxial
 camera-projector pairs is aligned at an oblique angle relative to the target surface and target
 surface normal.

9. The method of claim 8 wherein at least one of the first or second operative coaxial
 camera-projector pairs is aligned substantially perpendicularly relative to the target surface.

10. — A method of merging point clouds, comprising:
 generating reconstructed surface points in a first counterposed channel's point cloud;
 generating reconstructed surface points in a second counterposed channel's point cloud;
 identifying, for a selected reconstructed surface point in the first counterposed channel's
 point cloud, reconstructed surface points in the second counterposed channel's
 point cloud that are near an imaging system ray for the selected reconstructed
 surface point in the first counterposed channel's point cloud;

calculating a projection of each of the identified near points in the second counterposed channel's point cloud onto the imaging system ray for the selected reconstructed surface point in the first counterposed channel's point cloud;
 calculating an average projection of each of the identified near points in the second counterposed channel's point cloud onto the imaging system ray of the selected reconstructed surface point in the second counterposed channel's point cloud; and
 moving the selected reconstructed surface point in the first counterposed channel's point cloud along its imaging system ray a portion of the distance towards the calculated average projection of each of the identified near point in the second counterposed channel's point cloud.

11. — The method of claim 10 said moving of the reconstructed surface point in the first counterposed channel is configured to reduce at least one of the following measurement errors:
 specular glint measurement error;
 reflectance gradient measurement error; or
 target surface tilt measurement error.

12. — The method of claim 10 and further comprising:
 identifying, for a selected reconstructed surface point in the second counterposed channel's point cloud, reconstructed surface points in the first counterposed channel's point cloud that are near an imaging system ray for the selected reconstructed surface point in the second counterposed channel's point cloud;
 calculating a projection of each of the identified near points in the first counterposed channel's point cloud onto the imaging system ray for the selected reconstructed surface point in the second counterposed channel's point cloud;
 calculating an average projection of each of the identified near points in the first counterposed channel's point cloud onto the imaging system ray of the selected reconstructed surface point in the second counterposed channel's point cloud; and
 moving the selected reconstructed surface point in the second counterposed channel's point cloud along its imaging system ray a portion of a distance towards the

calculated average projection of each of the identified near points in the first counterposed channel's point cloud.

13.—~~The method of claim 12 wherein said moving of the selected reconstructed surface points in the first and second counterposed channels' point clouds is configured to reduce measurement errors caused by specular glints.~~

14.—~~The method of claim 12 wherein said moving of the selected reconstructed surface points in the first and second counterposed channels' point clouds is configured to reduce measurement errors caused by reflectance gradients of a target surface.~~

15.—~~The method of claim 12 wherein said moving of the selected reconstructed surface points in the first and second counterposed channels' point clouds is configured to reduce measurement errors caused by a tilt of a target surface.~~

16.—~~The method of claim 12 wherein the first counterposed channel comprises a first projector of a first operative coaxial imaging system illumination source pair and a first camera of a second operative coaxial imaging system illumination source pair and the second counterposed channel comprises a second projector of the second operative coaxial imaging system illumination source pair and a second camera of the first operative coaxial imaging system illumination source pair.~~

17.—~~The method of claim 16, wherein at least one of the first or second operative coaxial imaging system illumination source pairs are aligned at an oblique angle relative to the target surface and target surface normal.~~

18.—~~The method of claim 17, wherein at least one of the first or second operative coaxial imaging system illumination source pairs are aligned substantially perpendicularly relative to the target surface.~~

19.—A method of merging point clouds, comprising

~~generating, with a first counterposed channel, a first point cloud having a first plurality of surface points corresponding to a target surface;~~
~~generating, with a second counterposed channel, a second point cloud having a second plurality of surface points corresponding to the target surface;~~
~~determining first and second non-empty portions corresponding to each the first and second point clouds;~~
~~identifying a transformation for each the first and second point clouds;~~
~~determining the relative error for each the first and second point clouds based on the identified transformation;~~
~~subtracting the relative error from each the first and second point clouds;~~
~~aligning the first and second point clouds in the first and second non-empty portions; and~~
~~generating a dimensional profile of the target surface based on the alignment.~~

20. — ~~The method of claim 19 wherein determining the relative error for each the first and second point cloud comprises:~~

~~determining if the time since the most recent relative error was calculated is beyond a threshold, and where the time exceeds the threshold calculating a relative error average based on the most recent relative error and a newly determined relative error.~~