

WHAT IS CLAIMED IS:

1. A system for positioning a vehicle, comprising:
 - a communication interface configured to receive a set of point cloud data with respect to a scene captured under a first lighting condition by at least one sensor;
 - a storage configured to store the set of point cloud data; and
 - a processor configured to:
 - identify at least one local light source based on the set of point cloud data;
 - modify the set of point cloud data based on a simulated light from the at least one local light source corresponding to a second lighting condition; and
 - position the vehicle under the second lighting condition based on the modified set of point cloud data.
2. The system of claim 1, wherein the communication interface is configured to receive an image with respect to the scene captured by an imaging sensor under the second lighting condition, and wherein the processor is further configured to:
 - generate an estimated image based on the modified set of point cloud data; and
 - position the vehicle under the second lighting condition by comparing the estimated image with the captured image.
3. The system of claim 2, wherein the communication interface is further configured to receive a last position of the vehicle, and wherein the processor is further configured to estimate current pose information of the vehicle based on the last position of the vehicle.
4. The system of claim 3, wherein the processor is further configured to locate point cloud data corresponding to the current pose information of the vehicle among the modified set of point cloud data.
5. The system of claim 2, wherein to generate the estimated image, the processor is further configured to simulate illumination of the identified local light source as it would have illuminated under the second lighting condition.
6. The system of claim 2, wherein comparing the estimated image and the captured image includes calculating an information distance between the estimated image and the captured image.

7. The system of claim 1, wherein the second lighting condition includes less illumination than the first lighting condition.

8. The system of claim 1, wherein to modify the set of point cloud data, the processor is further configured to:

determine a depth map by projecting the simulated light from the identified local light source on the set of point cloud data; and

determine at least one shadow area and at least one semi-shadow area based on the depth map.

9. The system of claim 8, wherein to modify the set of point cloud data, the processor is further configured to shade the set of point cloud data using illuminations calculated based on the at least one shadow area and the at least one semi-shadow area.

10. A method for positioning a vehicle, comprising:

receiving a set of point cloud data with respect to a scene captured under a first lighting condition by at least one sensor;

identifying at least one local light source based on the set of point cloud data;

modifying the set of point cloud data based on a simulated light from the at least one local light source corresponding to a second lighting condition; and

positioning the vehicle under the second lighting condition based on the modified set of point cloud data.

11. The method of claim 10, further comprising:

receiving an image with respect to the scene captured by an imaging sensor under the second lighting condition;

generating an estimated image based on the modified set of point cloud data; and

positioning the vehicle under the second lighting condition by comparing the estimated image with the captured image.

12. The method of claim 11, further comprising:

receiving a last position of the vehicle; and

estimating current pose information of the vehicle based on the last position of the vehicle.

13. The method of claim 11, wherein comparing the estimated image with the captured image includes calculating an information distance between the estimated image and the captured image.

14. The method of claim 10, wherein modifying the set of point cloud data further includes:
determining a depth map by projecting the simulated light from the identified local light source on the set of point cloud data; and
determining at least one shadow area and at least one semi-shadow area based on the depth map.

15. The method of claim 14, wherein modifying the set of point cloud data further includes shading the set of point cloud data using illuminations calculated based on the at least one shadow area and the at least one semi-shadow area.

16. A non-transitory computer-readable medium having instructions stored thereon that, when executed by one or more processors, causes the one or more processors to perform a method for positioning a vehicle, the method comprising:
receiving a set of point cloud data with respect to a scene captured under a first lighting condition by at least one sensor;
identifying at least one local light source based on the set of point cloud data;
modifying the set of point cloud data based on simulated light from the at least one local light source corresponding to a second lighting condition; and
positioning the vehicle under the second lighting condition based on the modified set of point cloud data.

17. The computer-readable medium of claim 16, wherein the method further comprises:
receiving an image with respect to the scene captured by a camera under the second lighting condition;
generating an estimated image based on the modified set of point cloud data; and
positioning the vehicle under the second lighting condition by comparing the estimated image with the captured image.

18. The computer-readable medium of claim 17, wherein the method further comprises:
receiving a last position of the vehicle; and

estimating current pose information of the vehicle based on the last position of the vehicle.

19. The computer-readable medium of claim 17, wherein comparing the estimated image with the captured image includes calculating an information distance between the estimated image and the captured image.

20. The computer-readable medium of claim 16, wherein modifying the set of point cloud data further includes:

- determining a depth map by project the simulated light from the identified local light source on the set of point cloud data; and

- determining at least one shadow area and at least one semi-shadow area based on the depth map.