

CLAIMS

1. A computer implemented method of autonomously maneuvering a vehicle during a point-turn, the method comprising:

operating a scanning device from onboard the vehicle for scanning an area around the vehicle in a plurality of directions and generating real-time scanning output data;

operating a processing unit comprising at least one processing circuitry operatively connected to the scanning device, for:

generating, based on the real-time scanning output data, a range map including K set(s) of real-time range values, wherein $K \geq 1$; each set comprising a plurality of real-time range values, each range value in the set is determined from a given rotation-point of the vehicle towards a certain direction; each set of real-time range values having a corresponding set comprising a plurality of vehicle-contour range values; each vehicle-contour range value in the corresponding set is determined from the given rotation-point to the perimeter of the vehicle in a respective direction;

for each set of the K sets:

determining differences between real-time range values in the set and corresponding vehicle-contour range values in a corresponding set;

determining, based on the differences, conditions for executing a point-turn that avoids collision with nearby objects; and

generating a point-turn command for causing the vehicle to execute a point-turn according to the point-turn conditions.

2. The method of claim 1 further comprising executing the point turn command and causing the vehicle to turn accordingly.

3. The method of claim 1, wherein $K = 1$ and the rotation point are located at the center of a driving symmetry axis of the vehicle.

4. The method of claim 1, wherein $K > 1$, and determining conditions for executing a point-turn further comprises:

determining a selected rotation point from a plurality (K) of possible rotation points along a driving symmetry axis of the vehicle.

5. The method of claim 1, wherein the point-turn command includes data indicating a first velocity of a first driving element on a first side of the vehicle, and a second velocity of a second driving element on a second side of the vehicle during the point-turn; the method further comprising:

determining the first velocity and the second velocity according to the selected rotation point and its distance from the first driving element and the left driving element.

6. The method of any one of the preceding claims further comprising retrieving from a computer storage device on-board the vehicle one or more corresponding sets of vehicle-contour range values measured from a certain point along the driving symmetry axis of the vehicle. ,.

7. The method of any one of the preceding claims, wherein the conditions include a point-turn direction and range.

8. The method of any one of the preceding claims, wherein each set of real-time range values, and its corresponding set of vehicle-contour range values, include range values corresponding to the same angles.

9. The method of any one of the preceding claims, wherein each of the K sets of real-time range values and their corresponding sets of vehicle-contour range values are plotted in a first histogram and a second histogram, respectively; and wherein determining differences between real-time range values in the set and corresponding vehicle-contour range values in a corresponding set, is executed by

shifting between relative positions of the first histogram and second histogram and comparing values in the two histograms, in different relative positions.

10. The method of any one of the preceding claims, further comprising: determining one or more sets of vehicle-contour range values based on scanning device readings reflected from the perimeter of the vehicle.

11. The method of any one of claims 1-9, further comprising: determining one or more sets of vehicle-contour range values based on image processing of a top-view image of the vehicle.

12. The method of any one of the preceding claims further comprising:
while the vehicle is travelling, updating the vehicle-contour range values.

13. The method of any one of the preceding claims further comprising: implementing filtering on the real-time range values, and ignoring real-time range values which are greater than a certain threshold value.

14. A system mountable on an unmanned vehicle, comprising:
at least one processor operatively connected to a scanning device;
the scanning device is configured to scan an area around the vehicle in a plurality of directions and generate real-time scanning output data;
the at least one processor is configured to:

generate, based on the real-time scanning output data, a range map including K sets of real-time range values, wherein $K \geq 1$; each set comprising a plurality of real-time range values, each range value in the set is determined from a given rotation-point of the vehicle towards a certain direction; each set of real-time range values having a corresponding set comprising a plurality of vehicle-contour range values; each vehicle-contour range value in the corresponding set is a distance measured from the given rotation-point to the perimeter of the vehicle in a respective direction;

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for each set of the K sets:

determine differences between real-time range values in the set and corresponding vehicle-contour range values in a corresponding set;

determine, based on the differences, conditions for executing a point-turn that avoids collision with nearby objects;

generate a point-turn command for causing the vehicle to execute a point-turn according to the point-turn conditions; and

transmit the point-turn command to a vehicle control sub-system where the command is executed.

15. The system of claim 14 further comprising executing the point turn command and causing the vehicle to turn accordingly.

16. The system of any one of claims 14 to 15, wherein $K = 1$ and the rotation point is located at the center of a driving symmetry axis of the vehicle.

17. The system of any one of claims 14 to 15, wherein $K > 1$, wherein the at least one processor is configured for determining conditions for executing a point-turn to:

determine a selected rotation point from a plurality (K) of possible rotation points along a driving symmetry axis of the vehicle.

18. The system of any one of claims 14 to 17, wherein the point-turn command includes data indicating a first velocity of a first driving element on a first side of the vehicle and a second velocity of a second driving element on a second side of the vehicle during the point-turn; the at least one processor is further configured to:

determine the first velocity and the second velocity according to the selected rotation point.

19. The system of any one of claims 14 to 18, wherein the at least one processor is further configured to retrieve from a computer storage device on-board the vehicle one or more corresponding sets of vehicle-contour range values measured from a certain point along the driving symmetry axis of the vehicle.

20. The system of any one of claims 14 to 19, wherein the conditions include a point-turn direction and range.

21. The system of any one of claims 14 to 20, wherein each set of real-time range values and its corresponding set of vehicle-contour range values include range values corresponding to overlapping directions.

22. The system of any one of claims 14 to 21, wherein the at least one processor is further configured to execute the point-turn command for operating one or more vehicle control sub-systems and maneuvering the vehicle in a point-turn.

23. The system of any one of claims 14 to 22, wherein each of the K sets of real-time range values and their corresponding sets of vehicle-contour range values are plotted in a first histogram and a second histogram, respectively; and wherein determining differences between real-time range values in the set and corresponding vehicle-contour range values in a corresponding set is executed by shifting between relative positions of the first histogram and second histogram and comparing values in the two histograms in different relative positions.

24. The system of any one of claims 14 to 23, wherein the at least one processor is further configured to: determine one or more sets of vehicle-contour range values based on scanning device readings reflected from the perimeter of the vehicle.

25. The system of any one of claims 14 to 24, wherein the at least one processor is further configured to update the vehicle-contour range values while the vehicle is travelling.

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26. The system of any one of claims 14 to 25, wherein the at least one processor is further configured to implement filtering on the real-time range values, and to ignore real-time range values which are greater than a certain threshold value.

27. The system of any one of claims 14 to 26 further comprising the vehicle control sub-system.

28. An unmanned vehicle, comprising:

a scanning device for scanning an area around the vehicle in a plurality of directions and generating real-time scanning output data;

a vehicle control sub-system configured to receive vehicle control instructions and control the vehicle in accordance with the instructions; and

at least one processor configured to:

generate, based on the real-time scanning output data, a range map including K sets of real-time range values, wherein $K \geq 1$; each set comprising a plurality of real-time range values, each range value in the set is determined from a given rotation-point of the vehicle towards a certain direction; each set of real-time range values having a corresponding set comprising a plurality of vehicle-contour range values; each vehicle-contour range value in the corresponding set is a distance measured from the given rotation-point to the perimeter of the vehicle in a respective direction;

for each set of the K sets:

determine differences between real-time range values in the set and corresponding vehicle-contour range values in a corresponding set;

determine, based on the differences, conditions for executing a point-turn that avoids collision with nearby objects;

generate a point-turn command for causing the vehicle to execute a point-turn according to the point-turn conditions; and

the vehicle control sub-system is configured to execute the point-turn command and control the vehicle to turn accordingly.

29. A computer program product comprising a computer readable storage medium retaining program instructions, the program instructions when read by a processor, cause the processor to perform a method of autonomously maneuvering a vehicle during a point-turn, comprising:

receiving real-time scanning output data; the real-time scanning output data is generated by a scanning device from onboard the vehicle for scanning an area around the vehicle in a plurality of directions;

generating, based on the real-time scanning output data, a range map including K sets of real-time range values, wherein $K \geq 1$; each set comprising a plurality of real-time range values, each range value in the set is determined from a given rotation-point of the vehicle towards a certain direction; each set of real-time range values having a corresponding set comprising a plurality of vehicle-contour range values; each vehicle-contour range value in the corresponding set is a distance measured from the given rotation-point to the perimeter of the vehicle in a respective direction;

for each set of the K sets:

determining differences between real-time range values in the set and corresponding vehicle-contour range values in a corresponding set;

determining, based on the differences, conditions for executing a point-turn that avoids collision with nearby objects; and

generating a point-turn command for causing the vehicle to execute a point-turn according to the point-turn conditions.