{CLAIMS}

{Claim 1}

An apparatus for vehicle comprising:

a position-information obtaining means for obtaining position information of a moving object;

an intersection-information storage means for storing intersection information in which, for at least one intersection, the coordinates of intersection positions are registered in association with combinations of a direction of entry into and a turning direction at the intersection;

a detecting means for detecting, as a reference detection position, a position of the moving object at the time when an angle made by an advancing direction at a first predetermined time before and a current advancing direction reached a first predetermined angle in an intersection region set for each intersection;

an intersection-position obtaining means for obtaining, from the intersection information, the coordinates of a relevant intersection position based on a direction of entry of the moving object into the intersection region and a turning direction of the moving object in the intersection region; and

a correcting means for correcting the position information of the moving object obtained by the position-information obtaining means by using the position coordinates

of the intersection position obtained by the intersection-position obtaining means and the reference detection position detected by the detecting means.

{Claim 2}

The apparatus for vehicle according to Claim 1, wherein, in a case where an angle made by an advancing direction at a second predetermined time before and a current advancing direction, the second predetermined time being longer than the first predetermined time, has reached a second predetermined angle, the second predetermined angle being greater than the first predetermined angle, the detecting means detects, as a reference position, the position of the moving object where the moving object is at the first predetermined angle relative to the advancing direction at the second predetermined time before based on a traveling history from the second predetermined time before to a current time.

{Claim 3}

The apparatus for vehicle according to Claim 1 or 2, further comprising an angular-velocity sensor,

wherein the detecting means detects a traveling angle by using an integral value of values measured by the angular-velocity sensor.

{Claim 4}

The apparatus for vehicle according to any one of Claims 1 to 3,

wherein the correcting means includes:

a correcting-amount calculating means for calculating an offset vector for making the reference detection position detected by the detecting means coincide with the coordinates of the intersection position obtained by the intersection-position obtaining means; and

a position correcting means for correcting, by using the offset vector, the position information of the moving object obtained by the position-information obtaining means.

{Claim 5}

The apparatus for vehicle according to Claim 4, wherein the position correcting means corrects the offset vector by multiplying the offset vector by a weighting coefficient that gradually decreases to zero as time passes, and the position correcting means corrects the position information of the moving object by adding the corrected offset vector to the position information of the moving object obtained by the position-information obtaining means.

{Claim 6}

The apparatus for vehicle according to any one of Claims 1 to 5,

wherein the position-information obtaining means includes:

a GPS unit; and

a dead reckoning means,

wherein the correcting means executes correction for making the reference detection position coincide with the position coordinates of the intersection position, and

wherein, in a case where the correcting means has corrected the reference detection position, the position-information obtaining means adopts a position detected by the dead reckoning means with reference to the intersection position as the position information of the moving object and then switches to adopt a position detected by the GPS unit.

{Claim 7}

The apparatus for vehicle according to any one of Claims 1 to 5,

wherein the position-information obtaining means includes a GPS unit and a dead reckoning means and obtains the position information of the moving object by calculating a weighted average of the position information obtained by the dead reckoning means and the position information obtained by the GPS unit, and

wherein, in a case where the correcting means has corrected the reference detection position, a large weight is used for the dead reckoning means immediately after the correction, and a weight for the GPS unit is gradually increased as time passes.

{Claim 8}

The apparatus for vehicle according to Claim 6 or 7,

wherein information obtained by the GPS unit is used regarding velocity information when the dead reckoning means obtains position information.

{Claim 9}

The apparatus for vehicle according to any one of Claims 1 to 8, further comprising:

an output means for outputting the position information of the moving object obtained by the position-information obtaining means and for outputting corrected position information of the moving object during a period in which the position information of the moving object is being corrected by the correcting means; and

a map matching means for identifying a position of the moving object on a map by using the position information of the moving object output from the output means, the map matching means having map information in which roads are configured of multiple links and each of the links has unique identification information and position information assigned thereto.

{Claim 10}

The apparatus for vehicle according to Claim 9,

wherein, together with the coordinates of each intersection position in the intersection information, the identification information of a link that exists ahead of a turn at the relevant intersection is registered, and

wherein the output means outputs the identification information of the link together with the position information of the moving object.

{Claim 11}

A position correcting method for an apparatus for vehicle, wherein intersection information is prepared in advance, in which, for at least one intersection, the coordinates of intersection positions are registered in association with combinations of a direction of entry into and a turning direction at the intersection, the position correcting method comprising:

a position-information obtaining step of obtaining position information of a moving object;

a detecting step of detecting, as a reference detection position, the position of the moving object at the time when an angle made by an advancing direction at a first predetermined time before and a current advancing direction reached a first predetermined angle in an intersection region set for each intersection;

an intersection-position obtaining step of obtaining, from the intersection information, the coordinates of a relevant intersection position based on a direction of entry of the moving object into the intersection region and a turning direction of the moving object in the intersection region; and

a correcting step of correcting the position information of the moving object obtained in the position-information obtaining step by using the position coordinates of the intersection position obtained in the intersection-position obtaining step and the reference detection position detected in the detecting step.

{Claim 12}

A position correcting program for an apparatus for vehicle, wherein intersection information is stored in advance, in which, for at least one intersection, the coordinates of intersection positions are registered in association with combinations of a direction of entry into and a turning direction at the intersection, the position correcting program causing a computer to execute:

position-information obtaining processing for obtaining position information of a moving object;

detection processing for detecting, as a reference detection position, the position of the moving object at the time when an angle made by an advancing direction at a first predetermined time before and a current advancing direction reached a first predetermined angle in an intersection region set for each intersection;

intersection-position obtaining processing for obtaining, from the intersection information, the coordinates of a relevant intersection position based on a direction of entry

of the moving object into the intersection region and a turning direction of the moving object in the intersection region; and

correction processing for correcting the position information of the moving object obtained in the position-information obtaining processing by using the position coordinates of the intersection position obtained in the intersection-position obtaining processing and the reference detection position detected in the detection processing.

CLAIMS

WHAT IS CLAIMED IS:

1. An apparatus for vehicle comprising:

a position-information obtaining means for obtaining position information of a moving object;

an intersection-information storage means for storing intersection information in which, for at least one intersection, the coordinates of intersection positions are registered in association with combinations of a direction of entry into and a turning direction at the intersection;

a detecting means for detecting, as a reference detection position, a position of the moving object at the time when an angle made by an advancing direction at a first predetermined time before and a current advancing direction reached a first predetermined angle in an intersection region set for each intersection;

an intersection-position obtaining means for obtaining, from the intersection information, the coordinates of a relevant intersection position based on a direction of entry of the moving object into the intersection region and a turning direction of the moving object in the intersection region; and

a correcting means for correcting the position information of the moving object obtained by the position-

information obtaining means by using the coordinates of the intersection position obtained by the intersection-position obtaining means and the reference detection position detected by the detecting means.

2. The apparatus for vehicle according to Claim 1, wherein, in a case where an angle made by an advancing direction at a second predetermined time before and a current advancing direction, the second predetermined time being longer than the first predetermined time, has reached a second predetermined angle, the second predetermined angle being greater than the first predetermined angle, the detecting means detects, as the reference detection position, the position of the moving object where the moving object is at the first predetermined angle relative to the advancing direction at the second predetermined time before based on a traveling history from the second predetermined time before to a current time.

3. The apparatus for vehicle according to Claim 1 or 2, further comprising an angular-velocity sensor,

wherein the detecting means detects a traveling angle by using an integral value of values measured by the angular-velocity sensor.

4. The apparatus for vehicle according to any one of Claims 1

to 3,

wherein the correcting means includes:

a correcting-amount calculating means for calculating an offset vector for making the reference detection position detected by the detecting means coincide with the coordinates of the intersection position obtained by the intersection-position obtaining means; and

a position correcting means for correcting, by using the offset vector, the position information of the moving object obtained by the position-information obtaining means.

5. The apparatus for vehicle according to Claim 4, wherein the position correcting means corrects the offset vector by multiplying the offset vector by a weighting coefficient that gradually decreases to zero as time passes, and the position correcting means corrects the position information of the moving object by adding the corrected offset vector to the position information of the moving object obtained by the position-information obtaining means.

6. The apparatus for vehicle according to any one of Claims 1 to 5,

wherein the position-information obtaining means includes:

a GPS unit; and

a dead reckoning means,

wherein the correcting means executes correction for making the reference detection position coincide with the coordinates of the intersection position, and

wherein, in a case where the correcting means has corrected the reference detection position, the position-information obtaining means adopts a position detected by the dead reckoning means with reference to the intersection position as the position information of the moving object and then switches to adopt a position detected by the GPS unit.

7. The apparatus for vehicle according to any one of Claims 1 to 5,

wherein the position-information obtaining means includes a GPS unit and a dead reckoning means and obtains the position information of the moving object by calculating a weighted average of the position information obtained by the dead reckoning means and the position information obtained by the GPS unit, and

wherein, in a case where the correcting means has corrected the reference detection position, a large weight is used for the dead reckoning means immediately after the correction, and a weight for the GPS unit is gradually increased as time passes.

8. The apparatus for vehicle according to Claim 6 or 7, wherein information obtained by the GPS unit is used regarding velocity information when the dead reckoning means obtains position information.

9. The apparatus for vehicle according to any one of Claims 1 to 8, further comprising:

an output means for outputting the position information of the moving object obtained by the position-information obtaining means and for outputting corrected position information of the moving object during a period in which the position information of the moving object is being corrected by the correcting means; and

a map matching means for identifying a position of the moving object on a map by using the position information of the moving object output from the output means, the map matching means having map information in which roads are configured of multiple links and each of the links has unique identification information and position information assigned thereto.

10. The apparatus for vehicle according to Claim 9,

wherein, together with the coordinates of each intersection position in the intersection information, the identification information of a link that exists ahead of a

turn at the relevant intersection is registered, and

wherein the output means outputs the identification information of the link together with the position information of the moving object.

11. A position correcting method for an apparatus for vehicle, wherein intersection information is prepared in advance, in which, for at least one intersection, the coordinates of intersection positions are registered in association with combinations of a direction of entry into and a turning direction at the intersection, the position correcting method comprising:

a position-information obtaining step of obtaining position information of a moving object;

a detecting step of detecting, as a reference detection position, the position of the moving object at the time when an angle made by an advancing direction at a first predetermined time before and a current advancing direction reached a first predetermined angle in an intersection region set for each intersection;

an intersection-position obtaining step of obtaining, from the intersection information, the coordinates of a relevant intersection position based on a direction of entry of the moving object into the intersection region and a turning direction of the moving object in the intersection

region; and

a correcting step of correcting the position information of the moving object obtained in the position-information obtaining step by using the coordinates of the intersection position obtained in the intersection-position obtaining step and the reference detection position detected in the detecting step.

12. A position correcting program for an apparatus for vehicle, wherein intersection information is stored in advance, in which, for at least one intersection, the coordinates of intersection positions are registered in association with combinations of a direction of entry into and a turning direction at the intersection, the position correcting program causing a computer to execute:

position-information obtaining processing for obtaining position information of a moving object;

detection processing for detecting, as a reference detection position, the position of the moving object at the time when an angle made by an advancing direction at a first predetermined time before and a current advancing direction reached a first predetermined angle in an intersection region set for each intersection;

intersection-position obtaining processing for obtaining, from the intersection information, the coordinates of a

relevant intersection position based on a direction of entry of the moving object into the intersection region and a turning direction of the moving object in the intersection region; and

correction processing for correcting the position information of the moving object obtained in the position-information obtaining processing by using the coordinates of the intersection position obtained in the intersection-position obtaining processing and the reference detection position detected in the detection processing.