

Method for computing a range of positions of a railway vehicle on a railway track and associated device

5 The present invention relates to a method for computing a range of positions of a railway vehicle on a railway track, said range of positions corresponding to a track segment between a front end and a rear end.

 The invention applies to the field of railway safety, in particular to automatic systems for controlling railway traffic. Such systems for example are so-called communication based train control systems (or CBCTC systems).

10 Conventionally, for a railway vehicle circulating on a railway track, the range of positions of the vehicle on the railway track is determined by a computer on board the vehicle. The range of positions of the vehicle is then sent, for example via radio waves, to a central computer on the ground. The computer on the ground is adapted for receiving the range of positions of a plurality of railway vehicles and for controlling the running or
15 the stopping of each vehicle depending on the range of positions of the other vehicles and on other constraint points of present on the track. For example, a poorly positioned switch will lead the computer on the ground to controlling the stopping of the trains approaching this switch.

 By « range of positions », is meant in the sense of the present invention a segment
20 of a railway track in which the railway vehicle may be found with uncertainty less than a predetermined threshold.

 The onboard computer is adapted so as to determine the position of the vehicle, for example from beacons positioned on the railway track, and the locations of which on the railway track are known beforehand. More specifically, the onboard computer
25 determines the range of positions of the railway vehicle from the location of the last encountered beacon and from the displacement of the vehicle from this last beacon, said displacement for example being measured by an odometer.

 In certain situations, the onboard computer is not able to compute the range of positions of the railway vehicle with sufficient accuracy. This is then referred to as a loss
30 of localization. A loss of localization for example occurs if no new beacon is detected after the railway vehicle has covered a distance greater than or equal to a predetermined threshold, from the last detected beacon. For reasons of security, a control system of the railway vehicle then orders stopping of the vehicle.

 In the case of stopping of the railway vehicle, having an operator intervene is
35 known for manually maneuvering the stopped railway vehicle and to convey it as far as the next functional beacon, so that the onboard computer again determines the range of

positions of the vehicle in order to allow return to the autonomous and automatic operation of the railway vehicle.

Allowing a remote operator to maneuver the railway vehicle is also known, after the operator has checked the absence of obstacles in the direction towards which he/she wishes to convey the railway vehicle. As earlier, automatic operation is found as soon as the railway vehicle encounters a functional beacon.

Nevertheless, such methods do not give entire satisfaction.

Indeed, such methods require the intervention of an operator, which is able to cause incidents related to human error. Further, such methods involve the immobilization of the railway vehicle for long periods, for example for the intervention time of the operator, which is all the more a penalty for transport systems without any driver. This is detrimental to the quality of the traffic, notably for urban transportation networks.

An object of the invention is therefore to propose a method for localizing a railway vehicle which allows safe and automated operation, and rapid restoration of the railway traffic in the case of a localization loss.

For this purpose, the object of the invention is a method of the aforementioned type, wherein the method includes the steps:

- identifying by sensors on the track, a block of the railway track occupied by the railway vehicle;
- transmitting to a computer on the ground an identifier of the occupied block; and,
- computing with the ground computer, a range of positions of the railway vehicle taking into account a geographic position of the occupied block associated with the identifier of said occupied block.

Indeed, the computation of the range of positions of the railway vehicle by a computer on the ground from information provided by sensors on the track allows safe and automated localization of the railway vehicle, even if the onboard computer is no longer able to compute this localization.

According to other advantageous aspects of the invention, the method includes one or several of the following characteristics, taken individually or according to any technically possible combination:

- the method comprises a transmission step, from a computer onboard the railway vehicle towards the computer on the ground, of a range of positions of the railway vehicle determined by said onboard computer, the step for computing a range of positions of the railway vehicle also taking into account the range of positions determined by the onboard computer.

- the step for computing a range of positions comprises a first phase in which the range of positions is taken to be equal to the range of positions of the railway vehicle determined by the onboard computer, and a second phase in which a front end of the range of positions is displaced along the direction of displacement of the railway vehicle until an end of the occupied block is attained, which is found at the front of the railway vehicle;

- the front end of the range of positions is displaced during successive computing cycles of a predetermined duration of a distance equal to the product of the speed of the railway vehicle by the predetermined duration;

- the method further includes a computation step, by the computer on the ground, of a second range of positions of the railway vehicle from the range of positions of the railway vehicle determined by the onboard computer, the computation step including a first phase in which the computer determines a limiting position before the railway vehicle is allowed to pass it, a second phase in which the second position range is taken equal to the range of positions determined by the onboard computer, and a third phase in which a front end of the second position is displaced until the front limit is attained;

- the front end of the second range of positions is displaced during successive computing cycles of a predetermined duration of a distance equal to the product of the speed of the railway vehicle by the predetermined duration;

- if the speed of the vehicle is not available, the distance is equal to the product of the maximum speed of the railway vehicle by the predetermined duration;

- the method includes a step for computing an auxiliary range of the railway vehicle, the auxiliary range being equal to an intersection of the first range of positions and of a second range of positions.

Further, the object of the invention is a device for computing a range of positions of a railway vehicle on a railway track, for applying the computing method as defined above.

The invention will be better understood by means of the description which follows, only given as a non-limiting example and made with reference to the appended drawings wherein:

- Fig. 1 is a schematic illustration of a localization device able to apply a localization method according to the invention;

- Fig. 2 is a schematic illustration of a normal operating situation of the railway vehicle;

- Fig. 3 is a schematic illustration of an intermediate phase of a first step of the localization method according to the invention;

- Fig. 4 is a schematic illustration of a final phase of the step of Fig. 3;

- Fig. 5 is a schematic illustration of an intermediate phase of a second step of the method according to the invention;

- Fig. 6 is a schematic illustration of a final phase of the step of Fig. 5;

5 - Fig. 7 is a schematic illustration of a first step of the method for localizing a railway vehicle following the putting back into service of an onboard computer of the localization device;

- Fig. 8 is a schematic illustration of a step successive to the step of Fig. 7;

- Fig. 9 is a schematic illustration of a successive step to the step of Fig. 8; and

- Fig. 10 is a schematic illustration of a successive step to the step of Fig. 9.

10 A railway vehicle 2 circulating on a railway track 4 is illustrated in Fig. 1.

The localization of the railway vehicle 2 is achieved by a localization device 3 including a ground component and an onboard component.

By « localization », is meant the computation of a range of positions of the railway vehicle 2 on the railway track 4.

15 For the ground component, the railway track 4 is subdivided into a plurality of successive blocks 6. Each block is identified by an identifier, which is associated with the geographic position of the block.

A plurality of secondary detection devices 8, also called sensors on the track, are positioned along the railway track 4. Each secondary detection device 8 is associated with
20 a block 6. For example, the railway track 4 includes a first block 6A, a second block 6B and a third block 6C, each block 6A, 6B, 6C being associated with a corresponding secondary detection device 8.

Each secondary detection device 8 is able to determine whether the corresponding block 6 is vacant or occupied. By « occupied », is meant a block 6 on which the railway
25 vehicle 2 is at least partly engaged.

The secondary detection devices 8 are for example track circuits or axle counters.

Each secondary detection device 8 is further connected to a ground computer 12 for transmitting to the ground computer 12 a piece of information relating to the occupied or vacant state of the corresponding block 6. Further, each secondary detection device 8
30 is able to transmit to the ground computer 12 the identifier of the corresponding block 6.

For the onboard component, a plurality of beacons (not shown) is positioned along the railway track 4. The beacons are successively positioned along the railway track 4, at predetermined geographic locations. Each beacon is identified by a single beacon identifier.

35 The railway vehicle 2 includes at least one beacon sensor, i.e. an antenna, able to detect the presence of a beacon when it is found in proximity to the latter and to sense

information relating to this detected beacon. Preferably, the beacon is able to communicate its beacon identifier to the beacon sensor of the railway vehicle 2.

5 The railway vehicle 2 also includes instruments for measuring the displacement, the speed or the acceleration of the railway vehicle 2. The measurement instruments are for example odometers or accelerometers.

Further, the railway vehicle 2 includes an onboard computer 10.

The measurement instruments and the beacon sensor are connected to the onboard computer 10.

10 The beacon sensor is able to transmit to the onboard computer 10, data relating to the detected beacons. Notably, the beacon sensor is able to transmit to the onboard computer 10 the beacon identifier of each detected beacon during the displacement of the railway vehicle 2 along the railway track 4.

The onboard computer 10 includes a memory in which are stored the beacon identifier and the geographic location of each of the beacons of the railway track 4.

15 The onboard computer 10 is able to convert the measurements conducted by the measurement instruments into a displacement and/or speed measurement of the railway vehicle 2. For example, for measurement instruments adapted for measuring the displacement of the railway vehicle 2, the onboard computer 10 is able to determine the speed of the railway vehicle 2 by differentiation relative to the displacement time. For
20 example, for measurement instruments adapted for measuring the instantaneous displacement speed of the railway vehicle 2, the onboard computer 10 is able to compute the distance covered by the railway vehicle 2 by integrating relatively to time the speed of the railway vehicle 2. For example, for measurement instruments adapted for measuring the instantaneous acceleration of the railway vehicle 2, the onboard computer 10 is able
25 to compute the speed of the railway vehicle 2, and then the distance covered by the railway vehicle 2, by successive integrations relative to time of the acceleration of the railway vehicle 2.

The onboard computer 10 is also able to compute a range of positions S_0 of the railway vehicle 2. As illustrated by Fig. 2, the range S_0 corresponds to a front end A_0 and
30 rear end Z_0 segment. Notably, the onboard computer 10 is able to compute a range S_0 of the railway vehicle 2 from the location of the last beacon detected by the beacon detector. In particular, the onboard computer 10 is able to determine a range S_0 of the railway vehicle 2 from the location of the last detected beacon and from the displacement of the railway vehicle from said last detected beacon, the displacement being measured by the
35 measurement instruments of the railway vehicle 2 or computed by the onboard computer 10 from measurements conducted by the measurement instruments of the railway vehicle

2. Advantageously, the onboard computer 10 is able to take into account, during the computation of the range S_0 , a potential error margin related to the accuracy of the measurement instruments used, which leads to a safety computation of the position range S_0 . For example, for an odometer, the error margin takes into account the adherence coefficient between a wheel of the railway vehicle 2 and a rail of the railway track 4, this coefficient not being 100%.

The onboard computer 10 is further able to generate an alarm signal in the case of loss of localization. By « loss of localization », is meant a situation in which the data received by the onboard computer 10 do not give the possibility of determining the range of positions S_0 of the railway vehicle 2 with an error below a predetermined threshold. The onboard computer 10 is for example configured for generating an alarm signal if the location of a detected beacon is found outside the range of positions S_0 of the railway vehicle calculated at this instant by the onboard computer 10. The onboard computer 10 is for example configured for generating an alarm signal if no beacon was detected at the end of a displacement with a predetermined length from the detection of the last beacon. Further, the onboard computer 10 is for example configured for generating an alarm signal if, at a same instant, the values of the displacement or speed measurements are different from one measurement instrument to the other. For example, when the odometry means are redundant in the train, it is possible to generate an alarm if one of the odometers indicates that the train is stopped while the other odometer indicates that the train is moving.

Advantageously, the onboard computer 10 is also configured for generating an alert signal if the integrity detectors of the railway vehicle 2 detect a loss of integrity of the railway vehicle 2, during a time interval of duration of less than a predetermined duration. The railway vehicle 2 is said to be entire if it has not lost any wagon during its displacement. Preferably, the onboard computer 10 is configured for emitting an alarm signal following its setting into operation after a standby mode or extinction. In this case, when setting the onboard computer 10 into a standby mode or extinction, the ground computer 12 stores in memory the orientation of the railway vehicle 2 with respect to the railway track 4, i.e. the ground computer 12 stores in memory the direction of the running of the railway vehicle 2.

The onboard computer 10 is able to communicate with the ground computer 12. The onboard computer 10 and the ground computer 12 are for example able to communicate with each other via radio waves.

The onboard computer 10 is able to emit to the ground computer 12, the last range of positions S_0 of the railway vehicle 2 calculated by the onboard computer 10.

The onboard computer 10 is also able to emit, to the ground computer 12, the displacement values and the speed values either measured and/or computed.

The onboard computer 10 is further able to emit the alarm signal towards the ground computer 12, the alarm indicating a loss of localization.

5 The ground computer 12 includes a memory (not shown) in which the identifier of each block 6 is associated with the geographic position of the block 6.

The ground computer 12 is able to compute a front limiting position $A_{\max}$ and a rear limiting position $Z_{\max}$ for the railway vehicle 2. The front limiting $A_{\max}$ and rear $Z_{\max}$ limiting positions are respectively the point of the railway track 4 downstream from the railway vehicle 2 and the point of the railway track 4 upstream from the railway vehicle 2 which the railway vehicle 2 is not allowed to pass by the orders of movements given by the ground computer 12. In normal operation, the instantaneous position of the railway vehicle 2 is always comprised between the front $A_{\max}$ and rear $Z_{\max}$ limiting positions.

15 The ground computer 12 is able to re-transmit the front $A_{\max}$ and rear $Z_{\max}$ limiting positions to the onboard computer 10 and/or to a control system (not shown) of the railway vehicle 2. The limiting positions $A_{\max}$, $Z_{\max}$ correspond to the maximum movement authorizations given to the train. The onboard computer 10 is able to safely guarantee that these positions are never exceeded by the railway vehicle 2.

20 The front $A_{\max}$ limiting position depends on the spacing with the railway vehicle being found downstream from the relevant railway vehicle 2. The front $A_{\max}$ limiting position is advantageously located, downstream from the railway vehicle 2, and with respect to the front of the railway vehicle 2 at a distance of more than 100 m, preferably more than 200 m, preferably equal to 500 m.

25 The rear limiting position $Z_{\max}$ is advantageously located upstream from the railway vehicle 2, and with respect to the rear of the railway vehicle 2, at a distance of less than 100 m, preferably less than 50 m, for example equal to 20 m.

30 The ground computer 12 is able to compute a range of positions of the railway vehicle 2, a so called « auxiliary range » S_x , from information received from the onboard computer 10, the secondary detection devices 8 and the $A_{\max}$, $Z_{\max}$ limiting positions provided by the actual ground computer 12. As illustrated in Fig. 1, the auxiliary range S_x includes a front end A_x and a rear end Z_x .

35 For example, the ground computer 12 is able to calculate the auxiliary range S_x of the railway vehicle 2 in the case of receiving an alarm signal from the onboard computer 10. The ground computer 12 is able to calculate the auxiliary range S_x of the railway vehicle 2 from the last position of the railway vehicle 2 which was computed by the onboard computer 10, from measured and/or computed displacement and/or speed

values, from the secondary detection devices 8 and from the limiting positions $A_{\max}$ and $Z_{\max}$ provided by the ground computer 12 itself.

The ground computer 12 is able to transmit, to the onboard computer 10, the auxiliary range S_x of the railway vehicle 2.

5 The localization device 3 is able to determine the range S_0 and/or the auxiliary range S_x of the railway vehicle from data received by the onboard computer 10 and/or the ground computer 12.

The operation of the localization device 3 will now be described.

10 During an initial normal operating step of the railway vehicle 2, there is no loss of localization by the onboard computer and no alarm has been emitted. The onboard computer 10 determines the range of positions S_0 of the railway vehicle 2. The interval S_0 is said to be the « initial range » of the railway vehicle 2.

15 In the example illustrated by Fig. 2, the railway vehicle 2 occupies the second block 6B. Thus, the second block 6B is occupied and the first and third blocks 6A, 6C are vacant.

20 At the end of the initial step, a loss of localization occurs. The onboard computer 10 then emits an error signal intended for the ground computer 12. The onboard computer 10 also transmits to the ground computer 12 the initial range S_0 of the railway vehicle 2 before the loss of localization occurs. Further, the onboard computer 10 transmits to the ground computer 12 the value of the displacement and/or of the speed of the railway vehicle 2 which is measured by the displacement measurement instruments and by the speed measurement instruments respectively.

25 The ground computer 12 then computes a first auxiliary range S_p , during a first step of the method, and a second auxiliary range S_d , during a second step of the localization method. The ground computer 12 then computes the intersection of the auxiliary ranges S_p and S_d in order to determine the auxiliary range S_x , visible in Fig. 1.

The first auxiliary range S_p and the second auxiliary range S_d are respectively visible in figs. 4 and 6. The first auxiliary range S_p includes a front end A_p and a rear end Z_p . The second auxiliary range S_d includes a front end A_d and a rear end Z_d .

30 As illustrated by figs. 3 and 4, the ground computer 12 computes the first auxiliary range S_p from the initial range S_0 and from the front $A_{\max}$ and rear $Z_{\max}$ limiting positions.

35 The front end A_p is then taken to be equal to the front end A_0 of the range S_0 . During successive computing cycles of duration T , the ground computer 12 computes a new location of the point A_p of the first auxiliary range S_p . In particular, during successive computing cycles, the point A_p is displaced on the railway track 4 along the direction of displacement of the railway vehicle 2, by an amount equal to the speed v of the railway

vehicle 2 at the computing instant, multiplied by the duration T . For example, in Fig. 3, and for a constant speed v of the railway vehicle 2, at the end of a strictly positive integer number N of computing cycles, the point A_p is located at a distance $N \cdot v \cdot T$ along the displacement direction of the railway vehicle 2 with respect to the front end A_0 of the range S_0 . Advantageously, in the case of a loss of localization due to a measurement inconsistency between the different measurement instruments of the railway vehicle 2, the speed v used is the maximum speed accessible to the railway vehicle 2.

Further, the rear end Z_p is taken to be equal to the rear limiting point $Z_{\max}$.

The computation stops when the point A_p of the first auxiliary range attains the front limiting point $A_{\max}$.

Alternatively, the front A_p and rear Z_p ends of the first auxiliary range S_p are respectively taken to be equal to the front $A_{\max}$ and rear $Z_{\max}$ limiting points as soon as the first computing cycle.

As illustrated by figs. 5 and 6, the ground computer 12 computes the second auxiliary range S_d from the initial range S_0 and from information transmitted by the secondary detection devices 8 and relating to the occupied or vacant state of the block 6.

In the example illustrated by Fig. 2, at the end of the initial step, the second block 6B is occupied and the first and third blocks 6A, 6C are vacant.

The front end A_d is first taken to be equal to the front end A_0 of the initial range S_0 . During successive computing cycles of duration T , the ground computer 12 computes a new location of the point A_d of the second auxiliary range S_d . In particular, during successive computing cycles, the point A_d is displaced on the railway track 4 along the direction of displacement of the railway vehicle 2 by an amount equal to the speed v of the railway vehicle 2 at the computing instant, multiplied by the duration T . For example, in Fig. 5, and for a constant speed v of the railway vehicle 2, at the end of a strictly positive integer number N of computing cycles, the point A_d is located at a distance $N \cdot v \cdot T$ along the displacement direction of the railway vehicle 2 with respect to the front end A_0 of the initial range S_0 . Advantageously, in the case of loss of localization due to a measurement inconsistency between the different measurement instruments of the railway vehicle 2, the speed v used is the maximum speed accessible to the railway vehicle 2.

The computation stops when the front end A_d of the second auxiliary range S_d attains the transition between the presently occupied block and the front vacant block, i.e., in the example, at the transition between the second block 6B and the third block 6C. The rear end location Z_d is then taken to be equal to the transition between the presently occupied block and the rear vacant block, i.e. in the example, at the transition between the second block 6B and the first block 6A.

Depending on the instantaneous position of the railway vehicle 2 at the moment when the loss of localization occurs, the occupied block 6 at the end of the computation of the second auxiliary range S_d is the same or is different from the occupied block 6 at the beginning of the computation of the second auxiliary range S_d .

5 Preferably and as this appears in Fig. 6, at the end of the computation defined earlier, the front end A_d is shifted towards the front by a first predefined shift of D_A and the rear end Z_d is shifted towards the rear by a second predefined shift of D_Z . The first shift D_A and the second shift D_Z give the possibility of taking into account possible delays, for each secondary detection device 8, in the detection of the entering of the railway vehicle 2 on a
10 corresponding block 6 or of the exit of the railway vehicle 2 from a corresponding block 6.

The first shift D_A is advantageously comprised between 10 m and 400 m, preferably comprised between 50 m and 300 m, for example comprised between 100 m and 200 m.

The second shift D_Z is advantageously comprised between 10 m and 200 m,
15 preferably comprised between 20 m and 150 m, for example comprised between 30 m and 100 m.

The ground computer 12 then computes the auxiliary range S_x . The auxiliary range S_x is the intersection of the first auxiliary range S_p and of the second auxiliary range S_d . In particular:

20
$$A_x = \min (A_p, A_d)$$

$$Z_x = \max (Z_p, Z_d)$$

The ground computer 12 then transmits the auxiliary range S_x towards the onboard computer 10.

Upon receiving the auxiliary range S_x , the onboard computer 10 assumes that the
25 auxiliary range S_x is its current range of positions S_0 . The onboard computer 10 no longer emits any alarm signal. The railway vehicle 2 is then allowed to resume its running on the railway vehicle 4.

Advantageously, the period between the emission of the alarm signal by the onboard computer 10 to the ground computer 12, and the reception of the auxiliary range
30 S_x by the onboard computer 10 from the ground computer 12, is less than 20 s, preferably less than 10 s, preferably less than 5 s.

As this is illustrated in Fig. 7, in the case of resetting into operation the onboard computer 10 after being in a standby mode or an extinction, the onboard computer 10 emits an alarm signal indicating a loss of localization intended for the ground computer 12.
35 The ground computer 12 has stored in memory beforehand the orientation of the railway vehicle 2 with respect to the railway track 4, i.e. the relative position of the head wagon of

the railway vehicle 2, further designated as « front » with respect to the position of the tail wagon, further designated as « rear ».

During a following step, illustrated by Fig. 8, the ground computer 12 computes the second auxiliary range S_d according to the method described earlier. Notably, the location of the front end A_d of the second auxiliary range S_d is taken to be equal to the transition between the presently occupied block and the front vacant block, i.e., in the example, at the transition between the second block 6B and the third block 6C. Next, the front end A_d is shifted towards the front by the first predefined shift D_A .

During a next step, illustrated by Fig. 9, the ground computer 12 determines the location of a point P of the railway track 4. The point P is a point located downstream, according to the orientation of the railway vehicle 2, from the rear end Z_d of the second auxiliary range S_d . The point P is found at a distance L of the rear end Z_d , the distance L being equal to the length of the railway vehicle 2. The point P is the point which is the most upstream of the railway track 4 where the head of the railway vehicle 2 may be found.

During a next step, illustrated by Fig. 10, the ground computer 12 computes the location of the front limit A_{max} from the location of the point P. The ground computer 12 then transmits the second auxiliary range S_d towards the onboard computer 10, as well as the front limit A_{max} .

Upon receiving the second auxiliary range S_d , the onboard computer 10 takes the second auxiliary range S_d as its current range of positions S_0 . The onboard computer 10 no longer emits any alarm signal. The railway vehicle 2 is then allowed to move on the railway track 4.

CLAIMS

1.- A method for computing a range of positions of a railway vehicle (2) on a railway track (4), said range of positions corresponding to a segment of the track (4) between a front end and a rear end, the method including the steps:

- identifying, by sensors on the track (8), a block (6) of the railway track (4) occupied by the railway vehicle (2);

- transmitting to a computer (12) on the ground, an identifier of the occupied block (6); and,

- computing, by the ground computer (12) a range of positions (S_d) of the railway vehicle (2) by taking into account a geographic position of the occupied block (6) associated with the identifier of said occupied block (6),

the method comprising a step for transmitting, from an onboard computer (10) of the railway vehicle (2) towards the ground computer (12), a range of positions (S_0) of the railway vehicle (2) determined by said onboard computer (10), the step for computing a range of positions (S_d) of the railway vehicle (2) also taking into account the range of positions (S_0) determined by said onboard computer (10).

2.- The method according to claim 1, wherein the step for computing a range of positions (S_d) comprises a first phase in which the range of positions is taken equal to the range of positions (S_0) of the railway vehicle (2) determined by the onboard computer (10), and a second phase in which a front end (A_d) of the range of positions (S_d) is moved along a displacement direction of the railway vehicle (2) until an end of the occupied block (6) is attained, which is found at the front of the railway vehicle (2).

3.- The method according to claim 2, wherein the front end (A_d) of the range of positions (S_d) is displaced during successive computing cycles of a predetermined duration (T) by a distance equal to the product of a speed of the railway vehicle (2) by the predetermined duration (T).

4.- The method according to any of claims 1 to 3, further including a step for computing, by the ground computer (12), a second range of positions (S_p) of the railway vehicle (2) from the range of positions (S_0) of the railway vehicle (2) determined by the onboard computer (10), the computing step including a first phase in which the ground computer (12) determines a front limiting position (A_{max}) which the railway vehicle (2) is not

authorized to exceed, a second phase in which the second range of position (S_p) is taken equal to the range of positions (S_0) determined by the onboard computer (10), and a third phase in which a front end (A_p) of the second position (S_p) is displaced until the front limit (A_{max}) is attained.

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5.- The method according to claim 4, wherein the front end (A_p) of the second range of positions (S_p) is displaced during successive computing cycles of a predetermined duration (T) by a distance equal to the product of a speed of the railway vehicle (2) by the predetermined duration (T).

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6.- The method according to any of claims 3 to 5, wherein, when the speed of the vehicle is not available, the distance is equal to the product of a maximum speed of the railway vehicle (2) by the predetermined duration (T).

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7.- The method according to claims 2 and 4 as a combination, including a step for computing an auxiliary range (S_x) of the railway vehicle (2), the auxiliary range (S_x) being equal to an intersection of the first range of positions (S_d) and of the second range of positions (S_p).

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8.- A device (3) for computing a range of positions (S_0) of a railway vehicle (2) on a railway track (4), for applying a method according to any of claims 1 to 7.