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(54) Method and system for forward collision avoidance in an automotive vehicle

(57) A forward collision avoidance system and a method therefore is provided. The presence and state of a target (10) in front of the host vehicle (2) is established. A risk zone is established in front of the host vehicle (2). The future path of the target (10) and the host vehicle (2) are predicted and the lateral position of the target (10) at a moment when the host vehicle (2) reaches the target in a longitudinal direction determined. If the target (10) is predicted as being able to stop before entering the risk zone it is predicted to do so just before entering the risk zone and no collision avoidance task is executed. If the target (10) is predicted as not being able to stop before entering the risk zone, then the future position of the target (10) is predicted using the assumption that the target (10) will continue to move according to an observation based motion model and a collision avoidance task is executed.

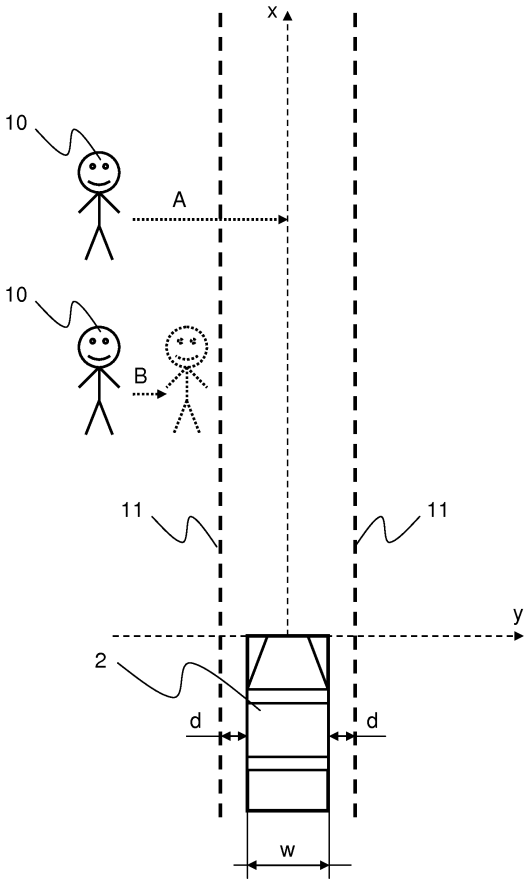


Fig. 3

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Description

Technical field

[0001] The present invention relates to an automotive vehicle forward collision avoidance system in accordance with the preamble of claim 1.

[0002] The present invention also relates to a method in an automotive vehicle forward collision avoidance system in accordance with the preamble of claim 9.

Background of the invention

[0003] A current trend in the automotive industry is to introduce active safety systems for avoiding or mitigating collisions. One type of system, with a potentially large positive impact on accident statistics, is a Forward Collision Avoidance System (FCAS). An FCAS uses sensors based on technologies such as RADAR (RAdio Detection And Ranging), LIDAR (Light Detection And Ranging), LASER (Light Amplification by Stimulated Emission of Radiation) and cameras to monitor the region in front of the host vehicle. In the FCAS a tracking algorithm is used to estimate the state of the objects ahead and a decision algorithm uses the estimated states to determine any action, e.g. warning the driver or autonomous braking.

[0004] Automotive manufacturers are today studying collision avoidance systems providing warning and auto-braking functionality for an imminent collision with a pedestrian. Such warning and auto-braking functionality is normally based on the use of sensors, such as mentioned above, in order to detect the position and motion of pedestrians. A threat assessor then estimates if the collision avoidance system equipped vehicle and the pedestrian is on a collision course by predicting the positions a short time in the future, usually one to three seconds.

[0005] Forward Collision Warning (FCW) is a function that warns the driver in case a collision with a target object seems likely. The target object may be another vehicle or a pedestrian. Collision Mitigation by Braking (CMbB) is a function that automatically applies braking for avoiding or mitigating a collision with a target object.

[0006] Typically, the decision of warning and auto-braking is based on predictions of the paths of the host vehicle and the target object. The position and motion of the target object is, as mentioned above, measured with a sensor such as a camera, radar or laser equipment, or a combination thereof.

[0007] In case the predicted future paths of the host vehicle and target objects intersect within such a short time that the driver will have to act instantly in order to avoid a collision, a warning is issued. In case the predicted future paths intersect within such a short time that avoidance of a collision by either steering or braking is unlikely, auto-braking is applied in order to avoid or mitigate the consequences of the collision.

[0008] During road following, road users such as vehicles, cars, trucks, buses, motorcycles and bicyclists usually move in such a way that observation based prediction, i.e. prediction based on an appropriate motion model and what may be observed and measured without assuming any change in behaviour, is sufficient for decision-making in FCW systems and CMbB systems.

[0009] One problem is that if observation based prediction methods are applied, a pedestrian who is walking towards the host vehicle path is predicted to continue walking into that path. The same is true for crossing vehicles. Once again, if observation based prediction methods are applied to a crossing vehicle it will be predicted to move into the host vehicle path. Both of the above cases are likely to lead to false warnings and false braking interventions in FCW systems and CMbB systems since the typical behaviour in such a case is that the crossing vehicle or pedestrian stops before entering the host vehicle path.

Summary of the invention

[0010] One object of the invention is to provide an improved automotive vehicle forward collision avoidance system.

[0011] This object is achieved by the method as claimed in claim 1.

[0012] Thanks to the provision of: means for establishing the presence of a target object in front of a vehicle hosting said system; and means for estimating the position, velocity and acceleration of the target object; and means for establishing a risk zone in front of the host vehicle; and means for predicting the future path of the target object and the host vehicle in order to predict the lateral position of the target object at a moment when the host vehicle reaches the target object in a longitudinal direction; and means for executing a collision avoidance task arranged such that: - if the target object, based on its current position, velocity and acceleration, is predicted as being able to stop before entering the risk zone through applying a certain predetermined maximum acceleration in a direction opposite to its velocity, it is predicted to stop at a position just before entering the risk zone and no collision avoidance task is executed; and - if the target object, based on its current position, velocity and acceleration, is predicted as not being able to stop before entering the risk zone, then the future position of the target object is predicted using the assumption that the target object will continue to move according to an observation based motion model and a collision avoidance task is executed, a system is provided which renders fewer false alarms and interventions and thereby a higher confidence of real threat when providing for alarms and interventions.

[0013] A further object of the invention is to provide an improved method in an automotive vehicle forward collision avoidance system.

[0014] This object is achieved by the system as claimed in claim 9.

[0015] Thanks to the provision of the steps of: estab-

lishing the presence of a target object in front of a vehicle hosting said system; and estimating the position, velocity and acceleration of the target object; and establishing a risk zone in front of the host vehicle; and predicting the future path of the target object and the host vehicle in order to find its lateral position at a moment when the host vehicle reaches the target object in a longitudinal direction; and executing a collision avoidance task arranged such that: - if the target object, based on its current position, velocity and acceleration, is predicted as being able to stop before entering the risk zone, it is predicted to stop at a position just before entering the risk zone and no collision avoidance task is executed; and - if the target object, based on its current position, velocity and acceleration, is predicted as not being able to stop before entering the risk zone, then the future position of the target object is predicted using the assumption that the target object will continue to move according to an observation based motion model and a collision avoidance task is executed, a method is provided which renders fewer false alarms and interventions and thereby a higher confidence of real threat when providing for alarms and interventions.

[0016] Preferred embodiments are listed in the dependent claims.

Description of drawings

[0017] In the following, the invention will be described in greater detail by way of example only with reference to attached drawings, in which

Fig. 1 is a schematic illustration of a forward collision avoidance system arranged in a host vehicle,

Fig. 2 illustrates a typical prior art case where the paths of a host vehicle and a pedestrian seem to intersect in the near future given an assumption of an observation based motion model,

Fig. 3 illustrates the risk zone and two hypotheses used for realizing the present invention.

[0018] Still other objects and features of the present invention will become apparent from the following detailed description considered in conjunction with the accompanying drawings. It is to be understood, however, that the drawings are designed solely for purposes of illustration and not as a definition of the limits of the invention, for which reference should be made to the appended claims. It should be further understood that the drawings are not necessarily drawn to scale and that, unless otherwise indicated, they are merely intended to conceptually illustrate the structures and procedures described herein.

Description of embodiments

[0019] Figure 1 illustrates schematically a Forward Collision Avoidance System (FCAS) 1, arranged in a host vehicle 2 in accordance with the present invention. The host vehicle 2 has a breaking system 4 such as an Anti-lock Brake System (ABS system), e.g. with brake discs 6 and appertaining calipers 7 associated with each of the front wheels 8 and rear wheels 9 of the host vehicle 2. The host vehicle 2 further usually has a power steering system 5, which is arranged to control the steering angle of the front wheels 8. A sensor 3, such as a radar, a lidar, a laser or a camera based sensor is mounted at the front end of the host vehicle 2 and arranged to monitor the region in front of the host vehicle 2. The FCAS is operatively connected with the braking system 4 of the host vehicle 2. Further, the FCAS is arranged to establish the presence of target objects in front of the host vehicle 2 and to estimate the position, velocity and acceleration of any target objects established to be present. These estimations are then used by the FCAS to determine how to avoid or mitigate collision with any target objects, e.g. by performing collision avoidance tasks such as providing warnings, e.g. using an acoustic and/or visual alarm actuated through an alarm actuator 12, or performing autonomous braking.

[0020] The present invention especially relates to prediction of future paths of pedestrians 10. It is also applicable to any other type of target object 10 that typically moves across a road rather than along it. The solution makes use of the fact that pedestrians 10 are usually aware of the danger of entering the road and thus are not assumed to continue over the road according to an observation based motion model, such as with constant velocity, just because they temporarily have a motion towards it.

[0021] The case where the pedestrian 10 stops very late just before entering the host vehicle 2 path is thus, using the prior art assumption of an observation based motion model (illustrated at A in figure 2), very likely to cause false warnings and brake interventions. This is a very common situation in urban areas. The same is true for crossing vehicles. Once again, if observation based prediction methods are applied to a crossing vehicle it will be predicted to move into the host vehicle 2 path. However, in many situations the crossing vehicle will stop safely before entering the host vehicle 2 path. Also this case is likely to lead to false warnings and braking interventions.

[0022] Pedestrians 10 are usually not users of the same road as the host vehicle 2 other than while crossing it. In case a pedestrian 10 moves towards the road as if it would cross it, it is likely to stop before crossing it if there is an upcoming vehicle. Since most pedestrians 10 are aware of the danger of entering a road, they are normally not likely to enter the road just because they temporarily have a motion towards it. Thus, using observation based motion prediction of the path of a pedestrian

10 yields an unacceptably large number of false alarms and interventions, especially in city environments where pedestrians 10 close to the road move in random directions, usually without entering the road.

[0023] Altogether, the assumption that a target object 10 will continue to move according to an observation based motion model is not as easily applicable to pedestrians 10 as it is to vehicles moving along the same road, i.e. non crossing vehicles. Hence, for pedestrians 10, there is a need for another approach when deciding whether a collision is likely.

[0024] The solution in accordance with the present invention is based on the use of two hypotheses. Firstly (illustrated at A in figure 3), that the pedestrian 10 will continue walking in the same direction and with the same acceleration as it currently is. Secondly (illustrated at B in figure 3), that the pedestrian 10 will stop before entering a risk zone in front of the host vehicle 2. When stopping, the pedestrian 10 is assumed to apply a certain acceleration in opposite direction to its velocity. The assumed acceleration may be tuned differently depending on the area of application. For collision warning, the assumed acceleration may reflect the behavior of stopping in an ordinary way, whereas that of CMbB may rather reflect the acceleration of stopping abruptly.

[0025] The risk zone is an area representing the predicted coverage of the host vehicle 2, i.e. the area between the predicted path of the leftmost and rightmost parts of the host vehicle 2, i.e. as defined by the host vehicle width w, as illustrated in figure 3. The prediction with respect to the risk zone takes curvature into account by using the current yaw rate of the host vehicle 2 (the host vehicle's angular velocity around its vertical axis), i.e. if the host vehicle 2 is inside a curve, the risk zone will be curved accordingly. In addition to the host vehicle 2 width w an extra width d of the risk zone may be applied on each side of the host vehicle 2. The additional width d may depend on velocity and other factors in order to better reflect the perceived risk of the situation.

[0026] In the case that the host vehicle 2 is equipped with a lane marker sensor (not shown), which provides for sufficiently good detection of lane markers 11 (see figure 3), the area between the left hand side and right hand side lane markers 11 may be used to define the risk zone, rather than the host vehicle 2 width w and additional width d. In the case that only lane markers 11 at one side of the host vehicle 2 exist or that only lane markers at one side of the host vehicle 2 are detected sufficiently well, these lane markers 11 may be used for defining that side of the risk zone whilst using the host vehicle 2 width w and additional width d at the other side of the host vehicle 2.

[0027] It is not uncommon that lane marker sensors provide a good detection also of the boundary between the road and a sidewalk, i.e. the curb (not shown), which in such case may be used instead of the line markers for defining the risk zone in accordance with the present invention. This could be quite useful in urban areas, where line markers 11 are frequently replaced with curbs.

[0028] In case of using the system 1 for providing a warning the risk zone may be defined to be wider than the host vehicle 2, e.g. the host vehicle 2 width w and additional width d or the width as defined by the lane markers 11.

[0029] In the case of using the system 1 for providing for auto-braking (or autonomous braking) the risk zone may be defined as having the width w of the host vehicle 2.

[0030] It is obvious to the person skilled in the art that the risk zone may be defined in a number of different ways in order to suit different applications and requirements.

[0031] Using the two hypotheses, the future path of the pedestrian 10 is predicted in order to find its lateral position y at the moment when the host vehicle 2 reaches the pedestrian 10 in a longitudinal direction x.

[0032] If the second hypotheses (illustrated at B in figure 3), i.e. that the pedestrian 10 will stop before entering a risk zone in front of the host vehicle 2, results in a predicted position outside the risk zone it is assumed that the pedestrian 10 intends to stop before entering the risk zone. The second hypothesis is then used when calculating the future path of the pedestrian 10.

[0033] If the second hypotheses (illustrated at B in figure 3), i.e. that the pedestrian 10 will stop before entering a risk zone in front of the host vehicle 2, yields a predicted position inside the risk zone, it is assumed that the pedestrian 10 does not intend to stop (based on the fact that it is too late to stop in a reasonable manner) before entering the risk zone. The first hypothesis (illustrated at A in figure 3), i.e. that the pedestrian 10 will continue walking in the same direction and with the same acceleration as it currently is, is then used when calculating the future path of the pedestrian 10.

[0034] In a similar way as previously described, a third hypothesis may be used. In accordance with this third hypothesis it is assumed that the pedestrian 10 accelerates in the other direction, i.e. that the pedestrian 10 will accelerate to escape the risk zone, rather than stop before entering it.

[0035] Thus, the proposed solution lies in using an improved motion model for pedestrians 10. This improved motion model takes into account that a pedestrian 10 is likely to stop before entering a host vehicle 2 future path. A predetermined maximum acceleration for pedestrians 10 is assumed. Thus, using straightforward physical calculations, it is possible to determine if a pedestrian 10 has the possibility to stop before entering a risk zone or not. If it is determined that the pedestrian 10 has the possibility to stop, based on its current position and velocity, it is predicted to stop at a position just before entering the host vehicle 2 path. In a similar manner, if it is determined that a crossing vehicle (not shown) has the possibility to stop before entering the host vehicle 2 path, this crossing vehicle is predicted to stop at a position just before entering the host vehicle 2 path. On the other

hand, if a pedestrian 10, or a crossing vehicle, is estimated as not being able to stop before entering the host vehicle 2 path, then the future position of this pedestrian 10, or crossing vehicle, is predicted using conventional motion models. Conventional motion models typically means that it is assumed that the pedestrian 10, or crossing vehicle, will continue moving according to an observation based motion model, e.g. with a constant velocity in the current direction.

[0036] An advantage with the proposed solution, compared to conventional methods, is that it will lead to fewer false alarms in pedestrian and intersection warning/intervention safety systems. In the end, it could be the difference between being able to reach an acceptable level of false alarms or not. Furthermore, when it is predicted that a pedestrian 10, or crossing vehicle, does not have the possibility to stop before entering the host vehicle 2 path, the confidence that there is a real threat is higher. Thus, the positive performance may also be increased, which in this case means earlier interventions and higher safety benefits by the system 1.

[0037] Thus, in accordance with the present invention is provided an automotive vehicle forward collision avoidance system 1, having means, such as a radar, a lidar, a laser or a camera based sensor 3 for establishing the presence of a target object 10 in front of a vehicle 2 hosting the system 1. Means are provided for estimating the position, velocity and acceleration of the target object 10. Further means are provided for establishing a risk zone in front of the host vehicle 2. Also provided are means for predicting the future path of the target object 10 and the host vehicle 2 in order to predict the lateral position y of the target object 10 at a moment when the host vehicle 2 reaches the target object 10 in a longitudinal direction x. Means are also provided for executing a collision avoidance task, which means are arranged such that: - if the target object 10, based on its current position, velocity and acceleration, is predicted as being able to stop before entering the risk zone through applying a certain predetermined maximum acceleration in a direction opposite to its velocity, it is predicted to stop at a position just before entering the risk zone, as illustrated at (B) in figure 3, and no collision avoidance task is executed; and - if the target object 10, based on its current position, velocity and acceleration, is predicted as not being able to stop before entering the risk zone, then the future position of the target object 10 is predicted using the assumption that the target object 10 will continue to move according to an observation based motion model, as illustrated at (A) in figure 3, and a collision avoidance task is executed.

[0038] In one embodiment, the means for executing a collision avoidance task are arranged to provide at least one of a warning to a driver of the host vehicle 2 and autonomous braking of the host vehicle 2.

[0039] In a further embodiment, the means for establishing a risk zone in front of the host vehicle 2 are arranged to establish the risk zone as an area representing the predicted coverage of the host vehicle 2 based on the host vehicle 2 width w.

[0040] In a yet further embodiment, the means for establishing a risk zone in front of the host vehicle 2 are further arranged to establish the risk zone taking curvature into account by using the current yaw rate of the host vehicle 2 and curving the risk zone accordingly.

[0041] In a still further embodiment, the means for establishing a risk zone in front of the host vehicle 2 are further arranged to establish the risk zone through, in addition to the host vehicle 2 width w, applying an extra width d on each side of the host vehicle 2, as illustrated in figure 3.

[0042] In another further embodiment, the host vehicle 2 is equipped with a lane marker sensor (not shown) for detection of lane markers 11 and that either the area between the detected left hand side and right hand side lane markers 11 is used to define the risk zone or, in the case that only lane markers 11 at one side of the host vehicle 2 are detected, these detected lane markers 11 at one side of the host vehicle 2 are used for defining that side of the risk zone whilst the host vehicle 2 width w and an additional width d are used for defining the other side of the risk zone, as illustrated in figure 3.

[0043] In a still further embodiment, the means for executing a collision avoidance task are further arranged such that if the target object 10, based on its current position, velocity and acceleration, is predicted as being able to accelerate, through applying a certain predetermined maximum acceleration in the direction of its velocity, and thereby escape the risk zone before the host vehicle 2 reaches the target object in a longitudinal direction x no collision avoidance task is executed.

[0044] In yet another further embodiment, the means for estimating the position, velocity and acceleration of the target object 10 are further arranged such that if the estimated acceleration of the target object 10 lies within a first range, when attempting to stop before entering the risk zone through applying a certain predetermined maximum acceleration in a direction opposite to its velocity and a collision avoidance task is executed, the collision avoidance task of providing a warning to a driver of the host vehicle 2 is executed, and if the estimated acceleration of the target object 10 lies within a second range, when attempting to stop before entering the risk zone through applying a certain predetermined maximum acceleration in a direction opposite to its velocity and a collision avoidance task is executed, the collision avoidance task of performing autonomous braking of the host vehicle 2 is executed.

[0045] The present invention also relates to a method in an automotive vehicle forward collision avoidance system 1 suitable to be utilized in an automotive vehicle forward collision avoidance system 1 as described above.

[0046] The present invention also relates to an automotive vehicle 2 comprising an automotive vehicle forward collision avoidance system 1 as described above.

[0047] The invention is not limited to the above-de-

scribed embodiments, but may be varied within the scope of the following claims.

[0048] Thus, while there have been shown and described and pointed out fundamental novel features of the invention as applied to a preferred embodiment thereof, it will be understood that various omissions and substitutions and changes in the form and details of the devices illustrated, and in their operation, may be made by those skilled in the art. For example, it is expressly intended that all combinations of those elements and/or method steps which perform substantially the same function in substantially the same way to achieve the same results are within the scope of the invention. Moreover, it should be recognized that structures and/or elements and/or method steps shown and/or described in connection with any disclosed form or embodiment of the invention may be incorporated in any other disclosed or described or suggested form or embodiment as a general matter of design choice. It is the intention, therefore, to be limited only as indicated by the scope of the claims appended hereto.

Claims

1. An automotive vehicle forward collision avoidance system (1), **characterized in that** it comprises:

   means for establishing the presence of a target object (10) in front of a vehicle (2) hosting said system (1);
   means for estimating the position, velocity and acceleration of the target object (10); means for establishing a risk zone in front of the host vehicle (2);
   means for predicting the future path of the target object (10) and the host vehicle (2) in order to predict the lateral position (y) of the target object (10) at a moment when the host vehicle (2) reaches the target object in a longitudinal direction (x);
   means for executing a collision avoidance task arranged such that:

   - if the target object (10), based on its current position, velocity and acceleration, is predicted as being able to stop before entering the risk zone through applying a certain predetermined maximum acceleration in a direction opposite to its velocity, it is predicted to stop at a position just before entering the risk zone and no collision avoidance task is executed; and;
   - if the target object (10), based on its current position, velocity and acceleration, is predicted as not being able to stop before entering the risk zone, then the future position of the target object (10) is predicted using the assumption that the target object (10) will continue to move according to an observation based motion model and a collision avoidance task is executed.

2. A system (1) according to claim 1, **characterized in that** the means for executing a collision avoidance task are arranged to provide at least one of a warning to a driver of the host vehicle (2) and autonomous braking of the host vehicle (2).

3. A system (1) according to any one of claims 1 or 2, **characterized in that** the means for establishing a risk zone in front of the host vehicle (2) are arranged to establish the risk zone as an area representing the predicted coverage of the host vehicle (2) based on the host vehicle (2) width (w).

4. A system (1) according to claim 3, **characterized in that** the means for establishing a risk zone in front of the host vehicle (2) are further arranged to establish the risk zone taking curvature into account by using the current yaw rate of the host vehicle (2) and curving the risk zone accordingly.

5. A system (1) according to any one of claims 3 or 4, **characterized in that** the means for establishing a risk zone in front of the host vehicle (2) are further arranged to establish the risk zone through in addition to the host vehicle (2) width (w) applying an extra width (d) on each side of the host vehicle (2).

6. A system (1) according to claim 3, **characterized in that** the host vehicle (2) is equipped with a lane marker sensor for detection of lane markers and that either the area between the detected left hand side and right hand side lane markers (11) is used to define the risk zone or, in the case that only lane markers (11) at one side of the host vehicle (2) are detected, these detected lane markers (11) at one side of the host vehicle 2 are used for defining that side of the risk zone whilst the host vehicle (2) width (w) and an additional width (d) are used for defining the other side of the risk zone.

7. A system (1) according to claims 1, **characterized in that** the means for executing a collision avoidance task further are arranged such that if the target object (10), based on its current position, velocity and acceleration, is predicted as being able to accelerate, through applying a certain predetermined maximum acceleration in the direction of its velocity, and thereby escape the risk zone before the host vehicle (2) reaches the target object (10) in a longitudinal direction (x) no collision avoidance task is executed.

8. A system (1) according to claim 1,

characterized in that the means for estimating the position, velocity and acceleration of the target object (10) further are arranged such that if the estimated acceleration of the target object (10) lies within a first range when attempting to stop before entering the risk zone through applying a certain predetermined maximum acceleration in a direction opposite to its velocity and a collision avoidance task is executed, the collision avoidance task of providing a warning to a driver of the host vehicle (2) is executed, and if the estimated acceleration of the target object (10) lies within a second range when attempting to stop before entering the risk zone through applying a certain predetermined maximum acceleration in a direction opposite to its velocity and a collision avoidance task is executed, the collision avoidance task of performing autonomous braking of the host vehicle (2) is executed.

9. A method in an automotive vehicle forward collision avoidance system, **characterized in that** it comprises the steps of:

establishing the presence of a target object (10) in front of a vehicle (2) hosting said system;
estimating the position, velocity and acceleration of the target object (10);
establishing a risk zone in front of the host vehicle (2);
predicting the future path of the target object (10) and the host vehicle (2) in order to find its lateral position at a moment when the host vehicle (2) reaches the target object (10) in a longitudinal direction;
executing a collision avoidance task arranged such that:

- if the target object (10), based on its current position, velocity and acceleration, is predicted as being able to stop before entering the risk zone, it is predicted to stop at a position just before entering the risk zone and no collision avoidance task is executed;
- if the target object (10), based on its current position, velocity and acceleration, is predicted as not being able to stop before entering the risk zone, then the future position of the target object (10) is predicted using the assumption that the target object (10) will continue to move according to an observation based motion model and a collision avoidance task is executed.

10. An automotive vehicle (2), **characterized in that** it comprises an automotive vehicle forward collision avoidance system (1) according to any one of claims 1 to 7.

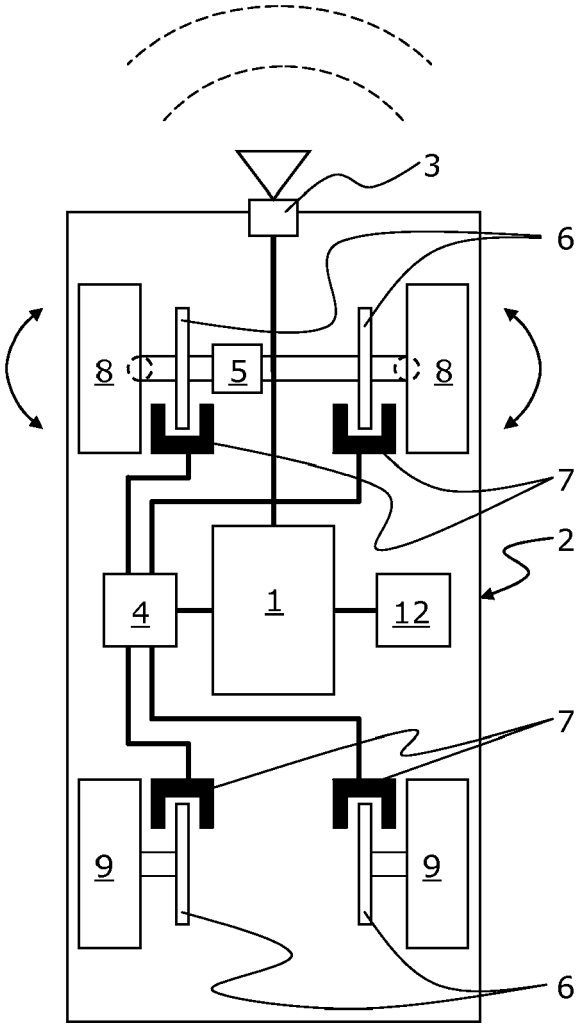


Fig. 1

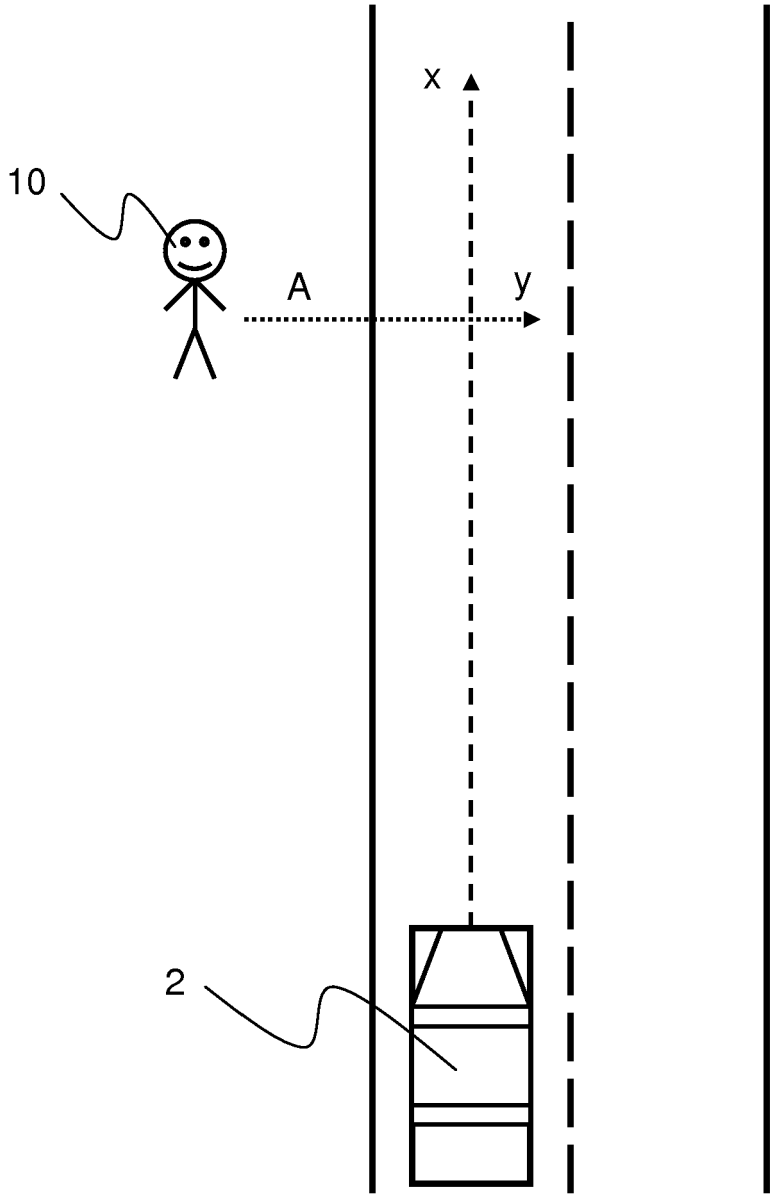


Fig. 2

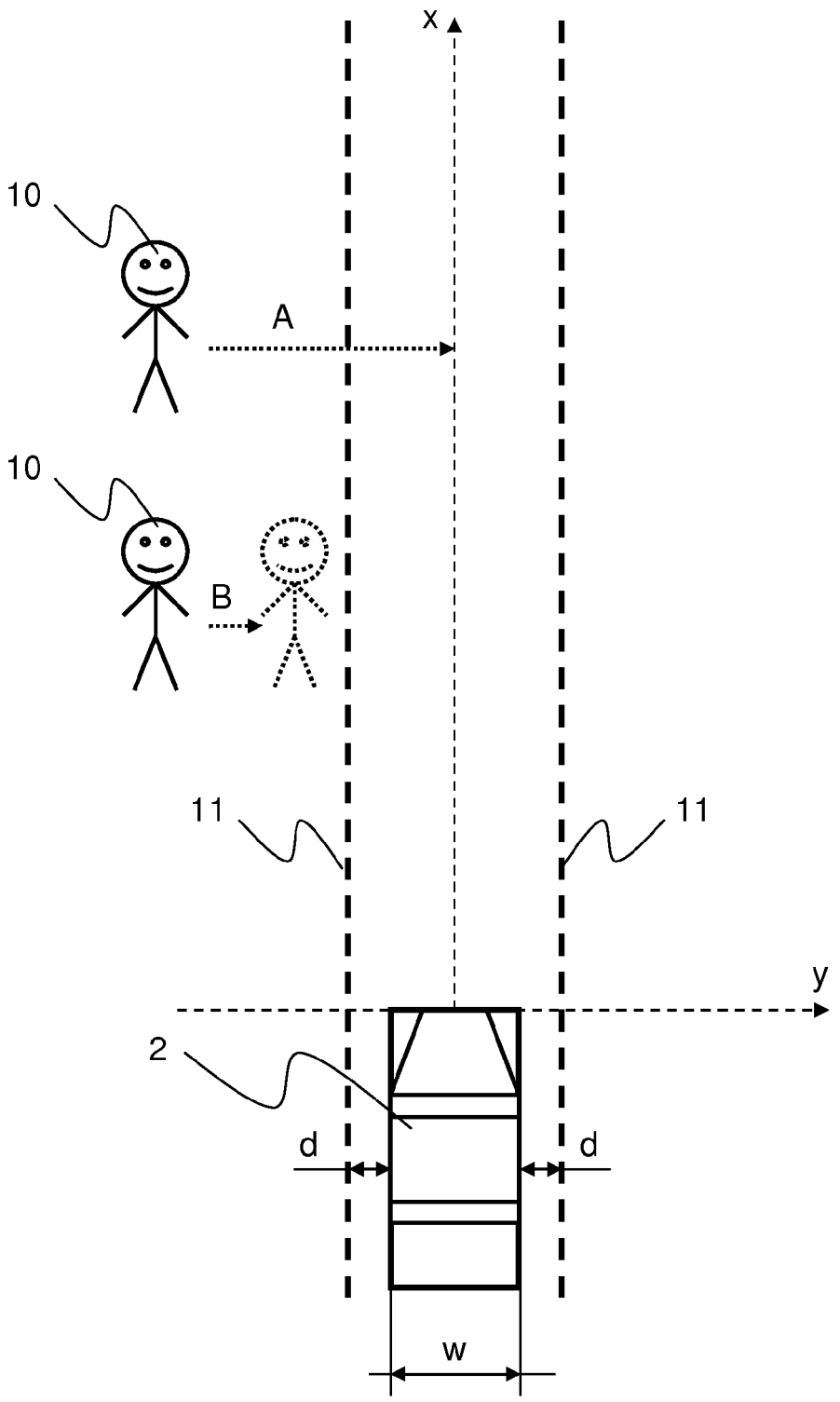


Fig. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 09 15 1294

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X A	EP 2 001 003 A (FORD GLOBAL TECH LLC [US]) 10 December 2008 (2008-12-10) * page 5, line 26 - page 11, line 3; figures 2,3 * * page 11, line 30 - page 13, line 16; figure 4 * -----	1,2,7,9, 10 3-5,8	INV. G08G1/16 B60W30/08
X A	US 2006/282218 A1 (URAI YOSHIHIRO [JP] ET AL) 14 December 2006 (2006-12-14) * abstract * * page 2, paragraph 32 - page 4, paragraph 64; figures 1-5 * -----	1,2,7,9, 10 3-5,8	
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TECHNICAL FIELDS SEARCHED (IPC)
G08G
B60W

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	28 April 2009	Heß, Rüdiger

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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D : document cited in the application
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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 09 15 1294

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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