



- (51) International Patent Classification:
B62D 15/02 (2006.01) *B60T 8/17* (2006.01)
- (21) International Application Number:
PCT/EP2017/063305
- (22) International Filing Date:
01 June 2017 (01.06.2017)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
10 2016 110 305.5
03 June 2016 (03.06.2016) DE
- (71) Applicant: **CONNAUGHT ELECTRONICS LTD.**
[IE/IE]; Dunmore Road, Tuam, County Galway (IE).
- (72) Inventors: **TOGHER, Mike**; 31 Chochran, Kilcloghans,
Tuam, County Galway (IE). **WARD, Enda Peter**;
18 Castlegrouds, Corofin, County Galway (IE).
O'MALLEY, Fergal; Dunmore Road, Tuam, County Galway (IE).

(74) Agent: **JAUREGUI URBahn, Kristian**; VALEO
SCHALTER UND SENSOREN GMBH, Laiernstr. 12,
74321 Bietigheim-Bissingen (DE).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

(54) Title: METHOD FOR ASSISTING A DRIVER OF A MOTOR VEHICLE IN MANEUVERING THE MOTOR VEHICLE WITH A TRAILER, DRIVER ASSISTANCE SYSTEM AS WELL AS MOTOR VEHICLE

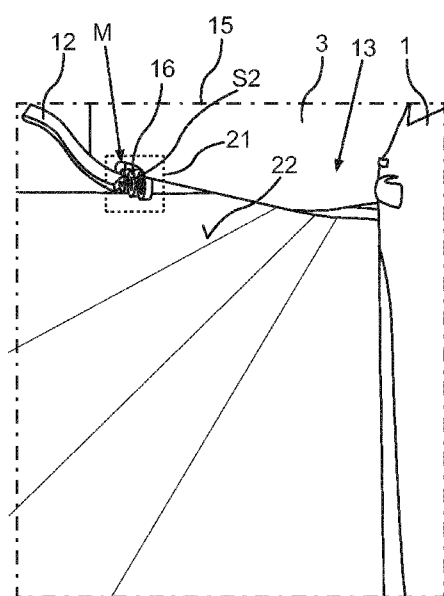


Fig.4

(57) Abstract: The invention relates to a method for assisting a driver of a motor vehicle (1) in maneuvering the motor vehicle (1) with a trailer (3), wherein an image (13) of a rear environmental region (9) of the motor vehicle (1) is captured by means of a rearward looking vehicle-side camera (5), at least one orientation line (12) describing a movement of a wheel (16) of the trailer (3) in maneuvering is predicted, and the at least one orientation line (12) is presented in the image (13) on a vehicle-side display device (11), wherein at least one feature (M) of the trailer (3) is recognized in the image and a start position (S2) for the at least one orientation line (12) is determined in the image (13) based on the at least one feature (M) such that the start position (S2) of the orientation line (12) coincides with a position of the wheel (16) of the trailer (3) in the image (13). The invention additionally relates to a driver assistance system (4) as well as to a motor vehicle (1).

Published:

— *with international search report (Art. 21(3))*

Method for assisting a driver of a motor vehicle in maneuvering the motor vehicle with a trailer, driver assistance system as well as motor vehicle

The invention relates to a method for assisting a driver of a motor vehicle in maneuvering the motor vehicle with a trailer, wherein an image of a rear environmental region of the motor vehicle is captured by means of a rearward looking vehicle-side camera, at least one orientation line describing a movement of a wheel of the trailer in maneuvering is predicted and the at least one orientation line is presented in the image on a vehicle-side display device. In addition, the invention relates to a driver assistance system as well as to a motor vehicle with such a driver assistance system.

It is already known from the prior art to assist a driver of a motor vehicle in maneuvering, in particular in reversing, with a trailer. Thereto, a device is described in US 2008/0231701 A1, which is able to display a predicted movement trajectory or orientation line of the trailer. Therein, an image is captured by a rearward looking camera of the motor vehicle, the movement trajectory is predicted depending on a steering angle of the motor vehicle and the image is displayed together with the movement trajectory. The movement trajectory describes a presumable movement of a wheel of the trailer with the current steering angle of the motor vehicle and therein is to be displayed starting from the wheel of the trailer.

For determining a start position, starting from which the orientation line is displayed on the display device and which ideally is to coincide with the position of the wheel in the image, usually, geometric dimensions of the trailer are used. These geometric dimensions are for example manually input by a user or driver of the motor vehicle. Such geometric dimensions can for example be a width of the trailer, a distance of the tow coupling to a center of the trailer axle or a length of the trailer. However, in this manual input of the geometric dimensions, it can occur that this geometric data or information is not sufficiently exactly known and thus results in an incorrect positioning of the orientation line

in the image. Usually, a control mechanism either does not exist, by which the driver is prevented from false input of values. In that the driver has to actively perform the input of the data, problems in the acceptance of the driver assistance system on the part of the driver can additionally arise.

It is the object of the present invention to provide a solution, how a driver of the motor vehicle can be assisted in maneuvering the motor vehicle with a trailer in particularly simple and low-effort manner.

According to the invention, the object is solved by a method, a driver assistance system as well as a motor vehicle according to the respective independent claims. Advantageous embodiments of the invention are the subject matter of the dependent claims, of the description as well as of the figures.

In an embodiment of a method for assisting a driver of a motor vehicle in maneuvering the motor vehicle with a trailer, an image of a rear environmental region of the motor vehicle is captured by means of a rearward looking vehicle-side camera. In particular, at least one orientation line describing a movement of a wheel of the trailer in maneuvering is then predicted and the at least one orientation line is presented in the image on a vehicle-side display device. Moreover, at least one predetermined feature of the trailer can be recognized in the image and a start position for the at least one orientation line can be determined in the image based on the at least one feature such that the start position of the orientation line coincides with a position of the wheel of the trailer in the image.

Preferably, in a method according to the invention for assisting a driver of a motor vehicle in maneuvering the motor vehicle with a trailer, an image of a rear environmental region of the motor vehicle is captured by means of a rearward looking vehicle-side camera, at least one orientation line describing a movement of a wheel of the trailer in maneuvering is predicted and the at least one orientation line is presented in the image on a vehicle-side display device. Moreover, at least one predetermined feature of the trailer is recognized in the image, and a start position for the at least one orientation line is determined in the image based on the at least one feature such that the start position of the orientation line coincides with a position of the wheel of the trailer in the image.

By means of the method according to the invention, the driver of a vehicle/trailer combination having the motor vehicle and the trailer is assisted in maneuvering the vehicle/trailer combination, in particular in reversing with the vehicle/trailer combination.

For example, the trailer can be a caravan or a horse trailer. Thereto, at least one image is captured by at least one rearward looking camera, which shows the environmental region behind the motor vehicle as well as the trailer in certain areas. This image captured by the camera is displayed on the vehicle-side display device such that the driver is able to recognize the area behind the motor vehicle on the display device. Therein, multiple images, in particular a video sequence, are in particular captured by the at least one camera and displayed on the display device.

Therein, the image is in particular captured from a perspective, from which the trailer is visible in certain areas in the image and thereby on the display device. Preferably, the rear environmental region is captured by means of a rear camera or a reversing camera and/or by means of at least one wing mirror camera. The image of the reversing camera can in particular be used if the trailer has a low height and thus does not cover the rear camera. In particular, the images of the wing mirror cameras are used, in which usually a lateral area of the trailer extending along a longitudinal axis of the trailer is additionally visible.

Therein, orientation lines are presented on the display device in particular in addition to the image of the rear environmental region and the trailer. The orientation lines describe a movement of the trailer, in particular of the wheels of the trailer. Usually, two parallel extending orientation lines are determined, which visualize the movement of both wheels of the trailer (with a single-axle trailer) or the movement of both rear wheels of the trailer (with a multi-axle trailer). Thus, the orientation lines are trajectories or movement trajectories, along which the wheels of the trailer will presumably move. These orientation lines are usually determined depending on a steering angle of the motor vehicle. A pivot angle of the trailer, which describes an angle between a longitudinal axis of the trailer and a vehicle longitudinal axis, can also be taken into account in determining the orientation line. The orientation lines can for example be presented as colored lines on the display device and be superimposed on the image also presented there. Therein, the extension of the orientation line is in particular continuously updated, for example when the steering angle of the motor vehicle and/or the pivot angle of the trailer change.

Now, in order to ensure that the respective orientation line is correctly displayed starting from that wheel of the trailer, the movement of which the orientation line visualizes, the start position of the orientation line is determined based on the image. Thereto, the at least one feature of the trailer is recognized in the image showing the trailer in certain areas. For example, the image is subjected to pattern recognition and thereby the at least one feature is identified. By this predetermined feature, in particular the position of the

wheels is defined in the image. Based on the at least one feature, the start position of the orientation line can then be determined, for example by determining the position of the wheel in the image based on the at least one feature and setting this determined position of the wheel as the start position.

Thus, in the method according to the invention, it is not required that the driver of the motor vehicle has to become active and has to input geometric data of the trailer. Thus, the orientation line can also be prevented from being presented in a false start position, for example spaced from the wheel of the trailer, in the image on the display device for example due to false input and/or due to inaccuracies of the geometric data. Thus, the start position of the orientation line can be particularly exactly and reliably determined in advantageous manner by means of the method, in particular without the driver having to become active thereto.

Particularly preferably, the wheel of the trailer itself is recognized in the image of the camera as the at least one feature, the position of the wheel of the trailer is determined in the image and the start position of the orientation line is determined as the position of the wheel. In other words, this means that the at least one image captured by the vehicle-side camera is searched for the at least one wheel, and after recognizing the wheel, the position of the wheel is determined. Depending on the position of the wheel, the start position for the orientation line describing the movement of this wheel can then be particularly simply determined. In particular, the at least one image is subjected to pattern recognition with respect to the wheel for recognizing the at least one wheel of the trailer. Herein, the invention is based on the realization that the wheels have a specific shape and color and thus can be identified by means of pattern recognition without much effort. Preferably, the at least one image is searched for an ellipse, in particular a black ellipse, in the pattern recognition. Namely, due to the capture of the image from the perspective of the motor vehicle, the wheels of the trailer are represented as ellipses in the image of the camera. For example, the wheel of the trailer can be recognized in the image by means of a Hough transform. Thereto, edges in the image can be detected for example based on detection of color transitions in the image, and the image can be searched for parameterizable geometric figures, for example ellipses, after the edge recognition by means of the Hough transform.

After recognizing the wheel of the trailer, the position of the wheel can be determined in the image, in particular the position of the wheel relative to the motor vehicle. This means that a location of the wheel of the trailer to the motor vehicle can be determined based on

the at least one image. Depending on this position of the wheel, the start position for the at least one orientation line can then be determined in the at least one image, starting from which the orientation line is then presented together with the image on the display device.

If the trailer is a multi-axle trailer, thus, the trailer has more than one wheel on each side, thus, a distance of the wheel relative to the motor vehicle can be determined for each wheel detected based on the image and the rear wheel of the trailer can be identified based on the distance. Starting from the position of the rear wheel in the image, the orientation line can then be determined.

It proves advantageous if an identity of the wheel is made plausible in that a roadway plane for the motor vehicle is additionally detected in the image and it is checked based on the image if the wheel contacts the roadway plane. By means of this step, it can be made plausible if the detected wheel is actually a wheel of the trailer, which is moved or rolled in maneuvering the vehicle/trailer combination. A wheel, which is not rolled in maneuvering, is for example a spare wheel, which can be disposed at an outside of the trailer and thereby can also be captured by the camera. Thus, the start position for the orientation line is to be prevented from being determined as the position of the spare tire in the image. Thereto, the roadway plane of the motor vehicle is additionally detected, and a distance between the roadway plane and the detected wheel is for example determined. If this distance falls below a predetermined threshold value, thus, it is assumed that the detected wheel is an active, rolling wheel of the trailer. If this distance exceeds the predetermined threshold value, thus, it is assumed that the detected wheel is a spare wheel of the trailer. Thus, the orientation line can be prevented from being determined starting from a false, non-plausible position and being presented at a location not comprehensible for the driver on the display device.

It can also be provided that an image region is determined in the image, within which the at least one feature is to be expected, and the image region is searched for the at least one feature. This means that a so-called region of interest (ROI) is determined in the at least one image, which is searched for the at least one feature, for example by means of pattern recognition. The image region can for example be determined depending on an orientation of the camera and/or the pivot angle of the trailer. Thus, computational effort as well as computing time can be reduced in recognizing the at least one feature in the at least one image.

Preferably, the image is only searched for the at least one feature of the trailer if it is detected that a pivot angle between a longitudinal axis of the trailer and a vehicle longitudinal axis exceeds a predetermined threshold value. The pivot angle can for example be detected by a sensor device in a tow coupling of the motor vehicle. At a pivot angle of about 0° , the trailer is in a non-pivoted state such that the longitudinal axis of the trailer is oriented along the vehicle longitudinal axis. In this non-pivoted state, the at least one feature of the trailer, for example the wheel of the trailer, is not or only poorly recognizable in the camera image. In a pivoted state of the trailer, the pivot angle is different from 0° and the longitudinal axis of the trailer is disposed obliquely to the vehicle longitudinal axis starting from the tow coupling. In the pivoted state of the trailer, the at least one feature is in a field of view or capturing range of the camera and can be recognized or identified in the image.

In a development of the invention, at least one geometric dimension of the trailer, in particular a width of the trailer, is determined and the start position of the at least one orientation line determined based on the image is made plausible based on the geometric dimension. In particular, for determining the geometric dimension, a user input of a user of the motor vehicle is acquired by a vehicle-side input device. In other words, this means that the user of the motor vehicle inputs values for the at least one geometric dimension, in particular the width of the trailer, into the vehicle-side input device. By the width of the trailer and the current pivot angle of the trailer, it can in particular be checked if the position of the wheel of the trailer determined based on the image is plausible. Thereby, it can also be checked if the start position for the orientation line is correctly determined and displayed. Thus, the method is particularly reliably configured.

Alternatively or additionally, a number of axles of the trailer can be determined as the at least one feature, a center of gravity of the trailer can be determined based on the number of axles and the start position of the at least one orientation line can be determined based on the center of gravity. By the number of axles, it can be determined if the trailer is a single-axle trailer, for example a caravan with tandem axle, or a multi-axle trailer, for example a horse trailer with twin axle. Based on the information on the number of axles, the center of gravity of the trailer and thereby the start position of the at least one orientation line can then be determined or made plausible in particularly simple manner.

In addition, the invention relates to a driver assistance system for assisting a driver of a motor vehicle in maneuvering the motor vehicle with a trailer, which has a rearward looking camera for capturing an image of a rear environmental region of the motor vehicle,

an evaluation device for predicting at least one orientation line describing a movement of a wheel of the trailer in maneuvering and a display device for presenting the at least one orientation line in the image in an embodiment. In particular, the evaluation device is adapted to recognize at least one predetermined feature of the trailer in the image and to determine a start position for the at least one orientation line in the image based on the at least one feature such that the start position of the orientation line coincides with a position of the wheel of the trailer in the image.

In a preferred embodiment of the driver assistance system for assisting a driver of a motor vehicle in maneuvering the motor vehicle with a trailer, it comprises a rearward looking camera for capturing an image of a rear environmental region of the motor vehicle, an evaluation device for predicting at least one orientation line describing a movement of a wheel of the trailer in maneuvering and a display device for presenting the at least one orientation line in the image. Moreover, the evaluation device is adapted to recognize at least one predetermined feature of the trailer in the image and to determine a start position for the at least one orientation line in the image based on the at least one feature such that the start position of the orientation line coincides with a position of the wheel of the trailer in the image.

A motor vehicle according to the invention includes a driver assistance system according to the invention. In particular, the motor vehicle is formed as a passenger car, which has a tow coupling for coupling a trailer to the motor vehicle.

The preferred embodiments presented with respect to the method according to the invention and the advantages thereof correspondingly apply to the driver assistance system according to the invention as well as to the motor vehicle according to the invention.

With indications of "behind", "rearward", "vehicle longitudinal axis", "lateral", etc., the positions and orientations given with an observer sitting in an interior of the motor vehicle and looking in the direction of a vehicle longitudinal axis are specified.

Further features of the invention are apparent from the claims, the figures and the description of figures. The features and feature combinations mentioned above in the description as well as the features and feature combinations mentioned below in the description of figures and/or shown in the figures alone are usable not only in the respectively specified combination, but also in other combinations or alone without departing from the scope of

the invention. Thus, implementations are also to be considered as encompassed and disclosed by the invention, which are not explicitly shown in the figures and explained, but arise from and can be generated by separated feature combinations from the explained implementations. Implementations and feature combinations are also to be considered as disclosed, which thus do not have all of the features of an originally formulated independent claim. Moreover, implementations and feature combinations are to be considered as disclosed, in particular by the implementations set out above, which extend beyond or deviate from the feature combinations set out in the relations of the claims.

Now, the invention is explained in more detail based on preferred embodiments as well as with reference to the attached drawings.

There show:

- Fig. 1 a schematic representation of an embodiment of a motor vehicle according to the invention with a trailer in a plan view;
- Fig. 2 a schematic representation of an embodiment of a motor vehicle according to the invention with a trailer in a front view;
- Fig. 3 a schematic representation of a presentation displayed on a display device, which has been generated by means of a method according to the prior art; and
- Fig. 4 a schematic representation of a presentation displayed on a display device, which has been generated by means of an embodiment of the method according to the invention.

In the figures, identical as well as functionally identical elements are provided with the same reference characters.

Fig. 1 shows a motor vehicle 1 according to the present invention in a plan view with a trailer 3 attached to a tow coupling 2 of the motor vehicle 1. In Fig. 2, the motor vehicle 1 with the attached trailer 3 is shown in a front view. The trailer 3 can for example be formed as a caravan or a horse trailer. The motor vehicle 1 includes a driver assistance system 4, which is adapted to assist a driver of the motor vehicle 1 in maneuvering the motor vehicle

1 with the trailer 3 attached thereto. In particular, the driver can be assisted in reversing with the trailer 3.

Thereto, the driver assistance system 4 has at least one rearward looking camera 5. In the present case, the driver assistance system 4 has three rearward looking cameras 5, wherein a first camera 5, a so-called rear camera, is attached to a rear area 6 of the motor vehicle 1, a second camera 5 is attached to a driver's side 7 of the motor vehicle 1 and a third camera 5 is attached to a passenger side 8 of the motor vehicle 1. The second and the third camera 5 are so-called wing mirror cameras and can be disposed at a respective wing mirror or at the motor vehicle 1 instead of a respective wing mirror. The cameras 5 are cameras 5 looking rearward, thus along a rearward direction R, which can capture an environmental region 9 of the motor vehicle 1 behind the motor vehicle 1 in images 13 (see Fig. 3 and Fig. 4). Therein, the images 13 captured by the rearward looking cameras 5 in particular also show the trailer 3 in certain areas.

In addition, the driver assistance system 4 has an evaluation device 10, which can for example be formed by a vehicle-side control unit. The evaluation device 10 serves for processing the images 13 of the environmental region 9 captured by the cameras 5 and for example providing them to a display device 11 of the driver assistance system 4. The display device 11 can for example be disposed in an interior of the motor vehicle 1. The display device 11 can for example be formed as a screen in a dashboard of the motor vehicle 1 and/or as a head-up display. The images 13 of the rear environmental region 9 captured by the cameras 5 can be presented on the display device 11, wherein the area of the trailer 3 located in the images 13 is in particular also displayed on the display device 11.

Now, in order to assist the driver in maneuvering the motor vehicle 1 with the trailer 3, so-called orientation lines 12 (see Fig. 3 and 4) can be displayed on the display device 11 in addition to the images 13 of the camera 5, which are superimposed on the images 13 captured by the camera 5. Therein, the orientation lines 12 are to visualize a movement trajectory of the one wheel 16 of the trailer 3, along which the wheel 16 of the trailer 3 will move depending on a current steering angle of the motor vehicle 1. Thereto, the orientation lines 12 are to start ideally from the wheel 16 of the trailer 3, for example a rear wheel of a multi-axle trailer 3.

In Fig. 3, therein, a presentation 14 output by the display device 11 is shown, which includes the image 13 captured by the camera 5 as well as an orientation line 12

superimposed on the image 13. Therein, a start position S1 of the orientation line 12 was determined by means of a method according to the prior art. Herein, it is visible that the orientation line 12 does not start from the wheel 16 of the trailer 3, but is positioned spaced from the wheel 16 of the trailer 3. The start position S1 of the orientation line 12 is therefore different from a position of the wheel 16 in the image 13. For example, this can result from the fact that the start position S1 of the orientation line 12 has been determined depending on at least one geometric dimension of the trailer 3, however, the value of which is incorrect or inaccurate. This geometric dimension, for example a width 17 of the trailer 3 or a length of a drawbar 18 of the trailer 3, can for example have been incorrectly or inaccurately input into a vehicle-side input device by the driver of the motor vehicle 1.

Now, in order to prevent such an incorrect presentation 14, as it is shown in Fig. 3, the evaluation device 10 of the driver assistance system 4 according to the invention is adapted to correctly determine a start position S2 of the orientation line 12. A correct representation 15 with the image 13 as well as with the orientation line 12 superimposed on the image 13 is shown in Fig. 4. Thereto, the evaluation device 10 recognizes at least one predetermined feature M of the trailer 3 in the image 13 captured by at least one of the cameras 5, based on which the evaluation device 10 can determine the start position S2 of the orientation line 12 in the image 13. Based on this feature M, the evaluation device 10 can for example determine the position of the wheel 16 in the image 13. In particular, the wheel 16 itself is recognized as the feature M of the trailer 3, starting from which the orientation line 12 is to be displayed on the display device 11 in the image 13. Depending on this position of the wheel 16 of the trailer 3, the start position S2 for the orientation line 12 is then determined. The start position S2 can for example be determined at a rear edge of the wheel 16, which is formed adjoining to the rear environmental region 9 of the motor vehicle 1. The orientation line 12 is then positioned in this start position S2.

Therein, it is in particular provided that the at least one image 13 is only searched for the feature M if a pivot angle between a longitudinal axis 19 of the trailer 3 and a vehicle longitudinal axis 20 (see Fig. 1) exceeds a predetermined threshold value. According to Fig. 1, the trailer 3 is shown in a non-pivoted state such that the pivot angle is about 0°. In this non-deflected state, the feature M, in particular the wheel 16, of the trailer 3 is not or only poorly recognizable in the image 13. In Fig. 2, the trailer 3 is shown in a pivoted state such that the pivot angle is greater than 0°. For example, in the image 13 captured by the passenger-side camera 5, one of the wheels 16, here the passenger-side rear wheel 16 of

the trailer 3, is represented and can be recognized or identified in the image 13 by the evaluation device 10.

For example, the feature M can be recognized in the image 13 by means of pattern recognition. Thereto, an image region 21 can in particular be determined in the image 13, in which the feature M is to be expected. This image region 21, a so-called region of interest or ROI is then searched for the at least one feature M, thus here for the at least one wheel 16. In particular, the image region 21 is searched for an ellipse for recognizing the wheel 16. Thereto, edges, in particular color transitions, are first recognized in the image 13 and the image 13 is then for example searched for the ellipse. For example, this can be effected via a Hough transform, by means of which parameterizable geometric shapes like ellipses or circles can be recognized in the images 13.

In addition, the identity of the wheel 16 can be made plausible. This means that it is checked if the recognized wheel 16 is in fact that active wheel of the trailer 3, which will move along the predicted orientation line 12. For making plausible, a roadway plane 22 of the motor vehicle 1 is additionally detected in the image 13, and it is checked if the detected wheel 16 contacts the roadway plane 22. Namely, a spare tire for the trailer 3, which can for example be laterally disposed at the trailer 3 and is therefore also captured by the camera 5, can thus be prevented from being erroneously identified as the feature M in the image 13 and thus the orientation line 12 can be prevented from being erroneously determined starting from this spare tire.

Alternatively or additionally, a number of axles of the trailer 3 can be detected as the at least one feature M and thus a center of gravity 23 (see Fig. 1) of the trailer 3 can be determined. In Fig. 1, a two-axle trailer 3 is for example shown. Depending on this center of gravity 23 of the trailer 3, which is between the two axles of the trailer, the start position S2 for the orientation line 12 can then be determined or the start position S2 of the orientation line 12 determined based on the wheel 16 recognized in the image 13 can be made plausible.

Claims

1. Method for assisting a driver of a motor vehicle (1) in maneuvering the motor vehicle (1) with a trailer (3), wherein an image (13) of a rear environmental region (9) of the motor vehicle (1) is captured by means of a rearward looking vehicle-side camera (5), at least one orientation line (12) describing a movement of a wheel (16) of the trailer (3) in maneuvering is predicted, and the at least one orientation line (12) is presented in the image (13) on a vehicle-side display device (11),
characterized in that
at least one feature (M) of the trailer (3) is recognized in the image and a start position (S2) for the at least one orientation line (12) is determined in the image (13) based on the at least one feature (M) such that the start position (S2) of the orientation line (12) coincides with a position of the wheel (16) of the trailer (3) in the image (13).
2. Method according to claim 1,
characterized in that
the wheel (16) of the trailer (3) itself is recognized in the image (13) of the camera (5) as the at least one feature (M), the position of the wheel (16) of the trailer (3) is determined in the image (13) and the start position (S2) of the at least one orientation line (12) is determined as the position of the wheel (16).
3. Method according to claim 2,
characterized in that
the image (13) is subjected to pattern recognition with respect to a wheel for recognizing the wheel (16) of the trailer (3).

4. Method according to claim 3,
characterized in that
the image (13) is searched for an ellipse in the pattern recognition for recognizing
the wheel (16).
5. Method according to any one of claims 2 to 4,
characterized in that
an identity of the wheel (16) is made plausible in that a roadway plane (22) for the
motor vehicle (1) is additionally detected in the image (13) and it is checked based
on the image (13) if the wheel (16) of the trailer (3) contacts the roadway plane (22).
6. Method according to any one of claims 2 to 5,
characterized in that
the wheel (16) of the trailer (3) is recognized in the image (13) by means of a Hough
transform.
7. Method according to any one of the preceding claims,
characterized in that
an image region (21) is determined in the image (13), within which the at least one
feature (M) is to be expected, and the image region (21) is searched for the at least
one feature (M).
8. Method according to any one of the preceding claims,
characterized in that
the image (13) is only searched for the at least one feature (M) of the trailer (3) if it is
detected that a pivot angle between a longitudinal axis (19) of the trailer (3) and a
vehicle longitudinal axis (20) exceeds a predetermined threshold value.
9. Method according to any one of the preceding claims,
characterized in that
at least one geometric dimension of the trailer (3), in particular a width (17) of the
trailer (3), is determined and the start position (S2) of the at least one orientation line
(12) determined based on the image (13) is made plausible based on the at least
one geometric dimension.

10. Method according to claim 9,
characterized in that
a user input of a user of the motor vehicle (1) is acquired by a vehicle-side input device for determining the geometric dimension.
11. Method according to any one of the preceding claims,
characterized in that
a number of axles of the trailer (3) is determined as the at least one feature (M), a center of gravity (23) of the trailer (3) is determined based on the number of axles and the start position (S2) of the at least one orientation line (12) is determined based on the center of gravity (23).
12. Method according to any one of the preceding claims,
characterized in that
the image (13) is captured by means of a reversing camera (5) and/or at least one wing mirror camera (5) of the motor vehicle (1).
13. Driver assistance system (4) for assisting a driver of a motor vehicle (1) in maneuvering the motor vehicle (1) with a trailer (3), comprising a rearward looking camera (5) for capturing an image (13) of a rear environmental region (9) of the motor vehicle (1), comprising an evaluation device (10) for predicting at least one orientation line (12) describing a movement of a wheel (16) of the trailer (3) in maneuvering and comprising a display device (11) for presenting the at least one orientation line (12) in the image (13),
characterized in that
the evaluation device (10) is adapted to recognize at least one predetermined feature (M) of the trailer (3) in the image (13) and to determine a start position (S2) for the at least one orientation line (12) in the image (13) based on the at least one feature (M) such that the start position (S2) of the orientation line coincides with a position of the wheel (16) of the trailer (3) in the image (13).
14. Motor vehicle (1) with a driver assistance system (4) according to claim 13.

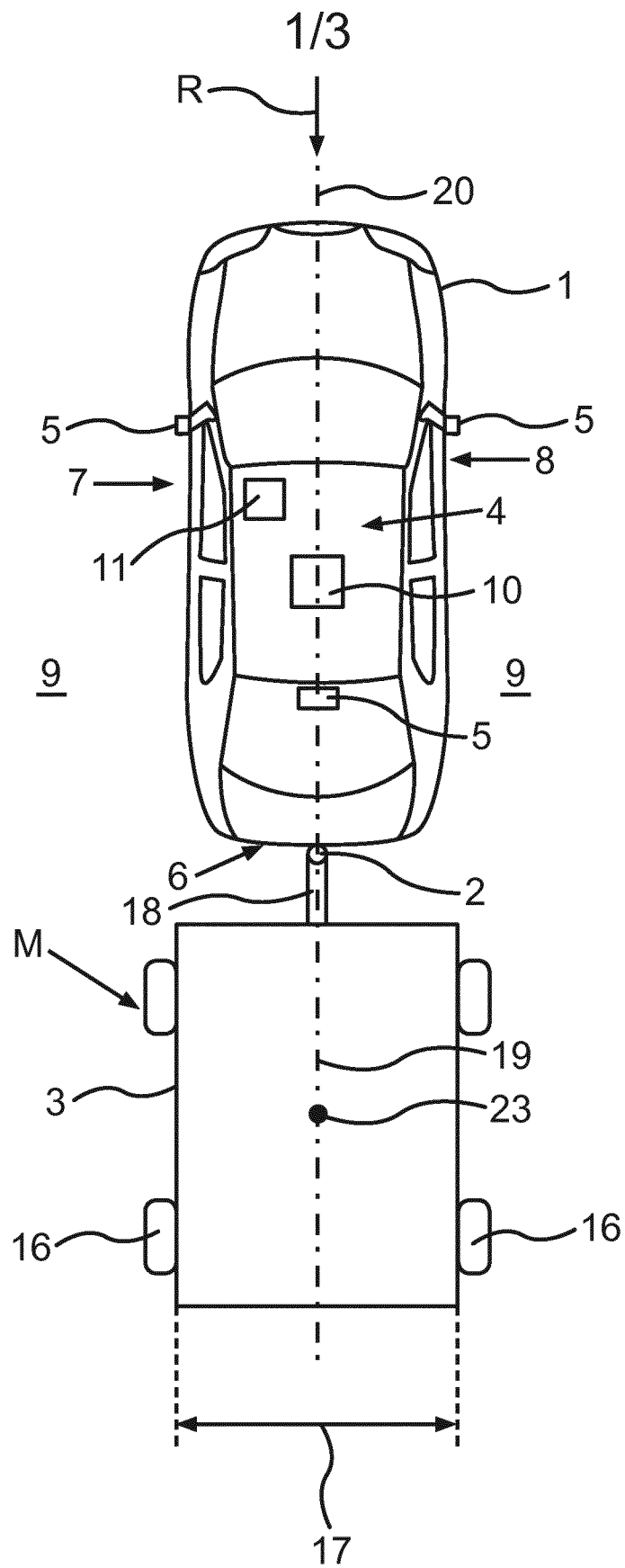


Fig.1

2/3

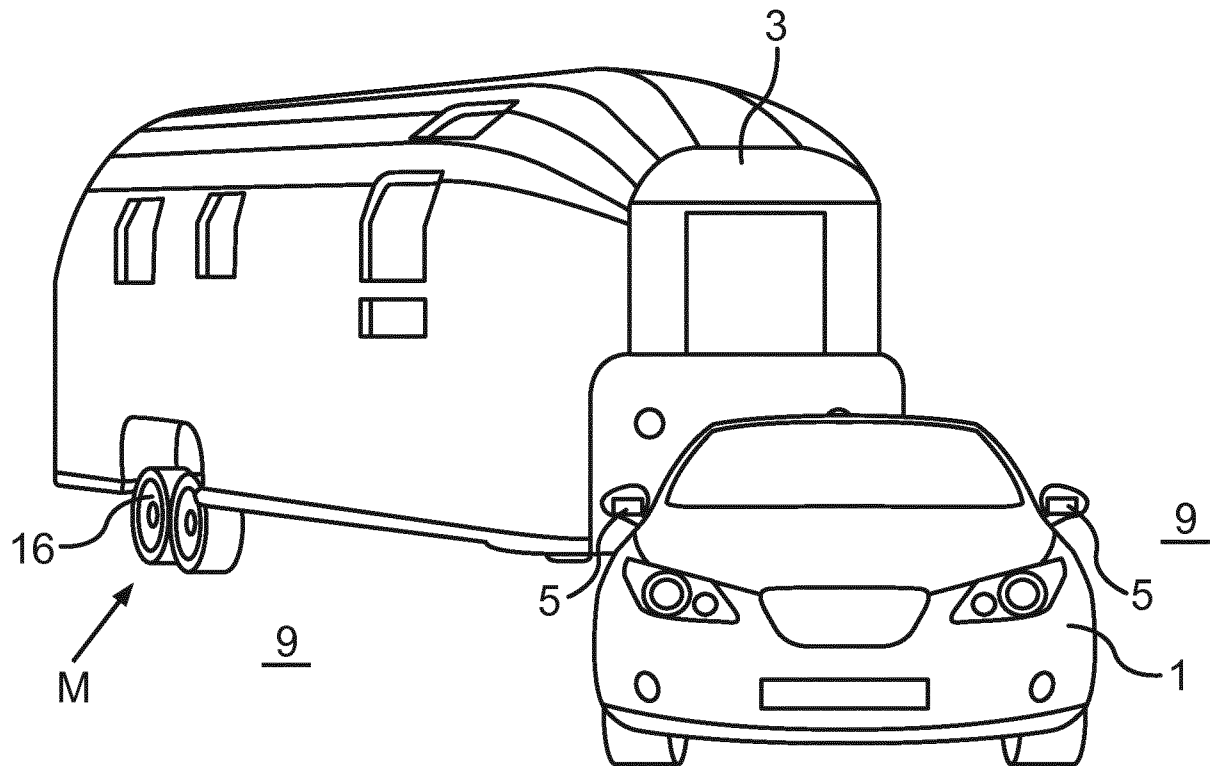


Fig.2

3/3

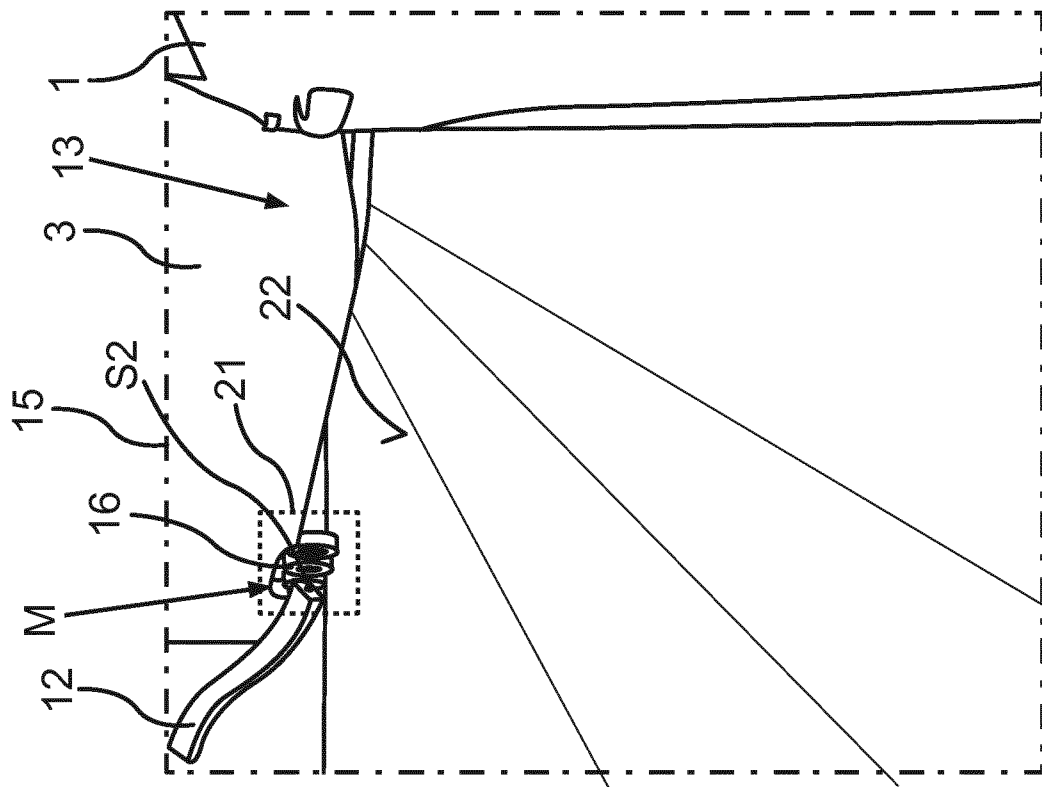


Fig. 4

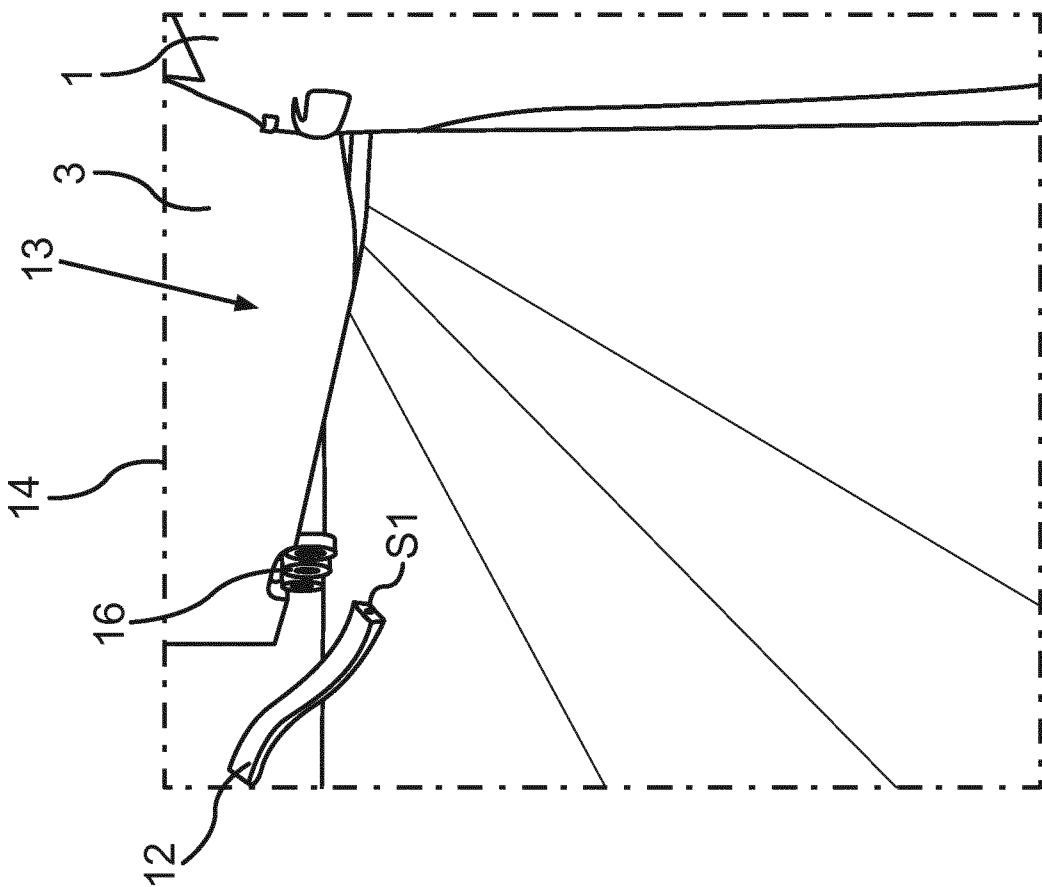


Fig. 3

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2017/063305

A. CLASSIFICATION OF SUBJECT MATTER

INV. B62D15/02 B60T8/17
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B62D B60T

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2014/160276 A1 (PLIEFKE SEBASTIAN [DE] ET AL) 12 June 2014 (2014-06-12)	1,2,9, 12-14
Y	paragraphs [0028], [0055]; claims; figures	3,4,7, 10,11
A	-----	5,6,8
Y	US 2015/344010 A1 (KURTOVIC KENAN [US] ET AL) 3 December 2015 (2015-12-03)	3,7,10, 11
	paragraphs [0032], [0033]; claims; figures	
Y	JP 2014 002056 A (HINO MOTORS LTD) 9 January 2014 (2014-01-09)	4
	paragraph [0029]; claims; figures	



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

4 July 2017

Date of mailing of the international search report

19/07/2017

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Ducher, Alban

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2017/063305

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2014160276 A1	12-06-2014	US 2014160276 A1	12-06-2014
		US 2017185852 A1	29-06-2017

US 2015344010 A1	03-12-2015	NONE	

JP 2014002056 A	09-01-2014	JP 6008605 B2	19-10-2016
		JP 2014002056 A	09-01-2014
