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(54) **Title:** METHOD FOR PROVIDING STORED DATA OF A TRAINED PARKING PROCEDURE, CORRESPONDING COMPUTER PROGRAM PRODUCT AND SYSTEM

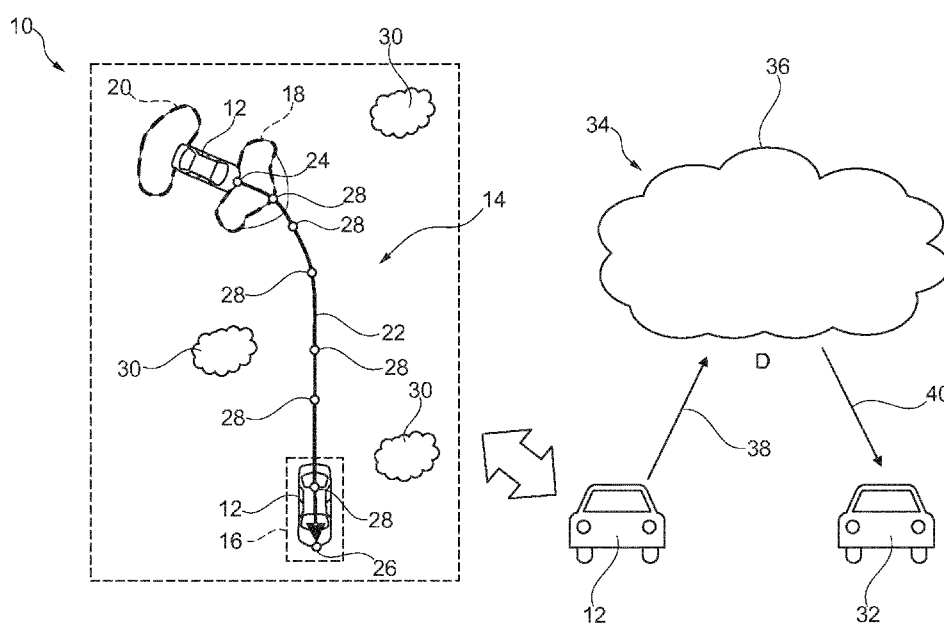


Fig. 1

(57) **Abstract:** The invention relates to a method for providing stored data (D) of a trained parking procedure for performing at least one subsequent parking procedure using said data (D), the data (D) of said trained parking procedure being generated by performing the complete parking procedure or at least a part of the parking procedure with a vehicle (12). It is provided that the data (D) are stored in such a way that the stored data (D) are not only accessible to the vehicle (12) by which the training was performed but also to at least one other vehicle (32). The invention further relates to a corresponding computer program product, and a corresponding system for providing stored data (D) of a trained parking procedure for performing at least one subsequent parking procedure using said data (D).

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Method for providing stored data of a trained parking procedure, corresponding computer program product and system

The invention relates to a method for providing stored data of a trained parking procedure for performing at least one subsequent parking procedure using said data, the data of said trained parking procedure being generated by performing the complete parking procedure or at least a part of the parking procedure with a vehicle.

The invention further relates to a corresponding computer program product and a corresponding trained parking system.

Modern semi-autonomous motor vehicles are designed to park themselves. In order to do this they need to be aware of the geometry of their environment. A new category of automated parking systems is the trained parking system. There are several solutions under development for home trained parking. The driver of the vehicle must train the driver assistance device of the vehicle for the particular path that they wish the vehicle to subsequently follow to park.

Document US 2013/0085637 A1 describes a method for assisting a driver of a motor vehicle when parking in a parking space using a driver assistance device of the motor vehicle, the method comprises a training mode (sometimes called learning mode) and a subsequent operating mode of the driver assistance device different from the training mode, wherein in the training mode of the driver assistance device, reference data related to the surrounding area of the parking space are recorded and stored using a sensor of the driver assistance device, while the motor vehicle is parked in the parking space along a corresponding path while controlled by the driver, a reference target position which is reached by the motor vehicle in the training mode, is recorded by the driver assistance device and data with information about this reference target position are stored, and in the operating mode of the driver assistance device, sensor data are detected by the sensor and compared with the reference data, wherein depending on this comparison the surrounding area of the parking space is identified using the detected sensor data and thereby a current position of the motor vehicle relative to the reference target position is determined and depending on the current position of the motor vehicle relative to the reference target position, a parking route is determined by

the driver assistance device, along which the motor vehicle is parked in the parking space from the current position.

It is an object of the invention to provide measures for providing stored data of a trained parking procedure for performing at least one subsequent parking procedure using said data, which measures enable a highly efficient use of said stored data.

This object is achieved by a method, a computer program product, as well as corresponding system having the features according to the respective independent claims. Advantageous implementations of the invention are the subject matter of the dependent claims, of the description and of the figures.

According to various aspects of the inventive method for providing stored data of a trained parking procedure for performing at least one subsequent parking procedure using said data, which data were generated by performing the complete parking procedure or at least a part of the parking procedure with a vehicle, it is provided that the data are stored in such a way that the stored data are not only accessible to the vehicle by which the training was performed but also to at least one other vehicle. This other vehicle can use the data of the trained parking procedure for performing a subsequent parking procedure in an operating mode just like the vehicle originally used for the training. Both vehicles, the vehicle used for the training and the other vehicle are equipped with a driver assistance device. As a rule, the vehicles are connectable by means of a data transmission technology. One example for such a data transmission is V2V-communication (V2V: vehicle to vehicle). In general these vehicles are motor vehicles.

The biggest advantage of the invention is that a plurality of vehicles can use the stored data of a trained parking procedure, wherein the corresponding training was performed by just one of the vehicles.

In general the data can be stored in the vehicle used for the training, but according to a preferred embodiment of the invention, the data are stored outside this vehicle. Preferably these data are stored by means of an external server.

According to a particularly preferred embodiment of the invention the stored data are accessible via a network. The vehicles using the data are connectable with this network. Preferably the data are stored by means of cloud computing in a cloud within the network.

According to another preferred embodiment of the invention, the data of the trained parking procedure comprise information about the vehicle used for the training. This information preferably is information about the dimensions of said vehicle, the vehicle type of said vehicle, and/or other vehicle related information.

According to yet another preferred embodiment of the invention, the data of the trained parking procedure comprise information about a trajectory describing a path of the vehicle during the training. The data define reference points of the trajectory/path trained in the training mode and/or landmark information about the objects in the surrounding area of said trajectory/path. The trajectory/path is sufficiently described by said reference points.

Preferably the trajectory extends to an end position (a) which is located at a corresponding parking space of the parking procedure ("fully trained parking"); and/or (b) from which at least one parking space can be reached by use of a non-trained automated parking system. Automated parking systems working without training are already in the market (e.g. Valeo Park4U®). Typical maneuver types performable by the automated parking system are, e.g., forward parking, reverse parking, parallel parking, perpendicular parking. Preferably a plurality of the parking spaces are reachable from the end position of the trajectory using the automated parking system.

The computer program product according to the invention comprises computer-executable program code portions having program code instructions configured to execute the aforementioned method.

According to various aspects of the inventive system for providing stored data of a trained parking procedure for performing at least one subsequent parking procedure using said data, the system comprises (i) a vehicle arranged for performing the parking procedure or at least a part of the parking procedure and for generating the data of the trained parking procedure from said performed parking procedure and (ii) a data

memory for storing said data, wherein the data memory is accessible not only to the vehicle by which the training was performed but also to at least one other vehicle. This other vehicle can use the data of the trained parking procedure for performing a subsequent parking procedure in an operating mode just like the vehicle originally used for the training. As a rule, the vehicles are connectable by means of a data transmission technology.

In general the data storage can be located in the vehicle used for the training, but according to a preferred embodiment of the invention the data storage is located outside this vehicle. Preferably these data are stored by means of an external server.

According to another preferred embodiment of this system the data storage is integrated in a network of the system, especially a cloud within the network. In other words the data are stored by means of cloud computing in a cloud within the network.

Further features of the invention are apparent from the claims, the figure and the description of the figure. All of the features and feature combinations mentioned above in the description as well as the features and feature combinations mentioned below in the description of the figure and/or shown in the figure alone are usable not only in the respectively specified combination, but also in other combinations or else alone.

Now, the invention is explained in more detail based on a preferred embodiment as well as with reference to the attached drawing.

In the drawing:

Fig. 1 shows a schematic representation of a system for providing stored data of a trained parking procedure for performing at least one subsequent parking procedure in an operating mode using said data.

Fig. 1 shows a schematic representation of a system for providing stored data D of a trained parking procedure for performing at least one subsequent parking procedure using said data D. This schematic representation includes (on the left side of the figure) a top view of a training scene 10 with a vehicle 12 on a road 14. This vehicle 12 is a motor vehicle, to be more specific: a passenger car. At the end of the road 12 there is a

parking space (parking slot) 16 suitable for said vehicle 12. The vehicle 12 comprises a driver assistance device with at least two sensors (not shown). The sensors used in the example are cameras located at the front area and the rear area of the vehicle 12. Other possible sensors for this purpose are based on ultrasonic, radar, etc. The detection areas of these sensors are corresponding environal regions 18, 20 at the front and rear area of the vehicle 12.

The vehicle 12 is driving on the road 14 along a path given by a trajectory 22 from a reference starting position 24 to a reference end position 26 of said trajectory 22. The trajectory 22 comprises a curved section followed by a straight section and is sufficiently described by a plurality of reference points 28 on the trajectory 22. There is a number of environal objects 30 in a surrounding area of the trajectory 22. The environed objects 30 of the example shown in Fig. 1 are roadside trees.

In the training mode of the driver assistance device (sometimes called learning mode) of vehicle 12: Reference data about the trajectory 22 from the reference starting position 24 to the reference end position 26 are recorded and stored as data D by means of the driver assistance device, while the motor vehicle 12 is driven along said trajectory 22 under driver control. This training mode can be performed by a single vehicle 12 or a plurality of vehicles 12 successive.

The data D of the trained parking procedure comprise information about the vehicle 12 used for the training, namely information about the dimensions of said vehicle 12 (length, width, etc.), the vehicle type of said vehicle, and/or other vehicle related information (turning circle, driver assistance device type, type and number of sensors, sensor positions, etc.). In addition, the data D of the trained parking procedure comprise information about a trajectory 22 describing the path of the vehicle 12 during the training. The data define reference points 28 of the trajectory/path trained in the training mode and/or landmark information about the objects 30 in the surrounding area of said trajectory/path 22. The trajectory/path 22 is sufficiently described by said reference points 28.

The parking procedure shown in Fig. 1 is a fully trained parking procedure. The reference end position 26 of this fully trained parking procedure is located at the parking space 16 of said parking procedure as illustrated in the figure.

Vehicle 12 and another vehicle 32 (or other vehicles 32) are interconnected via a network 34, e.g. a mobile network, which network comprises a (computer) cloud 36 for cloud computing. The corresponding situation is depicted on the right side of fig. 1. Vehicle 12 performs an upload (arrow 38) of the data D of the trained parking procedure to the cloud 36, where the data D are stored. In case the vehicle 12 or another vehicle 32 requires the stored data for performing an operation mode, said vehicle 12, 32 will download the data D (arrow 40) and perform a parking procedure in an operation mode using said data D. In said operating mode of the other vehicle 32 or the vehicle 12 which performed the training procedure, said vehicle 12, 32 is driven to the reference end position 26 of the trajectory 22 under control of the respective driver assistance device using the stored data D.

The usual steps for performing the training mode and the operating mode are, e.g., known from the aforementioned document US 2013/0085637 A1. The main difference is, that the data D are stored in such a way that the stored data D are not only accessible to the vehicle 12 by which the training was performed but also to the at least one other vehicle 32.

Contrary to the just described “fully trained parking”, where the trajectory 22 extends to an end position 26 located at the parking space 16, the trajectory 22 can extend to an end position from which at least one parking space 16 can be reached by use of a non-trained automated parking system (this parking scheme is not shown). This kind of automated parking systems working without training are already in the market (e.g. Valeo Park4U®).

After arriving at the end position 26 from which at least one parking space 16 can be reached, the parking space 16 is selected by the driver by means of a query protocol of the driver assistance device. Finally, the vehicle 12, 32 is parked into the selected parking space 16 under control of the automated parking system working without training (short: non-trained automated parking system) of the driver assistance device.

The corresponding parking path or parking trajectory of this parking manoeuvre is a typical path/trajectory determined by the non-trained automated parking system

reversing the vehicle 12, 32 into the parking space 16 in combination with a subsequent correction until the vehicle 12, 32 reaches the final parking position.

In the following main advantages of the inventive idea are discussed: The ability to store
- either distributed across vehicles 12, 32 or on a central server (especially cloud based)
- and to share data D (including trained trajectory data) with other vehicles 32 has many advantages:

The advantages in a private home situation include but are not limited to:

1) If there is more than one vehicle 12, 32 in the household only a single vehicle 12, 32 needs to be trained. The other vehicles 32 can download the new training data D directly from the trained vehicle 12 or more likely from a central server on arrival at the location. Allowing the choice of potentially multiple trajectories 22.

2) If the scene changes outside of the sensor FOV for a vehicle 12, 32 it will be aware of the changes if another vehicle 12 has previously observed, trained and shared the data D allowing for better trajectory planning of subsequent vehicles 32. It could also the unavailability of trajectories 22 to be shared, for example if blocked.

3) If the trained trajectory data is stored on a central server and the user changes their vehicle 12, 32 then they can load all their used trajectories 22 to their new vehicle 32 without having to retrain for every parking situation.

The advantages in a public parking situation include but are not limited to:

1) The private car park / parking lot can keep the trajectories information on a central server so that all vehicles 12, 32 that arrive to the parking lot can download and the trajectory information and use it to automatically replay. This means even new vehicles 32 that have never trained for the scene are able to use the car park / parking lot.

2) The vehicles 12, 32 using the automated replay function can be constantly updating the trajectory 22 and object data of the objects 30 in the scene 10 to ensure that the latest data is available for new vehicles 32 entering the car park / parking lot.

3) If the scene changes outside of the sensor FOV for a vehicle 32 it will be aware of the changes if another vehicle 12 has previously observed, trained and shared the data D allowing for better trajectory planning of subsequent vehicles 12, 32.

4) It allows for car park management. For example there will be stored trajectories 22 for all levels of a multi-storey carpark. The carpark management system can decide what level that the vehicle 12, 32 should go to, the decision based on level of parking availability. The system could also provide the option to the user on which level they would like to park the vehicle 12, 32 based on availability.

Hereinafter, a typical application situation in connection with a public carpark is described:

1) The driver arrives at the entrance to public carpark and wishes to have his vehicle 32 automatically park.

2) The vehicle 32 communicates with central parking server (located in the cloud 36) to request trajectory information for the carpark.

3) The carpark supplies the data D for available parking positions and levels to the driver to allow specific selection or the carpark automatically selects the most appropriate parking position.

4) The driver can leave the vehicle 32 or remain in it and the vehicle 32 traverses the selected trajectory.

5) The vehicle 32 continually updates the trajectory 22 with new object and feature data.

6) During the trajectory traverse or after the trajectory is complete the vehicle 32 uploads this new information gained while to the cloud 36 for fusion or as an addition to the already available data D.

7) The next user will receive this updated data D on entrance to the carpark.

The trajectory information that is shared with the vehicle 32 can include but is not limited to:

- 1) The parking levels available or selected, distance, time taken, last update for the parking trajectory;
- 2) The pose information for waypoints (keyframes) along the trajectory;
- 3) The associated 3D feature positions and descriptors for a camera, or a 3D point cloud in the case of other sensors such as Lidar;
- 4) The GPS coordinates along the trajectory 22 if available; and
- 5) Error check signal to ensure the trajectory 22 is transferred correctly.

List of Reference signs

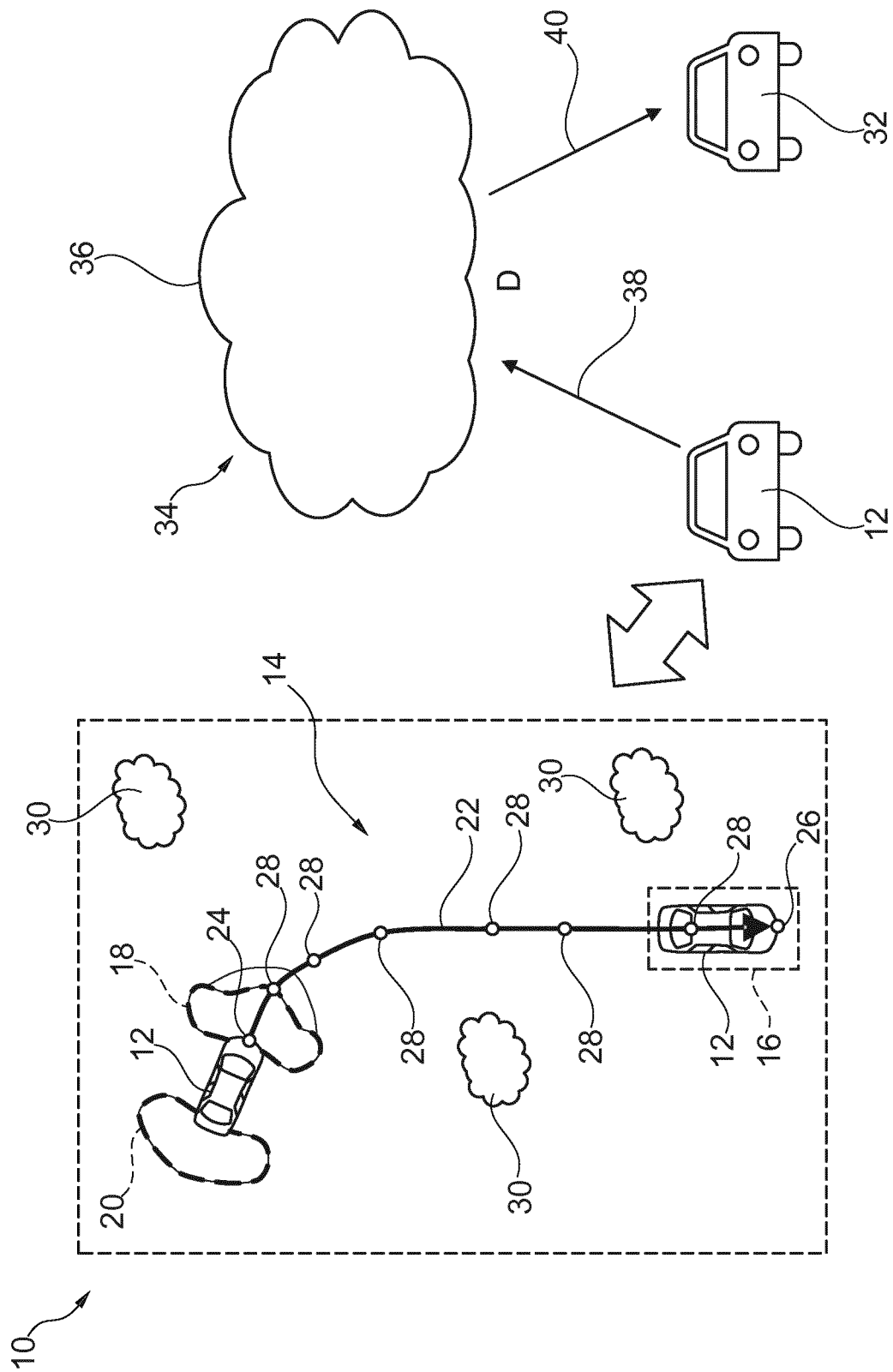
10	training scene
12	vehicle (performing the training)
14	road
16	parking space
18	region, environal
20	region, environal
22	trajectory, trained
24	starting point (trained trajectory)
26	end point (trained trajectory)
28	trajectory points (trained trajectory)
30	object, envorional (tree)
32	vehicle (untrained)
34	network
36	cloud
38	arrow (upload)
40	arrow (download)
D	Data

Claims

1. A method for providing stored data (D) of a trained parking procedure for performing at least one subsequent parking procedure using said data, the data (D) of said trained parking procedure being generated by performing the complete parking procedure or at least a part of the parking procedure with a vehicle (12), characterized in that the data (D) are stored in such a way that the stored data (D) are not only accessible to the vehicle (12) by which the training was performed but also to at least one other vehicle (32).
2. The method according to claim 1, characterized in that the data (D) are stored outside the vehicle (12) used for the training.
3. The method according to claim 1 or 2, characterized in that the stored data (D) are accessible via a network (34).
4. The method according to claim 3, characterized in that the data (D) are stored in a cloud (36) within the network (34).
5. The method according to any one of the preceding claims, characterized in that the data (D) of the trained parking procedure comprise information about the vehicle (12) used for the training, especially the dimensions of said vehicle (12) and/or the vehicle type of said vehicle (12).
6. The method according to any one of the preceding claims, characterized in that the data (D) of the trained parking procedure comprise information about a trajectory (22) describing a path of the vehicle (12) during the training.
7. The method according to claim 6, characterized in that the trajectory (22) extends to an end position (26) which is located at a corresponding parking space (16) of the parking procedure;
or

from which end position (26) at least one parking space (16) can be reached by use of a non-trained automated parking system.

8. The method according to claim 6 or 7, characterized in that the data describe reference points (28) of the trained trajectory (22).
9. A computer program product comprising computer-executable program code portions having program code instructions configured to execute the method according to one of claims 1 to 8.
10. A system for providing stored data (D) of a trained parking procedure for performing at least one subsequent parking procedure using said data, the system comprising
 - a vehicle (12) arranged for performing the parking procedure or at least a part of the parking procedure and for generating the data (D) of the trained parking procedure from said performed parking procedure and
 - a data memory for storing said data (D),characterized in that the data memory is accessible not only to the vehicle (12) by which the training was performed but also to at least one other vehicle (32).
11. The system according to claim 10, characterized in that the data storage is located outside the vehicle (12) by which the training was performed.
12. The system according to claim 10 or 11, characterized in that the data storage is integrated in a network (34) of the system, especially a cloud (36) within the network (34).



19.

INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER INV. B62D15/02 B60W30/06 G01C21/34 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 B60W G01C		
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	WO 2017/041927 A1 (VOLKSWAGEN AG [DE]) 16 March 2017 (2017-03-16) page 2, paragraph 6 - page 3, paragraph 1; figure 4 page 10, paragraph 6 - page 11, paragraph 3 -----	1-12
X	US 2014/180523 A1 (REICHEL MICHAEL [DE] ET AL) 26 June 2014 (2014-06-26) paragraphs [0021], [0030], [0036] - [0037], [0039] - [0042], [0044] -----	1-5,9-12
X	DE 10 2013 015349 A1 (DAIMLER AG [DE]) 10 April 2014 (2014-04-10) paragraphs [0025], [0027], [0039] -----	1-4,9-12
☐ 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 1 August 2018		Date of mailing of the international search report 27/08/2018
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 Stolle, Martin

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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