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(54) Title: ELECTRONIC CONTROL DEVICE FOR A VEHICLE AND METHOD FOR REDUCING FALSE-POSITIVE ELECTRONIC EMERGENCY BRAKE LIGHT DETECTIONS

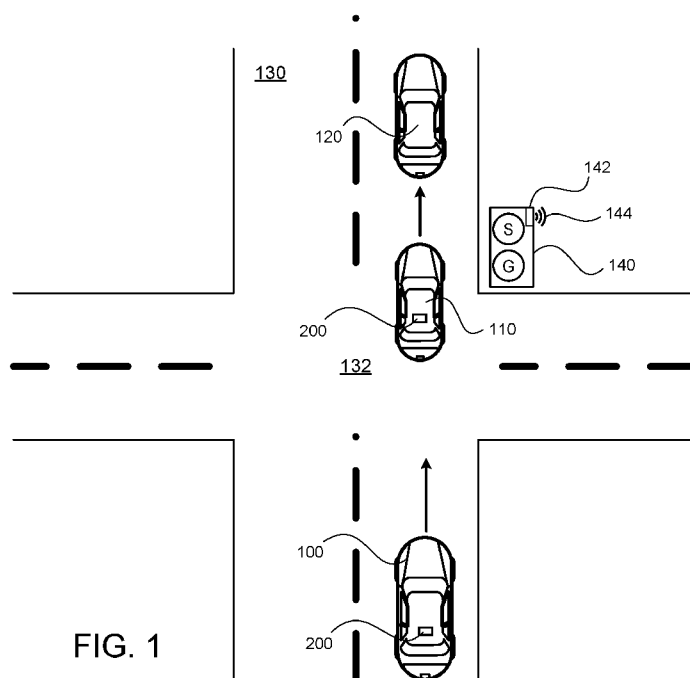


FIG. 1

(57) Abstract: A method and system supported by a vehicle for reducing false positive emergency brake light detections is provided that includes receiving position and status information from an intelligent infrastructure and determining the position and status of the infrastructure based on the received information; receiving position and status information from a second vehicle ahead of the first vehicle and determining a position and a status of the second vehicle based on the information received from the second vehicle; determining when to output a warning signal to a user interface or an autonomous vehicle controller based on the status of the intelligent infrastructure and the position of the intelligent infrastructure and the position of the second vehicle and the status of the second vehicle, the instruction signal causing the vehicle user interface to display a warning to a driver or causing the autonomous vehicle controller

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Electronic Control Device For A Vehicle And Method For Reducing False-Positive Electronic Emergency Brake Light Detections

TECHNICAL FIELD

5 **[0001]** The disclosure relates to an electronic control system for a vehicle and a corresponding method for reducing electronic emergency brake light false-positive detections.

BACKGROUND

10 **[0002]** Electronic Emergency brake light (EEBL) Application warns drivers of vehicles if a vehicle in front of the vehicle stops abruptly, based on information, e.g. typically obtained through V2X communication, but also by a vehicle camera. In cities, traffic lights may be closely spaced resulting in braking vehicles on or directly behind an intersection due to blocking vehicles ahead which may result in ongoing driver warnings of an EEBL Application. A driver of a vehicle could be distracted or
15 annoyed by these kinds of false-positive warnings.

SUMMARY

20 **[0003]** One aspect of the disclosure provides an electronic control system supported by a first vehicle and configured to reduce false positive electronic emergency brake light detections. The electronic control system includes data processing hardware, and memory hardware in communication with the data processing hardware. The memory hardware stores instructions that when executed on the data processing hardware cause the data processing hardware to perform a method including operations. The method includes receiving position information and status information from a second vehicle ahead of the first vehicle and determining a
25 position and a status of the second vehicle based on the position information and the status information received from the second vehicle. The method also includes receiving a position information and a status information from an intelligent infrastructure and determining the position and status of the intelligent infrastructure based on the received position information and status information from the intelligent
30 infrastructure. Furthermore, the method includes determining when to output a warning signal to a vehicle user interface or autonomous vehicle controller supported

by the first vehicle based on the status of the intelligent infrastructure and the position of the intelligent infrastructure and the position of the second vehicle and the status of the second vehicle, the instruction signal causing the vehicle user interface to display a warning to a driver or causes the autonomous vehicle controller to adjust a vehicle behavior, e.g. to avoid a potential safety threat in particular with the second vehicle.

[0004] The electronic control system or method provide reduced false-positive detections by electronic emergency brake light applications. Thus, a driver of a first vehicle is not distracted or disturbed or an autonomous vehicle controller to adjust a vehicle behavior is not triggered falsely by a warning signal of an electronic emergency brake light application if e.g. a stop signal indicating traffic light is in the direction of travel of the first vehicle located between the first vehicle and a decelerating or (hard-) braking vehicle ahead of the first vehicle. In this scenario the second vehicle may have braked or stopped on or after passing an intersection the traffic light is located at or assigned to, e.g. due to a blocking vehicle ahead of the second vehicle which also may have stopped due to a subsequent intersection traffic light.

[0005] A vehicle may be a motor vehicle, e.g. a car, a truck, a motorcycle, an electric vehicle or a hybrid vehicle, a water craft or an airplane.

[0006] The data processing hardware may be e.g. one or more processors, (micro)controllers, ASICs, FPGAs, digital signal processors, main processors, central processing units, multi-purpose processors or comparable hardware suitable for processing data. Accordingly, steps of the method respectively operations can be split and may be executed by different hardware and/or software components, e.g. different processors.

[0007] Implementations of the disclosure may include one or more of the following optional features. In some implementations, the operations further include, determining a position of the first vehicle and determining a relative position of the intelligent infrastructure regarding the positions of the first vehicle and the second vehicle and determining when to output the warning signal based on the relative position of the intelligent infrastructure regarding the positions of the first vehicle and the second vehicle.

[0008] In some examples, the operations further include, determining a functional attribution of the intelligent infrastructure to a traffic lane of a roadway and determine

when to output the warning signal based on the functional attribution of the intelligent infrastructure to the traffic lane of the roadway and at least one selected from the group of the positions of the first vehicle, the second vehicle and the relative position of the intelligent infrastructure.

5 **[0009]** In some implementations, the operations further include, determining when to output the warning signal based on the relative position of the intelligent infrastructure being in a direction of travel between the first vehicle and the second vehicle.

10 **[0010]** Besides other conditions to be fulfilled, the warning signal may be outputted if it is determined that the intelligent infrastructures functional attribution refers to the traffic lane the first vehicle and the second vehicle are driving on and the relative position of the intelligent infrastructure is between the first vehicle and second vehicle in their direction of driving.

15 **[0011]** In some examples, the operations further include, determining when to output the warning signal based on if the status of the second vehicle indicates a deceleration or stop of the second vehicle.

20 **[0012]** In some implementations, the operations further include, outputting the warning signal when the status of the intelligent infrastructure does not indicate a stop signal and the status of the second vehicle indicates a deceleration or stop of the second vehicle and at least one selected from the group of the relative position of the intelligent infrastructure is in a direction of travel between the first vehicle and the second vehicle and the functional attribution of the intelligent infrastructure relates to the traffic lane of the roadway the first vehicle and the second vehicle are driving on.

25 **[0013]** In some implementations, the operations further include, outputting no warning signal (or not outputting the warning signal) when the status of the second vehicle indicates no deceleration or stop of the second vehicle or the status of the intelligent infrastructure indicates a stop signal, unless the relative position of the intelligent infrastructure is not in a direction of travel between the first vehicle and the second vehicle or the functional attribution does not relate to the traffic lane of the roadway the first vehicle and the second vehicle are driving on.

30 **[0014]** In some implementations, the operations further include, determining driving dynamics data of the first vehicle based on position information received by a position determination device or vehicle dynamics information determined by a

vehicle determination device supported by the first vehicle; determining driving dynamics data of the second vehicle based on the received position information or driving dynamics information of the second vehicle; and determining if a potential safety threat is given based on the information suitable for the determination of driving dynamics data of the second vehicle and the driving dynamics data of the first vehicle.

[0015] In some implementations the electronic control system includes at least one selected from the group of a wireless communication device, e.g. a Vehicle-to-X communication device, and a sensor device, e.g. a camera, wherein the operations further include receiving the position information and status information of the second vehicle based on information included by at least one selected from the group of a first vehicle-to-X message from the second vehicle and information regarding the second vehicle determined by the sensor; and receiving the position information and status information of the intelligent infrastructure based on information included by at least one selected from a group of a second vehicle-to-X message from the intelligent infrastructure and information regarding the intelligent infrastructure determined by the sensor; and communicating the position information and status information from the second vehicle and the position information and status information from the intelligent infrastructure to the processing hardware. Alternatively or additionally the position or status information of at least one selected from the group of the intelligent infrastructure and second vehicle may be received from a backend server or dynamic map information incorporating the information. E.g. a traffic light may notify by at least one selected from the group of an indicating traffic light and vehicle-to-X communication.

[0016] In some examples, the method is executed at least in part by an electronic emergency brake light (EEBL) application. Hence, the received information may be utilized by the first vehicle for the avoidance of outputting false-positive electronic emergency brake light detections.

[0017] The received position and status from the intelligent infrastructure may be included in a BSM message (Basic Safety Message), a MAP (Map Data) message or a SPaT (Signal Phase and Timing message) message.

[0018] In some implementations, the intelligent infrastructure broadcasts the position or status information into its surroundings after receiving a vehicle-to-X

message from the first vehicle or periodically. Alternatively or additionally the intelligent infrastructure transmits the information after reception of a vehicle-to-X message from the first vehicle to the first vehicle.

[0019] A computer program typically includes program coding means in order to perform all the steps of the indicated method if the computer program is run on the data processing hardware.

[0020] The details of one or more implementations of the disclosure are set forth in the accompanying drawings and the description below. Other aspects, features, and advantages will be apparent from the description and drawings, and from the claims.

DESCRIPTION OF DRAWINGS

[0021] FIG. 1 is a schematic view of an exemplary vehicle that includes an electronic control system during a traffic situation;

[0022] FIG. 2 is a schematic view of the electronic control system of FIG. 1; and

[0023] FIG. 3 is a schematic view of an exemplary arrangement of operations for reducing EEBL false-positive detections based on the traffic situation shown in FIG. 1.

[0024] Like reference symbols in the various drawings indicate like elements.

DETAILED DESCRIPTION

[0025] A first vehicle supporting an electronic control system executing an EEBL application may utilize position and status information from an intelligent infrastructure, e.g. an intelligent traffic light, to reduce the number of false-positive detections determined by an electronic emergency brake light (EEBL) application. The first vehicle supporting the electronic control system furthermore may determine a position and status of a second vehicle ahead in the direction of driving of the first vehicle. If it is determined that the second vehicle is decelerating and/or braking, e.g. by a perception of brake lights or the reduction of speed of the second vehicle by an environmental perception device, e.g. a camera, Radar and/or other environmental sensors, and/or by receiving at least one Vehicle-to-X (V2X) message from the second vehicle indicating the braking or stopping of the second vehicle. Based on this information an electronic emergency brake light application of the first vehicle would

usually reveal a potential safety threat, e.g. a potential collision of the first and the second vehicle, based on determined actual driving dynamics data of the first and second vehicle in particular if it is prognosed that the direction and speed of travel of the first vehicle would continue essentially unchanged. Based on the information
5 received from the intelligent infrastructure, the electronic control system of the first vehicle may determine that the intelligent infrastructure is located between the first vehicle and the second vehicle in their direction of driving and is functionally attributed to a lane of a roadway the first and second vehicle are driving on and is indicating a stop signal for the first vehicle and therefore currently a safety threat is
10 not given. Hence, it may be concluded by the EEBL application that no warning to a driver of the first vehicle is provided.

[0026] Referring to FIGS. 1 and 2, in some implementations, a first vehicle 100 with an electronic control system 200 is approaching an intersection 132. The vehicle 100 may be a motor vehicle, such as, but not limited to, a passenger motor vehicle, a
15 commercial motor vehicle, a motorcycle, an electric motor vehicle or a hybrid vehicle. A second vehicle 110 passing the intersection 132 and having a Vehicle-to-X communication device is ahead of the first vehicle 100. The vehicle corresponding arrows indicate the directions of travel of the vehicles 100, 110 which are driving in the same directions on the same lane along the roadway 130. The second vehicle 110
20 is decelerating or braking behind a third vehicle 120 which stopped after passing the intersection, e.g. due to a traffic jam ahead. The first vehicle 100 may receive at least one Vehicle-to-X message from the second vehicle 110. The vehicle-to-X message 112 may include position information and status information of the second vehicle 110. The position information may be determined by a Position Determination
25 Device (not shown), utilizing e.g. a Global Navigation Satellite System and/or Dead Reckoning, supported by the second vehicle 110. Furthermore, the first vehicle 100 may determine its own position by a Position Determination Device 260, utilizing e.g. a Global Navigation Satellite System and/or Dead Reckoning, supported by the first vehicle 100. Based on the received information, an electronic emergency brake light
30 application (EEBL) 226 of the first vehicle 100 may determine a potential safety threat if the direction and speed and deceleration or acceleration of travel of both vehicles 100, 110 would continue essentially unchanged.

[0027] In some implementations, an Intelligent Infrastructure 140, e.g. a traffic light, may be positioned in local proximity of the intersection 132 of the roadway 130. The Intelligent Infrastructure 140 broadcasts a vehicle-to-X signal/message 144 by a wireless Vehicle-to-X communication device 142. The Intelligent Infrastructure V2X signal 144 may include positions information and status information included in, but not limited to SPaT messages and/or MAP-messages and/or BSM messages. The information may be indicative of a position of the Intelligent Infrastructure 140 and a status of the Intelligent Infrastructure 140, e.g. in case of a traffic light a stop signal S or go signal G for passing the intersection 132.

[0028] The first vehicle 100 includes an electronic control system 200 configured to reduce electronic emergency brake light false-positive detections of safety threats by the EEBL 226. The electronic control system 200 includes a wireless communication device 210, e.g., a Vehicle-to-X communication device. The wireless communication device 210 receives signals and messages 112, 144 by way of an antenna 212. The electronic control system 200 includes a vehicle controller 220 that includes a computing device (processor or data processing hardware) 222 (e.g. central processing unit having one or more computing processors) in communication with non-transitory memory 224 (e.g., a hard disk, flash memory, random-access memory) capable of storing instructions executable on the computing processor(s) 222. The controller 220 executes the EEBL 226 application which receives the vehicle-to-X message 112 from the second vehicle 110 by way of the wireless communication device 210. The electronic control system 200 includes a signal interface 230. The signal interface 230 may be part of the processor 222 (not shown). Alternatively, the signal interface 230 may be in communication with the controller 220.

[0029] The electronic control system 200 is configured to receive, at the wireless communication device 210, a (V2X-)signal or (V2X-)message 144 including position information and status information indicating a position and a status of the Intelligent Infrastructure 140 from the Intelligent Infrastructure 140 and provide the position information and status information 144 to the processor 222, and evaluate, by the processor 222, the position and status of the Intelligent infrastructure 140 based on the received information 144. In addition, the electronic control system 200 outputs, by the signal interface 230, a signal 232 including a warning to a driver of a vehicle via a user interface 240, e.g., by display 242 and/or audio 244 warning. Additionally or

alternatively, the electronic control system 200 outputs, by the signal interface 230, a signal 232 including a warning to an autonomous vehicle controller 250 to adjust a vehicle dynamics behavior of the first vehicle 100 by activating actuators, e.g. brakes or drive motor of the vehicle 100, in order to avoid a collision with the second or third vehicle 110, 120 or other road users or objects based on the received warning signal. The Processor 222 is configured to determine a potential safety thread based on position information received from the Position Determination device 260 and/or Vehicle Dynamics Determination Device 270 and/or Environmental Perception Device 280.

[0030] The First vehicle 100 includes the wireless communication device 210 (e.g., a vehicle-to-X communication device 210) that receives the Intelligent Infrastructure 140 signal 144 including position information and status information from the Intelligent Infrastructure 140 and the Vehicle-to-X message 112 from the second vehicle 110. The processor 222 receives the position information and status information 144 from the wireless communication device 210.

[0031] In some implementations, the electronic control system 200 includes a position determination device 260 that determines a vehicle position 262 of the vehicle 100. The position determination device 260 determines the vehicle position 262 based on a Global Navigation Satellite System, e.g., by GPS, GLONASS, GALILEO or BAIDU, and/or Dead Recognition supported by the first vehicle 100.

[0032] In some examples, the electronic control system 200 includes a vehicle dynamics determination device 270 that determines vehicle dynamics data 272. The vehicle dynamics determination device 270 may include at least one acceleration sensor (not shown) in one or more directions and/or at least one gyroscopic sensor (not shown) in one or more planes. It is common that the direction of measurements of the individual acceleration sensors and/or gyroscopic sensors are orthogonal to each other.

[0033] In some examples, the electronic control system 200 includes an Environmental Perception Device 280 that determines subject and/or object data 282.

The subjects and/or objects in the surrounding of the first vehicle 100 may be perceived by e.g. a camera, radar, lidar, ultrasonic sensors, and/or other environmental sensor.

[0034] In some examples, the signal or (V2X-) message 112 includes at least one selected from the group of a second vehicle position information of the second vehicle 110 and a second vehicle dynamics information of the second vehicle 110 and status information of the second vehicle 110. The controller 220 (i.e., the processor 222) executing the EEBL application 226 may determine a safety threat based on the vehicle position 262 and the vehicle dynamics data 272 of the first vehicle 100 and the received second vehicle position and the second vehicle dynamics information and the second vehicle status information. The potential hazardous situation may include, but is not limited to, a collision between the two vehicles 100, 110 or getting in close proximity, e.g. under a predetermined distance which may be dependent on the velocity of at least one of the vehicles 100, 110. In some examples, the electronic control system 200 outputs the warning signal 232 when the status of the intelligent infrastructure 140 does not indicate a stop signal S and the status of the second vehicle 110 indicates a deceleration or stop of the second vehicle 110. Furthermore, a functional attribution of the intelligent infrastructure 140 may be taken into account for the determination if a potential hazardous situation is given, by considering if the intelligent infrastructure 140 is functional attributed to a traffic lane of the roadway 130 the first vehicle and the second vehicle are driving on.

[0035] The signal interface 230 may output the warning signal 232 where the signal data indicates the potential hazardous situation. In this case, the user interface 240 warns the driver of the potential hazardous situation, e.g., by way of the display 242 or the audio 244.

[0036] FIG. 3 provides an example arrangement of operations for a method 300 of reducing electronic emergency brake light false-positive detections based on the traffic situation shown in FIG. 1 and using the electronic control system 200 shown in FIG. 2. At block 302, the method 300 includes receiving, at the data processing hardware 222, position information and status information 112 from the second vehicle 110 and based on this received information, determining a position and status of the second vehicle 110. At block 304, the method 300 includes receiving, at data processing hardware, i.e., processor 222, position information and status information 144 from the Intelligent Infrastructure 140 and based on this received information, determining a position and status of the intelligent infrastructure based on this information. At block 306, the method 300 includes determining when to output a

warning signal 232 to a vehicle user interface 240 or an autonomous vehicle controller 250 supported by the vehicle 100 based on the status of the intelligent infrastructure and the position of the intelligent infrastructure and the position of the second vehicle and the status of the second vehicle. The warning signal 232 causing the user interface 240 to display a message on a vehicle display 242 or to output a sound on a vehicle audio 244 indicating a warning to a driver of the vehicle about a potential safety threat, e.g. a potential collision with the second vehicle if the driving dynamics remains unchanged. Alternatively or additionally the warning signal 232 causing the autonomous vehicle controller 250 to adjust a vehicle dynamics behavior of the first vehicle 100, e.g. by activating actuators, in particular brakes or drive engine of the vehicle 100, in order to avoid a collision with the second or third vehicle 110, 120 or other road users or objects based on the received warning signal.

[0037] In some implementations, the method 300 includes determining, at the processor 222, a position of the first vehicle 100 and a relative position of the intelligent infrastructure 140 regarding the positions of the first vehicle 100 and the second vehicle 110 based on the determined position of the intelligent infrastructure 140, the position of the first vehicle 100 and the position of the second vehicle 110. The method furthermore may include, determining when to output the warning signal 232 based on the relative position of the intelligent infrastructure 140 regarding the positions of the first vehicle 100 and the second vehicle 110.

[0038] In some implementations, the method 300 includes determining a functional attribution of the intelligent infrastructure 140 to a traffic lane of the roadway 130 and determining when to output the warning signal 232 based on the functional attribution of the intelligent infrastructure 140 to the traffic lane of the roadway 130 and the positions of the first vehicle 100, the second vehicle 110 or the relative position of the intelligent infrastructure 140.

[0039] In some implementations, the method 300 includes determining when to output the warning signal 232 based on the relative position of the intelligent infrastructure 140 being in a direction of travel between the first vehicle 100 and the second vehicle 110.

[0040] In some implementations, the method 300 includes determining, when to output the warning signal 232 based on if the status of the second vehicle 110 indicates a deceleration or stop of the second vehicle 110.

[0041] In some implementations, the method 300 includes outputting the warning signal 232 when the status of the intelligent infrastructure 140 does not indicate a stop signal and the status of the second vehicle 110 indicates a deceleration or stop of the second vehicle 110.

5 **[0042]** In some implementations, the method 300 includes outputting no warning signal 232 when the status of the intelligent infrastructure 140 indicates a stop signal or the status of the second vehicle 110 indicates no deceleration or stop of the second vehicle.

10 **[0043]** In some implementations, the method 300 includes determining driving dynamics data of the first vehicle 100 based on position information received by the position determination device 260 or vehicle dynamics information determined by the vehicle dynamics determination device 270 supported by the first vehicle 100. The method 300 may include determining driving dynamics data of the second vehicle 110 based on the received position information of the second vehicle 110 or received
15 vehicle dynamics information. The method 300 may also include determining if a potential safety threat is given based on the information suitable for the determination of driving dynamics data of the second vehicle 110 and the driving dynamics data of the first vehicle 100.

20 **[0044]** In some implementations, the method 300 includes determining the position information of the second vehicle 110 and status information of the second vehicle 110 based on information included by at least one selected from the group of a first vehicle-to-X message from the second vehicle 110 and information regarding the second vehicle 110 determined by the environmental perception device 280. The method 300 also includes determining the position information and status information
25 of the intelligent infrastructure 140 based on information included by at least one selected from the group of a second vehicle-to-X message from the intelligent infrastructure 140 and information regarding the intelligent infrastructure 140 determined by the environmental perception device 280 and communicating the position information and status information from the second vehicle 110 and the
30 position information and status information from the intelligent infrastructure 140 to the controller 220.

[0045] In some examples, the received the position and status from the intelligent infrastructure 140 may be included in a MAP message or a SPaT message or a BSM message.

[0046] If in the course of the proceedings it transpires that a feature or a group of features is not absolutely necessary, then the applicant here and now seeks a wording of at least one independent claim, no longer including the feature or the group of features. This may, by way of example, involve a sub-combination of a claim existing as at the application date or a sub-combination of a claim existing as at the application date restricted by further features. Such claims or combinations of features, which are to be newly worded, are understood to also be covered by the disclosure of this application.

[0047] It is further pointed out that configurations, features and variants of aspects of the invention, which are described in the various embodiments or embodiment examples and/or shown in the figures, can be combined with one another as desired. Individual or multiple features are interchangeable as desired. Resulting combinations of features are understood to also be covered by the disclosure of this application.

[0048] Back references in dependent claims should not be construed as a waiver of the right to independent, objective protection for the features of the subclaims referred back to. These features can also be used in any combination with other features.

[0049] Features which are only disclosed in the description or features which are disclosed in the description or a claim only in conjunction with other features can, in principle, be of independent inventive relevance. They can therefore also be included separately in claims to distinguish from the prior art.

[0050] It should be pointed out in general that vehicle-to-X communication means, in particular, a direct communication between vehicles and/or between vehicles and infrastructure facilities and/or road users in general. By way of example, therefore, vehicle-to-vehicle communication or vehicle-to-infrastructure communication may be involved. Where communication between vehicles is referred to within the framework of this application, this can essentially, by way of example, take place within the framework of vehicle-to-vehicle communication, which typically takes place without the intermediary of a mobile network or a similar

external infrastructure and which can therefore be distinguished from other solutions which, by way of example, are based on a mobile network. By way of example, vehicle-to-X communication can take place using the standards IEEE 802.11p or IEEE 1609.4. Vehicle-to-X communication can also be referred to as C2X

5 communication. The sub-areas can be referred to as C2C (Car-to-Car) or C2I (Car-to-Infrastructure). The aspects of the invention expressly do not, however, exclude vehicle-to-X communication with the intermediary of, for example, a mobile network.

[0051] A number of implementations have been described. Nevertheless, it will be understood that various modifications may be made without departing from the spirit and scope of the disclosure. Accordingly, other implementations are within the scope
10 of the following claims.

WHAT IS CLAIMED IS:

1. An electronic control system supported by a first vehicle and configured to reduce false positive electronic emergency brake light detections, the electronic control system comprising:

5 data processing hardware; and
memory hardware in communication with the data processing hardware, the memory hardware storing instructions that when executed on the data processing hardware cause the data processing hardware to perform operations comprising:
receiving position information and status information from a second
10 vehicle ahead of the first vehicle;
determining a position and a status of the second vehicle based on the position information and the status information received from the second vehicle;
receiving a position information and a status information from an intelligent infrastructure;
15 determining the position and status of the intelligent infrastructure based on the received position information and status information from the intelligent infrastructure; and
determining when to output a warning signal to a vehicle user interface or an autonomous vehicle controller supported by the first vehicle based on the
20 position and status of the intelligent infrastructure and the position and status of the second vehicle, the warning signal causing the vehicle user interface to provide a warning to a driver or causing the autonomous vehicle controller to adjust a vehicle behavior.

25 2. The electronic control system according to claim 1, wherein the operations further comprise:

determining a position of the first vehicle and a relative position of the intelligent infrastructure with respect to the positions of the first vehicle and the second vehicle; and

30 determining when to output the warning signal based on the relative position of the intelligent infrastructure with respect to the positions of the first vehicle and the second vehicle.

3. The electronic control system according to at least one of the preceding claims, wherein the operations further comprise:

5 determining when to output the warning signal based on the relative position of the intelligent infrastructure being in a direction of travel between the first vehicle and the second vehicle.

4. The electronic control system according to at least one of the preceding claims, wherein the operations further comprise:

10 determining when to output the warning signal based on if the status of the second vehicle indicates a deceleration or stop of the second vehicle.

5. The electronic control system according to at least one of the preceding claims, wherein the operations further comprise:

15 determining a functional attribution of the intelligent infrastructure to a traffic lane of a roadway; and

determining when to output the warning signal based on the functional attribution of the intelligent infrastructure to the traffic lane of the roadway and at least one selected from the group of the position of the first vehicle, the position of the second vehicle and the relative position of the intelligent infrastructure.

6. The electronic control system according to at least one of the preceding claims, wherein the operations further comprise:

25 outputting the warning signal when the status of the intelligent infrastructure does not indicate a stop signal and the status of the second vehicle indicates a deceleration or stop of the second vehicle and at least one selected from the group of:

the relative position of the intelligent infrastructure is in a direction of travel between the first vehicle and the second vehicle, and

30 the functional attribution of the intelligent infrastructure relates to the traffic lane of the roadway the first vehicle and the second vehicle are driving on.

7. The electronic control system according to at least one of the preceding claims, wherein the operations further comprise:

outputting no warning signal when:

the status of the second vehicle indicates no deceleration or stop of the second vehicle; or the status of the intelligent infrastructure indicates a stop signal, unless

5 the relative position of the intelligent infrastructure is not in a direction of travel between the first vehicle and the second vehicle or

the functional attribution of the intelligent infrastructure does not relate to the traffic lane of the roadway the first vehicle and the second vehicle are driving on.

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8. The electronic control system according to at least one of the preceding claims, wherein the operations further comprise:

determining driving dynamics data of the first vehicle based on position information received by a position determination device or vehicle dynamics

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information determined by a vehicle determination device supported by the first vehicle;

determining driving dynamics data of the second vehicle based on the received position information or driving dynamics information of the second vehicle; and

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determining if a potential safety threat is given based on the information suitable for the determination of driving dynamics data of the second vehicle and the driving dynamics data of the first vehicle.

9. The electronic control system according to at least one of the preceding claims, including at least one selected from the group of a wireless communication device and a sensor device, wherein the operations further comprise:

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determining the position information of the second vehicle and status information of the second vehicle based on a first vehicle-to-X message from the second vehicle or based on information regarding the second vehicle determined by the sensor device;

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determining the position information and status information of the intelligent infrastructure based on a second vehicle-to-X message from the intelligent infrastructure or based on information regarding the intelligent infrastructure determined by the sensor device; and

communicating the position information and status information from the second vehicle and the position information and status information from the intelligent infrastructure to the data processing hardware.

5 10. The electronic control system according to at least one of the preceding claims, wherein the received position and status from the intelligent infrastructure is included in a MAP message or a SPaT message or BSM message.

11. A method for reducing false positive intersection detections for an electronic control system supported by a first vehicle, the method comprising:

10 receiving, at a data processing hardware, position information and status information from a second vehicle ahead of the first vehicle;

determining, by the data processing hardware, a position and a status of the second vehicle based on the position information and the status information received from the second vehicle;

15 receiving, by the data processing hardware, a position information and a status information from an intelligent infrastructure;

determining, by the data processing hardware, the position and status of the intelligent infrastructure based on the received position information and status information from the intelligent infrastructure;

20 determining, by the processing hardware, at least selected from the group of a relative position and functional attribution of the intelligent infrastructure regarding the first vehicle and the second vehicle based on the determined position of the intelligent infrastructure and the determined position of the second vehicle; and

25 determining, by the processing hardware, when to output a warning signal to a vehicle user interface or an autonomous vehicle controller supported by the first vehicle based on the status of the intelligent infrastructure and the relative position or functional attribution of the intelligent infrastructure and the position and status of the second vehicle, the warning signal causing the vehicle user interface to display a warning to a driver or causing the autonomous vehicle controller to adjust a vehicle behavior.

12. The method according to claim 11, further comprising:

determining a position of the first vehicle and a relative position of the intelligent infrastructure regarding the positions of the first vehicle and the second vehicle; and

determining when to output the warning signal based on the relative position of the intelligent infrastructure regarding the positions of the first vehicle and the second vehicle.

13. The method according to at least one of the claims 11 or 12, further comprising:

determining when to output the warning signal based on the relative position of the intelligent infrastructure being in a direction of travel between the first vehicle and the second vehicle.

14. The method according to at least one of the claims 11 to 13, further comprising:

determining when to output the warning signal based on if the status of the second vehicle indicates a deceleration or stop of the second vehicle.

15. The method according to at least one of the claims 11 to 14, further comprising:

determining a functional attribution of the intelligent infrastructure to a traffic lane of a roadway; and

determining when to output the warning signal based on the functional attribution of the intelligent infrastructure to the traffic lane of the roadway and at least one selected from the group of the position of the first vehicle, the position of the second vehicle and the relative position of the intelligent infrastructure.

16. The method according to at least one of the claims 11 to 15, further comprising:

outputting the warning signal when the status of the intelligent infrastructure does not indicate a stop signal and the status of the second vehicle indicates a deceleration or stop of the second vehicle and at least one selected from the group of:

the relative position of the intelligent infrastructure is in a direction of travel between the first vehicle, and

the second vehicle and the functional attribution of the intelligent infrastructure relates to the traffic lane of the roadway the first vehicle and the second vehicle are driving on.

17. The method according to at least one of the claims 11 to 16, further comprising:

outputting no warning signal when the status of the second vehicle indicates no deceleration or stop of the second vehicle; or the status of the intelligent infrastructure indicates a stop signal unless

the relative position of the intelligent infrastructure is not in a direction of travel between the first vehicle and the second vehicle or

the functional attribution of the intelligent infrastructure does not relate to the traffic lane of the roadway the first vehicle and the second vehicle are driving on.

18. The method according to at least one of the claims 11 to 17, further comprising:

determining driving dynamics data of the first vehicle based on position information received by a position determination device or vehicle dynamics information determined by a vehicle determination device supported by the first vehicle;

determining driving dynamics data of the second vehicle based on the received position information of the second vehicle; and

determining if a potential safety threat is given based on the information suitable for the determination of the driving dynamics data of the second vehicle and the driving dynamics data of the first vehicle.

19. The method according to at least one of the claims 11 to 18, further comprising:

receiving the position information of the second vehicle and status information of the second vehicle based on information included by at least one selected from the

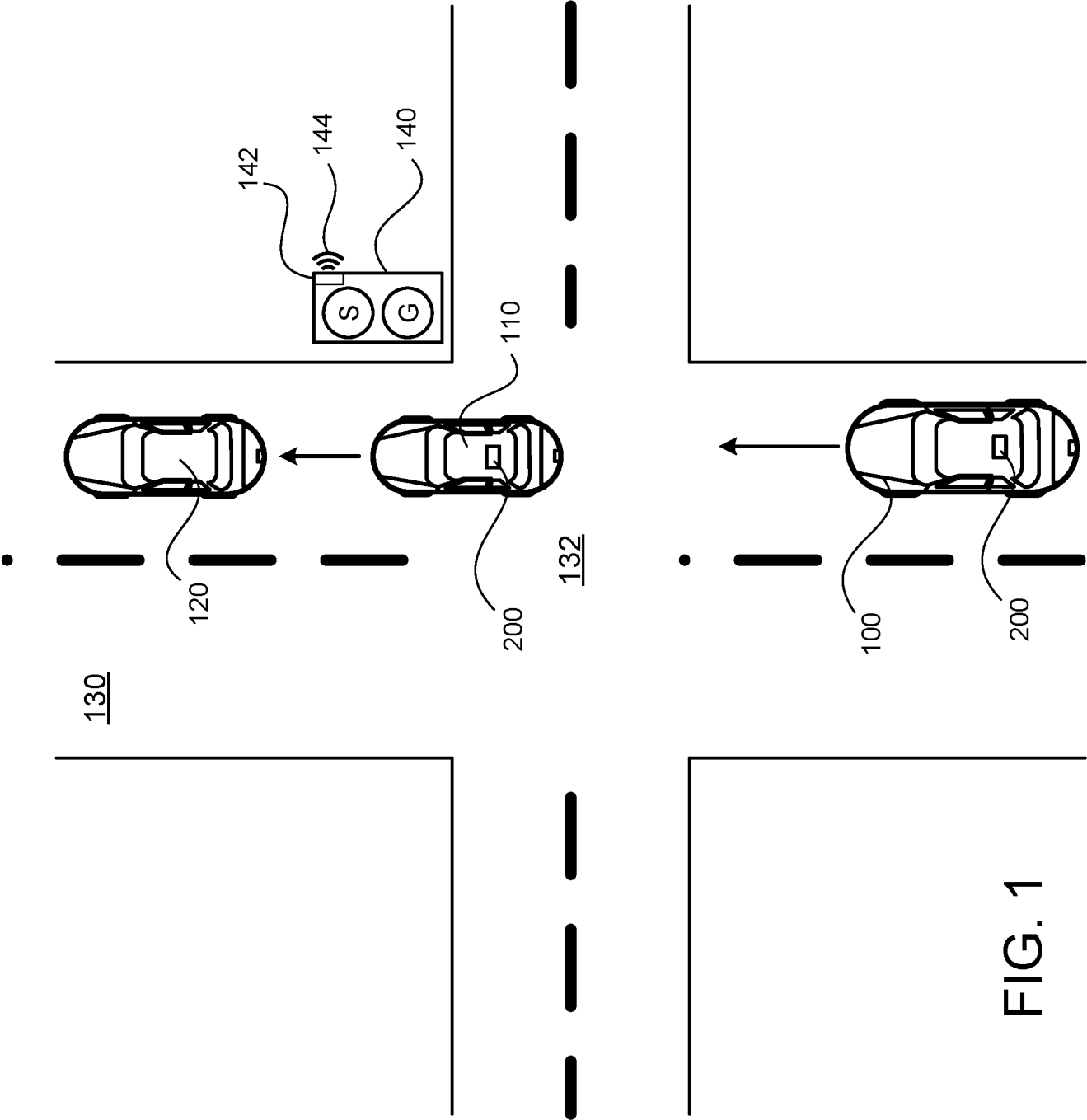
group of a first vehicle-to-X message from the second vehicle and information regarding the second vehicle determined by a sensor device;

receiving the position information and status information of the intelligent infrastructure based on information included by at least one selected from the group
5 of a second vehicle-to-X message from the intelligent infrastructure and information regarding the intelligent infrastructure determined by the sensor device; and

communicating the position information and status information from the second vehicle and the position information and status information from the intelligent infrastructure to the processing hardware.

10

20. The method according to at least one of the claims 11 to 19, wherein the received the position and status from the intelligent infrastructure is included in a MAP message or a SPaT message or a BSM message.



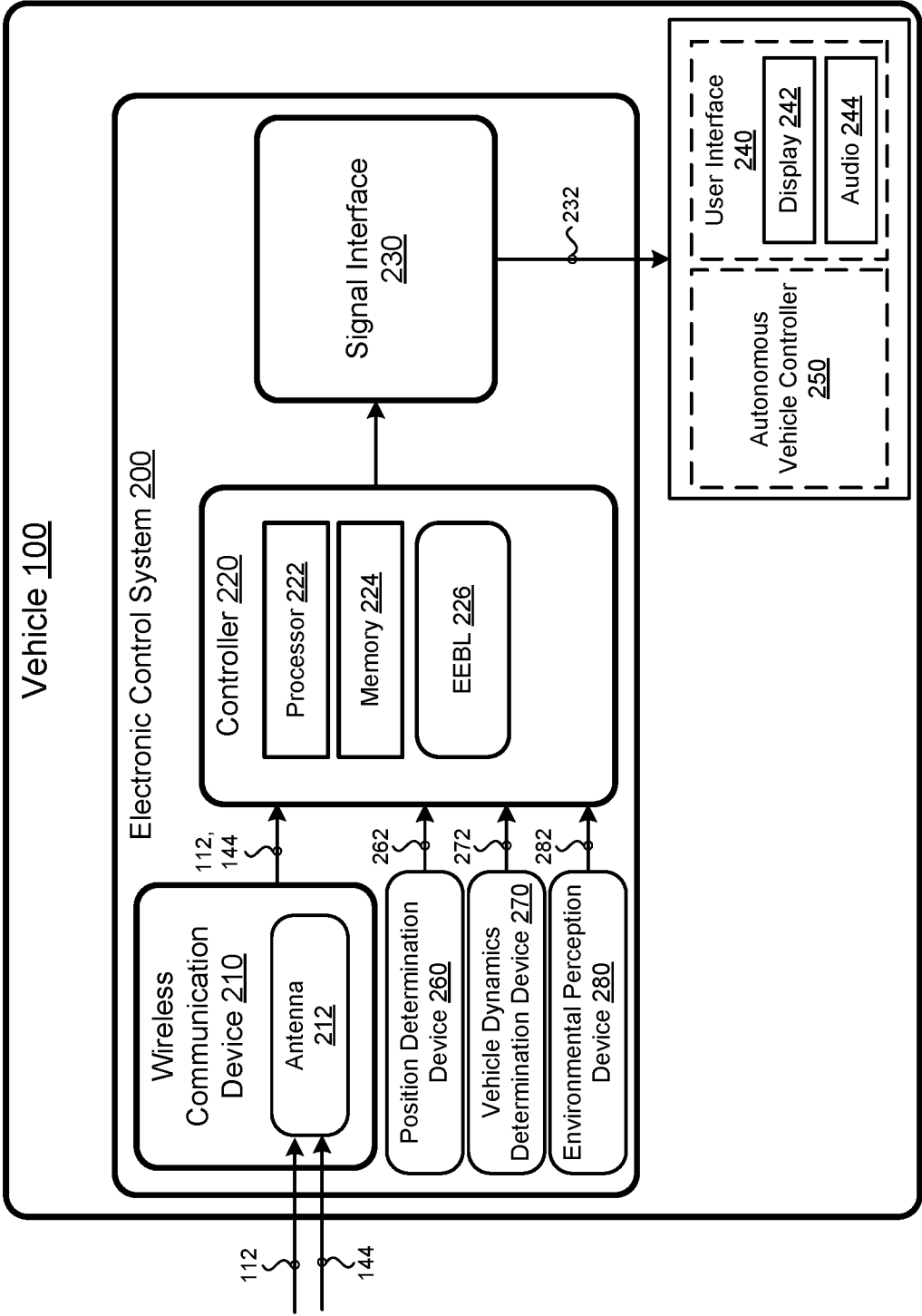


FIG. 2

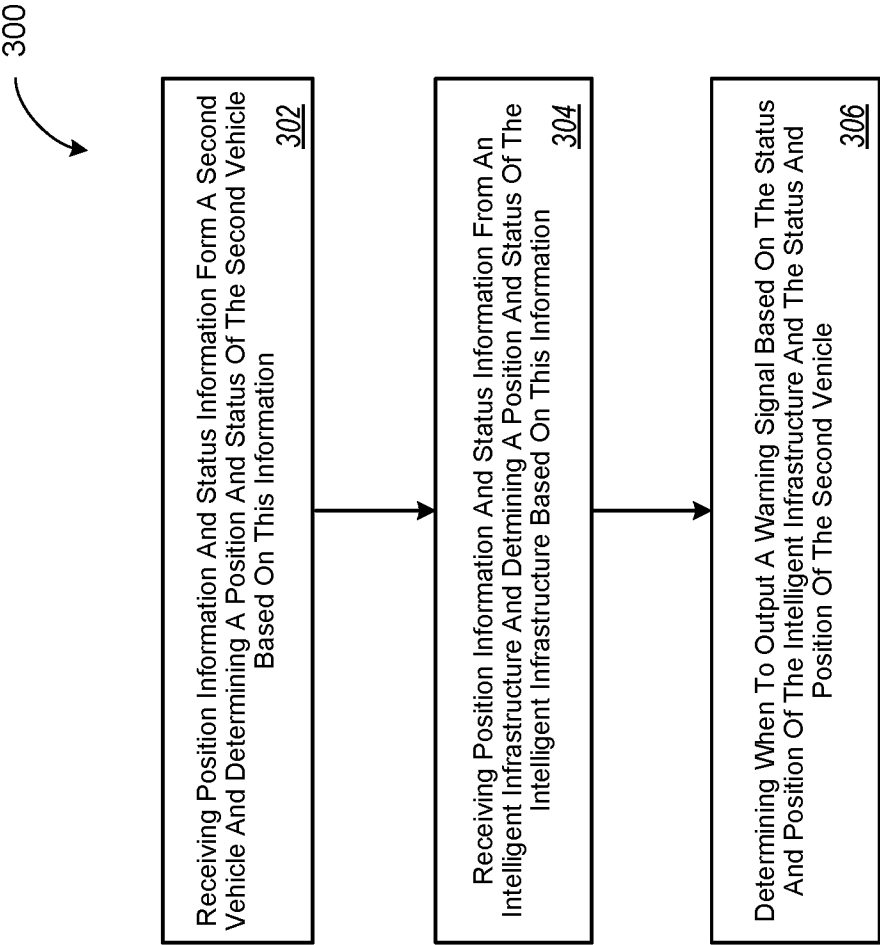


FIG. 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2020/027273

A. CLASSIFICATION OF SUBJECT MATTER

INV. B60W30/09 B60W50/14 B60W30/18
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)
B60W

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 2016/185347 A1 (LEFEVRE STEPHANIE [FR] ET AL) 30 June 2016 (2016-06-30) paragraphs [0003] - [0008], [0016] - [0031], [0038] - [0065] -----	1-20
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Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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"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

20 July 2020

Date of mailing of the international search report

29/07/2020

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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