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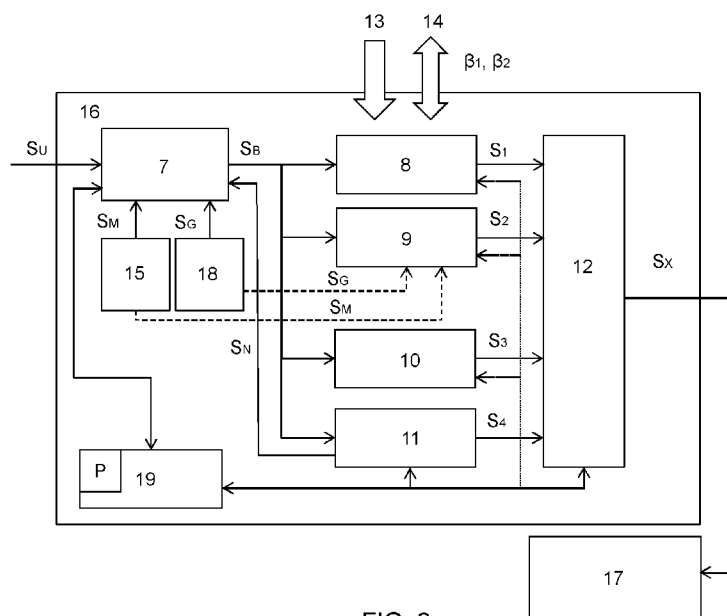


FIG. 2

- (57) Abstract:** The invention relates to a system for regulating an autonomous vehicle in a traffic system which comprises a plurality of autonomous vehicles. The system analyses the external information according to predetermined rules and generates analysis signals to the vehicle which are given different priorities depending on the particular analysis carried out and its results. A composite analysis signal S_x is determined on the basis of the contents of the analysis signals and their prioritisation. The vehicle may then adapt its regulation according to the composite analysis signal S_x . The invention relates also to a method for regulating an autonomous vehicle in a traffic system which comprises a plurality of autonomous vehicles.

Method and system for control of autonomous vehicles

Field of the invention

The present invention relates to techniques for handling various situations in
5 traffic systems which comprise a plurality of autonomous vehicles.

Background to the invention

A vehicle which can travel on the ground without a driver is referred to as a
driverless ground vehicle (unmanned ground vehicle, UGV). There are two types
10 of driverless ground vehicles, those which are remote-controlled and those which
are autonomous.

A remote-controlled UGV is a vehicle which is regulated by a human operator via
a communication link. Each control action is determined by the operator either on
15 the basis of direct visual observation or by using sensors such as digital video
cameras. A simple example of a remote-controlled UGV is a remote-controlled
toy car. A great variety of remote-controlled vehicles are now in use, often in
dangerous situations and environments which are inappropriate for humans to be
in, e.g. disarming of bombs and dealing with hazardous chemical discharges.
20 Remote-controlled driverless vehicles are also used in surveillance operations
and the like.

Autonomous vehicle means here a vehicle capable of navigating and
manoeuvring without human control. Such a vehicle uses sensors to gain
25 understanding of the surroundings. Sensor data are then used by regulating
algorithms to determine the next step to be taken by the vehicle with respect to a
superordinate objective set for it, e.g. collecting and delivering goods at different
locations. More specifically, an autonomous vehicle has to be able to read the
surroundings well enough to be able to perform the assignment set for it, e.g.
30 "move blocks of stone from point A to point B via mine adit C". The autonomous
vehicle needs to plan and follow a route to the chosen destination while at the
same time detecting and avoiding obstacles on the way. It has also to perform its

assignment as quickly as possible without making mistakes. Autonomous vehicles have inter alia been developed for potential use in dangerous environments, e.g. in the military and defence industry and the mining industry, both above and below ground. Any people or ordinary manually controlled vehicles approaching the area where autonomous vehicles operate will normally cause interruption of the operation of the autonomous vehicles for safety reasons. When their operating area becomes clear again, the autonomous vehicles may be ordered to resume operating.

- 10 An autonomous vehicle uses information about the road, the surroundings and others aspects which affect its operation, in order to automatically regulate its power mobilised, braking and steering. Accurate assessment and identification of the planned route ahead is necessary for assessing whether a road is negotiable and for being able to successfully replace human judgement in operating the vehicle. Road conditions may be complex and when driving an ordinary driver-controlled vehicle the driver will make hundreds of observations per minute and adjust the operation of the vehicle on the basis of the road conditions perceived, e.g. to find a feasible way past any objects which may be on the road. Using an autonomous system to replace human perception entails inter alia being able accurately to perceive objects to make it effectively possible to regulate the vehicle so that it is directed past them.

- The technical methods used for identifying an object close to a vehicle comprise inter alia using one or more cameras and radar to create images of the surroundings. Laser techniques are also used, both scanning lasers and fixed lasers, to identify objects and measure distances. These techniques are often called LIDAR (light detection and ranging) or LADAR (laser detection and ranging). In addition, various sensors on board the vehicle are used inter alia to detect its speed and accelerations in different directions. Positioning systems and other wireless technologies may also be used to determine whether the vehicle is

for example approaching an intersection, a narrower stretch of road and/or other vehicles.

5 The human ability to conform both to traffic rules and to traffic culture needs to be emulated by the control systems of autonomous vehicles. For example, a driver of an ordinary vehicle will usually avoid a crash instinctively before complying with speed limits. The traffic perception of today's autonomous vehicles is usually confined to "stopping if anything comes close or enters my operating area". To be able to take many different parameters into account, the autonomous vehicle
10 needs to know which one or more of them are the most important.

US-8103438-B2 describes a method and a system for automatically controlling traffic in an operating area. Manned vehicles are given different priorities depending for example on how heavy they are and what kind of road they are on.
15 In the event of conflict, the priorities of the vehicles are compared and a vehicle with lower priority has to give way to a vehicle with higher priority.

US-7979174-B2 refers to automatic planning and regulation of the speed of autonomous vehicles. Their speed planning is conducted on the basis of a
20 number of restrictions with different prioritisations, e.g. avoiding collisions is a higher priority than complying with speed limits.

For a whole transport system comprising many autonomous vehicles mixed with, for example, manually controlled vehicles and pedestrians to be able to function
25 sustainably in conjunction, improved methods are needed for taking many different parameters and assignments into account while at the same time enabling the autonomous vehicles to achieve most efficiently their set objectives.

The object of the invention is therefore to propose an improved method for
30 assisting an autonomous vehicle to make decisions where it has to take a number of different factors into account.

Summary of the invention

One aspect of the invention achieves the object by a system for regulating an autonomous vehicle in a traffic system comprising a plurality of autonomous vehicles according to the first independent claim. The system analyses external
5 information according to predetermined rules and generates analysis signals to the vehicle which are given different priorities depending on the particular kind of analysis and its results. A composite analysis signal S_x is determined on the basis of the content of the analysis signals and their prioritisation. The vehicle can adapt its regulation on the basis of the composite analysis signal S_x .

10

This system makes it possible for transport operations within it to be consistently conducted in the most efficient way, not only by avoiding collisions and conforming to traffic rules but also by continuously ensuring that all parts of the traffic system cooperate towards the objectives indicated. The autonomous
15 vehicle will know in each situation how to act so that its operation will be safe and efficient for the whole traffic system.

Another aspect achieves the object by a method for regulating an autonomous vehicle in a traffic system which comprises a plurality of autonomous vehicles.

20

A third aspect achieves the object with a computer programme product which comprises programme instructions for enabling a computer system to perform steps according to the method.

25 The vehicles herein described are preferably autonomous but may also in one embodiment be partly controllable manually. They are each aware of where the others are, and what they are doing, by communication between them and between them and management centres. An autonomous vehicle may in one embodiment also detect unconnected other road-users in motion within the traffic
30 area and convey this to the management centre and the other vehicles.

Preferred embodiments are defined by the dependent claims.

Brief description of drawings

Figure 1 illustrates a traffic system with a plurality of autonomous vehicles.

Figure 2 depicts a system for regulating an autonomous vehicle in a traffic system
5 according to an embodiment of the invention.

Figure 3 is a flowchart for a method according to an embodiment of the invention.

Detailed description of preferred embodiments to the invention

Figure 1 depicts schematically three autonomous vehicles 2, 3 and 4 travelling
10 along a road. The arrows in the vehicles represent their respective directions of movement. These vehicles can communicate with a management centre 1 by, for example, V2I (vehicle-to-infrastructure) communication 5 and/or with one another by, for example, V2V (vehicle-to-vehicle) communication 6. This communication is wireless and may for example take place by WLAN (wireless local area
15 network) protocol IEEE 802.11, e.g. IEEE 802.11p, although other forms of wireless communication are also conceivable. The management centre 1 organises the autonomous vehicles 2, 3 4 and gives them assignments to perform. When an autonomous vehicle has received an assignment, it can independently see to it that it is duly performed. It may for example take the form
20 of an instruction to collect goods at a freight collection point A. The vehicle is then able to determine its current location, determine a route thence to point A, and go there. On the way it also needs to be able to avoid obstacles and to allow for other autonomous vehicles which may possibly be on more important assignments and have to be given precedence. While on its current assignment,
25 the vehicle may also receive a new assignment which is to be prioritised over the current one. In a manned vehicle the driver will take these decisions continuously while on the move. An autonomous vehicle needs predetermined rules on how to prioritise in different situations which may arise, in order to be able to direct itself in the most efficient way for the whole traffic system.

30

Figure 2 illustrates a system 16 according to an embodiment of the invention for regulating an autonomous vehicle in a traffic system which comprises a plurality of

autonomous vehicles. The vehicle may for example be one of the autonomous vehicles depicted in Figure 1 and referred to as 2, 3 or 4. The system 16 may be situated entirely in the autonomous vehicle or in the management centre 1, or partly in the vehicle and partly in the management centre. The system will now be explained with reference to Figure 2. It comprises a route unit 7 adapted to receiving an assignment signal S_U which conveys to the vehicle an assignment comprising information about at least one destination for it. The assignment preferably comes from the management centre 1. It may for example comprise destination information in the form of GPS coordinates. The route unit is further adapted to determining at least partly a route for the vehicle to follow in order to reach said destination on the basis of at least the destination information, and to generating a route signal S_B which indicates the route. The route unit 7 may for example receive map information from an external map unit 15 via a map signal S_M , and location information from a location determination unit 18 via a location signal S_G . This may be by satellite positioning (global navigation satellite system, often shortened to GNSS) in cases where the system 16 is used outdoors. GNSS is a composite name for a group of worldwide navigation systems which receive signals from a constellation of satellites and pseudosatellites to make it possible to provide location input for a receiver. The American GPS system is the best-known GNSS system, but there are also others such as the Russian GLONASS and the future European Galileo. The vehicle's location may also be determined by monitoring the signal strength from two or more wireless network (WiFi) access points in the vicinity. Another way of determining the vehicle's location is to measure the rotation speed of its wheels and use their circumference to determine how far the vehicle has travelled. In conjunction with knowing the vehicle's direction, its location relative to a map can be determined. It is thus possible to know at any time where the vehicle is.

The system 16 further comprises a plurality of analysis units 8, 9, 10, 11 adapted to receiving external information 13 along the route. This external information is represented schematically by an arrow 13 into the system 16 and may for example comprise further assignments from the management centre 1,

information from sensors on board the vehicle, information by V2V from other vehicles, information by V2I from, for example, traffic lights, speed limit signs etc. The analysis units 8, 9, 10, 11 are adapted to analysing the external information 13 at least according to predetermined rules and to determining and generating
5 analysis signals S_1 , S_2 , S_3 , S_4 for the analysis units 8, 9, 10, 11 on the basis of the results of the analyses.

In one embodiment the analysis units comprise a collision unit 8, a navigation unit 9, a cooperation unit 10 and/or an assignment unit 11. An analysis unit may be
10 adapted to receiving external information 13 in the form of sensor signals from various sensors on board the autonomous vehicle, e.g. cameras, lasers (e.g. LIDAR or LADAR), radar, speed sensors, acceleration sensors, and information about other vehicles or obstacles by V2V and/or V2I communication. The external information may also comprise a new assignment for the vehicle or other
15 information from the management centre 1. This external information may then be used by the various analysis units 8, 9, 10, 11 in different ways, as explained in more detail below.

The collision unit 8 is adapted to using the external information 13 to anticipate a
20 risk of collision with another vehicle or object along the route indicated by the route signal S_B . In one embodiment the collision unit is adapted to analysing the external information on the basis of rules for the risk of collision with the host vehicle. The risk of collision may thus be evaluated continuously. The external information is therefore analysed according to predetermined rules and an
25 analysis signal S_1 is determined for the collision unit on the basis of the results of the analysis. This signal indicates for example whether there is risk of collision. It may in one embodiment also comprise instructions indicating how the vehicle should be directed to avoid an obstacle, e.g. by speed reduction, avoidance, coming to a halt or taking a different route. If there is no risk of collision, this is
30 also indicated by the analysis signal S_1 in one embodiment.

The navigation unit 9 may use the external information 13 to ensure that the vehicle does not break any traffic rules and/or that it finds the nearest way to its assignment while travelling along the route indicated by the route signal S_B . The traffic rules may differ depending on the kind of environment in which the traffic system is. There may for example be different traffic rules in a mine and in ordinary civil traffic. In one embodiment the navigation unit is adapted to analysing the external information on the basis of traffic rules and/or in order to find the nearest way to reach the assignment. Traffic rules may for example comprise a maximum number of vehicles on a stretch of road or maximum and minimum speeds for the autonomous vehicle. The navigation unit may receive map information from the map unit 15 via a map signal S_M and location information from a location determination unit 18 via a location signal S_G , both signals being represented by broken lines in Figure 2, in order to be able to determine the nearest way for performing the assignment. Combining the need to conform to traffic rules and taking the nearest way makes it possible to achieve efficient operation in accordance with traffic rules. The navigation unit is adapted to determining and generating an analysis signal S_2 for the navigation unit on the basis of the results of the analysis. The analysis signal S_2 may for example indicate that the predetermined route indicated by the route signal S_B cannot be followed because of the traffic rules, or that it is not the nearest way. In one embodiment the navigation unit is adapted to determining a new route which conforms to the traffic rules and/or is the nearest way for performing the assignment. This may then be indicated by the analysis signal S_2 . If there is no change in the length of the route on the basis of traffic rules and/or the vehicle is already on the nearest way, this is indicated by the analysis signal S_2 in one embodiment.

The cooperation unit 10 may use the external information 13 to ensure that the autonomous vehicle cooperates with other vehicles in the traffic system in a way which is efficient for the whole traffic system. In one embodiment the cooperation unit is adapted to analysing the external information on the basis of rules for cooperation with other road users. Cooperation involves both the individual

autonomous vehicles and the management centre 1 catering for the efficiency of the whole traffic system. The requirements for efficiency may differ from one traffic system to another and may be selected by the system's human supervisor. If two different heavy vehicles meet at a bottleneck, e.g. a tunnel or a mine adit

5 with only one traffic lane, and the heavier of the two vehicles is travelling uphill, it may be more efficient that it takes precedence over the lighter vehicle which is travelling downhill. The cooperation unit may then be adapted to comparing parameters from the different vehicles, e.g. weight parameters. If a lone autonomous vehicle meets a vehicle train, it may be more efficient that the lone
10 vehicle comes to a halt, even if it is heavier, but not if this leads to its being unable to move off again after the stoppage. In some situations one of the vehicles may instead reduce speed in good time to completely avoid any conflict. The cooperation unit is then adapted to determining and generating an analysis signal S_3 for the cooperation unit on the basis of the results of the analysis. This signal
15 may for example indicate that cooperation is needed and/or what form of cooperation. If there is no need for cooperation, this is indicated by the analysis signal S_3 in one embodiment.

The external information 13 may in one embodiment comprise an external traffic
20 management decision, e.g. for an autonomous vehicle to make its way out of a mine after the ending of an assignment because an accident has occurred. The traffic management decision will then also comprise a new assignment, viz. to make its way out of the mine to a predetermined location. In one embodiment the assignment unit 11 is adapted to analysing the external information 13 on the
25 basis of rules for external traffic management decisions. The assignment unit is then adapted to determining and generating an analysis signal S_4 for the assignment unit on the basis of the results of the analysis. This signal may then comprise information about a new assignment having come in and, for example, destination information.

30

In difficult particular situations where there are no clear rules on how vehicles should act, e.g. how two vehicles should cooperate, the system 16 may ask a

management centre 1, possibly including a human supervisor, for advice with a view to reaching a decision. In one embodiment at least one of the analysis units 8, 9, 10, 11 is adapted to sending to a management centre 1 a query signal β_2 which conveys a query related to the external information 13. The query will then
5 be processed at the management centre and a decision will be taken. It may for example be taken by a human supervisor or operator. The analysis unit is then adapted to receiving a decision signal β_2 which conveys the decision from the management centre, and to analysing the external information on the basis of the decision. Even difficult or complex situations in the system 16 may be handled in
10 this way.

The system 16 further comprises a result unit 12 adapted to receiving analysis signals S_1, S_2, S_3, S_4 . The result unit is adapted to relating a prioritisation to at least one analysis signal S_1, S_2, S_3, S_4 on the basis of which analysis units they
15 come from and their contents. An analysis signal S_1 indicating no risk of collision will be given no priority. Similarly, an analysis signal S_2 indicating no need for any change will likewise be given no priority. An analysis signal S_3 indicating no need for cooperation will be given no priority. An analysis signal S_4 indicating no new assignment will be given no priority. If none of the analysis signals indicate any
20 need to change from the current route, the vehicle will in one embodiment follow a specific route, e.g. S_B . In one embodiment the analysis signal S_1 from the collision unit 8 ranks highest, followed by the analysis signal S_3 from the cooperation unit 10, then the analysis signal S_2 from the navigation unit 9 and finally the analysis signal S_4 from the assignment unit 11. Any collision risk will
25 thus always have the highest priority. A different prioritisation from that exemplified is nevertheless possible. The result unit is further adapted to determining a composite analysis signal S_x based on the contents of the analysis signals and any prioritisations of them. To determine a composite analysis signal S_x , the result unit is adapted to catering for the possibility of the vehicle for
30 example avoiding a crash by travelling past an obstacle, cooperating with other vehicles, conforming to traffic rules and receiving a new assignment, without conflicting with any result from any other analysis unit. This analysis is conducted

by continuously comparing the contents of the various analysis signals S_1 - S_4 .
The result unit is thus adapted to determining whether the vehicle can act
according to whichever analysis signal S_1 - S_4 has the highest prioritisation, without
conflicting with any of the results of the other analysis units which have lower
5 priorities.

If for example two vehicles are each moving towards their respective end of a
narrow tunnel and the vehicle which has the lower prioritisation from the traffic
system's perspective expects to be able to make its way through the tunnel before
10 the higher-priority vehicle travelling in the opposite direction reaches the tunnel,
the lower-priority vehicle will go right ahead. This may for example be indicated in
the analysis signal S_3 to the effect that no cooperation is needed if the vehicle with
less priority maintains a certain speed or reaches the tunnel within a particular
time, etc. Just before the tunnel, however, the collision unit 8 detects an obstacle
15 which according to rules for risk of collision with the host vehicle results in an
analysis signal S_1 which indicates a risk of collision. Making its way round the
obstacle is possible but the extra time involved in doing so means that the vehicle
travelling in the opposite direction will have reached the tunnel. The result unit 12
is then adapted to analysing whether the lower-priority vehicle can make its way
20 past the obstacle and still reach the tunnel within the particular time, and to
determining a composite analysis signal S_x which indicates the result of the
analysis. In this case the lower-priority vehicle cannot make its way round the
obstacle and still reach the tunnel in time, resulting in a composite analysis signal
which contains instructions for it to come to a halt and wait for the vehicle
25 travelling in the opposite direction to pass before it can itself make its way past the
obstacle.

The result unit 12 is then adapted to sending to a control system 17 on board the
autonomous vehicle the composite analysis signal S_x for the vehicle to adjust its
30 regulation in accordance with. In this way the autonomous vehicle can prioritise in
different situations so that the whole traffic system becomes as efficient as

possible. The analysis signal S_x may in one embodiment also comprise control parameters for the control system 17 to base itself on.

5 The units described may be incorporated in a processor unit comprising one or more processors and an associated computer memory 19. Instructions may be stored in the computer memory for the processor or processors to perform steps herein described.

10 The invention relates also to a method for regulating an autonomous vehicle in a traffic system which comprises a plurality of autonomous vehicles, which method will now be explained with reference to the flowchart in Figure 3. The method comprises a first step A1) of receiving for the autonomous vehicle an assignment which contains information about at least one destination for the vehicle. The assignment may for example come from a management centre 1. The method
15 further comprises a second step A2) of at least partly determining a route along which the vehicle should travel to reach said destination. The description of the system 16 above explained how a route might be determined, and this also applies in the method. As a third step A3) external information 13 is received along the route. While the autonomous vehicle is travelling along the specific
20 route, it continually receives external information which may comprise information via cameras, lasers (e.g. LIDAR or LADAR), radar, speed sensors, acceleration sensors, and information about other vehicles or obstacles by V2V and/or V2I communication. The external information may also comprise a new assignment for the vehicle, or other information from the management centre 1. As a fourth
25 step A4) the external information is analysed at least according to predetermined rules. The analysis is conducted according to specific rules, depending on what needs to be investigated. In one embodiment the analysis step A4) comprises analysing the external information on the basis of rules about the risk of collision with the host vehicle. The risk of the vehicle colliding with another vehicle or
30 object may thus be determined. The autonomous vehicle may at a later stage then be regulated to avoid the collision. In another embodiment the analysis step A4) comprises analysing the external information on the basis of traffic rules

and/or in order to find the nearest way to reach the assignment. Different traffic systems may have different traffic rules which the autonomous vehicles have to adapt to. How the nearest way may be determined was described with reference to the system 16, and this also applies in the method. In another embodiment the analysis step A4) comprises analysing the external information on the basis of rules for cooperation with other road users. Efficient operation for a plurality of vehicles may thus be achieved. In another embodiment the analysis step A4) comprises analysing the external information on the basis of rules for external traffic management decisions. Such decisions may thus be handled. The above examples of step A4) may for example take place in parallel. As a fifth step A5) analysis signals S_1 , S_2 , S_3 , S_4 indicating the results of the analyses are determined. As a sixth step A6) a prioritisation is related to at least one analysis signal S_1 , S_2 , S_3 , S_4 on the basis of the particular analysis carried out and the contents of the analysis signals. In one embodiment the analysis signal S_1 which indicates the risk of collision is given highest priority, followed by the analysis signal S_3 which indicates the need for cooperation, and then the analysis signal S_2 which indicates whether the predetermined route indicated by the route signal S_B cannot be followed because of the traffic rules or is not the nearest way. Lowest priority is then given to the analysis signal S_4 , which may for example indicate a new assignment. This is on the basis that an analysis signal given a priority also indicates a change for the vehicle.

As a sixth step A6) a composite analysis signal S_x is determined on the basis of the contents of the analysis signals and their prioritisation. As a seventh step A7) the composite signal S_x is sent to a control system 17 on board the autonomous vehicle, for the vehicle to adjust its regulation in accordance with.

In one embodiment the analysis step A4) comprises substeps A41) – A43) such that A41) sends a management centre 1 a query related to the external information 13, A42) receives a decision from the management centre and A43) analyses the external information on the basis of the decision. Expert help is thus available when a complicated situation arises.

The invention relates also to a computer programme P for an autonomous vehicle 2, which programme comprises programme code for enabling the system 16 to perform steps according to the method. Figure 2 shows the computer programme

5 P as part of the computer memory 19. The programme is thus stored on the computer memory 19. The computer memory is connected to the units 7, 8, 9, 10, 11, 12 in the system 16, and when the whole or parts of the programme P are executed by one or more of these units, at least parts of the methods herein described are conducted. The invention further comprises a computer
10 programme product comprising a programme code stored on a computer-readable medium for performing method steps herein described when the programme code is run on the system 16.

The present invention is not restricted to the preferred embodiments described
15 above. Various alternatives, modifications and equivalents may be used. The above embodiments are therefore not to be regarded as limiting the invention's protective scope which is defined by the attached claims.

Claims

1. A system (16) for regulating an autonomous vehicle in a traffic system which comprises a plurality of autonomous vehicles, characterised in that the system (16) comprises a route unit (7) which is adapted to:
- 5 - receiving an assignment signal S_u which indicates for said autonomous vehicle an assignment which comprises destination information about at least one destination for the vehicle;
- determining at least partly a route which the vehicle should follow in order to reach said destination on the basis of at least said destination information, and
- 10 generating a route signal S_B which indicates said route;
- the system (16) further comprises a plurality of analysis units (8), (9), (10), (11) which are adapted to:
- receiving external information (13) along the route;
- 15 - analysing said external information (13) at least according to predetermined rules, and determining and generating analysis signals S_1 , S_2 , S_3 , S_4 for the analysis units (8), (9), (10), (11) on the basis of the results of the analyses;
- the system (16) further comprises a result unit (12) which is adapted to:
- receiving said analysis signals S_1 , S_2 , S_3 , S_4 ;
- 20 - relating a prioritisation to at least one analysis signal S_1 , S_2 , S_3 , S_4 on the basis of which analysis units (8), (9), (10), (11) they come from and their contents;
- determining a composite analysis signal S_x on the basis of the contents of the analysis signals and their prioritisation;
- which result unit (12) is adapted to sending the composite analysis signal S_x to a control system (17) of the autonomous vehicle, after which the vehicle adapts its
- 25 regulation in accordance with the composite analysis signal S_x .
2. A system according to claim 1, in which said analysis units (8), (9), (10), (11) comprise a collision unit (8), a navigation unit (9), a cooperation unit (10) and/or an assignment unit (11).
- 30

3. A system according to claim 2, in which the collision unit (8) is adapted to analysing said external information (13) on the basis of rules for risk of collision with the host vehicle.

5 4. A system according to either of claims 2 and 3, in which the navigation unit (9) is adapted to analysing said external information (13) on the basis of traffic rules and/or in order to find the nearest way to reach the assignment.

10 5. A system according to any one of claims 2 to 4, in which the cooperation unit (10) is adapted to analysing said external information (13) on the basis of rules for cooperation with other road users.

15 6. A system according to any one of claims 2 to 5, in which the assignment unit (11) is adapted to analysing said external information (13) on the basis of rules for external traffic management decisions.

7. A system according to any one of claims 2 to 6, in which at least one of the analysis units (8), (9), (10), (11) is adapted to

20 - sending to a management centre (1) a query signal β_1 which conveys a query related to the external information (13);

- receiving a decision signal β_2 which conveys a decision from the management centre (1);

- analysing said external information (13) on the basis of said decision.

25

8. A method for regulating an autonomous vehicle in a traffic system which comprises a plurality of autonomous vehicles, which method comprises the steps of

30 - receiving for said autonomous vehicle an assignment which comprises destination information about at least one destination for the vehicle;

- determining at least partly a route which the vehicle should follow in order to reach said destination;

- receiving external information (13) along the route;
- analysing said external information (13) at least according to predetermined rules;
- determining analysis signals S_1 , S_2 , S_3 , S_4 which indicate the results of the analyses;
- relating a prioritisation to at least one analysis signal S_1 , S_2 , S_3 , S_4 on the basis of the particular analysis carried out and the contents of the analysis signals;
- determining a composite analysis signal S_x on the basis of the contents of the analysis signals and their prioritisation;
- sending the composite analysis signal S_x to a control system (17) of the autonomous vehicle, after which the vehicle adapts its regulation in accordance with the composite analysis signal S_x .

9. A method according to claim 8, in which said analysis step comprises analysing said external information (13) on the basis of rules for risk of collision with the host vehicle.

10. A method according to either of claims 8 and 9, in which said analysis step comprises analysing said external information (13) on the basis of traffic rules and/or in order to find the nearest way to reach the assignment.

11. A method according to any one of claims 8 to 10, in which said analysis step comprises analysing said external information (13) on the basis of rules for cooperation with other road users.

12. A method according to any one of claims 8 to 11, in which said analysis step comprises analysing said external information (13) on the basis of rules for external traffic management decisions.

13. A method according to any one of claims 8 to 12, in which said analysis step comprises the substeps of

- sending to a management centre (1) a query related to the external information (13);
- receiving a decision from the management centre (1);
- analysing said external information (13) on the basis of said decision.

5

14. A computer programme (P) pertaining to an autonomous vehicle and comprising programme code for enabling a system (16) to perform steps according to any one of claims 8 to 13.

10

15. A computer programme product comprising a programme code stored on a computer-readable medium for performing method steps according to any one of claims 8 to 13 when said programme code is run on a system (16).

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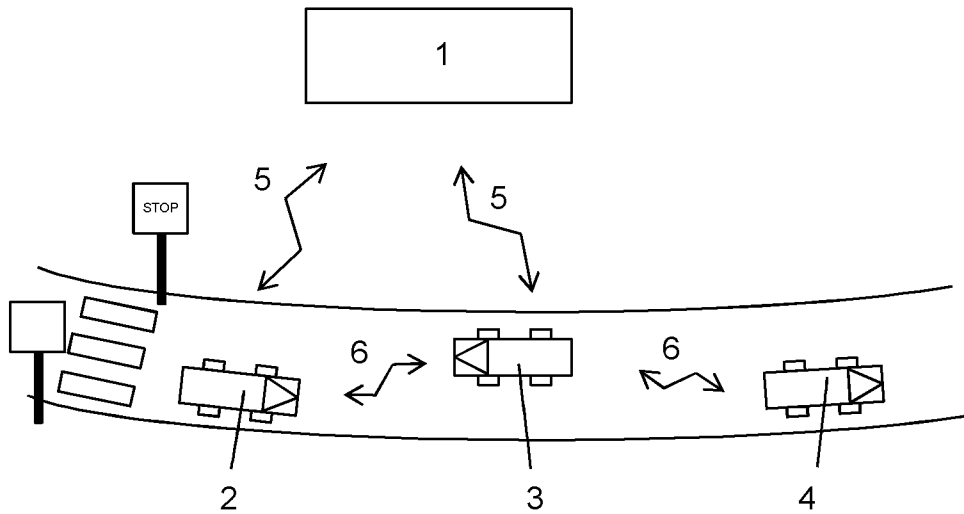


FIG. 1

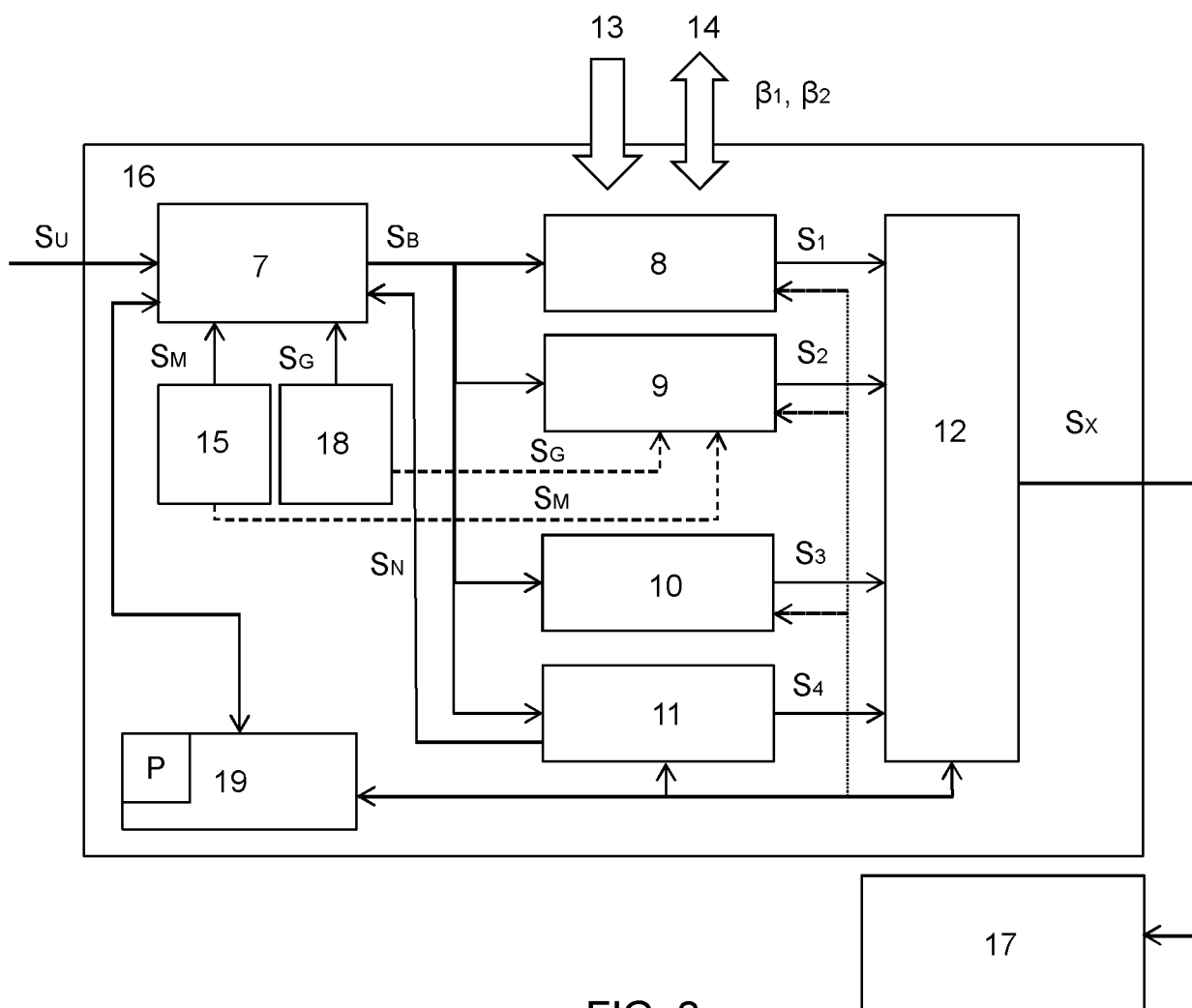


FIG. 2

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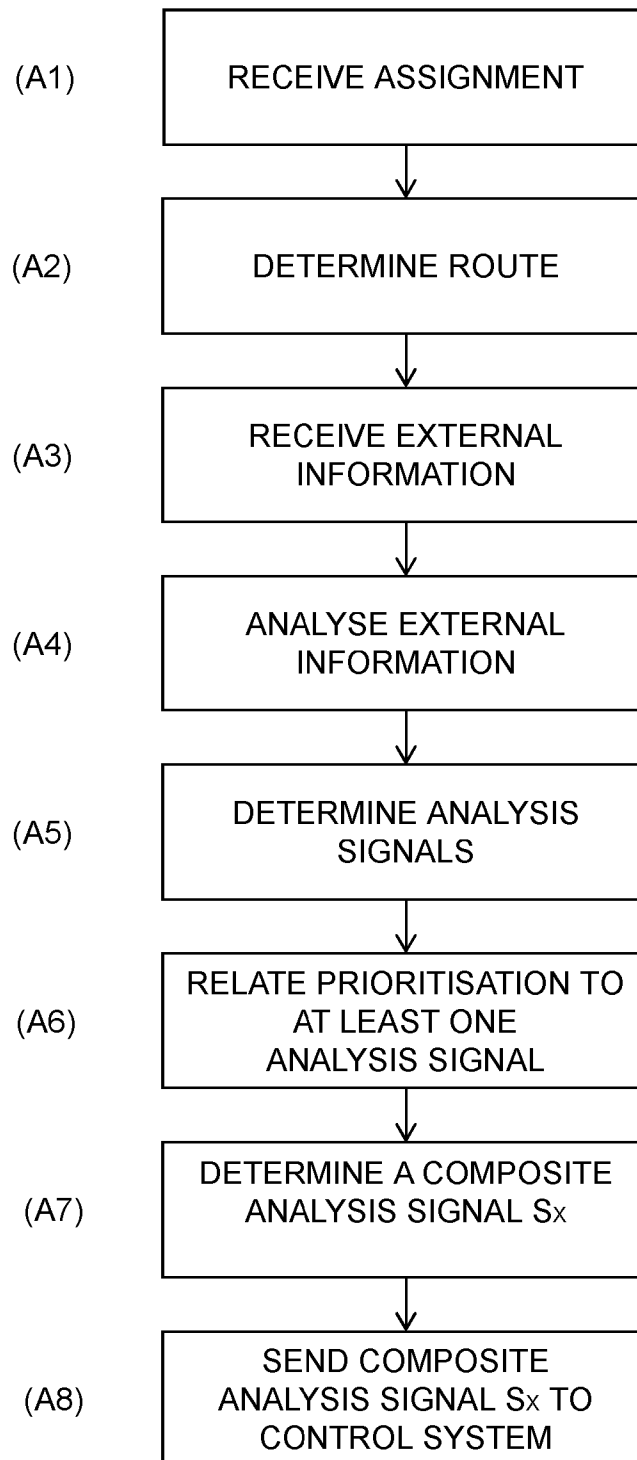


FIG. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2014/050278

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

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)

IPC: B62D, G05D

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

SE, DK, FI, NO classes as above

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

EPO-Internal, PAJ, WPI data, COMPENDEX, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 20090319112 A1 (FREGENE KINGSLEY O C ET AL), 24 December 2009 (2009-12-24); abstract; paragraphs [0007]-[0019]	1-4, 8-10, 14, 15
Y		6, 12
A	--	5, 7, 11, 13
Y	US 6151539 A (BERGHOLZ RALF ET AL), 21 November 2000 (2000-11-21); abstract; column 8, line 6 - column 8, line 34	6, 12
A	--	1-5, 7-11, 13-15

☒ 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

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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

07-07-2014

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

 International application No.
 PCT/SE2014/050278

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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A	WO 9613024 A1 (CATERPILLAR INC), 2 May 1996 (1996-05-02); abstract --	1-15
A	US 20090037033 A1 (PHILLIPS EMILIE ET AL), 5 February 2009 (2009-02-05); abstract --	1-15
A	US 20080027591 A1 (LENSER SCOTT ET AL), 31 January 2008 (2008-01-31); abstract --	1-15
A	US 20070288132 A1 (LAM JUAN F), 13 December 2007 (2007-12-13); abstract -- -----	1-15

Continuation of: second sheet**International Patent Classification (IPC)*****G05D 1/00*** (2006.01)***B62D 1/28*** (2006.01)***G05D 1/02*** (2006.01)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

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