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(54) **Title:** METHOD AND SYSTEM FOR DETERMINING AN ENERGY CONSUMPTION OF AN ENGINE-DRIVEN VEHICLE UNDER DYNAMICAL DRIVING CONDITIONS

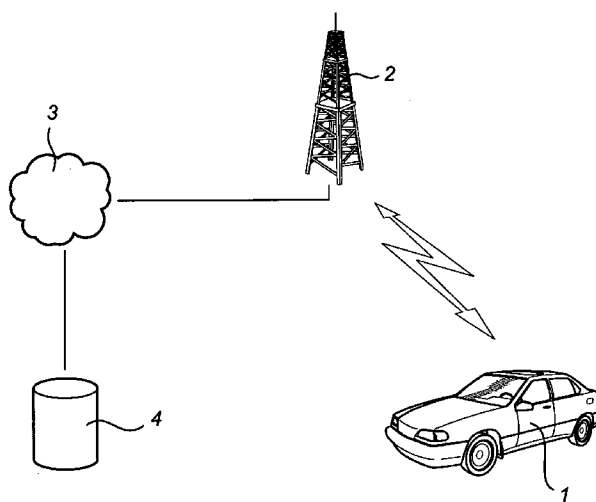


Fig. 1

(57) **Abstract:** A method for determining an energy consumption of an engine-driven vehicle under dynamical driving conditions is disclosed. The method comprises: determining a geographic position of the vehicle; determining at least one vehicle-specific parameter; determining at least one environmental property of said geographic position of the vehicle; estimating an energy consumption for the vehicle at said geographic position based on said, at least one, environmental property and said, at least one, vehicle-specific parameter; determining an actual energy consumption for the vehicle at said geographic position, and generating a signal if said actual energy consumption differs from said estimated energy consumption. The invention further relates to a system for determining an energy consumption of an engine-driven vehicle under dynamical driving conditions.

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METHOD AND SYSTEM FOR DETERMINING AN ENERGY CONSUMPTION
OF AN ENGINE-DRIVEN VEHICLE UNDER DYNAMICAL DRIVING
CONDITIONS

Field of invention

The present invention relates to a method for determining an energy consumption of an engine-driven vehicle under dynamical driving conditions. The present invention further relates to a system for determining an energy consumption of an engine-driven vehicle under dynamical driving conditions.

10 Background of the invention

A general desire in the society today is to reduce the energy consumption, especially to reduce the consumption of fuel resulting in carbon dioxide emissions. Despite this desire, a major part of all transports takes place by vehicles such as cars, lorries and buses. Due to the higher costs for fuel and due to the emissions caused by the combustion of fossil fuel, a more efficient use of the consumed energy is desired.

Today, most vehicles are provided with a fuel consumption indicator, measuring the instant fuel consumption. The information given by the fuel consumption indicator may be combined with information relating to an average fuel consumption per driven distance. Nevertheless, this information is not related to a desired level of fuel consumption and the information does not provide any guidance for the driver to change his/her driving behaviour. Nor does this information provide any guidance for the driver if the driving conditions are changing due to the weather, road condition, traffic situation, road topology etc. These dynamic driving conditions affect the lowest possible

energy consumption at every moment. If the vehicle reaches a hillside, the instant fuel consumption rises due to the increased energy required to drive the vehicle forward. Naturally, the instant fuel consumption must be
5 higher than the average fuel consumption but the driver does not know how much higher the instant fuel consumption should be or the ideal fuel consumption. Correspondingly, when descending the hill, the instant fuel consumption must be lower than the average, but the
10 driver does not know the desired level of instant fuel consumption.

Therefore, it is desirable to measure how efficiently the consumed fuel is used in the vehicle in relation to an optimum fuel consumption during dynamic
15 driving conditions.

WO 83/01686 discloses that the instant fuel consumption can be corrected with a measurement of the stored energy per driven unit of length for providing the driver with guidance during dynamic driving conditions.
20 In that way, consideration has been taken to that stored energy can be used later and a higher instant fuel consumption can be justified. When a vehicle accelerates, kinetic energy is stored and may, later on, be used to drive the vehicle forward. During hilly road conditions,
25 potential energy is invested in the vehicle uphill. The instant fuel consumption per driven length unit is therefore corrected with the invested energy per driven length unit. This corrected fuel consumption is then presented to the driver.

30 Even if consideration has been taken to invested energy in the vehicle during driving according to the disclosed process, there are still many parameters that affect the fuel consumption. Subsequently, the instant fuel consumption has to be corrected for several
35 parameters, in addition to the invested energy, in order to provide guidance to the driver about the actual energy

consumption in relation to the desired energy consumption.

Summary of the invention

5 It is an object of the present invention to provide an improvement of the above techniques and prior art.

 A particular object is to provide an improved comparison of an actual energy consumption with an estimated energy consumption which is corrected for a
10 number of properties that affect the energy consumption for a specific vehicle at a specific moment during dynamic driving conditions.

 Another object is to provide guidance to the driver regarding the actual energy consumption compared to the
15 estimated energy consumption during dynamic driving conditions.

 A further object is to reduce the fuel consumption of a vehicle.

 According to a first aspect of the invention, a
20 method for determining an energy consumption of an engine-driven vehicle under dynamical driving conditions is provided. The method comprises:

 determining a geographic position of the vehicle,
 determining at least one vehicle-specific parameter,
25 determining at least one environmental property of said geographic position of the vehicle,
 estimating an energy consumption for the vehicle at said geographic position based on said, at least one, environmental property and said, at least one, vehicle-specific parameter,
30 determining an actual energy consumption for the vehicle at said geographic position, and
 generating a signal if said actual energy consumption differs from said estimated energy
35 consumption.

 An advantage according to the present method is that it is possible to compare the actual energy consumption

with the estimated energy consumption, wherein the estimated energy consumption has been compensated for a number of parameters affecting the energy consumption of the vehicle. Therefore, the estimated energy consumption is close to an optimal energy consumption during the current driving condition at a specific location and moment. In this way, it is possible to track deviations between an actual and a desired energy consumption. Subsequently, this deviation can be communicated to the driver or the management of, for example, a logistic company or a bus company. A further advantage is that the energy consumption can be reduced due to the fact that the driver is informed when the actual energy consumption exceeds the estimated energy consumption. The driver can then change his/her driving behaviour in order to decrease the energy consumption. Additionally, a company possessing several vehicles can use the information to monitor their vehicles and use the deviation between the actual and desired energy consumption as an indication that technical service may be required for that specific vehicle.

The information regarding said geographic position and said, at least one, vehicle-specific parameter may be transmitted to a host. In this way, only one host or server is required for a number of vehicles. Moreover, the processing of the information and the required processing capacity can be gathered to a single location.

Further, said at least one environmental property may be determined at the host. When the environmental properties are determined at the host, it is possible to collect the environmental properties from different sensors arranged at different locations, or collect the information from external databases. Consequently, according to this embodiment, there is no need to provide every single vehicle with expensive equipment and the information from a single sensor, or the like, can be used by several vehicles.

Further, the estimation of the energy consumption and the generation of the signal, if the actual energy consumption differs from the estimated energy consumption, may be performed at the host. In this way, the processing capacity for performing the present invention can be gathered at one location and a number of vehicles can use the same host. Consequently, according to this embodiment, there is no need to provide every vehicle with expensive or fragile equipment.

10 The determination of the actual energy consumption may be performed at the host. The processing capacity can then be gathered at one location and be used by several vehicles. Necessary information for processing the actual energy consumption for a specific vehicle can then be stored at the host.

15 The determination of the actual energy consumption may be performed at the vehicle. Information relating to the energy supplied to the engine, for example from the fuel supply pump, can be used to directly calculate the actual energy consumption at the vehicle.

20 The generated signal may be transmitted to the vehicle. In this way, the estimations and processing can take place at the host, accessible for several vehicles, and only the signal has to be transmitted to the vehicle. Therefore, a major part of the equipment required for performing the present invention can be placed outside the vehicle.

25 The geographic position of the vehicle may be determined at the vehicle. A conventional GPS-device can then be installed in the vehicle in order to determine the position of the vehicle.

30 Further, said at least one vehicle-specific parameter may be determined at the vehicle. Then, the vehicle-specific parameters can be stored in a memory in the vehicle and the parameters defined by the manufacturer of the vehicle can thus be used.

Further, said at least one vehicle-specific parameter may be determined at the host. In this manner, the vehicle can transmit information regarding an identification of the vehicle, for example the vehicle model, to the host. The host can then determine the vehicle-specific parameters based on the identification of the vehicle, either by collecting information from an external database or from stored parameters at the host. Consequently, only a small amount of data have to be transmitted to the host from the vehicle.

The information relating to said at least one environmental property may be transmitted to the vehicle. Accordingly, information from different sensors or from external databases can be used by transmitting the information to the vehicle. Consequently, according to this embodiment, there is no need for detecting the required environmental property at every vehicle and every vehicle must not be provided with a plurality of sensors.

The estimation of the energy consumption, the determination of the actual energy consumption and the generation of the signal, if said actual energy consumption differs from said estimated energy consumption, may be performed at the vehicle. In this manner, no processing has to be done outside the vehicle. The invention, according to this embodiment, is thus less complex and requires fewer components at the host in order to achieve the desired result of the present invention. Further, the need for means for transmitting information is then reduced.

The generated signal may be transmitted to the host. Thereby, it is possible for e.g. the central management of a logistic company or a bus company to supervise or track the vehicles.

The geographic position of the vehicle may be determined at the host and may be transmitted to the vehicle. In this situation, the vehicle only has to

transmit a signal which identifies the vehicle and which is used to determine, outside the vehicle, the geographic position of the vehicle. Accordingly, no positioning equipment has to be placed in the vehicle and the same
5 equipment may be used by several vehicles.

Additionally, said environmental property may relate to any of: ambient temperature, air pressure, air density, road surface property, wind direction, wind speed, current speed limit at the geographic position,
10 number of imposed stops in a predetermined geographic area surrounding the geographic position, and/or a topology of the geographic position. These environmental properties are properties that affect the actual energy consumption, and, therefore, consideration has to be
15 taken for these parameters when estimating the energy consumption. By including these properties when estimating the energy consumption, the estimated energy consumption is near the optimal energy consumption during current driving conditions.

Further, the road surface property may relate to an friction coefficient of the road surface and/or an surface temperature of the road surface. In this manner, the estimated energy consumption is compensated for different road surfaces such as asphalt, gravelled road,
25 and for the influence on the road surface by snow, ice or water. The surface temperature affects the resistance between the road surface and the tyres of the vehicle.

The predetermined geographic area may be established by determining a plurality of connected geographic
30 positions forming a boundary for the predetermined geographic area (normally referred to as "geofencing"). Thereby, the geographic area is well defined and it is possible to relate the present environmental property to a predetermined geographic area. Moreover, conventional
35 maps for vehicle navigators may be used.

Further, said vehicle-specific parameter may relate to vehicle model, air resistance of the vehicle, current

tyre pressure, and/or current load of the vehicle. The vehicle-specific properties are properties that affect the energy consumption, and, therefore, the estimation of the energy consumption must compensate for these
5 properties. By including any of these parameters when estimating the energy consumption, the estimated energy consumption is near the optimal energy consumption during current driving conditions.

The signal may comprise information in respect of
10 the magnitude of the difference between the actual and estimated energy consumption. In this way, it is possible to monitor how much the actual energy consumption differs from the estimated energy consumption and thereby providing guidance to the driver.

15 Further, the signal may comprise a recommendation to change current motor speed, current vehicle speed, and/or travelling route. Accordingly, the method informs the driver how to change his/her driving behaviour in order to reduce the energy consumption.

20 According to another aspect of the invention, a system for determining an energy consumption of an engine-driven vehicle under dynamical driving conditions is provided. The system comprises a means for determining a geographic position of the vehicle, a means for
25 determining at least one vehicle-specific parameter, a means for determining at least one environmental property of said geographic position of the vehicle, a means for estimating an energy consumption for the vehicle at said geographic position based on said, at least one,
30 environmental property and said, at least one, vehicle-specific parameter, a means for determining an actual energy consumption for the vehicle at said geographic position, and a means for generating a signal if said actual energy consumption differs from said estimated
35 energy consumption. The system incorporates all the advantages of the method, which previously has been discussed. Whereby, the previous discussion is applicable

also for the inventive system.

Brief description of the drawings

The present invention will be further described
5 hereinafter with reference to the accompanying drawings,
which show an embodiment of the invention as a non-
limiting example.

Fig. 1 is a schematic illustration of a system for
determining an energy consumption of an engine-driven
10 vehicle under dynamical driving conditions, in which the
present invention may be applied.

Fig. 2 is a flow chart according to the inventive
method.

15 Detailed description

A system for determining an energy consumption of an
engine-driven vehicle under dynamical driving conditions
in which the present invention may be applied will first
be described with reference to Fig. 1.

20 Fig. 1 illustrates a vehicle 1; a
transmitter/receiver 2, such as a base station (GSM), a
node B (3G), an access point (WLAN); a network 3 such as
the Internet and a host 4. The vehicle may be any engine-
driven vehicle, such as a car, lorry, truck, bus, or rail
25 transit. The engine may be driven by fuels, such as
petrol, diesel, gas, ethanol, or be driven by electrical
energy, for example from a rechargeable battery, or any
other kind of energy. The vehicle may also be driven by a
combination of these examples. Further, the vehicle may
30 comprise one or more sensors arranged to collect
information relating to at least one environmental
properties. The vehicle may also be equipped with a GPS
device, a mobile communication device or the like in
order to communicate with the transmitter/receiver and to
35 determine the geographic position of the vehicle.

The vehicle communicates with the transmitter/
receiver by any means suitable for wireless

communication. The communication between the vehicle and transmitter may be performed by means of short or long range wireless technology, such as WLAN, GPRS, GSM, 3G or any other suitable communication protocol.

5 The transmitter transmits a signal to a network such as the Internet. The signal may be transmitted by wireless communication such as WLAN, GPRS, GSM, 3G or any other suitable communication protocol or by a physical (electrical/optical) connection. The network forms a
10 connection to a host, and this connection may be established by means of wireless communication such as WLAN, GPRS, GSM, 3G or any other suitable communication protocol or by a physical (electrical/optical) connection. By this arrangement, the vehicle is connected
15 to the host.

 The host may store information regarding a number of environmental properties. The host may also determine a number of environmental properties by collecting information relating to the environmental properties from
20 a number of sensors. The host may additionally, or complementary, collect information relating to the environmental properties from the Internet or an external database. The sensors may be arranged at different locations in a geographic area. As previously described,
25 the sensors may be arranged at the vehicle, or at several vehicles, such that different environmental properties are collected from different vehicles. In this manner, it is not required that a specific vehicles is provided with sensors for collecting all the desired information
30 relating to the environmental properties. One vehicle may be provided with only one sensor and use the information collected by the sensors arranged at other vehicles or at other locations.

 The environmental properties may, for example,
35 relate to information regarding ambient temperature, air pressure, air density, road surface property such as a friction coefficient of the road surface and a surface

temperature of the road surface, wind direction, wind speed, current speed limit at the geographic position, number of imposed stops in a predetermined geographic area surrounding the geographic position, and a topology
5 of the geographic position. All these environmental properties affect the energy consumption of the vehicle by influencing, for instance, the current air resistance of the vehicle. Moreover, water, snow or ice on the road surface as well as the temperature at the road surface
10 affect the friction between the road surface and the tyres of the vehicle. Further, the properties previously described affect the efficiency of the engine, the driving behaviour, and the need for supplementary equipment, such as heating or air conditioning.

15 The information regarding the topology may be collected from a digital map, which may be stored at the host, an external database or retrieved from the Internet. The information relating to current speed limit and the roadway covering may be collected in a similar
20 way. The information relating to properties such as ambient temperature, air pressure, air density, road surface properties such as a friction coefficient of the road surface and a surface temperature of the road surface, wind direction, and wind speed may be collected
25 by means of sensors, either arranged at one or more vehicles or fixedly arranged at predetermined locations in the predetermined geographic area. Alternatively, some information relating to environmental properties may be collected from an external database providing information
30 for a geographic area via a network such as the Internet.

To establish the predetermined geographic area, geofencing may be used. By determining a plurality of connected geographic positions forming a boundary, a predetermined geographic area is established. If the
35 digital map is divided into predetermined geographic areas, the division of the digital map may be used for the objects of the present invention.

For determining an estimated energy consumption, consideration has to be taken to inherent vehicle-specific properties. For example, current load of the vehicle affects the energy consumption. Similarly, the vehicle model defines a number of vehicle-specific properties which all have influence on the energy consumption of the vehicle. These properties may be, among others, air resistance, weight, tyre pressure, efficiency of the engine, indicated horse power, and electrical equipment. The vehicle may transmit a signal comprising information only about the vehicle model, or transmit a signal comprising information regarding all current parameters for that specific vehicle to the host. If only information regarding the vehicle model being transmitted, parameters corresponding to that specific vehicle model may either be stored at the host or collected from an external database. A combination of these two procedures may also be possible, i.e. transmitting a vehicle model and a specific parameter changing one of the original parameters for that model.

In one embodiment of the present invention, the geographic position of a vehicle, driving in a geographic area, is determined. The determination of the geographic position is performed by means of a conventional GPS unit, or the like, arranged at the vehicle. Alternatively, the determination of the geographic position is performed by means of a positioning unit arranged outside the vehicle. The positioning unit registers a signal transmitted by the vehicle and determines the position of the vehicle based on the transmitted signal. Information regarding the geographic position of the vehicle is then transmitted to the host. At least one vehicle-specific parameter is determined, either at the vehicle or at the host. If the vehicle-specific parameters are determined at the vehicle, information stored at the vehicle relating to the vehicle-specific parameters such as exemplified above, is

transmitted to the host. If the vehicle-specific parameters are determined at the host, information regarding the vehicle-specific parameters for the current vehicle model are stored at host or retrieved from an external database or from the Internet.

Further, at least one environmental property of the predetermined geographic area wherein the vehicle is driving, is determined at the host. As previously described, the information regarding the environmental properties are stored at the host, or collected from a number of external sensors, arranged at the vehicles or fixedly arranged at different locations. The information may also be retrieved from an external database or the Internet, or a combination thereof.

At the host, the estimated energy consumption is determined based on at least one environmental property and at least one vehicle specific parameter.

In one embodiment, the following calculation could be used to determine the estimated energy consumption for the vehicle per time unit, i.e. the estimated power demand for the vehicle:

$$P = \frac{P_{trac}}{\eta_t} + P_{acc} \quad \text{and}$$

$$P_{trac} = Mg(vC_{R_0} + v^2C_{R_1}) + \left(MgC_{R_2} + \frac{A_f C_D \rho_{air}}{2} \right) v^3 + M(1 + \varepsilon)v(a + g \sin \theta)$$

wherein P is power required to drive the vehicle with its accessories, i.e. the estimated power demand for the vehicle. P_{trac} is the sum of tractive power required, η_t the transmission efficiency which is dependent of the vehicle configuration and temperature, and P_{acc} is the power required for accessories in the vehicle such as air condition and electrical equipment. M is the mass of the vehicle, g is the gravitation constant, A_f is the front area of the vehicle, C_D is a drag coefficient for the vehicle, and ρ_{air} is the density of the air, thus a function of air pressure and ambient temperature. C_{R_0} , C_{R_1} and C_{R_2} are road load coefficients which are dependent on

type of road and weather conditions. ε is a vehicle mass correction factor due to rotating components, and $\sin \theta$ is a road gradient. Further, a is the acceleration of the vehicle and v is the velocity of the vehicle. It is contemplated that it is possibly to calculate the estimated energy consumption in many other ways. As an additional step, an instant estimated fuel consumption may be calculated using the formula

$$f_f = \frac{P}{LHV \cdot \text{eff}(\text{rpm}, \text{torque})}$$

wherein f_f is the estimated fuel flow, i.e. the estimated fuel consumption, and LHV is the lower heating value of the fuel, i.e. the energy content of the fuel, and eff is the efficiency of the engine as a function of the number of revolutions per minutes and torque.

The actual energy consumption for the vehicle at the geographic position is determined at the host or at the vehicle. For example, the fuel supply is determined in the vehicle and the processing for determining the actual energy consumption is either performed at the vehicle or at the host.

If the actual energy consumption differs from the estimated energy consumption, a signal is generated at the host. The signal is then transmitted to the vehicle in order to be communicated to the driver of the vehicle.

In another embodiment of the present invention, the geographic position of a vehicle, driving in a geographic area, is determined at the vehicle by means of a conventional GPS unit, or the like, arranged at the vehicle. Alternatively, the determination of the geographic position may be performed outside the vehicle and at the host, which registers a signal transmitted by the vehicle and determines the position of the vehicle based on the transmitted signal. In this case, information relating to the geographic position of the vehicle is transmitted to the vehicle.

At least one vehicle-specific parameter is then determined at the vehicle and at least one environmental property is determined at the host and information relating to the, at least, environmental property is transmitted to the vehicle. At the vehicle, the estimated energy consumption for the vehicle at the geographic position based on the environmental properties and the vehicle-specific parameters and the actual energy consumption for the vehicle are determined. If the estimated energy consumption differs from the actual energy consumption, a signal is generated at the vehicle in order to communicate this deviation to the driver of vehicle. The estimated energy consumption may be calculated in a similar way as previously described.

The signal may be transmitted to a host in order to make it possible to track or supervise the vehicle or vehicles of a logistic company or a bus company.

Additionally, in both embodiments the generated signal may guide the driver of the vehicle to change, among others, vehicle speed, motor speed, or travelling route. Alternatively, the generated signal may be used by electronic circuitry in the vehicle in order to control e.g. vehicle speed or motor speed. The signal may also comprise information relating to the magnitude of the difference between estimated and actual energy consumption.

It is contemplated that there are numerous modifications of the embodiments described herein, which are still within the scope of the invention as defined by the appended claims. The scope of protection is only limited by the appended claims.

It is contemplated that it is not necessary to perform the actions described above in the described sequence. Further, it is contemplated that a combination of the two described embodiments is possible and that the actions can be performed by any available method.

CLAIMS

1. Method for determining an energy consumption of an engine-driven vehicle under dynamical driving conditions, said method comprising:
- 5 determining a geographic position of the vehicle and transmitting position data for said geographic position to a host,
- receiving, from the host, data relating to at least one environmental property of said geographic position of the vehicle,
- 10 determining at least one vehicle-specific parameter,
- estimating an energy consumption for the vehicle at said geographic position based on said, at least one, environmental property and said, at least one, vehicle-specific parameter,
- 15 determining an actual energy consumption for the vehicle at said geographic position, and
- 20 generating a signal if said actual energy consumption differs from said estimated energy consumption.
2. Method according to claim 1, wherein
- 25 information regarding said at least one vehicle-specific parameter is transmitted to a host.
3. Method according to any of the preceding claims, wherein the estimation of the energy consumption and the generation of the signal, if the actual energy consumption differs from the estimated energy consumption, are performed at the host.
- 30
4. Method according to any of the preceding claims, wherein the determination of the actual energy consumption is performed at the host.
- 35

5. Method according to any of claims 1-3, wherein the determination of the actual energy consumption is performed at the vehicle.

5 6. Method according to any of the preceding claims, wherein the generated signal is transmitted to the vehicle.

7. Method according to any of the preceding
10 claims, wherein the geographic position of the vehicle is determined at the vehicle.

8. Method according to any of the preceding claims, wherein said at least one vehicle-specific
15 parameter is determined at the vehicle.

9. Method according to any of the preceding claims, wherein said at least one vehicle-specific parameter is determined at the host.
20

10. Method according to claim 1, wherein the estimation of the energy consumption, the determination of the actual energy consumption and the generation of the signal, if said actual energy consumption differs
25 from said estimated energy consumption, are performed at the vehicle.

11. Method according to claim 10, wherein the generated signal is transmitted to the host.
30

12. Method according to any of the preceding claims, wherein said environmental property relates to any of: ambient temperature, air pressure, air density, road surface property, wind direction, wind speed,
35 current speed limit at the geographic position, number of imposed stops in a predetermined geographic area surrounding the geographic position, and/or a topology of

the geographic position.

13. Method according to claim 12, wherein the road surface property relates to an friction coefficient of the road surface and/or an surface temperature of the road surface.

14. Method according to claim 12, wherein the predetermined geographic area is established by determining a plurality of connected geographic positions forming a boundary for the predetermined geographic area.

15. Method according to any of the preceding claims, wherein said vehicle-specific parameter relates to vehicle model, air resistance of the vehicle, current tyre pressure, and/or current load of the vehicle.

16. Method according to any of the preceding claims, wherein said signal comprises information in respect of the magnitude of the difference between the actual and estimated energy consumption.

17. Method according to any of the preceding claims, wherein the signal comprises a recommendation to change current motor speed, current vehicle speed, and/or travelling route.

18. System for determining an energy consumption of an engine-driven vehicle under dynamical driving conditions, which system comprises

means for determining a geographic position of the vehicle,

means for transmitting position data for said geographic position to a host,

means for receiving, from the host, data relating to at least one environmental property of said geographic position of the vehicle,

means for determining at least one vehicle-specific parameter,

means for estimating an energy consumption for the vehicle at said geographic position based on said, at
5 least one, environmental property and said, at least one, vehicle-specific parameter,

means for determining an actual energy consumption for the vehicle at said geographic position, and

means for generating a signal if said actual energy
10 consumption differs from said estimated energy consumption.

19. System according to claim 18, further comprising means for transmitting information regarding
15 said, at least one, vehicle-specific parameter to a host.

20. System according to claim 18, wherein said means for estimating energy consumption and said means for generating the signal, if said actual energy
20 consumption differs from said estimated energy consumption, are arranged at the host.

21. System according to any of claims 18-20, wherein said means for determining the actual energy
25 consumption is arranged at the host.

22. System according to any of claims 18-20, wherein said means for determining the actual energy consumption is arranged at the vehicle.
30

23. System according to any of claims 18-22, further comprising means for transmitting the generated signal to the vehicle.

24. System according to any one of claims 18-23, wherein said means for determining the geographic
35

position of the vehicle is arranged at the vehicle.

25. System according to any one of the claims 18-
24, wherein said means for determining said at least one
5 vehicle-specific parameter is arranged at the vehicle.

26. System according to any one of the claims 18-
24, wherein said means for determining said at least one
vehicle-specific parameter is arranged at the host.

10

27. System according to claim 18, wherein said
means for estimating energy consumption, said means for
determining said actual energy consumption and said means
for generating the signal, if said actual energy
15 consumption differs from said estimated energy
consumption, are arranged at the vehicle.

System according to claim 27, further comprising
means for transmitting the generated signal to the host.

20

28. System according to claim 18, wherein said
environmental property relates to any of: ambient
temperature, air pressure, air density, road surface
property, wind direction, wind speed, current speed limit
25 at the geographic position, number of imposed stops in a
predetermined geographic area surrounding the geographic
position, and/or a topology of the geographic position.

29. System according to claim 28, wherein the road
30 surface property relates to an friction coefficient of
the road surface and/or an surface temperature of the
road surface.

30. System according to claim 28, wherein the
35 predetermined geographic area is established by
determining a plurality of connected geographic positions

forming a boundary for the predetermined geographic area.

31. System according to any one of claims 18-30,
wherein said vehicle-specific parameter relates to
5 vehicle model, air resistance of the vehicle, current
tyre pressure, and/or current load of the vehicle.

32. System according to any one of claims 18-31,
wherein said signal comprises information in respect of
10 the magnitude of the difference between the actual and
estimated energy consumption.

33. System according to any one of claims 18-32,
wherein the signal comprises a recommendation to change
15 current motor speed, current vehicle speed, and/or
travelling route.

1/2

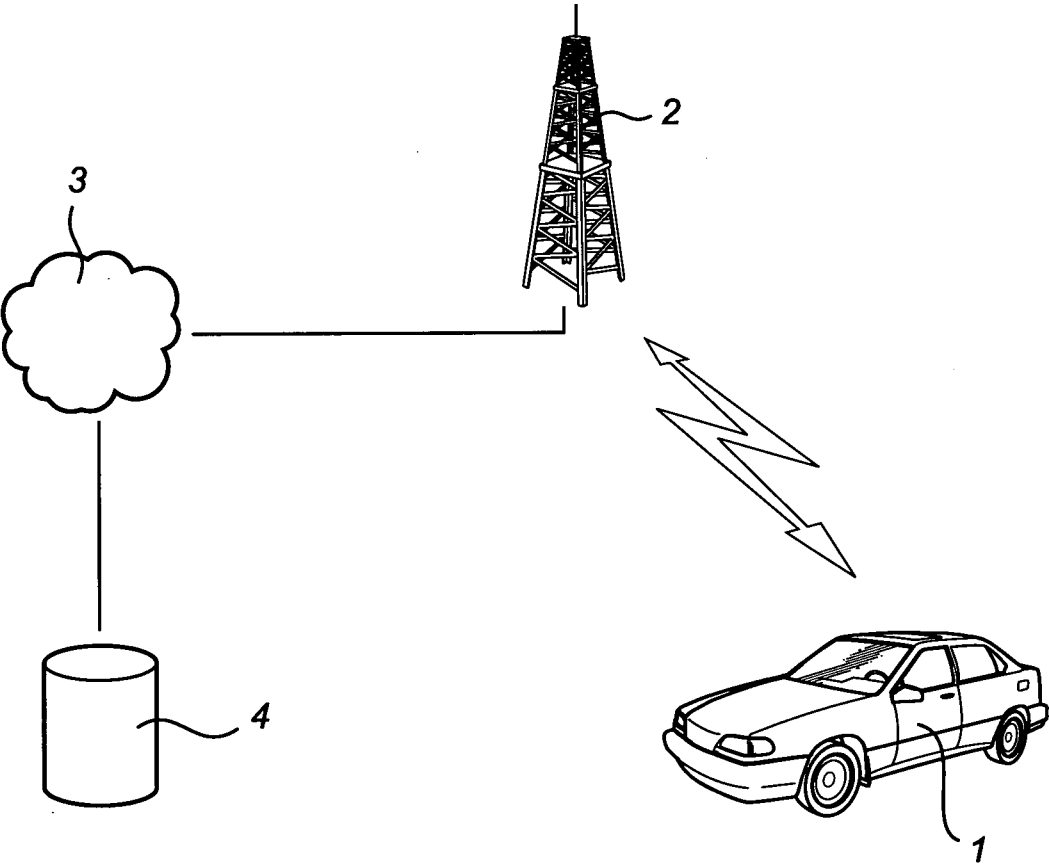
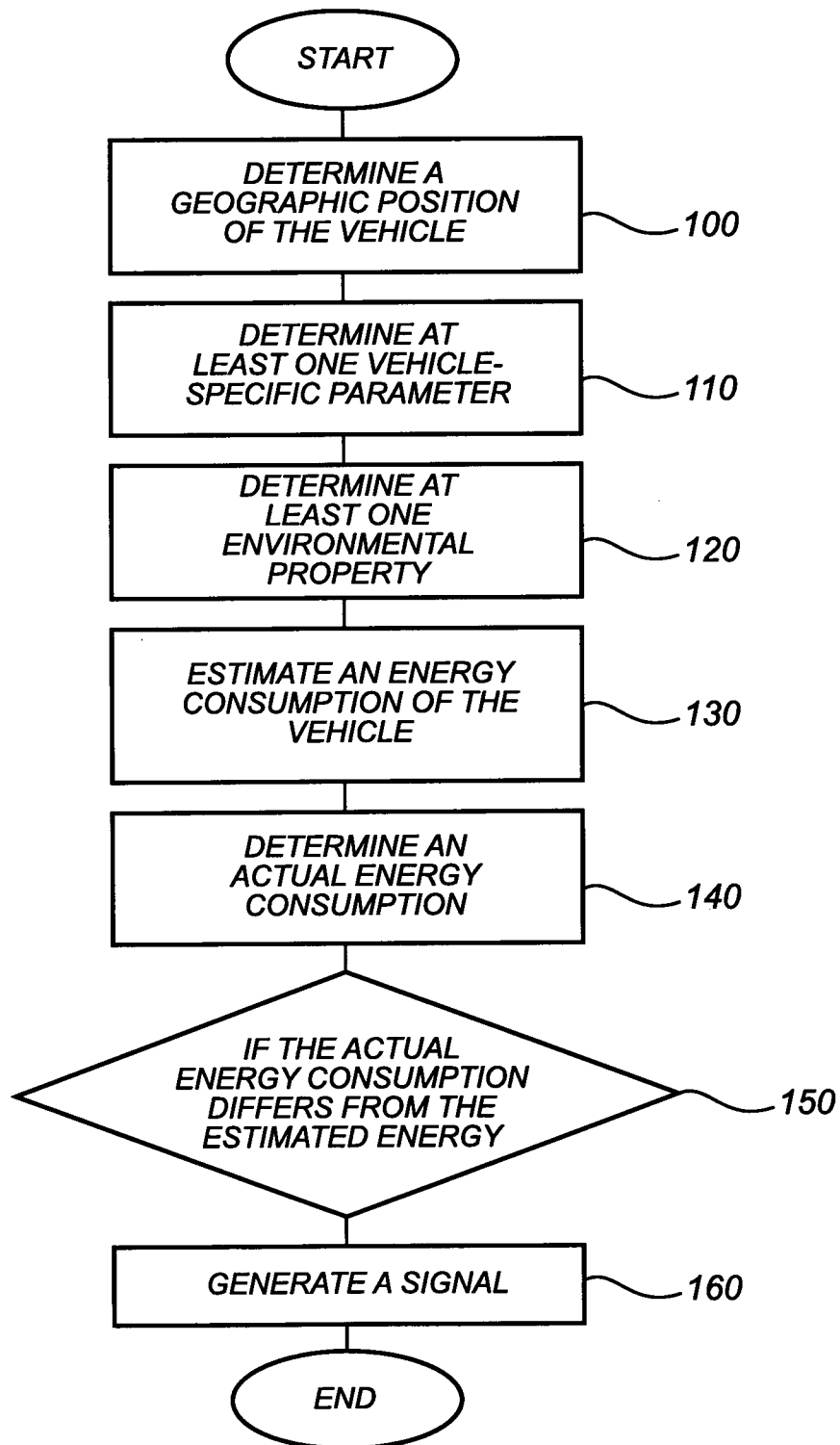


Fig. 1

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*Fig. 2*

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE2008/000324

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: G01F, B60R

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, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 20060089785 A1 (SATO, T ET AL), 27 April 2006 (27.04.2006), figures 1,3, sections [0020], [0024], [0032] - [0034] --	1-33
Y	US 5913917 A (MURPHY, M), 22 June 1999 (22.06.1999), column 3, line 11 - line 20; column 9, line 31 - line 41; column 15, line 28 - line 44, claim 1 --	1-33
A	US 20060089781 A1 (SATO, T ET AL), 27 April 2006 (27.04.2006), see the whole document --	1-33

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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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

3 Sept 2008

Date of mailing of the international search report

08-09-2008

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE2008/000324**C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5652378 A (DUSSAULT, R), 29 July 1997 (29.07.1997), claims 1,14 --	1-33
A	US 4647902 A (TESHIMA, T ET AL), 3 March 1987 (03.03.1987), claim 1 -- -----	1-33

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2008/000324

International patent classification (IPC)

G01F 9/00 (2006.01)

B60R 16/023 (2006.01)

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Cited literature, if any, will be enclosed in paper form.

INTERNATIONAL SEARCH REPORT

Information on patent family members

28/06/2008

International application No.

PCT/SE2008/000324

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